

How rural residence and gender associate with Mental Health: a cross-sectional study among Chinese early adolescents

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Research

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Abstract

Background: Mental health disorders are the leading cause of disability in youth globally. China has the world's second largest pediatric population with growing urban-rural inequalities.

Objectives: 1) to examine the prevalence and gender differences in drug use, depressive symptoms, social support and externalizing behaviors in adolescents from an underserved rural community; 2) to compare results to a known urban sample

Methods: A cross-sectional study was conducted among children 12-14 years-old from rural Guizhou (N=76) using the 2003 Global School-based Student Health Survey. Prevalence and gender differences of 19 mental health outcomes were calculated and compared to those from a public urban Beijing sample (N=1,629). Associations of outcomes with gender and rural residence were assessed using multivariate logistic regression models in a combined analysis.

Results: The prevalence of 9 out of the 19 investigated outcomes was significantly higher in the rural sample. In rural Guizhou, female gender was associated only with lower prevalence of physical fights. In the combined analysis, rural residence was associated with higher risks of lifetime troubles due to drinking, loneliness, insomnia, hopelessness, injuries and absenteeism. Girls had lower risks of recent drinking, inebriation, troubles due to drinking, recent smoking, fights, injures and bullying victimization compared to boys.

Conclusion: Higher risks of excessive drinking, depressive symptoms, poor social support, and externalizing behaviors were found in rural adolescents compared to their urban peers. Girls had lower risks of drug use, poor peer support and externalizing behaviors. These findings call for targeted interventions informed by contextual and gender specifications.

Background

Mental health and substance use disorders are the leading cause of disability in the world (GBD, 2017) and in children and adolescents (Erskine et al., 2014). Ninety percent of the affected youth live in low- and middle-income countries—LMICs (Fleischmann & De Leo, 2014) but only 10% of publications come from these countries (Saxena et al., 2006). The disease burden in LMICs is often overwhelming due to insufficient economic and healthcare resources (Vikram et al., 2013) and evidence from developed countries may not apply contextually (Maselko, 2017). Mental Health research in children and adolescents in LMIC is urgently needed to combat the burden of disease and to develop effective interventions to help billions of vulnerable youth develop their full potential (Kieling et al., 2011).

China is a high-middle-income country with the world's second largest youth population (UNFPA report, 2014) and growing urban-rural economic inequality (Zhou & Song, 2016). Though the country's overall development has improved some pediatric physical health disparities such as malnutrition (Dong et al., 2019), little is known about mental health disparities. A few recent publications showed concerning

patterns of higher prevalence of substance use (She et al., 2016), anxiety (Liu et al., 2018), lower self-esteem and social support (Zhang et al., 2017) in rural youth. The causes are likely multifactorial. Rural children reportedly have lower rates of preschool and kindergarten enrollment, poorer social skills and less caregiver involvement in their education (Chen et al., 2015). In addition, more than 20 million have been impacted by the family disruption due to parental out-migration in the last few decades (Gao et al., 2010), which increased risks in educational and health problems (Meng & Yamauchi, 2017). Rural China is also known for traditional gender roles—girls are often assigned more domestic responsibilities and receive fewer resources (Tian et al., 2018). Historically this led to higher female child mortality (Ren, 1995) and poorer health (Li et al., 2004). Recently the gender gap seems to be closing for all health outcomes except for mental health (Zhou et al., 2016). This phenomenon is poorly understood.

Guizhou (Appendix 1) is the poorest province in China based on per capita income (National Bureau of Statistics of China, 2014). Zhijin county is a mountainous area of Guizhou particularly isolated due to difficult transportation (at least 6 hours of cliff-side bus ride from the nearest station at the time of data collection). In addition to limited economic and healthcare resources, more than one third of the rural children have been “left behind” by parents due to out-migration (All China Women’s Federation, 2013). These children suffer from long-term separation from parents during formative years and often live with overburdened relatives or grandparents (Zhao et al., 2018). This phenomenon of “left-behind-children” is common among LMICs and has been associated with higher rates of depression, anxiety, suicidal ideation, conduct disorder and substance use (Fellmeth et al., 2018).

Objectives

1) to examine the prevalence and gender differences in drug use, depressive symptoms, social support and externalizing behaviors in early adolescents in an underserved rural county in China; 2) to compare outcomes to those in a public urban sample; 3) to examine the associations of gender and residence with mental health outcomes in all subjects

Methods

This study used cross-sectional survey data collected by the authors in grades 4–6 (ages 11–14) at two underserved schools in rural Zhijin County (Guizhou province, China). A total of 100 students completed the Chinese version of the 2003 Global School Health Survey, or GSHS (WHO, 2003). The sample size satisfied our power calculation using an α of 0.05 and a hypothesized between-group difference of 10%. The data collection was twofold. First, two local schools participating in a community library project were contacted and both agreed to enroll in the study. After obtaining consent from the principals, we randomly selected 2 classrooms from each school (cluster randomization) with fifty students each. All guardians of the 100 students gave verbal assesnt prior to student participation. The urban Beijing sample included in the rural-urban analysis was previously published by the Chinese Center for Disease Control (CCDC) in collaboration with the World Health Organization and the US CDC (USCDC, 2016). The same 2003 GSHS was used in a 2-stage cluster sample selection process. First, a list of all middle

schools in Beijing was gathered and schools were selected with probability proportional to enrollment size. Next, classes were randomly selected as clusters and all students in these classes were eligible to participate. The school response rate in Beijing was 100% and the student response rate was 99%. A total of 2,348 students ages 12–16 were included in the Beijing sample. For this study students ages 12–14 were chosen to represent early adolescents. Our analysis included 76 Zhijin students and 1,629 Beijing students.

For the survey, the 2003 GSHS is a widely used tool validated and applied by the WHO in many countries in conjunction with local governments (WHO, 2003). It covered 68 core questions in 8 categories: “Hygiene,” “Drug Use,” “Mental Health,” “Nutrition,” “Activity,” “Protective Factors,” “Tobacco,” and “Safety.” Table 1 lists the 19 survey questions from the Chinese GSHS used to create all the binary categorical outcome variables in our study. We grouped them into four domains for conceptualization: “drug use”, “depression”, “social support” and “externalizing behaviors”.

Table 1

Mental health questions of the Chinese 2003 Global School-based Student Health Survey used in this analysis (English translation)

Variable	Question
1. Recent drinking	In the past 30 days, how many alcoholic drinks did you have?
2. Ever drunk	In your lifetime, how many times have you ever gotten drunk?
3. Trouble with alcohol	In your lifetime, how many times have you ever had hangover, felt sick, or gotten into trouble because of alcohol?
4. Recent smoking	In the past 30 days, on how many days have you smoked a cigarette or more?
5. Passive smoking	In the past 7 days, on how many days did other people smoke around you?
6. Other drugs	In your lifetimes, how many times have you ever used any drugs such as marijuana, methamphetamine, Ecstasy, heroine?
7. Loneliness	In the past 12 months, how many times have you felt lonely?
8. Insomnia	In the past 12 months, how often have you lost sleep due to worries?
9. Hopelessness	In the past 12 months, did you ever feel so sad or hopeless almost every day for 2 weeks or more in a row that you stopped doing your usual activities?
10. Suicidal ideation	In the last 12 months, how many times have you seriously considered suicide?
11. Suicidal plan	In the last 12 months, how many times have you seriously planned a suicide?
12. Close friends	How many close friends do you have?
13. Helpful schoolmates	In the past 30 days, how often did you find most schoolmates kind or helpful?
14. Parental supervision	In the past 30 days, how often did your guardians really knew what you were doing with your free time?
15. Parental understanding	In the past 30 days, how often did your guardians understand your problems or worries?
16. Fighting	In the past 12 months, how many times were you involved in a physical fight?
17. Injuries	In the past 12 months, how many times were you seriously injured?
18. Bullying	In the past 30 days, on how many days were you bullied?
19. Absence	In the past 30 days, on how many days were you absent without permission?

For the analysis, we used descriptive statistics to calculate the prevalence of each outcome variable in the rural sample. Then we compared the results with those from the urban sample using the χ^2 test. Next, we calculated the prevalence of each outcome variable in the rural sample by gender. The χ^2 test was again used to assess gender differences by statistical significance. The same process was applied to examine gender differences in the urban sample. Finally, multivariate logistic regression models were applied to a combined rural-urban sample (N = 1,705) accounting for the effects of clustered sampling to examine the associations between each mental health outcome, gender and residence adjusting for age, grade, height and weight. In sensitivity analysis, interaction terms between gender and residency were added to test potential effect modification on the outcomes. All analyses were performed using 95% confidence intervals. A two-sided *P* value of < 0.05 was used to define statistical significance. Data analysis was completed using STATA version 15.0 (StataCorp, College Station, TX).

Results

Table 2 summarizes the background characteristics of rural and urban students.

Table 2
Background characteristics in rural (N = 76) and urban (N = 1,629) samples, **p* < 0.05

	Zhijin (rural)	Beijing (urban)	<i>P</i> -value
Gender, freq (%)			
Female	54.4	54.2	0.97*
Male	45.6	45.8	
Mean age (SD)	12.6 (0.7)	13.3 (0.7)	< 0.01*
Grade, freq (%)			
6	14.5	38.5	< 0.01*
7	65.8	41.9	
8	19.7	19.4	
9	0.0	0.3	
Height (m), mean (SD)	1.35 (0.13)	1.60 (0.08)	< 0.01*
Weight (kg), mean (SD)	32.3 (7.23)	50.6 (11.60)	< 0.01*

Gender distribution was close to even (54.4% female in the rural sample and 54.1% in the urban sample). Both samples included students ages 12–14 with a younger distribution in the rural sample (mean of 12.4, SD 0.7) compared to the urban sample (mean of 13.3, SD 0.7). Both rural and urban samples included participants from grade 6–8, with the highest proportion of students in grade 7 (65.8% of the rural sample and 41.9% of the urban sample). The rural sample had a lower mean height of 1.35 m (SD

0.13) vs. 1.60 m (SD 0.08) in the urban sample and a lower mean weight of 32.3 kg (SD 7.23) vs. 50.6 kg (SD 11.60) consistent with the rural sample's younger mean age.

Table 1 present the prevalence of all investigated mental health outcomes first in the rural sample and then compared to the urban sample. Under the “drugs” category, the rural sample showed higher prevalence of ever getting into trouble due to alcohol (14.9% vs. 3.7% in the urban sample, $p < 0.001$) and ever using drugs other than alcohol and cigarettes (5.3% vs. 0.6% in the urban sample, $p < 0.001$). Under “depression”, rural students showed no significantly different prevalence of suicidal ideation in the past year (8.2% vs. 14.2% in urban students, $p = 0.15$) but higher prevalence of ever feeling hopeless for 2 weeks straight in the past year (32.0% vs. 18.2% in the urban sample, $p = 0.003$). Under “social support”, rural students reported higher prevalence of rarely or never finding schoolmates helpful (38.2% vs. 17.9% in urban students, $p < 0.001$), rarely or never having guardians supervise their free time (46.1% vs. 30.1% in urban students, $p = 0.003$) and rarely or never having guardians understand their problems (63.2% vs. 34.0% in urban students, $p < 0.001$) all in the past month. Under “externalizing behaviors”, rural students reported higher prevalence of being seriously injured in the past year (46.7% vs. 16.2% in urban students, $p < 0.001$), being bullied (47.4% vs. 20.3% in urban students, $p < 0.001$) and missing school without permission (14.7% vs. 4.8% in urban students, $p < 0.001$) both in the past month.

Figure 1 (also see supplementary table 1 for detailed data) compares the prevalence of all mental health outcome measures by gender first in the rural sample, and then in the urban sample. In rural Zhijin, only the prevalence of getting into physical fights in the past year was statistically different by gender (41.9% of boys vs. 2.7% of girls, $p < 0.001$). In the urban sample, boys reported significantly higher prevalence of many outcomes compared to girls—drinking in the past month (12.1% vs. 7.7% in girls, $p = 0.002$), ever getting drunk (9.7% vs. 5.3% in girls, $p = 0.002$), ever getting into trouble because of alcohol (5.1% vs. 2.5% in girls, $p = 0.006$), smoking in the past month (10.7% vs. 1.6% in girls, $p < 0.001$), experiencing passive smoking in the past week (61.5% vs. 54.8% in girls, $p = 0.005$), rarely or never finding their schoolmates helpful in the past month (23.3% vs. 13.3, $p < 0.001$), getting into physical fights in the past year (25.1% vs. 5.9% in girls, $p < 0.001$), getting injured in the past year (15.8% vs. 11.3% in girls, $p = 0.001$) and being bullied in the past month (22.3% vs. 16.8% in girls, $p = 0.002$).

Table 3 presents the associations of mental health outcomes with female gender and rural residence in the combined rural-urban sample ($N = 1,705$), adjusting for age, grade, height and weight. We also performed a sensitivity analysis that showed no statistically significance in any of the interaction terms (gender*residence) in the multivariate logistic regression models—therefore omitted from the table. Girls were less likely to have drunk alcohol in the past month (OR 0.65, $p = 0.01$), ever gotten drunk (OR 0.13, $p = 0.02$), ever gotten into trouble because of drinking (OR 0.40, $p < 0.001$), smoked in the past month (OR 0.13, $p < 0.001$), or experienced passive smoking in the past week (OR 0.74, $p = 0.03$). They were less likely to perceive their schoolmates as rarely or never helpful in the past month (OR 0.47, $p < 0.001$). They were less likely to have gotten into physical fights (OR 0.17, $p < 0.001$) or gotten injured (OR 0.65, $p = 0.01$) in the past year, or suffered from bullying in the past month (OR 0.68, $p = 0.01$). Rural students were more likely to have ever gotten into trouble due to alcohol (OR 5.09, $p = 0.001$). They were more likely to report

frequent loneliness (OR 2.08, $p = 0.03$), frequent insomnia (OR 2.07, $p = 0.04$) and hopelessness for 2 weeks straight (OR 2.56, $p = 0.04$) in the past year. They were more likely to perceive fellow schoolmates as rarely or never helpful (OR 2.90, $p = 0.001$), and their guardians as rarely or never understanding of their problems (OR 4.12, $p < 0.001$) in the past month. Finally, they were much more likely to have been seriously injured in the past year (OR 5.00, $p < 0.001$) and to have missed school unexcused in the past month (OR 5.21, $p < 0.001$).

Table 3

Prevalence of mental health outcomes in rural (N = 76) and urban (N = 1,629) students, *p < 0.05

Number (%) of students who...		Zhijin (rural)	Beijing (urban)	p- value
Drug use	1. Recent drinking \geq 1	10 (13.3%)	158 (10.3%)	0.41
	2. Ever drunk \geq 1	7 (9.2%)	119 (7.3%)	0.53
	3. Trouble with alcohol \geq 1	11 (14.9%)	60 (3.7%)	< 0.001*
	4. Recent smoking \geq 1	3 (3.9%)	94 (5.9%)	0.48
	5. Passive smoking \geq 1	48 (63.2%)	943 (58.1)	0.38
	6. Other drugs \geq 1	4 (5.3%)	9 (0.6%)	< 0.001*
Depression	7. Loneliness \geq sometimes	25 (32.9%)	427 (26.3%)	0.20
	8. Insomnia \geq sometimes	19 (25.3%)	322 (19.8%)	0.24
	9. Hopelessness \geq 1	24 (32.0%)	294 (18.2%)	0.003*
	10. Suicidal ideation \geq 1	6 (8.2%)	231 (14.2%)	0.15
	11. Suicidal plan \geq 1	3 (3.9%)	114 (7.0%)	0.30
	12. Close friends = 0	9 (11.8%)	122 (7.5%)	0.17
	13. Helpful schoolmates = never/rarely	29 (38.2%)	291 (17.9%)	< 0.001*
Social Support	14. Parental supervision = never/rarely	35 (46.1%)	490 (30.1%)	0.003*
	15. Parental understanding = never/rarely	48 (63.2%)	553 (34.0%)	< 0.001*
Externalizing behaviors	16. Fighting \geq 1	16 (21.1%)	239 (14.7%)	0.13
	17. Injuries \geq 1	35 (46.7%)	218 (16.2%)	< 0.001*
	18. Bullying \geq 1	36 (47.4%)	314 (20.3%)	< 0.001*
	19. Absence \geq 1	11 (14.7%)	78 (4.8%)	< 0.001*

Table 4

Associations between mental health outcomes, gender and rural residence in combined analysis (N = 1,705).

		Girls vs. Boys		Zhijin vs. Beijing (rural) (urban)	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Drug use	1. Recent drinking ≥ 1	0.65 (0.47–0.89)	0.01*	2.16 (0.94–4.99)	0.07
	2. Ever drunk ≥ 1	0.13 (0.02–0.76)	0.02*	2.82 (0.99–7.96)	0.05
	3. Trouble with alcohol ≥ 1	0.40 (0.25–0.65)	< 0.001*	5.09 (1.87–13.87)	0.001*
	4. Recent smoking ≥ 1	0.13 (0.06–0.28)	< 0.001*	2.02 (0.44–9.20)	0.36
	5. Passive smoking ≥ 1	0.74 (0.57–0.97)	0.03*	1.04 (0.63–1.70)	0.89
	6. Other drugs ≥ 1	0.69 (0.21–2.29)	0.54	9.20 (0.74–114.05)	0.08
Depression	7. Loneliness \geq sometimes	1.30 (1.00–1.69)	0.05	2.08 (1.09–3.94)	0.03*
	8. Insomnia \geq sometimes	1.16 (0.89–1.52)	0.27	2.07 (1.19–3.61)	0.01*
	9. Hopelessness ≥ 1	0.90 (0.74–1.10)	0.32	2.56 (1.05–6.23)	0.04*
	10. Suicidal ideation ≥ 1	1.17 (0.87–1.57)	0.29	0.67 (0.27–1.65)	0.38
	11. Suicidal plan ≥ 1	1.09 (0.77–1.56)	0.62	0.60 (0.18–2.02)	0.41
	12. Close friends = 0	0.80 (0.47–1.35)	0.40	0.60 (0.19–1.84)	0.37
	13. Helpful schoolmates = never/rarely	0.47 (0.36–0.61)	< 0.001*	2.90 (1.58–5.34)	0.001*
Social Support	14. Parental supervision = never/rarely	0.83 (0.67–1.05)	0.12	1.74 (0.91–3.34)	0.09
	15. Parental understanding = never/rarely	0.84 (0.68–1.05)	0.12	4.12 (2.12–8.02)	< 0.001*
Externalizing behaviors	16. Fighting ≥ 1	0.17 (0.11–0.27)	< 0.001*	1.97 (0.57–6.88)	0.29

	Girls vs. Boys		Zhijin vs. Beijing (rural) (urban)	
17. Injuries \geq 1	0.65 (0.48– 0.88)	0.01*	5.00 (1.70– 14.76)	< 0.001*
18. Bullying \geq 1	0.68 (0.51– 0.92)	0.01*	2.75 (1.00– 7.60)	0.05
19. Absence \geq 1	0.65 (0.38– 1.11)	0.12	5.21 (2.39– 11.38)	< 0.001*

Discussion

This study used a unique rural sample from the poorest province in China to study the prevalence of mental health outcomes in underserved early adolescents, and to examine the associations between mental health, gender and rural residence by comparing this sample to a public urban sample. Major findings include: (1) 9/19 investigated mental health outcomes were found to be more prevalent in the rural sample compared to the urban sample; (2) rural residence was associated with significantly higher odds for 7/19 outcomes after adjusting for age, grade, weight and height; (3) girls were overall less likely to report drug use, poor peer support and externalizing behaviors but this gender difference was mostly driven by the urban sample.

In terms of drug use, the prevalence of alcohol use in the past month was similar in the rural (13.3%) and the urban samples (10.3%). However, the prevalence of having ever gotten into trouble due to alcohol was significantly higher in rural Zhijin (14.9% vs. 3.7%, $p < 0.001$). In the combined analysis, rural residence was also significantly associated with this outcome (OR 5.09, $p = 0.001$). These findings highlighted excessive drinking reaching harm as more likely in rural adolescents. Consequences of youth excessive drinking on a single occasion have been documented to range from poisoning to motor vehicle crash deaths, drownings and falls, suicides and burns to later dependency and injuries globally (Jernigan, 2001). Our findings were consistent with previous literature in many Chinese adolescents start drinking alcohol before 6th grade (Li et al., 1996). Therefore, alcohol use should be a priority target for mental health interventions, ideally starting before 6th grade and especially in rural China.

In terms of depressive symptoms, an alarming 32% of Zhijin students have felt “sad and hopeless almost every day for 2 weeks straight in the past year” (vs. 18.2% in Beijing, $p = 0.003$). In the combined analysis, rural residence was also significantly associated with this outcome (OR 2.56, $p = 0.04$). Though suicidal thought and planning were not significantly different between samples, hopelessness may be an early red flag for later depression (Mac Giollabhui et al., 2018). The combined analysis also showed that rural residence was associated with frequent insomnia (OR 2.07, $p = 0.01$). Previous studies have shown insomnia as a predictor of depression in Chinese teenagers (Luo et al., 2014). Future interventions against adolescent depression could use insomnia as a measurable target in early adolescents especially in rural China, before clinical depression was evident.

Under “social support”, 38.2% of Zhijin students (vs. 17.9% in Beijing, $p < 0.001$) rarely or never found their schoolmates helpful. 46.1% of them has little or no supervision on their free time (vs. 30.1% in Beijing, $p = 0.003$) and more than 63.2% felt not understood by their guardians (vs. 34.0% in Beijing, $p < 0.001$). In the combined analysis, rural residence was associated both with poor peer support (OR 2.90, $p = 0.001$) and poor parental understanding (OR 4.12, $p < 0.001$). Poor parental involvement and inadequate parenting practices have been shown to be modifiable mediators between socioeconomic status and child mental health, with a few published family-level programs that improved children’s cognitive and socioemotional skills by optimizing parenting skills and involvement (Verhulst et al., 2020). On the other hand, peer relationships have been found as an effective buffer between traumatic life events and depression in Chinese teens (Greenberger et al., 2000), making it an important target for school-level interventions.

Under “externalizing behaviors”, the prevalence of being bullied in the past month was 47.4% in rural Zhijin (vs. 20.3% in Beijing, $p < 0.001$). The high rural prevalence was concerning for being much higher than the 13.3% previous estimate in China (Eslea et al., 2003), the 35.5% in neighboring LMICs such as the Philippines (Rudatsikira, 2008), and almost four times the 12% average in developed Western Europe (WHO, 2016). Bullying victimization in early teenage years have been shown to be associated with anxiety and depression (Bond et al., 2001), and with teenage suicidal ideation in a Chinese study (Liu et al., 2017). Given our findings in early adolescents, interventions targeting bullying should start at or before 12 years-old. The prevalence of serious injuries was also much higher in the rural sample (46.7% in Zhijin vs. 16.2% in Beijing, $p < 0.001$), confirmed by an OR of 5.0 ($p < 0.001$) associated with rural residence in combined analysis. One explanation is the risk of farm-work-related injuries in rural youth, with known associations to sleep disturbances and school-related stress (Postel et al., 2009). Other researchers suggested maltreatment by guardians and involvement in violent episodes as major risk factors (Shi et al., 2014). Injuries, in turn, can lead to unexplained school absenteeism, confirmed by our finding of OR 5.21 for missing school ($p < 0.001$) associated with rural residence. High absenteeism is likely to also involve anxiety, transport, bullying and difficulties with schoolwork (Melvin et al., 2019).

In terms of gender differences, combined analysis showed that girls were overall less likely to have drunk recently, to ever get drunk, to have drinking-related troubles, to smoke and to experience passive smoking. However, separate gender analysis by sample showed that most gender differences were noted in the urban sample alone, likely due to the relatively small size of our rural sample. The combined analysis findings were consistent with the global male predominance in smoking (WHO, 2010) and drinking (Wilsnack et al., 2009), as well as parallel findings in Chinese adolescents (Yue et al., 2016). Being a girl was overall associated with better perceived social support from their peers but not from their guardians. This was interesting because Chinese families are known to favor male children in resource-allocation (Tian et al., 2018). Perceived peer support is thus especially important for girls as it is a protective factor associated with increased prosocial behavior, better motivation and academic performance in school (Wentzel et al., 2004). Finally, girls had lower odds of suffering from physical fights, serious injuries and bullying. These findings were consistent with the literature on male predominance of externalizing behaviors in children (Chaplin & Aldao, 2013). Overall, gender differences found in the combined analysis

raise questions regarding the necessity to adopt different strategies and outcome measures by gender when designing future interventions.

This study has several strengths. First, its unique, underserved rural population from Guizhou has rarely been studied despite its needs and limited resources. Second, the combined analysis highlights the rural-urban inequality in adolescent mental health in China. Third, the GSHS survey covers a variety of mental health topics and has a wide international data base. Our findings help to add to the knowledge in adolescent mental health especially in LMICs. This study has a few important limitations. First, a cross-sectional study is unable to confirm causality or temporality. Second, the specific rural Guizhou sample and urban Beijing sample may not be generalizable to other contexts. They are examples of health inequity in China due to social determinants of health. Third, the rural and urban samples were collected in different studies, although this was done using the same GSHS tool in anonymous data collection. There is no reason to believe that the survey procedure may induce any difference. The comparison of the prevalence between samples may be affected by age distribution difference between your rural and urban sample. However, we were able to adjust the difference when estimating the ORs. Finally, the lack of information on internalized mental health measures and broader social-economic factors limited our ability to draw conclusions on important mental health outcomes such as anxiety, self-esteem and self-efficacy and the associations between outcomes and specific social determinants of health. More standardized, comprehensive mental health data in children and adolescents in LMICs are needed to understand the evolution of mental health in adolescents and their determinants.

Conclusion

This study is an examination of the prevalence of common mental health outcomes and their associations with gender and rural residence among early Chinese adolescents, using an underserved rural sample and a known public urban sample surveyed with the 2003 GSHS. Higher prevalence of excessive drinking, hopelessness, poor social support, and externalizing behaviors was found in rural adolescents compared to their urban peers. Girls had lower risks of drug use, poor peer support and externalizing behaviors. These findings call for targeted interventions informed by contextual and gender specifications.

Declarations

*Ethics approval and consent to participate

This study has been determined to have “exempt” status from the **Stanford University IRB** due to its lack of identifiable data and minimal risk with secondary data analysis from a previously collected sample and a public sample (please see **attachment under supplementary files**).

*Consent for publication

It was not possible to reach any individuals for consent due to the de-identified nature of our data.

*Availability of data and material

The Zhijin data and materials are available in de-identified form upon reasonable request. The Beijing data and materials are publically available at <https://www.cdc.gov/gshs/countries/westpacific/china.htm>

*Competing interests

All authors declare no competing interests.

*Funding

The authors did not receive any funding.

*Authors' contributions

Dr. She was the originator of the project idea, participated in data collection, analysis and drafting of the manuscript. Dr. Zhao was key to project design, data collection as well as community distribution of preliminary results. Dr. Li was instrumental in the data analysis, drafting of the manuscript and edition of the final submission. All three authors have approved this submission for publication.

This manuscript has not been published and is not in submission to any other journal.

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*Authors information

The rural data collection was born of a collaboration between first and second authors starting in 2010. At the time XS was a Public Health student helping DZ in a community health education project targeting teenagers entering puberty with various physical and psychological health challenges. DZ was the district medical officer and was deeply passionate about improving preventive care among community youth. XS completed her M.D. training in 2011 and kept communicating with DZ about way to help implement Public interventions that promoted school-age adolescent health. In 2013 XS volunteered to help obtain a baseline for student health at two local schools due to a lack of rural baseline data for measuring the impact of health-promoting programs. In 2014 the data collection was completed for the original baseline study and results were communicated to the community through the schools. Qualitative interviews with 18 community members including principals, teachers and parents during home visits revealed that Mental Health and the impact of gender-based expectations starting at a young age was one of the top three concerns for the community regarding early adolescent years. Therefore, after the publication of the original study, we decided to embark on this secondary analysis to focus on mental health and gender differences.

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

This study was approved by the IRB at Stanford University School of Medicine and at the Zhijin County Medical Office.

All participants and authors have provided either written consent or verbal assent for publication. Data and material are available for review upon request. This study did not receive any official research funding.

Dr. She contributed to the conception and design of the study, contributed to acquisition, analysis, and interpretation of data, drafted the manuscript, critically revised the manuscript for important intellectual content and gave final approval for publication. Dr. Zhao substantially contributed to acquisition, analysis, and interpretation of data, critically revised the manuscript for important intellectual content and gave final approval for publication. Dr. Li substantially contributed to the conception and design of the study, contributed to analysis and interpretation of data, critically revised the manuscript for important intellectual content and gave final approval for publication.

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Figures

	Prevalence (%) of students who...	Rural (%)	Urban (%)	Rural vs. Urban (Odds Ratio)
Drugs	Had at least 1 alcoholic drink on 1 or more days in the past 30 days	13.33	10.34	1.06
	Ever gotten really drunk in their life	6.56	5.48	1.22
	Had hang-over, felt sick, got into trouble as a result of alcohol	14.86**	3.70**	7.28**
	Used drugs one or more times	5.26**	0.56**	8.54**
Depression	Felt lonely most of the time or always in 12 months	11.84	6.83	2.10 (p=0.06)
	Ever seriously considered attempting suicide in 12 months	8.22	14.22	0.68
	Have no close friends	47.37**	7.51**	8.23**
Protective Factors	Parents or guardians never or rarely knew what they were doing with their free time in the past 30 days	68.06**	51.48**	1.81*
Externalizing Behaviors	Were in a physical fight $\geq 1x$ in the past 12 months	21.05	14.67	1.58*
	Were seriously injured $\geq 1x$ in the past 12 months	46.67**	16.20**	4.64**
	Were bullied $\geq 1x$ in 12 months	47.37**	20.35**	4.01**

* $p \leq 0.05$; ** $p \leq 0.01$

Figure 1

Comparison of the prevalence of all mental health outcome measures by gender first in the rural sample, and then in the urban sample



Figure 2

(Appendix 1) Map of Guizhou and Beijing. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

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