# Mental Health in China: Social Change in Life Course Trajectories

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*Knowledge about life course trajectories and intercohort changes in mental health is limited mainly to Western populations. To address this gap, our study analyzes mental health trajectories in China, drawing on data on depressive symptoms from the China Family Panel Studies over the period 2012–2020 (*N = *31,700 individuals aged 16–70;* N = *87,787 person-years). Employing hierarchical linear regression models, our findings reveal moderate increases in depressive symptoms over the life course and across cohorts. Subgroup analyses indicate that women, people with lower educational attainment, and people with rural hukou experienced more depressive symptoms and a more pronounced increase in depressive symptoms with age. These disparities narrowed across cohorts. We discuss these patterns in the context of Chinese cultural dynamics, including son preference, the impact of education and hukou on the accumulation of stress over the life course, family policy and equity policy transitions, and the changing stigma of mental health.*

## Introduction

How does mental health change as people move through various stages of life, adopt multiple social roles and undergo biological ageing? How do these life course trajectories differ across cohorts exposed to shifting economic, political, social, and cultural conditions?

Although these questions have occupied scholars since the nineteenth century (Durkheim 1897; Weber 1919), our knowledge is still limited in important ways. Most notably, although the crucial role of sociocultural

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context for change in mental health is widely acknowledged, research has remained Western-centric (Clarke et al. 2011; Jorm 2000; Luo et al. 2021a; Mirowsky 1996; Spiers et al. 2011; Thomson and Katikireddi 2018). Expanding the study to a non-Western setting, the present study of the Chinese context provides a lens into how diverse sociocultural and historical landscapes shape mental health trajectories. In China, mental health is rapidly emerging as a significant public health concern. According to recent estimations, the lifetime prevalence of mental disorders in China is about 17 percent, and over 90 percent of people with symptoms of mental disorders never receive treatment (Huang et al. 2019; Lu et al. 2021). Moreover, mental disease is highly stigmatized and the awareness of the public health burden caused by mental health problems is low (Yu et al. 2018). At the same time, the Chinese sociocultural context appears highly—and increasingly—challenging for mental health.

The present study aims at contributing to knowledge about population-level changes in mental health in China. Our data allowed us to study these changes both within individuals as they aged and between individuals born across a wide range of cohorts. We also explored how both of these aspects of change differed across population groups.

Regarding changes in mental health over the life course, the Chinese context differs significantly from most Western contexts studied previously. Shaped by the long-standing influence of Confucian culture and traditional family values, coupled with the constraints imposed by the less-developed economy and limited social security systems, the Chinese experience is distinct. Specifically, academic pressure from childhood through adolescence is high (Sun et al. 2013), financial burden in young adulthood is substantial, working conditions are hard across various sectors and career stages (Chang 2023; Qian and Xu 2019), care responsibilities toward young children and elderly parents are significant during mid-adulthood (Zhang and Goza 2006), and social security systems and health care for older adults are weak (Jiang, Yang, and Sánchez-Barricarte 2016).

Yet, the potential impact of these factors on individual life courses must be considered within the unique sociohistorical conditions experienced by different cohorts. These include periods characterized by wars, famine, a planned economy, the Cultural Revolution, the one-child policy, and the transition to a market economy. These economic, social, and political transformations of unprecedented speed and scope have likely shaped mental health trajectories differently across cohorts (Jiang and Wang 2018).

Finally, different population groups within Chinese society likely vary in their susceptibility to life course stressors and sociohistorical conditions experienced by different birth cohorts. Women, individuals with lower education, and rural hukou holders appear particularly vulnerable, as these groups have fewer economic and social resources that may protect their mental health. At the same time, changes in societal norms, economic

development, and policy initiatives have altered the distribution of resources and stressors among these groups, potentially leading to population differences in life course trajectories of mental health and change across cohorts in these trajectories.

The analyses conducted for the present study drew on longitudinal data from the China Family Panel Studies (CFPS), following 31,700 individuals across 87,787 panel observations (person-years) between 2012 and 2020. These population-representative data include wide ranges of age and cohort as well as measures of mental health, offering a unique opportunity to analyze life course and intercohort changes in mental health as well as population group differences in both processes.

## Background

### Life course trajectories of mental health

According to demographic life-course research and psychological life span theories, mental health changes in response to stress that accompanies important life course stages, transitions, and events (Arnett and Tanner 2006; Erikson 1950; Marcia 1966; Slavich 2016). Several hypotheses have been advanced in the study of life course trajectories of mental health. According to the "age as life cycle" hypothesis, mental health fluctuates through various stages of life, with different stressors impacting individuals at different ages (Mirowsky and Ross 1992). Periods of increased stress typically correspond with declines in mental health, while periods of relief and stability are linked to improvements (Cusack and Merchant 2013). Prominent examples of life stage-specific declines in mental health outcomes include "teenage angst," "midlife crisis," and "old age depression" (Mirowsky and Ross 1992; Weiss et al. 2012; WHO 2021). Alternatively, the "age as decline" hypothesis posits that mental health deteriorates steadily with age due to accumulated stress, as stressful events, transitions, exposures, and ageing-related physical and cognitive declines are not sufficiently mitigated by periods of relief, stability, and improvement (Mirowsky and Ross 1992). An alternative view posits that individuals develop powerful coping mechanisms allowing them to remain resilient to stressful events or even prolonged periods of chronic stress (Lazarus and Folkman 1984). This view, known as the "age as maturity" hypothesis, suggests that mental health improves with age as individuals acquire more experience and coping skills (Lazarus and Folkman 1984; Mirowsky and Ross 1992).

Most previous studies have analyzed Western societies, predominantly supporting the "age as life-cycle" hypothesis with a finding of a "U-shaped" pattern in mental health. This pattern is characterized by a decline in mental health between young and middle adulthood, followed by improvement in older age (Blanchflower 2021; Cheng et al. 2017; Graham and Ruiz Pozuelo

2017; Lang et al. 2011). Theoretical explanations for this pattern include the mental challenges of transitioning into adulthood, which bottom out in mid-age (Schwandt 2013). This is followed by a relief around retirement age—evident in stability and improvement—due to settling in all important areas of life (Bossé et al. 1991; Drentea 2002). Research focusing on later life stages (approximately from age 75 onward) suggests that the "U-shaped" pattern precedes a decline in mental health in old age (Bramajo 2022; Yang 2007), attributed to physical health decline, and the loss of partners and other social ties (Kessler et al. 2010).

While some studies have argued that the "U-shaped" pattern is universal (Blanchflower 2021), mental health trajectories across the life span can vary significantly based on cultural and socioeconomic factors, leading to different patterns in non-Western settings (Ng et al. 2010). In East Asian societies, for example, job and family strain likely remain substantial throughout life, and retirement is frequently associated with poverty, dependence, disability, and unmet healthcare needs rather than relief (Phillips and Chan 2002; Chen, Yang, and Liu 2010). Our study provides an example of such an East Asian context by focusing on the unique life stressors typically faced by the Chinese population. In the following sections, we outline these stressors and explore how they may shape mental health trajectories in China.

## Life course trajectories of mental health in China

In China, typical life courses are different from those in Western societies, primarily due to intense educational competition, chronic job strain, ongoing family pressures, and highly limited social security systems, suggesting potentially different life course trajectories of mental health in the Chinese context.

First, *intense educational competition* places significant psychological pressure on children, adolescents, and young adults in China. Under the long-term influence of Confucian culture, educational institutions constitute a crucial avenue, shaping the entire life courses in Chinese society (Liu, Jiang, and Chen 2020). The National College Entrance Examination in China, known as "Gaokao," is regarded as an exam that decides the fate of life. Consequently, Chinese parents hold high educational expectations for their children and often adopt harsh and demanding educational practices, which impose substantial psychological pressure on children, adolescents, and young adults who depend on financial support from their families during their education (Chen et al. 2022).

Second, *chronic job strain* affects most Chinese people throughout their working lives. First, the job competition is very high across sectors and occupations. Statistics indicate that in 2023, China will witness 11.58 million students graduating from university (MOE 2022). Nevertheless, the

youth unemployment rate in China, aged 16–24, has surged to its highest historical level at 21.3 percent (NBS 2023). Intense job competition places significant psychological stress on graduates (Liu and Yu 2011). Yet, even if young adults secure employment, unfavorable work cultures such as unpaid overtime, low wages that do not align with working hours, the prevailing "996 work regime"[1] and increasing living expenses together subject them to substantial stress (Chang 2023; Qian and Xu 2019). Those who never attended a university, are even more strongly affected by poor work environments, low salaries and restricted job opportunities, next to stressors related to stigma and discrimination associated with lower educational and occupational statuses in China (Wang et al. 2010).

Third, *ongoing family pressures* significantly impact the mental health of Chinese adults. Chinese middle-aged adults face considerable pressure to shoulder the dual responsibility to support their younger children and older parents. For instance, Chinese parents not only have to bear the expenses of their children before they reach adulthood but also pay the costs related to children's marriage, such as housing and bride price (Wang 2019). Moreover, the duty of caring for older parents remains predominantly on middle-aged adults' shoulders (Croll 2006).

Finally, highly *limited social security systems* for older adults prevent old age from being a stage of relief in China. Deteriorating health conditions, and unmet care needs due to the inadequate social security systems in China, exert significant pressure on older adults. In 2014, there were already 40 million disabled or semi-disabled individuals aged 60 and above in China, and numbers are projected to surpass 52.71 million by 2020 and 77.65 million by 2030 (Jiang, Yang, and Sánchez-Barricarte 2016; Luo, Su, and Zheng 2021b). However, China's long-term care system remains underdeveloped and costly (Glass, Gao, and Luo 2013; Wu, Mao, and Zhong 2009). The basic endowment insurance subsidies, at 14 USD per month in 2014, are insufficient to cover daily expenses, let alone caregiving costs (Jiang, Yang, and Sánchez-Barricarte 2016).

In sum, these considerations suggest that mental health challenges accumulate over the life course in China. In this respect, the Chinese context contrasts sharply with many Western societies, such as Sweden and the Netherlands, where social security systems provide substantial support, educational pressure is less intense, job stability in midlife is common, and retirement is often a period of relief (Leopold 2018). These differences suggest that the life-cycle hypothesis may not apply in the Chinese context. Given the chronic and accumulative nature of stressors, the "age as decline" hypothesis appears more applicable to China than to Western societies. However, even under intense and accumulative stressors, a pattern of "age as maturity" reflecting increasing resilience to mental health challenges cannot be excluded either. Exceptional resilience has been widely reported among people exposed to severe conditions such as wars, genocides,

natural disasters, and prolonged periods of stress and deprivation (Bonanno 2004; Norris et al. 2002).

Although these arguments pertain to typical life courses in China, research has demonstrated that life trajectories often differ across cohorts, as individual life courses unfold under changing sociohistorical conditions (Elder 1974; Ryder 1965). In the following sections, we first summarize key arguments and findings from Western countries regarding social change in mental health across cohorts and then explain the unique sociohistorical conditions that may have produced differences in mental health trajectories between Chinese cohorts.

## Social change in mental health trajectories

The idea that life courses are embedded in the sociohistorical context surrounding cohorts is well-established and supported in empirical research (Elder 1998; Ryder 1965). According to the life course perspective, social change in life trajectories is driven by the succession of cohorts, with each generation encountering unique sociohistorical conditions during their impressionable years and other vulnerable life stages (Elder 1998).

Several perspectives on social change in mental health trajectories across cohorts in Western contexts have developed. The prevailing "negative social change" perspective posits that mental health declines across cohorts due to factors like increased urbanization, which disrupts social bonds and community support (Klerman 1979); geographic mobility leading to loss of attachment and social isolation (Twenge 2006); social anomie from rapid societal changes (Hidaka 2012); instability in family structures and job market insecurity, heightening stress and anxiety (Baxter et al. 2014); and the rise of social media, which exacerbates symptoms of anxiety and bipolar disorder (Twenge 2013). These factors are thought to increase social isolation and psychosocial stressors, intensifying mental challenges of copying with typical life course stressors and potentially leading to less favorable mental health trajectories in more recent cohorts.

Conversely, the "positive social change" perspective suggests that mental health may improve across cohorts. Improvements in childhood conditions, such as better socioeconomic circumstances and reduced family violence (Baxter et al. 2014), the expansion of education, and advances in psychiatric and psychological treatments, along with reduced stigma around mental illness, may have assisted copying with typical life stressors and contributed to more favorable mental health trajectories across cohorts (Angermeyer et al. 2014; Suanet and Antonucci 2017).

The "stability in mental health" perspective acknowledges that mental health trajectories may stay similar across cohorts as unique positive and negative sociohistorical conditions that surround the life courses of different cohorts may balance each other out. For instance, while earlier

cohorts experienced stable working conditions but childhood deprivation, more recent cohorts faced job market instability and mental health risks of social media but benefited from improved childhood conditions and advancements in mental health care (Angermeyer et al. 2014; Baxter et al. 2014). Therefore, life course trajectories of mental health may be similar across cohorts, even given the unique sociohistorical conditions to which different birth cohorts were exposed.

In Western populations, studies report mixed patterns of change in mental health across cohorts. While studies from countries such as the United States (Kessler et al. 2010; Luo et al. 2021a; Yang 2007), the United Kingdom (Bell 2014), Canada (Drapeau, Marchand, and Forest 2014), and Belgium (Brault, Meuleman, and Bracke 2012) found that mental health was deteriorating across cohorts, others studies reported improvements in the United Kingdom (Thomson and Katikireddi 2018) or stability in the United States (Johnson 2021; Spiers et al. 2011). Although the evidence leans toward the "negative social change" perspective, the mechanisms remain speculative, and further research is needed to understand these dynamics fully. While these expectations and findings pertain primarily to Western contexts, some of the proposed sociohistorical conditions may also apply to Chinese cohorts, while others have been unique. In the following, we outline sociohistorical conditions experienced by Chinese cohorts born during the past century and explain how these changes may have modified their mental health trajectories.

## Social changes and mental health trajectories in China

Similar to the arguments from Western studies, patterns of decline, improvement or stability in mental health can be expected across cohorts in China. These expectations reflect the sociohistoric conditions under which life courses of distinct Chinese cohorts unfolded.

Those born before 1949 spent their childhood, adolescence, and young adulthood during periods of ongoing wars, which created harsh living conditions and psychological trauma (Jiang and Wang 2018). Cohorts born between 1959 and 1961 spent vulnerable periods of early life and impressionable years during one of the most severe famines on record, which left many people malnourished, caused a significant death toll, and left its imprint also on those who survived (Smil 1999). Cohorts born between 1962 and 1965 belonged to the Chinese baby boom generation, which put China's limited resources under pressure on and eventually spurred the implementation of the one-child policy.

Those born between 1966 and 1976—during the decade-long Cultural Revolution—experienced educational disruptions and were brought up in an atmosphere of moral ambiguity and uncertainty (Chu 1985; Huang 1981). Cohorts born thereafter grew up during the rapid advancement of

marketization, urbanization, industrialization, and globalization following the implementation of the reform and opening-up policy in China in 1978, bringing unprecedented competitive pressure (Li 2019).

In 1980, the one-child policy was officially implemented, producing the "only-child generations," who faced pressures from their families to perform, not only to provide for themselves but also to fulfill the traditional filial duty to aging parents in the absence of siblings to share such responsibilities (Cameron et al. 2013). Those growing up and spending their young adulthood in China since the 1990s experienced increasing educational competition when enrolling in high school and college, and fiercer job competition as China's economy slowed down when they entered the labor market (Li 2022). For example, after the 1999 "University Expansion" and the 2000 "Postgraduate Expansion," the Chinese government initiated a further expansion plan for doctoral students in 2020, indicating that it will become increasingly challenging for undergraduate students to find a job. Even if they manage to secure a position, the "996 work regime" currently adopted by numerous Chinese companies exerts significant pressure on young adults (Qian and Xu 2019). Finally, the rise of social media likely increased feelings of stress among more recent cohorts, similar to trends observed in Western contexts (Tang, Koh, and Gan 2017).

Nevertheless, there have also been developments in China that may have led to positive trends in mental health trajectories, especially among more recent cohorts, such as the elevated emphasis on mental health, the decreasing stigma toward mental disorders, and the relaxation of the one-child policy. For instance, in 2002, the Chinese government formulated the "China Mental Health Work Plan (2002–2010)" to strengthen mental health knowledge publicity, conduct psychological interventions for vulnerable groups, and improve mental health services. Subsequently, many policies were issued by the Chinese government to strengthen the care system and services in terms of mental health (Qin, Wang, and Hsieh 2018). At the same time, depression is becoming more accepted and less stigmatized among later-born Chinese cohorts (Zhang and Zhao 2021). The Chinese government began to relax fertility restrictions in 2013 and now allows couples to have three children, which may alleviate to some extent the psychological problems and eldercare pressures among the only children reported in previous studies (Cameron et al. 2013; Festini and Martino 2004). These social changes likely positively affected the mental health of cohorts born and spending their impressionable years in China since the 2000s, who likely internalize a more accepting attitude toward mental health issues and seek treatment when needed.

Overall, both China and Western societies underwent unique social changes that may have altered mental health trajectories across cohorts. On the one hand, similar negative and positive changes are observed

in both contexts. For example, increased marketization, urbanization, industrialization, and globalization since the 1980s have brought unprecedented competitive pressures that may cause mental health declines in younger cohorts (Li 2019). Moreover, both contexts have seen similar positive changes, as policies are promoting mental health treatment and services while societal stigma against depression is decreasing (Angermeyer et al. 2014; Qin, Wang, and Hsieh 2018; Suanet and Antonucci 2017; Zhang and Zhao 2021). On the other hand, China has experienced many unique stressors, such as the Great Famine, the one-child policy, the Cultural Revolution, and, more recently, fierce social competition. Additionally, China's rapid economic transformation and growth have occurred within a shorter time frame, leaving people with less time to adapt.

Given the diverse and rapidly changing sociohistoric conditions faced by Chinese cohorts, predicting the direction of intercohort changes in mental health in China is complex. The multitude of mentally challenging sociohistorical conditions faced by most cohorts could result in a *decline in mental health across cohorts*, especially given the cumulative nature and intergenerational transmission of stressors from events like wars, famines, the unprecedented competitiveness in the education and labor market, as well as persistently harsh working conditions (Elder 1998; Ferraro and Shippee 2009). However, resilience mechanisms and more recent positive changes—such as reduced stigma around mental illness and improved treatments—could have mitigated this negative trend, leading to *mental health improvements*, especially among more recent cohorts who did not personally experience extreme stressors such as wars, famines, or revolutions. Moreover, they are likely to benefit from growing up in times of reduced stigma of mental illness and advancements in treatments, as their mental health problems are more likely to be detected at an earlier age, treated adequately, and less often accompanied by experiences of stigmatization or discrimination. When considering the complex set of countervailing factors shaping cohort trends in mental health, it is also possible that a pattern of *stability in mental health across cohorts* emerges from the ebb and flow of adverse and beneficial conditions under which individual trajectories unfold.

## Demographic heterogeneity in mental health trajectories

Both stressors producing variation in mental health trajectories over the life course and sociohistorical conditions producing social change in these trajectories across cohorts affect different population groups to an unequal degree (Yang and Lee 2009). Research on demographic heterogeneity in health trajectories has focused on gender as well as various socioeconomic indicators and was guided by the cumulative (dis)advantage hypothesis. The cumulative (dis)advantage hypothesis posits that initial advantages or

disadvantages that are attached to one's group membership or position in a society, such as more or less favorable working and living conditions, exposure to stress, social support and the number and intensity of negative or positive life events, tend to accumulate over time, leading to widening gaps between different groups in health as individuals age (Dannefer 2003; Ferraro and Shippee 2009; Ross and Wu 1995). In addition, studies have suggested that cumulative (dis)advantage processes may change across cohorts. In line with this idea, research on education differences in health trajectories from Western societies has shown that the widening pattern predicted by the cumulative (dis)advantage hypothesis is often more pronounced in recent cohorts than in earlier cohorts. These results are interpreted as being due to increasing returns to higher education in terms of income and living conditions as well as due to an increasing negative selection among people with lower levels of education (Mirowsky and Ross 2008). Guided by these theoretical ideals, we will outline how demographic heterogeneity in mental health trajectories may develop over the life course and across cohorts in China in the following section.

## Demographic heterogeneity in mental health trajectories in China

In China, health related advantages and disadvantages are mainly structured by gender, education, and rural–urban residence status (hukou) (Chen, Yang and Liu 2010; Zhao 2023). First, under the influence of sociocultural norms such as "son preference" and traditional gender roles, Chinese women have been traditionally disadvantaged in education, employment, income, and the division of family work (Hu, Li, and Martikainen 2019). During school age, families typically allocated more educational resources to sons due to "son preference," resulting in fewer enrollment opportunities and lower educational attainment for daughters (Wang 2005; Liu, Jiang, and Chen 2020). Under the market economy, women's labor value has been typically perceived to be inferior to men's (Zhang and Zhao 2021), as they are assumed to be more likely to be distracted by childbearing, childcare, and household responsibilities, thus unable to devote as much energy to labor (Pearson 1995). Even if employed, women are less likely to hold high-status occupations (Glei et al. 2013).

Second, China formally established the hukou system in 1958, an administrative and redistributive arrangement through which rural–urban migration was restricted and resources such as education and health care were allocated disproportionately to urban residents (Chan and Buckingham 2008; Jiang and Wang 2018; Wu and Treiman 2004). Moreover, workers holding rural hukou, commonly labeled "peasant workers," are even more strongly affected by poor work environments, low salaries, restricted job opportunities, and discrimination as compared to workers holding urban hukou status (Wang et al. 2010).

Third, in the process of China's reform and opening up and market economy transformation, economic development created new nonfarm jobs, and those with higher education were generally better able to access these jobs (Deng and Ding 2013). Initial advantages of being male, higher educated, or an urban hukou holder likely accumulate with age, leading to a widening gap in exposure to risk factors for mental health and in resources protective for mental health, consequently widening the mental health gap by gender, education, and hukou status.

However, these demographic heterogeneity in mental health trajectories likely changed across cohorts due to shifts in gender inequalities, educational expansion, and balancing urban–rural resources. Policies such as the Maoist slogan "Women can hold up half the sky" and the 2006 "Care for Girls" campaign targeted women's labor market participation and educational opportunities (Li 2007). Additionally, the one-child policy and a cultural preference for sons have led to a persistent imbalance in the sex ratio at birth, resulting in a surplus of men in the marriage market, particularly in rural areas (Jiang et al. 2014). It is estimated that by 2025, China's surplus population of men aged 20–49 will exceed 30 million, increasing the risk of lifelong unmarried status for more recent cohorts of men (Chen 2004). Regarding educational opportunities, the Chinese government initiated several reforms, such as the University Expansion Program in 1999, the Postgraduate Expansion Program in 2000, and the Universal Nine-year Compulsory Education in 2006, enabling broader access to higher education for more recent cohorts. Yet, these expansions led to an inflation in the labor market value of educational degrees, resulting in declining return rates to higher education (Ding, Yang, and Ha 2013; Mok and Wu 2016). Finally, regarding the urban–rural divide, efforts like the Mass Public Health Campaigns in the 1950s and the New Rural Cooperative Medical Insurance in 2002 have effectively narrowed the gap in medical care between urban and rural areas. Given these developments, the intensified divergence in health trajectories between population groups across cohorts observed in Western societies (Kim and Durden 2007; Mirowsky and Ross 2008) appears less likely in the Chinese context. Furthermore, due to the equalization efforts by the Chinese government and the new challenges faced by Chinese men in more recent cohorts, it appears likely that gender, education, and urban–rural differences in mental health trajectories would diverge less in more recent cohorts than in earlier ones.

## Previous research and the present study

Existing studies in China have mainly focused on the variation of self-rated health (SRH) over the life course and across cohorts (e.g., Chen, Yang, and Liu 2010; Jiang and Wang 2018; Zhao 2023; Zhu and Ye 2020), which partly reflects mental health, but is mainly seen as a general health

measure that predicts physical health decline, chronic conditions and mortality (Singh-Manoux et al. 2006). Regarding demographic heterogeneity, existing studies have only examined differences in mean levels of mental health across groups, such as gender, hukou, and educational attainment (Li et al. 2014; Phillips et al. 2009), ignoring the variation of demographic heterogeneity in mental health trajectories. Only a few studies have analyzed the life course trajectories, cohort patterns, and demographic heterogeneity in mental health. For example, Hu, Li, and Martikainen (2019) examined rural–urban disparities in age trajectories of later-life depression risk, while Zhang and Zhao (2021) investigated the gender disparities and depressive symptoms over the life course and across cohorts. However, the former only looked at older people without looking at cohorts, and the latter did not consider the population differences.

In view of these limitations of previous research, the present study aims to investigate the life course trajectories and social change in mental health across cohorts in China using data from a nationally representative longitudinal survey. We analyze not only typical patterns of mental health over the life course and across cohorts, but also look at differences in these processes between women and men, higher and lower education levels and rural and urban hukou statuses.

## Data and methods

### Sample

The data used in the current study were derived from the CFPS conducted by the Institute of Social Science Survey, Peking University. The CFPS 2010 baseline survey used a multi-stage probability sample to cover 33,600 adults aged 16 years and older in 25 provinces (municipalities or autonomous regions) across China. The CFPS conducted five follow-up surveys in 2012, 2014, 2016, 2018, and 2020, with a cross-wave retention rate above 80 percent. By continuously tracking and collecting individual-level data, the CFPS accurately reflects changes in China's social, economic, demographic, educational, and health dimensions.

We used the CFPS data from 2012, 2016, 2018, and 2020 since there is no information on depressive symptoms in the 2010 and 2014 surveys. Although the available data only covered a period of eight years, studies have demonstrated that relatively short observation periods are sufficient to study life course trajectories and intercohort changes therein (Mirowsky and Kim 2007; Mirowsky and Ross 2008). Our analytic sample was obtained according to the following criteria: (1) Excluding individuals who were not Chinese citizens (n = 4 individuals); (2) To retain enough data for estimating the average level of depressive symptoms at each specific age–cohort–gender cell, we constrained the sample to include participants aged up to 70

**TABLE 1 Sample characteristics**

| Variables | Whole sample | | Men | | Women | |
|---|---|---|---|---|---|---|
| | Mean/% | SD | Mean/% | SD | Mean/% | SD |
| Participant characteristics[a] | | | | | | |
| Gender | | | | | | |
| Men | 48.61 | | | | | |
| Women | 51.39 | | | | | |
| Education | | | | | | |
| Lower | 25.38 | | 17.57 | | 32.77 | |
| Intermediate | 48.28 | | 53.36 | | 43.47 | |
| Higher | 26.34 | | 29.07 | | 23.76 | |
| Hukou | | | | | | |
| Rural | 72.11 | | 71.48 | | 72.71 | |
| Urban | 27.89 | | 28.52 | | 27.29 | |
| Birth year | 1969.01 | 14.72 | 1968.79 | 14.80 | 1969.21 | 14.65 |
| Observation characteristics[b] | | | | | | |
| Age | 45.55 | 13.99 | 45.56 | 14.05 | 45.55 | 13.93 |
| Survey year | 2015.79 | 2.99 | 2015.81 | 2.99 | 2015.77 | 2.99 |
| Number of waves | 2.11 | 1.04 | 2.10 | 1.03 | 2.12 | 1.04 |
| Depressive symptoms | 3.24 | 3.08 | 2.84 | 2.92 | 3.62 | 3.18 |

[a] Time-constant variables are summarized at the 2012 baseline.
[b] Time-varying variables are summarized over all observations.
SD = Standard deviation.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

at the time of the interviews (n = 2420 individuals); (3) Excluding individuals who had missing values in education, hukou status and depressive symptoms (n = 1595 individuals). The final analytic sample included 31,700 individuals with 87,787 observations. Details on sample restrictions are shown in Table A1 in the Appendix of the Supporting Information. Descriptive statistics of all variables included in our analyses are presented in Table 1.

## Measures

*Mental health* was assessed by depressive symptoms using the short form of the Center for Epidemiologic Studies Depression instruments. Depressive symptoms constitutes one of the most common mental health conditions, is strongly related to general psychological well-being (Byllesby et al. 2016; Watson, Anna, and Carey 1988), and has been extensively used in previous research on mental health. Depressive symptoms were measured by the following six negative mental states people have experienced in the past week: (1) "I feel depressed"; (2) "I find it difficult to do anything"; (3) "I have a poor sleep"; (4) "I feel lonely"; (5) "I feel sad"; (6) "I feel that I am unable to keep on with my life". Four options, from "Almost never" (0) to "Most of the time" (3), were available for each question. A depressive symptoms summary score (0–18) was obtained by calculating the total score

of six questions and was standardized, with a higher score indicating higher levels of depressive symptoms.

*Age* was assessed as a time-varying variable ranging from 16 to 70, reflecting age in years at the wave in which the survey was conducted.

*Cohort* was assessed as a time-constant variable that indicated the year of birth. It was minimum-centered and ranged from 0 to 54, corresponding to cohorts from 1942 to 1996.

*Gender* was based on self-reports and distinguished between men and women. All analyses have been carried out separately for women and men.

*Hukou* status was measured as a dummy variable, coded as 1 for individuals with an urban hukou and 0 for those with a rural hukou.

*Educational attainment* was measured by the highest level of education attained until the end of the observation window and was categorized as lower, intermediate, and higher education. Lower education refers to some primary education or no education at all; intermediate education includes primary or junior high education; higher education in this study consists of those with a senior high education, a three- or four-year college degree, a master's degree, or a doctoral degree. The Nine-Year Compulsory Education System implemented in China mandates the universal provision of education from primary to junior high school. However, individuals possessing a formal college education or higher remain relatively scarce—only approximately 5 percent in our sample. Hence, drawing from previous research (Zhang and Zhao 2021), we combined senior high education and above into the category—"higher education".

*Potential periodic confounding.* Although this analysis focuses on life course and intercohort changes in mental health, periodic influences may affect both processes under study. During our observation period between 2012 and 2020, China experienced several continuous changes and discrete events that may have impacted the mental health of most Chinese. In terms of public health policy, the Chinese government enacted the "Mental Health Law of the People's Republic of China" in 2012, addressing the legal void in mental health, and in 2020, it released the "Work Plan for Exploring Depression Prevention and Treatment Services." Both policies emphasize improved access to mental health care and reduction of stigma surrounding mental illness, which may have positively affected mental health. However, the beginning of the COVID-19 pandemic in late 2019 likely had a negative impact on mental health due to increased stress, social isolation, and economic uncertainty (Zhou, Cai, and Xie 2022).

We employed visual analyses to examine the potential presence of nonlinear and linear periodic trends, a strategy widely used in research on life course trajectories and intercohort changes (Luo and Hodges 2022; Masters and Powers 2020). Our analyses showed that age patterns differed between cohorts, indicating the likely presence of age–period or age–cohort

interactions (see Figure A1 in the Appendix of the Supporting Information). Furthermore, period changes appeared to be different for different cohorts. Notably, while most cohorts showed an increase in depressive symptoms across the observation window, in 2018, depressive symptoms decreased for the earliest cohorts (age > 70 during the observation span) for both men and women; and in 2020 for women born between 1951 and 1960 and between 1971 and 1980 (aged between 40 and 60 during the observation span) (see Figure A2 in the Appendix of the Supporting Information). Finally, we did not find a discrete decline in mental health for all cohorts in 2020 that may have been expected due to the pandemic outbreak.

It has been argued before that in the case of mental health, continuous period changes that affect people in different life stages in the same way are unlikely (Bell 2014, 2020; Spiers et al. 2011). However, we acknowledge that the possibility of linear periodic effects cannot be fully excluded. Still, due to the analyses of potential period confounders and the theoretical focus of the present paper, we interpret the observed changes as age and cohort patterns rather than periodic patterns. Nonetheless, we acknowledge that periodic effects can be present and consider them when interpreting and discussing the results of the present study.

## Statistical modeling

We used hierarchical linear regression models (HLMs) to estimate the life course trajectories and intercohort changes in mental health. HLM estimation enables the trajectories of depressive symptoms to have different average levels (random intercepts) and rates of change (random slopes) (Raudenbush and Bryk 2002), providing information about individual mean trajectories of depressive symptoms as well as group differences in these trajectories.

We analyzed (1) the age trajectories and cohort patterns of depressive symptoms, (2) the gender differences in these trends, (3) differences by education and hukou status in these trends following the approach used in previous studies of life course trajectories and intercohort changes in physical and mental health outcomes (Kim and Durden 2007; Leopold 2019; Yang et al. 2021). Because life courses are highly gendered in China, and in line with previous research, we have performed the educational and hukou differences separately for women and men (Hu, Li, and Martikainen 2019; Zhu and Ye 2020). The parametrizations of age and cohort effects as well as their interactions with gender, education and hukou on depressive symptoms were guided by theoretical arguments and three methodological criteria, which were commonly used in prior studies on age and cohort trajectories as well as population differences in these trajectories in physical health (Leopold 2019; Willson, Shuey, and Elder, Jr 2007; Yang et al. 2021): (a) similarity between observed data and fitted data examined by diagnostic

plots (see Figure A3 in the Appendix of the Supporting Information), (b) BIC, and (c) model parsimony if models were similar on criterion (a) and did not differ by more than 10 BIC points (Raftery 1995). Guided by our theoretical framework and these model fit criteria, we compared numerous models with different parametrizations of age and cohort terms and interactions between these terms and between these terms and gender, education and hukou status. Specifically, we compared models with various combinations of linear, squared or categorical parametrization of the cohort term (distinguishing between the "Wars" cohorts born before 1949, the "Great Famine" cohorts born between 1959 and 1961, the "Baby Boom" cohorts born between 1962 and 1965, the "Cultural Revolution" cohorts born between 1966 and 1976, the "Marketization and One-child" cohorts born after 1978), linear or squared parametrization of the age term, as well as with interactions between these terms and between these terms and gender, education and hukou status. Despite the theoretical reasons for studying distinct cohorts in a discrete fashion, the best model fit was achieved with a linear cohort term. The main conclusions did not differ between models with a linear cohort term and those with a categorical cohort term (see Figure A4 in the Appendix of the Supporting Information). The model fit also did not improve when the interaction terms between squared age and squared cohort, along with their interactions with gender, education, or hukou status, were added. The BIC of these models was higher, most of these interaction effects were not statistically significant, and all main conclusions remained similar to those of more parsimonious models. Overall, our model fit analyses suggested slightly different model specifications in terms of the functional forms of age and cohort, as well as interactions between age, cohort and the indicators of education and hukou status for women and men, most commonly including linear terms of age, linear and squared terms of cohort, and interaction terms between linear terms of age and cohort and of these terms with gender, education and hukous status (see Tables 2, 4, and 5 for details).

Finally, we conducted several additional analyses to examine the robustness of our results to issues such as selective attrition, missing values, and measurement bias. These analyses are described following the presentation of our primary results and can be found in Tables A2–A10 and Figures A5–A7 in the Appendix of the Supporting Information.

## Results

### Age and cohort patterns

Table 2 shows our estimates of life course trajectories and intercohort changes in depressive symptoms, as well as the gender differences in these trends in the total sample. To enhance the interpretation, we illustrate these results in Figure 1.

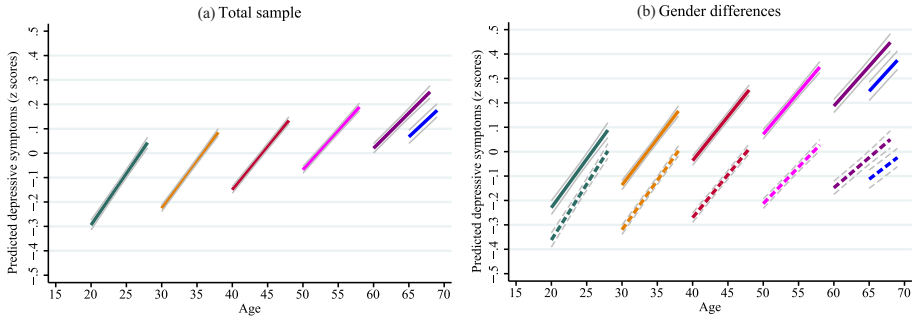
**TABLE 2 Results of the hierarchical linear model**

| Variables | M1 | | M2 | |
|---|---|---|---|---|
| | Coeff. | SE | Coeff. | SE |
| Age | 0.026*** | (0.002) | 0.020*** | (0.003) |
| Cohort | −0.002 | (0.006) | −0.016 | (0.008) |
| Cohort$^2$ | 0.000*** | (0.000) | 0.001*** | (0.000) |
| Age # Cohort | 0.000*** | (0.000) | 0.001*** | (0.000) |
| Women | | | −0.222 | (0.246) |
| Women # Age | | | 0.011** | (0.004) |
| Women # Cohort | | | 0.025* | (0.012) |
| Women # Cohort$^2$ | | | −0.000* | (0.000) |
| Women # Age # Cohort | | | −0.000* | (0.000) |
| Intercept | −1.264*** | (0.123) | −1.134*** | (0.175) |
| Variance components | | | | |
| Residual (level 1) | 0.5738*** | | 0.5742*** | |
| Intercept (level 2) | 0.1688*** | | 0.1672*** | |
| Age (level 2) | 0.0002*** | | 0.0002*** | |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
NOTE: Age is minimum-centered at age 16 and birth-year cohort at 1942.
SE = Standard errors.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

Figure 1 shows model-based predictions for initial levels of depressive symptoms and their change over time. To illustrate cohort effects, we fixed the linear cohort term at six values of age at initial observation (birth years of 1947, 1952, 1962, 1972, 1982, and 1992, corresponding to the ages at the initial observation of 65, 60, 50, 40, 30, and 20) to enhance the visualization of trends in depressive symptoms over time. The y-axis indicates the predicted average depressive symptoms level, which was z-standardized

**FIGURE 1 Predicted age and cohort patterns of depressive symptoms**




NOTE: The estimates are based on M1 and M2 in Table 2; in both panels, colors indicate six birth cohorts: 1992 (green), 1982 (ochre), 1972 (red), 1962 (purple), 1952 (violet), and 1947 (blue); in the left panel, solid lines show trajectories for the total sample; in the right panel, solid lines show trajectories of women, while the dashed lines show trajectories of men; gray shading indicates 95% confidence interval.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

(overall standardized in the results presented in Figure 1, Tables 2 and 3, and sex-specific standardized in the results presented in Figures 2 and 3, and Tables 4–6) to enhance the interpretation in substantive terms. In each panel, higher values indicate higher depressive symptoms levels. The x-axis shows each cohort's age at the beginning and at the end of the observation period. An important advantage of this illustration is that it simultaneously visualizes the age trajectories of depressive symptoms as well as cohort differences in these trajectories, and associated levels of depressive symptoms (Mirowsky and Kim 2007).

Based on results from the left panel in Figure 1 and associated M1 in Table 2, we found that depressive symptoms gradually increased over the life course and across cohorts. To examine these results in more detail, Table 3 shows the corresponding marginal effects for age and cohort along with their confidence intervals for depressive symptoms at the age of initial observation and eight years later separately for six cohorts. Results show that depressive symptoms increased with age for all cohorts. As visible from the second column in Table 3, the average increase over the observation period was 0.26 or 26 percent of a standard deviation across all cohorts. Yet, age-related increase in depressive symptoms has intensified across cohorts. Although depressive symptoms increased during the observation period by approximately 23 percent of a standard deviation among those born in 1952, they increased by about 34 percent among those born in 1992.

## Gender differences

As visible from the right panel in Figure 1 and the associated M2 in Table 2, women and men differed not only in average levels of mental health, but also in life course trajectories and intercohort changes in depressive symptoms. Men showed lower levels and a slightly slower rate of increase in depressive symptoms as compared to women over the life course. As a result, differences in depressive symptoms between women and men grew with age. However, this pattern lessened across cohorts: while clearly visible among earlier cohorts (i.e., those born in 1947, 1952, and 1962), trajectories of women and men became increasingly parallel, and average differences narrowed in more recent cohorts.

## Differences by education and hukou status

Tables 4 and 5 show the results of differences in life course trajectories and intercohort changes in depressive symptoms by education and hukou status for men and women, respectively. We illustrate the results in Figures 2 and 3.

**TABLE 3 Estimated 8-year change in depressive symptoms, by cohort**

| Age at first wave (Birth cohort) | Age and cohort effect[a] | | Gender differences[b] | |
|---|---|---|---|---|
| | Initial level | Change over 8 years | Initial difference | Change over 8 years |
| 20 | −0.295 | +0.338 | 0.132 | −0.047 |
| (1992) | [−0.315, −0.274] | [0.337, 0.339] | [0.092, 0.173] | [−0.050, −0.045] |
| 30 | −0.226 | +0.312 | 0.183 | −0.020 |
| (1982) | [−0.239, −0.212] | [0.310, 0.312] | [0.156, 0.210] | [−0.022, −0.017] |
| 40 | −0.150 | +0.284 | 0.234 | +0.007 |
| (1972) | [−0.164, −0.136] | [0.284, 0.285] | [0.206, 0.261] | [0.007, 0.009] |
| 50 | −0.068 | +0.257 | 0.284 | +0.036 |
| (1962) | [−0.082, −0.055] | [0.255, 0.261] | [0.257, 0.312] | [0.031, 0.039] |
| 60 | 0.020 | +0.231 | 0.335 | +0.063 |
| (1952) | [0.001, 0.040] | [0.225, 0.236] | [0.297, 0.373] | [0.051, 0.075] |
| 65 [c] | 0.067 | +0.136 | 0.361 | +0.047 |
| (1947) | [0.040, 0.094] | [0.135, 0.137] | [0.307, 0.414] | [0.046, 0.050] |
| Averages for all cohorts [d] | −0.109 | 0.260 | 0.255 | 0.014 |

[a] Estimates are average marginal effects in standard deviations for age and cohort.
[b] Estimates are average marginal differences in standard deviations between women and men in depressive symptoms.
[c] Change over five years was calculated due to the sample constraints.
[d] Averages of initial levels, initial differences, and changes over 8 years were calculated for all cohorts.
NOTE: 95% confidence intervals are shown in brackets. Estimates are based on M1 and M2 in Table 2. Initial differences are predicted mean differences in depressive symptoms at the age of first observation. Changes over 8 years are calculated as differences between predicted mean differences at initial observation and predicted mean differences 8 years later.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

**TABLE 4 Results of the hierarchical linear model for men**

| Variables | M3 | | M4 | |
|---|---|---|---|---|
| | Coeff. | SE | Coeff. | SE |
| Age | 0.051*** | (0.005) | 0.053*** | (0.003) |
| Age$^2$ | −0.000*** | (0.000) | −0.000*** | (0.000) |
| Cohort | 0.012** | (0.004) | 0.017*** | (0.004) |
| Cohort$^2$ | 0.000*** | (0.000) | 0.000*** | (0.000) |
| Intermediate | −0.782*** | (0.224) | −0.245*** | (0.019) |
| Higher | −0.117 | (0.253) | −0.328*** | (0.023) |
| Intermediate # Age | 0.008* | (0.004) | | |
| Higher # Age | −0.006 | (0.004) | | |
| Intermediate # Cohort | 0.011** | (0.004) | | |
| Higher # Cohort | −0.001 | (0.005) | | |
| Urban | −0.085*** | (0.016) | 0.199 | (0.171) |
| Urban # Age | | | −0.008** | (0.003) |
| Urban # Cohort | | | −0.002 | (0.003) |
| Intercept | −1.578*** | (0.201) | −1.837*** | (0.090) |
| Variance components | | | | |
| Residual (level 1) | 0.5782*** | | 0.5785*** | |
| Intercept (level 2) | 0.2017*** | | 0.2027*** | |
| Age (level 2) | 0.0002*** | | 0.0002*** | |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
NOTE: Age is minimum-centered at age 16 and birth-year cohort at 1942.
SE = Standard errors.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

The findings illustrated in Figure 2 and the associated M3 in Table 4 and M5 in Table 5 show educational differences in life course trajectories and intercohort changes in depressive symptoms for women and men. Regarding the life course trajectories, the gaps between education groups grew with age, as depressive symptoms increased at a steeper rate among people with lower levels of education as compared to people with higher levels of education. As visible from Table 6, the average education difference across all cohorts in the initial period was 0.310 (or approximately 31 percent of a standard deviation) for men and 0.290 (or approximately 29 percent of a standard deviation) for women and increased to 0.354 and 0.370 (or approximately to 35 percent and 37 percent of a standard deviation), respectively, at the end of observation period, indicating that the increase in depressive symptoms by education was more pronounced among women than men (8 percent points vs. 4 percent points). Across cohorts, while depressive symptoms increased among each education group, particularly among people with lower levels of education, the divergent pattern in depressive symptoms by education lessened.

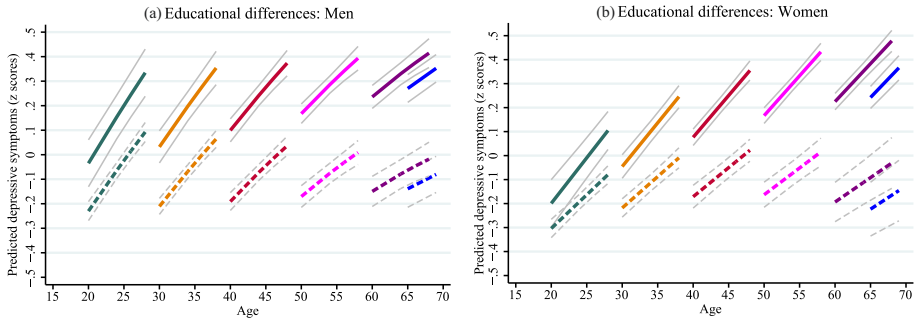
Differences in levels, life course trajectories and intercohort changes in depressive symptoms between people with different hukou status were similar to findings on education. As visible in Figure 3 and the associated

**TABLE 5 Results of the hierarchical linear model for women**

| Variables | M5 | | M6 | |
|---|---|---|---|---|
| | Coeff. | SE | Coeff. | SE |
| Age | 0.030*** | (0.003) | 0.041*** | (0.002) |
| Cohort | 0.020*** | (0.003) | 0.033*** | (0.002) |
| Age # Cohort | 0.000* | (0.000) | −0.000* | (0.000) |
| Intermediate | −0.894*** | (0.194) | −0.252*** | (0.016) |
| Higher | 0.115 | (0.230) | −0.300*** | (0.021) |
| Intermediate # Age | 0.011** | (0.004) | | |
| Higher # Age | −0.012* | (0.005) | | |
| Intermediate # Cohort | 0.016*** | (0.004) | | |
| Higher # Cohort | −0.004 | (0.005) | | |
| Intermediate # Age # Cohort | −0.000* | (0.000) | | |
| Higher # Age # Cohort | 0.000 | (0.000) | | |
| Urban | −0.110*** | (0.016) | 0.754*** | (0.187) |
| Urban # Age | | | −0.022*** | (0.004) |
| Urban # Cohort | | | −0.015*** | (0.004) |
| Urban # Age # Cohort | | | 0.000*** | (0.000) |
| Intercept | −1.372*** | (0.150) | −1.869*** | (0.095) |
| Variance components | | | | |
| Residual (level 1) | 0.5870*** | | 0.5870*** | |
| Intercept (level 2) | 0.1432*** | | 0.1444*** | |
| Age (level 2) | 0.0002*** | | 0.0002*** | |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
NOTE: Age is minimum-centered at age 16 and birth-year cohort at 1942.
SE = Standard errors.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

**FIGURE 2 Predicted age trajectories of depressive symptoms-by-education by cohort**




NOTE: The estimates are based on M3 and M5 shown in Tables 4 and 5; in both panels, colors indicate six birth cohorts: 1992 (green), 1982 (ochre), 1972 (red), 1962 (purple), 1952 (violet), and 1947 (blue); solid lines show trajectories of people with lower levels of education, while the dashed lines show trajectories of people with higher levels of education; gray shading indicates 95% confidence interval.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

M4 in Table 4 and M6 in Table 5, disparities in depressive symptoms between hukou groups grew with age, as depressive symptoms among rural residents increased at a faster rate with age as compared to their urban counterparts. However, the divergent pattern in depressive symptoms with age lessened across cohorts. Although depressive symptoms became more prevalent in each hukou group, this was even more strongly pronounced among those with rural hukou status. Although hukou differences in depressive symptoms grew substantially in earlier cohorts, with an increase of approximately 6 percent of a standard deviation among men and 15 percent of a standard deviation among women born in 1952 within the observation period of only eight years, hukou differences almost diminished in the most recent cohorts. Yet, the reduction in population differences in depressive symptoms by hukou status—similar to the results for differences by education—occurred at higher overall levels.

## Robustness checks

*Selective attrition analyses.* In the CFPS 31.95 percent of the participants were lost due to panel attrition. If those with higher depressive symptoms levels are more likely to drop out of the panel, this may underestimate increase in depressive symptoms with age. If attrition was related to cohort membership, gender, education, and hukou status, differences in depressive symptoms related to these factors might be biased. By comparing the mean depressive symptoms of dropouts and nondropouts in each age group, we found that there were almost no significant differences by gender, education, and hukou status (Figure A5 in the Appendix of the Supporting Information). Results of the Probit model showed that participants with higher depressive symptoms in the previous period were more likely to drop out in the next period, though the effect was small ($R^2 \leq 0.03$) (Table A2 in the Appendix of the Supporting Information). Yet, we applied the Inverse Probability Weighting (IPW) to correct for potential selective attrition bias. The variables included in the models to calculate IPWs were depressive symptoms, age, gender, education, hukou, and interactions between each of these variables measured at $t - 1$. Our main analyses remained unchanged after the IPW analyses (Tables A3–A5, Figure A6 in the Appendix of the Supporting Information).

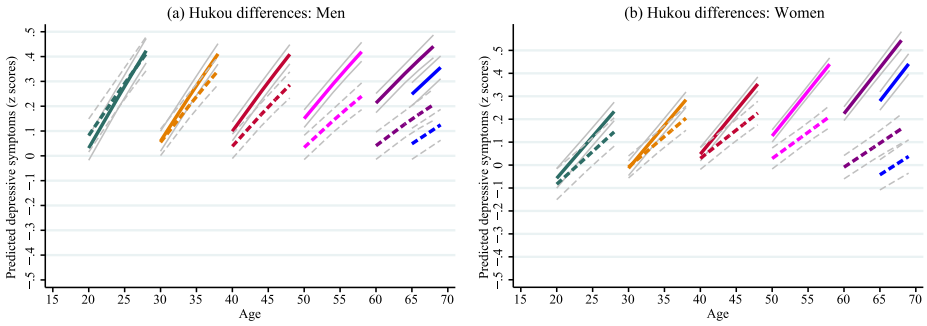
*Missing values.* In 8.74 percent of respondents, information on depressive symptoms was missing or incomplete. Results of the Probit model showed that individuals with higher depressive symptoms levels in the previous period tended to have missing values in depressive symptoms in the next period for both genders. Still, the effect was small, with an $R^2$ of less than 0.05 (Table A6 in the Appendix of the Supporting Information).

**TABLE 6 Estimated 8-year change in population differences in depressive symptoms, by gender and cohort**

| | Educational differences | | | | Hukou differences | | | |
|---|---|---|---|---|---|---|---|---|
| | Men | | Women | | Men | | Women | |
| Age at first wave (Birth cohort) | Initial difference | Change over 8 years | Initial difference | Change over 8 years | Initial difference | Change over 8 years | Initial difference | Change over 8 years |
| 20 | 0.195 | +0.047 | 0.105 | +0.079 | −0.051 | +0.063 | 0.026 | +0.063 |
| (1992) | [0.097, 0.293] | [0.046, 0.048] | [−0.001, 0.210] | [0.061, 0.098] | [−0.106, 0.003] | [0.063, 0.065] | [−0.038, 0.090] | [0.056, 0.071] |
| 30 | 0.243 | +0.047 | 0.173 | +0.082 | 0.005 | +0.063 | −0.006 | +0.086 |
| (1982) | [0.169, 0.316] | [0.044, 0.050] | [0.111, 0.235] | [0.082, 0.082] | [−0.037, 0.046] | [0.060, 0.067] | [−0.047, 0.035] | [0.080, 0.093] |
| 40 | 0.290 | +0.047 | 0.248 | +0.085 | 0.060 | +0.064 | 0.019 | +0.108 |
| (1972) | [0.233, 0.348] | [0.041, 0.053] | [0.190, 0.306] | [0.082, 0.087] | [0.025, 0.096] | [0.057, 0.069] | [−0.026, 0.064] | [0.104, 0.112] |
| 50 | 0.338 | +0.047 | 0.330 | +0.087 | 0.116 | +0.063 | 0.098 | +0.130 |
| (1962) | [0.280, 0.396] | [0.038, 0.056] | [0.269, 0.390] | [0.081, 0.094] | [0.076, 0.156] | [0.057, 0.070] | [0.053, 0.143] | [0.128, 0.133] |
| 60 | 0.386 | +0.046 | 0.419 | +0.090 | 0.172 | +0.063 | 0.233 | +0.153 |
| (1952) | [0.310, 0.461] | [0.038, 0.056] | [0.331, 0.506] | [0.064, 0.117] | [0.120, 0.224] | [0.056, 0.070] | [0.178, 0.289] | [0.136, 0.168] |
| 65[a] | 0.409 | +0.030 | 0.466 | +0.057 | 0.200 | +0.039 | 0.322 | +0.102 |
| (1947) | [0.322, 0.497] | [0.029, 0.030] | [0.345, 0.586] | [0.038, 0.077] | [0.140, 0.260] | [0.039, 0.040] | [0.246, 0.397] | [0.091, 0.114] |
| Averages for all cohorts[b] | 0.310 | 0.044 | 0.290 | 0.080 | 0.084 | 0.059 | 0.115 | 0.107 |

[a] Change over five years was calculated due to the sample constraints.
[b] Averages of initial differences and changes over 8 years were calculated for all cohorts.
NOTE: Estimates are average marginal differences in standard deviations between lower- and higher-education groups, and between rural and urban groups in depressive symptoms. 95% confidence intervals are shown in brackets. Estimates are based on M3-M6 in Tables 4 and 5. Initial differences are predicted mean differences in depressive symptoms at the age of first observation. Changes over 8 years are calculated as differences between predicted mean differences at initial observation and predicted mean differences 8 years later.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

**FIGURE 3 Predicted age trajectories of depressive symptoms-by-hukou by cohort**




NOTE: The estimates are based on M4 and M6 shown in Tables 4 and 5; in both panels, colors indicate six birth cohorts: 1992 (green), 1982 (ochre), 1972 (red), 1962 (purple), 1952 (violet), and 1947 (blue); solid lines show trajectories of people with rural hukou, while the dashed lines show trajectories of people with urban hukou; gray shading indicates 95% confidence interval.
SOURCE: Data are from CFPS 2012–2020, v.6.1 release 2019 for CFPS 2012; v.2.2 release 2019 for CFPS 2016; v.2.1 release 2020 for CPFS 2018; v.1.0 release 2021 for CFPS 2020.

Using the Multiple Imputation to fill in the missing values of depressive symptoms, our main results remained unchanged (Tables A7–A9, Figure A7 in the Appendix of the Supporting Information).

*Measurement invariance.* As the meaning of mental health may vary across time or groups (Putnick and Bornstein 2016), the results on trajectories in mental health and population differences therein may partly reflect different interpretations of the questions on depressive symptoms. To investigate if our measure of depressive symptoms assesses an equivalent construct across populations under study and over time, we tested for measurement invariance of depressive symptoms across waves, cohorts, genders, education, and hukou statues in the sample who completed each of the four assessments. Two levels of measurement invariance were tested: (1) configural measurement invariance, that is participants across waves or groups conceptualize the constructs in the same way; (2) metric measurement invariance, which is an important prerequisite for cross-group comparison, particularly for comparing regression slopes or change scores in longitudinal studies (Chen 2007). We performed measurement invariance tests via the Mplus Version 8.3. Table A10 in the Appendix of the Supporting Information shows that configural measurement invariance was supported, as the CFI $> 0.950$, RMSEA $< 0.060$, and SRMR $< 0.080$ (West, Taylor, and Wu 2012). The overall model fit is not significantly worse in the metric invariance model compared to the configural invariance model ( CFI $< 0.01$, RMSEA $< 0.015$, or SRMR $< 0.03$; Chen 2007), indicating that the metric measurement invariance was supported as well.

## Discussion

Using four waves of CFPS data from 2012 to 2020 and hierarchical linear models, we analyzed the life course trajectories and social change in depressive symptoms, as well as population differences therein by gender, education and hukou status. We found an increase in depressive symptoms with age and across cohorts in China. Disparities by gender, education and hukou status increase with age, less so across cohorts, though at higher overall levels of depressive symptoms.

### Life course trajectories of mental health

Depressive symptoms rose gradually with age in China, which is in line with the "age as decline" hypothesis rather than with the "age as life cycle" or "age as maturity" hypotheses typically supported in Western countries, such as the United States and many European countries (Blanchflower 2021; Bramajo 2022; Cheng et al. 2017; Graham and Ruiz Pozuelo 2017; Lang et al. 2011; Mirowsky and Ross 1992; Yang 2007). The linear increase in depressive symptoms with age found in China likely reflects the gradual accumulation of stressors during the life span of the Chinese. During adolescence, academic pressure constitutes a primary stressor. Upon entering university, Chinese college students primarily face intense competition in the job market. Subsequently, as they commence their careers, they contend with elevated work-related stress and financial pressures, continually challenging their mental well-being. As individuals progress into middle age, work-related stress coincides with the onset of physical health decline and familial obligations mandated by cultural norms, which include support the younger generation—own children, but also older parents. In older age, people encounter an accumulation of chronic diseases and disabilities, necessitating more frequent medical attention and medication therapy. However, the current levels of basic endowment insurance and medical insurance subsidies in China are relatively low and are insufficient to cover the daily needs and medical expenses of the older population (Jiang, Yang, and Sánchez-Barricarte 2016). Furthermore, China's care system is unable to provide affordable health management and caregiving services for disabled older adults (Glass, Gao, and Luo 2013). In sum, mental health of Chinese people is continuously challenged throughout the life course, resulting in a sustained increase in depressive symptoms as they age.

### Social change in mental health trajectories

We found a negative trend in depressive symptoms across cohorts, whereby more recent cohorts exhibit higher levels of depressive symptoms than earlier cohorts, aligning with the "negative social change" perspective. This finding is in line with previous studies from Western societies, such as

the United Kingdom (Bell 2014), Belgium (Brault, Meuleman, and Bracke 2012) and Canada (Drapeau, Marchand, and Forest 2014), and with one previous study from China (Zhang and Zhao 2021). The negative trend across cohorts found in our study might be partly due to similar factors as in Western societies, such as increased individualization, competition, instability in work and family life, and social comparison on social media in more recent cohorts, and partly due to unique sociohistorical conditions faced by Chinese cohorts.

First, in the process of profound changes in Chinese society, the mental health of younger generations has encountered a heightened array of challenges. For example, the University Expansion in 1999 and the Postgraduate Expansion around 2000 have flooded China's job market with a large number of graduates with university and higher diplomas, which undoubtedly puts greater employment pressure on young people (Wang and Ye 2020; Xing and Li 2011). Moreover, many of them have to face age discrimination, normally at the age of 35, and harsh work regimes such as "996" after working, leaving the younger generation little time to enjoy life and relax from stress (Chang 2023). For middle-aged people, the conventional filial responsibility for older parents is becoming increasingly pressing, as the "one-child generation" (born after 1980) enters middle age and the "baby boom generation" (born between 1962 and 1965) enters old age. The dramatic transition during the era of economic reform has disintegrated the traditional large family and weakened the family ties in China (Yu et al. 2012), leaving older adults with less family support. However, China's social security systems are still insufficient, and the degree of aging is rapidly deepening, which may potentially subject future older people to even greater pressures.

Second, more recent cohorts may be more vulnerable to depression risk factors than earlier cohorts. China's older population grew up in an environment characterized by wars, famines, and natural disasters, which made them more inclined to be satisfied with their current lives. However, there may be a healthy survivor effect, as those who survived this as children may be particularly physically and mentally robust. In contrast, the rise of individualistic culture and economic prosperity following China's economic transformation may have led the younger generation to pursue external values, heightening their expectations for an ideal life and rendering them more susceptible to disappointment (Zhang and Zhao 2021). Faced with substantial psychological pressures, many young individuals in China opt for a "lying flat" lifestyle or choose to become "full-time sons and daughters" (Chang 2023; Zhang 2022).

Finally, as the government continues its advocacy efforts and people's levels of education gradually increase, mental diseases become more widely understood and accepted. Consequently, more recent cohorts may be more willing to express their emotional problems than earlier cohorts (Yu et al.

2012). This could imply that depressive symptoms might actually not have become more prevalent in China across cohorts, but that people became more open about sharing their complaints. One implication of this potential alternative explanation, which we tested empirically, was that our measure of depressive symptoms may capture different concepts across cohorts or age groups. Yet, our analyses of measurement invariance indicated that the structure of our measure of depressive symptoms did not vary across cohorts or age groups. These results provide some confidence in the substantive interpretation of our results as an actual increase in depressive symptoms across cohorts. Yet, they do not entirely exclude the possibility that members of more recent generations may have still become more open to sharing information about their psychological problems and that this may partially explain an increase in depressive symptoms across cohorts. This alternative explanation needs to be further addressed in future research.

### Demographic heterogeneity in mental health trajectories

Demographic heterogeneity in depressive symptoms by gender, education and hukou status increased with age, in line with the cumulative (dis)advantage hypothesis—similar to previous studies from Western societies (Kim and Durden 2007; Mirowsky 1996; Mirowsky and Ross 2008). First, we found that gender disparity in depressive symptoms increased with age during the middle and late adulthood, as the depressive symptoms increased more rapidly among women than men. This is in line with previous Chinese studies on gender difference in physical health trajectories, such as cognitive ability (Lei et al. 2012) and physical function (Chu 2023). One possible explanation could be that under the influence of the "son preference" culture, families tend to allocate more resources toward the education and development of boys. Consequently, men gain more educational opportunities, better careers, and higher social status, equipping them to better handle challenges over the course of life as compared to women (Glei et al. 2013).

Second, the educational gap in depressive symptoms widened with age, whereby the increase in depressive symptoms among people with higher levels of education was less pronounced as compared to their counterparts with lower levels of education. Previous studies on the Chinese population also reached similar conclusions, that is, educational differences in self-rated health (Chen, Yang, and Liu 2010) and exercise time (Shi, Gu, and Fu 2020) increased with age. A study conducted in a Western context suggested that the beneficial effects of having higher levels of education increased over the life course (Bell 2014), which also applies to the situation in China. Especially in later life, less educated older adults may face more adversities in their daily lives compared to seniors with higher education in China. For instance, the level of basic endowment insurance subsidies in

China is correlated with occupational types and income levels. People with unstable jobs or lower income during their youth will receive lower pension benefits in their later years (China Labour Bulletin 2021). Consequently, older adults with lower educational attainment may experience a lack of income sources, leading to greater financial pressures. In contrast, people with higher levels of education not only possess more financial resources but also have more adaptable coping strategies to regulate their mental states and maintain positive emotions (Ross and Wu 1996; Williams 1990).

Finally, differences in depressive symptoms by hukou status increased with age due to slower increase with age among urban residents as compared to rural residents. This is also consistent with previous studies on the rural–urban divide in depressive symptoms (Hu, Li, and Martikainen 2019) and self-rated health (Zhao 2023) in China. China's hukou system institutionalizes inequality in socioeconomic status between urban and rural populations (Li et al. 2016), and rural residents are disadvantaged in accessing resources such as education and healthcare compared to their urban counterparts (Jiang and Wang 2018). The importance of resources in protecting mental health gradually comes to the fore as people grow older.

### Social change and demographic heterogeneity in mental health trajectories

We found that though disparities in depressive symptoms by gender, education, and hukou status widened with age, this tendency has lessened across Chinese cohorts. This finding contradicts previous studies from Western contexts, which typically find the health disparities to intensify across cohorts (Kim and Durden 2007; Luo et al. 2021a; Yang and Lee 2009).

First, the gap in depressive symptoms between men and women reduced across cohorts as the increase in depressive symptoms with age became steeper among men than among women. These intercohort changes may, on the one hand, reflect declining gender inequality in school enrolment and educational attainment (Liu, Jiang, and Chen 2020), which may have contributed to a reduction of depressive symptoms among women. On the other hand, they might reflect the mental health consequences of continued imbalance in the sex ratio at birth that has led to a surplus of men in the marriage market (Jiang et al. 2014). This factor may have contributed to both—a reduction in depressive symptoms among women due to better opportunities to find a male romantic partner, and an increase in depressive symptoms among men due to worsening opportunities to find a female romantic partner. In addition, steeper increases in depressive symptoms among men might be partly driven by men from the "only-child generation," who remain without a partner, as this not only translates to the mental burden of inability to establish their own families but also entails shouldering the sole responsibility of caring for aging parents. This dual

burden places them in a uniquely challenging position, balancing familial obligations without the traditional support of a spouse or siblings. With the rapid aging of the Chinese population, where people aged 65 and above are projected to reach 371 million (over 27 percent) by 2050 (Jiang, Yang, and Sánchez-Barricarte 2016), it may become an even bigger challenge for single men to take financial and daily care of older parents in the future.

Second, although educational and hukou gaps diverged with age, we found that the disparities lessened in successive cohorts. This finding is consistent with a previous study by Chen, Yang, and Liu (2010) on the socioeconomic (SES) gradient in self-rated health in China, which argued that the decline in the SES gradient in health in China reflects the government's interventions in health, such as Mass Public Health Campaigns since the 1950s. Indeed, some of the Chinese government's efforts in recent years, such as the establishment of the New Rural Cooperative Medical Insurance (2002), University and Postgraduate Expansion (1999–2000), and Universal Nine-year Compulsory Education (2006), have been instrumental in alleviating education and hukou inequalities in mental health. More specifically, we found that the reduced educational differences in mental health across cohorts were related to respondents with a lower education doing better than those with a higher education. For the narrowing of hukou differences, the reason was that urban residents were doing worse among men, while rural residents were doing better among women.

However, our findings suggest that education and hukou disparities in mental health still persist in recent cohorts. Although China's Universal Nine-year Compulsory Education program expanded enrollment opportunities, the Vocational School System since the 1980s limited many people's opportunities to receive further education. Under this system, Chinese middle schoolers who rank in the bottom 50 percent at the city level are forcibly assigned to vocational schools over typical academic high schools (Yu 2022). However, the education quality of vocational schools is low, making it difficult for students to acquire the skills needed by the market; moreover, students who receive vocational education can no longer receive higher education such as universities, which strongly limits the opportunities for these students to pursue continuing education (Guo 2021; Yu 2022). In addition, there is still significant inequality in medical resources for mental health between urban and rural areas in China. For example, currently available mental health services in China are concentrated in specialist psychiatric hospitals in urban areas, with most rural areas having little or no access to mental health services (Phillips et al. 2009). Thus, continued efforts by the Chinese government are still needed to expand educational opportunities and reduce the rural–urban disparity in resource allocation.

This study contributes to empirical knowledge and theoretical understanding of changes in mental health over the life course and across birth cohorts in China. Empirically, we have identified patterns of change in mental

health, finding that the mental health of Chinese people deteriorates with age and across cohorts. Furthermore, we found that mental health disparities by gender, education, and hukou status widened with age but narrowed across cohorts. These findings enhance our understanding of mental health in a context where it remains understudied and highly stigmatized, despite recent improvements. Our study provides insight into the processes shaping mental health in China, identifying key developments and vulnerable groups. Our findings align with studies on self-rated health in China, which found that gaps in self-rated health between socioeconomic groups and between rural and urban hukou holders widened over the life course (Chen, Yang, and Liu 2010; Zhao 2023) and slightly narrowed across cohorts (Chen, Yang, and Liu 2010). Since mental health is a primary component of self-rated health (Singh-Manoux et al. 2006), the results of our study suggest that patterns observed in these previous studies are partly driven by mental health. Furthermore, by examining gender gaps our study highlights another important divide in mental health trajectories in the Chinese context, next to socioeconomic status and hukou. Finally, our study covers recent periods, extending the evidence of previous Chinese studies and showing that negative trends observed in self-rated health in the 1990s and early 2000s have continued until today, at least concerning depressive symptoms.

At a theoretical level, the present study challenges seemingly "universal" arguments that have been developed and empirically supported in Western countries. For example, the expectation of a midlife crisis producing a "U-shaped" life course pattern in mental health appears not applicable to the Chinese context. Regarding the gender gap in mental health, our findings indicate faster mental health declines among Chinese men in more recent cohorts. If these trends continue, Chinese men will soon exhibit more depressive symptoms than Chinese women. These results challenge theoretical arguments regarding gender gaps in depression, which unanimously assume that women are at a higher risk of depression in view of differences between women and men in social roles, labor market involvement, and family responsibilities. Although these arguments partly apply to China as well, important family responsibilities are traditionally shouldered by men, especially by men born in "one-child" generations. The Chinese context highlights the need for considering higher depression risks among men and challenges the validity of gender-based assumptions in mental health research outside Western settings. Finally, the common theoretical assumption that mental health problems are more prevalent among the urban population, widely supported in Western contexts, is challenged by our findings, which show a reversed relationship in China. These findings show that even in the presence of factors that are commonly assumed to be detrimental to mental health—crowding, noise, and pollution—urban residents may exhibit better mental health than those living in rural areas. Differences in social insurance, health resources, and community

infrastructure between urban and rural areas in China are suggested to play a vital role in these urban–rural health disparities (Jiang and Wang 2018; Zhang, Chandola, and Zhang 2023).

### Limitations

This study has several limitations. First, it focuses on one dimension of mental health. Although depression is the primary indicator of mental health and well-being in previous research and is the most common mental disease world-wide, mental health encompasses other dimensions such as anxiety, personality integration, cognition, or addictions. Future research should further investigate trajectories and population differences in other dimensions of mental health, as patterns found for depressive symptoms may differ from other pathologies (Yang et al. 2023). Second, caution should be exercised when interpreting the results of this study due to the potential influence of period effects. Although we explored potential periodic influences theoretically and descriptively, our statistical models implicitly assumed that no period effects were present. Although this assumption appeared plausible given our theoretical arguments and robustness checks, we cannot fully exclude the possibility of periodic factors being influential. Finally, the data used in this study spanned from 2012 to 2020, providing only an eight-year observation window for each cohort. This limited time span offers only a partial view, and caution in interpretation is particularly warranted when extrapolating trends from eight years to the entire life course and comparing cohorts with nonoverlapping observation spans in our data.

Despite the limitations, this study contributes to mental health research by identifying patterns of mental health over the life course and across cohorts, as well as demographic heterogeneity in these processes within the Chinese context. Our findings reveal that mental health shows very different patterns in China as compared to what we know from the Western countries, particularly in terms of life course patterns and disparities based on gender and rural–urban divisions. Future research should continue to dig into mental health in China and other non-Western contexts and address potential explanations—we outlined and it was beyond the scope of our study to include them—but future studies should test this explanation.

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## Data availability statement

The data that support the findings of this study are openly available at http://www.isss.pku.edu.cn/cfps/index.htm

## Note

1 The "996 work regime" refers to that working hours are from 9 am to 9 pm, six days a week, without subsidies or overtime pay, and no leave is allowed.

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