

13 **Abstract**

14 **Background**

15 In China, improving mental health has been far behind its accomplishments for other diseases. With depression as
16 one of the most prevalent mental disorders, the aim of this study was to evaluate temporal trends in the prevalence
17 and treatment of those who screen positive for depression in China, by age, gender, and province

18
19 **Methods**

20 We used data from three nationally representative sample surveys: the China Health and Retirement Longitudinal
21 Study (CHARLS), the China Family Panel Studies (CFPS), and the Chinese Longitudinal Healthy Longevity Survey
22 (CLHLS). Depression was judged by the Centre for Epidemiologic Studies Depression Scale. Access to treatment
23 was judged by two items: if respondents received any treatment like anti-depressants, or if respondents received
24 counselling from a mental health professional. Survey-specific weighted regressions were fitted to estimate the
25 temporal trend and subgroup disparities, and then pooled by meta-analysis.

26 **Results**

27 168,887 respondents were investigated. The overall prevalence of China populations who screen positive for
28 depression was 25.7% (95%CI 25.2-26.2) during 2016-2018, decreased from 32.2% (95%CI 31.6-32.8) during 2011-
29 2012. The gender gap increased with age and had no significant improvement from 2011-2012 to 2016-2018.
30 The prevalence of depression in developed areas is more likely to show a lower value and decreasing trend,
31 while the prevalence in underdeveloped areas is more likely to show a higher value and increasing trend,
32 from 2011-2012 to 2016-2018. The overall proportion of those who received any needed treatment or
33 counselling from a mental health professional slightly increased from 2011 (0.5%, 95%CI 0.4-0.7) to 2018 (0.9%,
34 95%CI 0.7-1.2), and mainly occurred for older adults aged 75 and above.

35
36 **Conclusion**

37 The prevalence of those who screen positive for depression decreased by about 6.5% from 2011-2012 to 2016-
38 2018 in China, but only tiny improvements were made in accessibility to mental health care. Corresponding
39 disparities were identified in age, gender, and province.

40
41 **Keywords:** Depression; Temporal trend, Age, Gender, Geographic, Subgroup disparity, China
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44 **Background**

45 In China, mental health has typically been left far behind its achievements in communicable and non-
46 communicable diseases[1]. Since the 21st century, mental health has drawn the attention of the Chinese
47 government, reflected in taking measures such as promulgating a series of National Mental Health Plans and
48 introducing its first mental health law. However, the mental health situation in China is still alarming[2]. As
49 estimated in 2013, China accounted for 17% of the global disease burden attributed to mental, neurological and
50 substance use disorders[3].

51 In China, about 15.9-38.6% of the general population suffer from common mental health problems [2; 4; 5; 6; 7],
52 and females are nearly twice as likely to have common mental health problems as males [5; 6]. Previous studies
53 have also estimated the prevalence of mental disorders by age, gender, and year [2; 8; 9; 10; 11]. To improve the
54 worrying mental health situation, it has significant practical implications for policymakers in China to understand
55 the temporal trend of prevalence and treatment of mental disorders. However, there is very little attention being
56 paid specifically from this perspective, and meanwhile taking into account the geographic, gender, and age
57 differences that exist in China.

58 Depression is one of the common types of mental disorder and a leading cause of disability [12]. The aim of this
59 study was to evaluate temporal trends in the prevalence and treatment of those who screen positive for depression
60 in China, by age, gender, and province.

61 **Methods**

62 **Database and participants**

63 We used publicly available data from three nationally representative sample surveys: the China Health and
64 Retirement Longitudinal Study (CHARLS) (wave 2011 and 2018), the China Family Panel Studies (CFPS) (wave 2012,
65 2016 and 2018), and the Chinese Longitudinal Healthy Longevity Survey (CLHLS) (wave 2018). The CHARLS is a
66 biennial social science and health household survey conducted among Chinese adults aged 45 and older in 28
67 provinces of China. The CFPS is a biennial survey focused on the economic, non-economic, and well-being of the
68 Chinese population of all ages in 25 provinces of China. The CLHLS was conducted to shed light on the determinants
69 of healthy human longevity and oldest-old mortality, and provides information on the health status and quality of
70 life of older adults aged 65 and above in 22 provinces of China. All the above three surveys were widely used in
71 the scientific community. Detailed descriptions of these data, sampling methods and quality-control
72 procedures have been reported elsewhere [13; 14; 15; 16].

73 The data are publicly available. The use of secondary de-identified data made/has made this study exempt
74 from the institutional review board. CHARLS was approved by the Ethical Review Committee of Peking
75 University (IRB00001052-11015). CFPS was approved by the Ethical Review Committee of Peking University
76 (IRB00001052-14010). CLHLS was approved by the Ethical Review Committee of Duke University and Peking
77 University (IRB00001052-13074).

78 **Measures**

79 Depression was judged by the Centre for Epidemiologic Studies Depression (CES-D) Scale. This scale was
80 developed for use in studies of the epidemiology of depressive symptomatology in the general population[17].
81 Its purpose differs from previous depression scales that have been used mainly for diagnosis at clinical intake
82 and/or evaluation of the severity of illness over the course of treatment[17]. CES-D originally is a 20-item
83 scale that asks individuals to rate how often over the past week they experienced symptoms associated with
84 depression, such as restless sleep, poor appetite, and feeling lonely. Response options range from 0 to 3 for
85 each item (0 = Rarely or None of the Time, 1 = Some or Little of the Time, 2 = Moderately or Much of the time,
86 3 = Most or Almost All the Time). The CES-D has various short versions. CHARLS and CLHLS used a 10-item
87 version of CES-D (CES-D-10), and CFPS used a full-item version of CES-D (CES-D-20). The total score of CES-D-
88 10 ranges from 0 to 30 with a validated cut-off point of 10 for depression, and the total score of CES-D-20 ranges
89 from 0 to 60 with a validated cut-off score of 16 for depression[18]. Although the inconsistency of the
90 instrument used by surveys, a prior validation study showed a strong agreement between CES-D-10 and CES-
91 D-20, with 98% of sensitivity and 83% of specificity[19].

92 Access to treatment was judged by two items: asking respondents “if they received any treatment like anti-
93 depressants” or “if they received counselling from a mental health professional”. Notingly, only CHARLS
94 provided the information on access to treatment.

95 **Other variables**

96 We investigated socio-demographic characteristics including age (years), gender (male vs female), marital status
97 (married/cohabitation, never married, and widowed/divorced/separated), education attained (illiterate, primary
98 school, middle school, high school or equivalent, and bachelor or above), minority ethnicity (yes or no), and
99 average annual household income per person. We also investigated the following variables because of their
100 identified influence on depression in China, including residence place (urban vs rural), and self-rated health status
101 (poor or lower, fair, and good or above)[10; 20; 21].
102

103 **Statistical analysis**

104 Due to the difference in the purpose, subjects, and sampling methods of the three nationally representative
105 surveys we explored, the data cannot be pooled at the individual level. Therefore, we combined the results
106 through a meta-analysis, which not only avoids the problem of bias caused by different surveys, but also
107 increases the accuracy of our estimates for specific age groups (especially very old people).

108 To estimate the prevalence of depression and its 95% confidence interval, we first estimated the sub-group
109 prevalence within each survey by province, age, gender, and year. In this step, the survey weights were used
110 to account for the complex survey design to make a representative estimation for each sub-group from
111 different surveys. Next, we pooled the estimations by meta-analysis with the inverted width of the confidence
112 interval as the weight. Heterogeneity between estimates based on different data sources was assessed by
113 Cochran's Q test[22]. For the presence of significant heterogeneity ($p < 0.1$), a random-effect meta-analysis
114 was performed to pool the estimates[22]. Vice versa, a fixed-effects meta-analysis was conducted. To
115 estimate gender differences, we fitted weighted logistic regression models, with depression (yes or no) as the
116 dependent variable and gender (with males as the reference) as the predictor, controlled for age, marital
117 status, education attained, and average annual household income per person, residence place, self-rated
118 health status, and survey year. To test if the gender difference changed during the studied period, we then
119 added an interaction term of gender \times year to the above model. The regression model was also fitted by
120 survey, province, and age, and the estimations were also pooled by meta-analysis with the inverted width of
121 the confidence interval as the weight.

122 Similar analyses were conducted to estimate the prevalence and trend of those who received any needed
123 treatment or counselling from a mental health professional. Differently, no meta-analysis was conducted as
124 only CHARLS provided information on access to treatment.

125 Analyses used R version 3.6.0. $P < .05$ was considered statistically significant. Results are reported following
126 the STROBE checklist for cohort studies.

127 **Results**

128 168,887 respondents were investigated, of which 51.2% were female. The mean age (SD) was 51.0 (21.3)
129 years.
130

131 The overall prevalence of China populations who screen positive for depression in the past week was 25.7%
132 (95%CI 25.2-26.2) during 2016-2018, decreased from 32.2% (95%CI 31.6-32.8) during 2011-2012. The
133 decrease in prevalence of depression was greater among younger people and older people, while it was
134 relatively small among middle-aged adults aged 45-54 (**Figure 1, Panel A and C**). This resulted in an "inverted
135 U-shaped" distribution for the female prevalence of depression during 2016-2018 (**Figure 1, Panel A**). Pre-
136 pooled results were provided in **Supplementary Tables 1 and 3**.
137

138 The prevalence of depression had a 7.6% gender gap (29.5% of females vs 21.9% of males) during 2016-2018,
139 decreased from 10.9% (37.4% of females vs 26.5% of males) during 2011-2012. The decrease favoured
140 adolescents and older adults, but the improvement was not significant (**Figure 1, Panel C, D, and E**). Pre-
141 pooled results were provided in **Supplementary Tables 3 to 5**.

142
143 Both the prevalence of depression and its temporal trends showed great geographic variances. The
144 prevalence of depression in developed areas was the lowest and decreased, such as Beijing (decreased from
145 15.4% during 2011-2012 to 10.8% during 2016-2018) and Shanghai (decreased from 18.2% during 2011-2012
146 to 12.0% during 2016-2018); but the prevalence in underdeveloped areas was the highest and increased, such
147 as Xinjiang (increased from 39.4% during 2011-2012 to 47.1% during 2016-2018) and Qinghai (increased from
148 55.8% during 2011-2012 to 62.5% during 2016-2018) (**Figure 1, Panel B**). Pre-pooled results were provided in
149 **Supplementary Tables 2**.

150
151 Among those who screen positive for depression and aged 45 and above, the overall proportion of those who
152 received any needed treatment or counselling from a mental health professional increased from 2011 (0.5%,
153 95%CI 0.4-0.7) to 2018 (0.9%, 95%CI 0.7-1.2), but remained quite low. Corresponding results by province, by
154 age, and by gender were presented in **Figure 2**, and indicated that access to needed treatment primarily
155 improved in developing or underdeveloped areas in central and western China (**Figure 2, Panel B**), access to
156 needed treatment primarily improved for older adults aged 75 and above (**Figure 2, Panel A and C**), and no
157 gender gap existed (**Figure 2, Panel D**) or emerged (**Figure 2, Panel E**).

158 159 **Discussion**

160 Here we evaluated the temporal trends in the prevalence and treatment of those who screen positive for
161 depression in China, by age, gender, and province. The prevalence of those who screen positive for depression
162 in China decreased from 32.2% during 2011-2012 to 26.7% during 2016-2018, with the decrease mainly
163 occurring in younger people and older adults. Salient subgroup disparities of the above prevalence were
164 detected for age, gender, and province. The gender gap increased with age and had no significant
165 improvement from 2011-2012 to 2016-2018. The prevalence of depression in developed areas is more likely
166 to show a lower value and decreasing trend, while the prevalence in underdeveloped areas is more likely to
167 show a higher value and increasing trend, from 2011-2012 to 2016-2018. The accessibility of mental health
168 care slightly improved from 2011-2012 to 2016-2018 and mainly occurred for older adults aged 75 and above,
169 but remained quite low (around 1%) both overall and by subgroup.

170
171 Our findings indicated that the decrease in the prevalence of depression mainly happened in younger people
172 and older adults, while the decrease in middle-aged adults aged 45-54 was relatively low. Given that the
173 access to mental health care in China was quite low as revealed by our study, the above age-related decrease
174 may be due to improvements in areas beyond mental health care. For younger people, the above decrease
175 might be because of the prevalence of the internet and games, along with a focus on physical activity in school,
176 which can help young people release their pressures or emotions[23; 24]. For older adults, this decrease in
177 depression prevalence might be attributed to the improvement in treating physical diseases, especially multi-
178 morbidity, a significant factor contributing to the mental health issues of the ageing population[25; 26].

179
180 An unexpected finding was that the distribution between age and prevalence of depression in China changed
181 from a linear growth trend in 2011-2012 to an "inverted U-shaped" pattern in 2016-2018, found within
182 females but not males. A similar "inverted U-shaped" distribution was also reported by another China-based
183 study[5]. The resulting pattern can be explained by the age-related decrease in the prevalence of depression
184 identified in our study, and women between the ages of 45 and 55 go through a period of physiological
185 transition. In addition, this "inverted U-shaped" distribution also matched the prevailing situation within
186 China, where women in their middle years usually take on the role of caretaking elderly relatives under
187 traditional concepts, and mothers are more concerned about their children's life and career development
188 than fathers. Our study also found that the gender disparity in the prevalence of depression had no significant

189 improvement from 2011-2012 to 2016-2018. Females are usually at higher risk of depression than males[27].
190 Besides more interventions are needed for women's mental health as advocated by researchers, our study
191 also emphasized that special attention should be paid to middle-aged women.
192

193 The finding of low accessibility of mental health care is consistent with previous studies conducted in China[2].
194 In general, patients with mental disorders in China are ashamed of disclosing their symptoms or feelings to
195 others due to the stigma of mental illness and fear of discrimination, which could lead to the underutilization
196 of mental health care. In addition, the lack of public awareness of mental health may also result in patients
197 not realizing they have conditions that need professional treatment. Evidence from China revealed that less
198 than 5% of those with depressive symptoms were aware of their conditions[2]. Those aged 75 or above had
199 the greatest improvement in access to needed mental health treatment. This could be explained by that they
200 are the primary group visiting professional physicians, and their mental illness has a higher possibility of being
201 discovered by their doctors.
202

203 Both the prevalence of depression and its temporal trend, as well as corresponding findings on access to
204 mental health treatment, showed great geographic variances in China. These geographic variances may be
205 caused by geography-related differences in health behavior (like alcohol usage and physical exercise)[28; 29],
206 available social support and social capital (like social trust in relatives and friends, distance to the nearest
207 medical institution, and medical assistance from non-spouse)[30; 31; 32], the prevalence of
208 multimorbidity[25], and economic development, (including average household income[25; 33], economic
209 welfare and social service welfare[34], and the probability of being to left-behind children[35] or empty-nest
210 elderly[7]). In addition, as for the geographic difference in the prevalence of depression, evidence also
211 suggested that higher altitude is more likely to be associated with symptoms of depression, with a possible
212 mechanism that increased altitude is associated with low-pressure hypoxia, which may alter the way the brain
213 works[36; 37]. These evident geographic variances suggested that the central government-issued action plans
214 related to mental health in China should be customized by local governments according to local customs,
215 habits, needs, and available resources.
216

217 To our knowledge, this is the first study to assess the temporal trends in the prevalence and treatment of
218 those who screen positive for depression in China, by age, gender, and province. The longitudinal
219 representative data enabled the exploration of the progress made to improve mental health in China. The
220 subgroup analysis allowed for a more nuanced and practical assessment of this improvement process, and
221 would contribute to formulating policies and implementing concrete action plans in practice.
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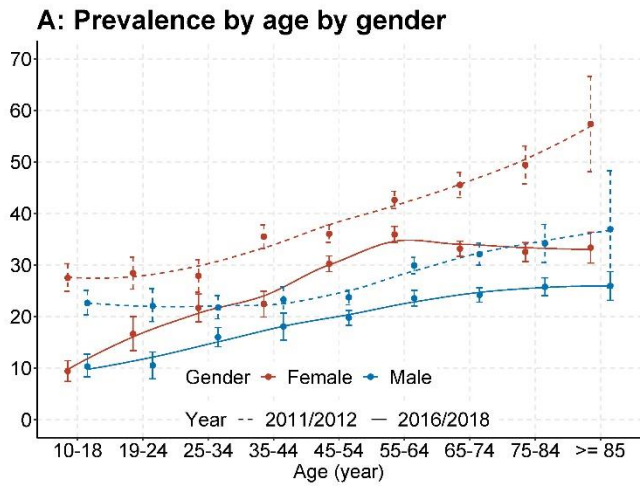
223 Our study was limited by the use of self-reported data, which may be subject to recall bias. Third, the evidence
224 on the cut-off point for probable depression primarily comes from the western population, whether the
225 validated cut-off point for probable depression meets Asian especially Chinese conditions need more studies
226 in the future. Fourth, people with depression may have been taking antidepressants but they had no residual
227 symptoms to be identified by the survey instruments. Such people would have been missed by this study,
228 resulting in underestimating the proportion of people with depression.
229

230 **Conclusion**

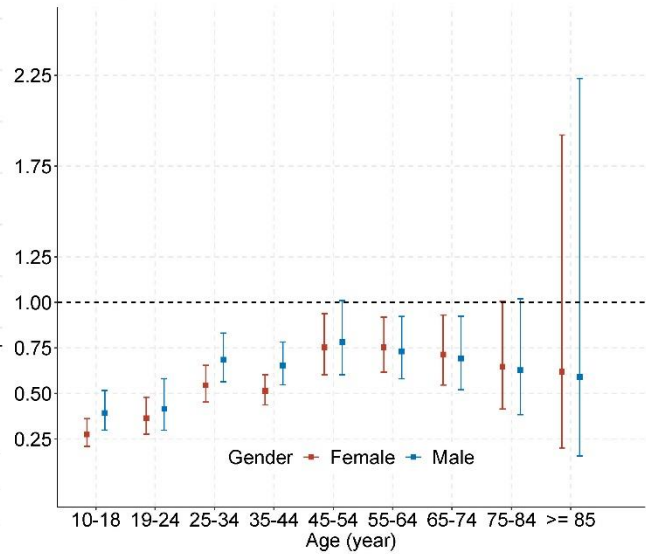
231 The prevalence of those who screen positive for depression had decreased in China, but only a tiny
232 improvement was made in access to mental health care. There were disparities in temporal trends in the
233 prevalence and treatment of those who screen positive for depression in China, by age, gender, and province.
234 The disparities in the prevalence of depression and the low proportion of receiving treatment suggested that
235 China's mental health system needs to be fully integrated into all aspects of its health-system reform.
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238 **Author contributions** SC had full access to all the data in the study and takes responsibility for the integrity of the
239 data and the accuracy of the data analysis.

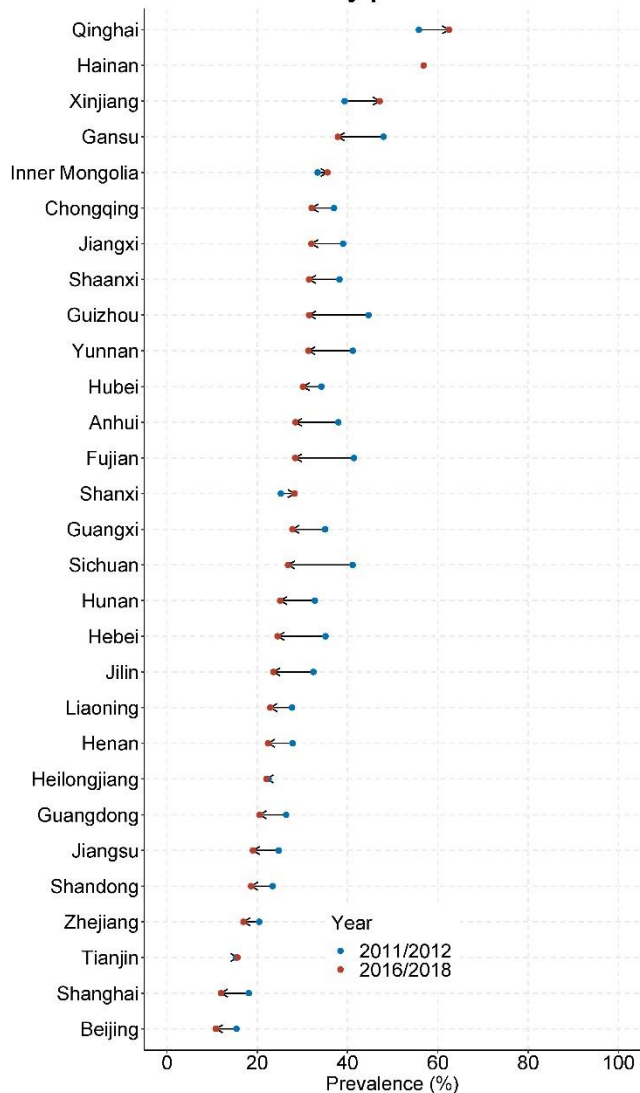
240 Concept and design: SC and YW.
241 Acquisition, analysis, or interpretation of data: SC.
242 Drafting of the manuscript: SC and YW.
243 Critical revision of the manuscript for important intellectual content: SC and YW.
244 Statistical analysis: SC.
245 Administrative, technical, or material support: SC.
246 Supervision: SC.
247 **Conflict of Interest Disclosures:** None reported.
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251 analysis, data interpretation, or writing of the article. The views expressed are those of the authors and not
252 necessarily those of the NIHR.
253
254 **Acknowledgment:** We sincerely thank the teams of CHARLS, CFPS, and CLHLS, for their efforts in data collection
255 and for making the data publicly available.
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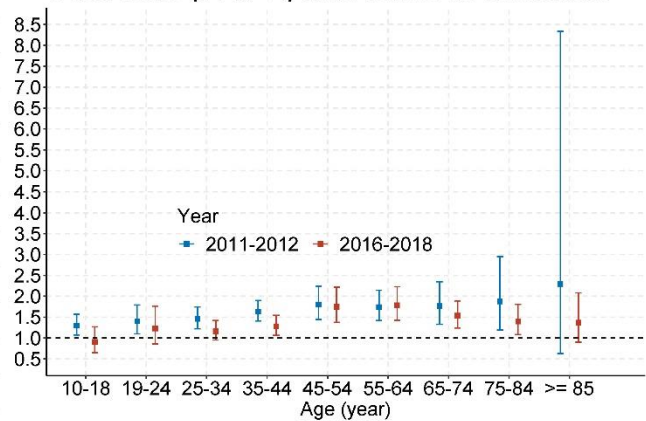
C: Trends by age by gender, measured by Odds ratio (95% CI) with 2011-2012 as reference



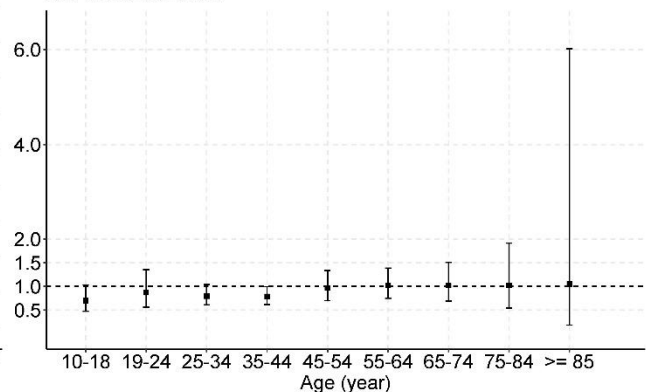
B: Prevalence by province



D: Gender gaps by age by year, measured by Odds ratio (95% CI) with males as reference

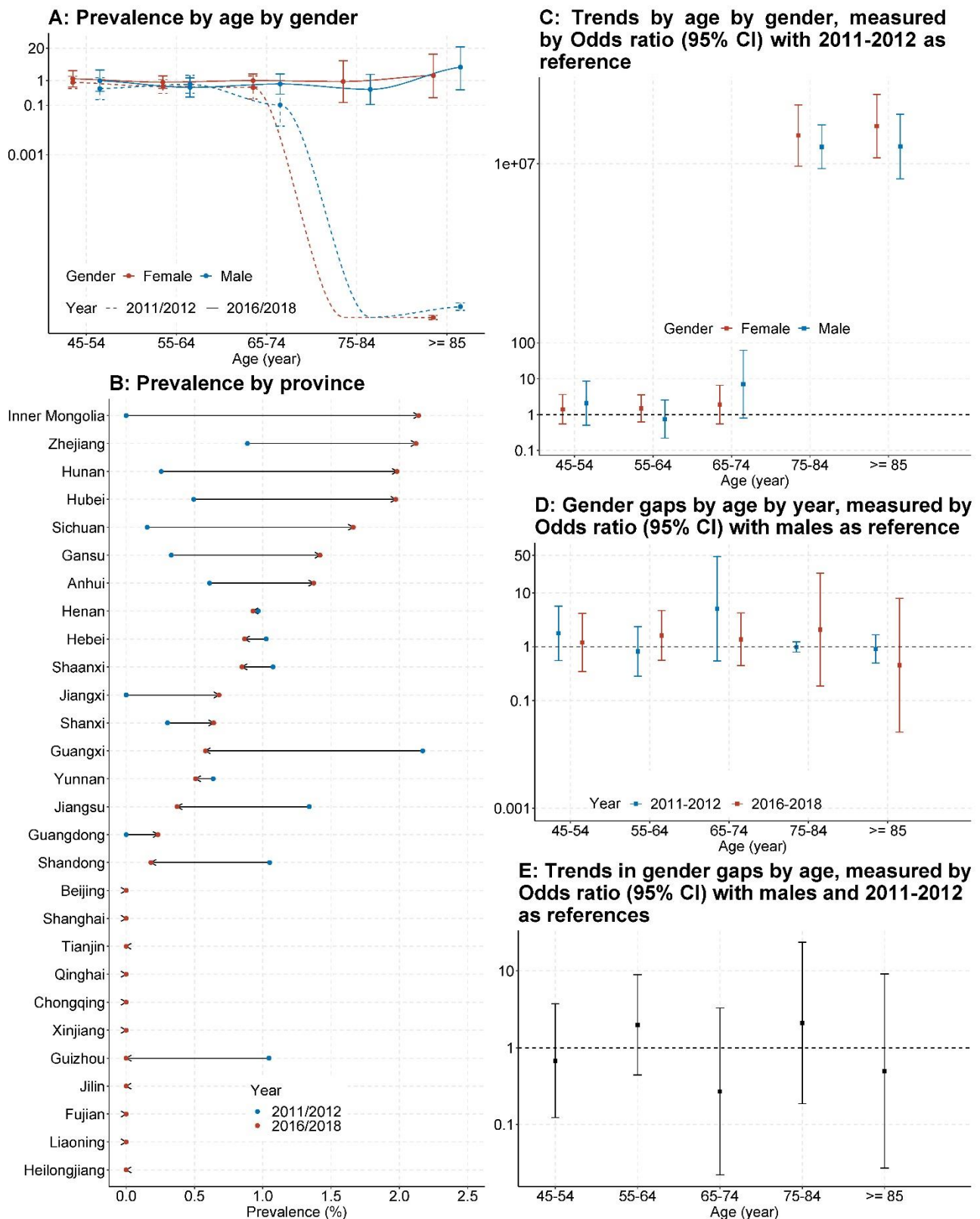


E: Trends in gender gaps by age, measured by Odds ratio (95% CI) with males and 2011-2012 as references



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Figure 1. Prevalence and trend of those who screen positive for depression in China, from 2011-2012 to 2016-2018. Shown is the prevalence of populations who screen positive for depression in China by age and gender (Panel A) or by sampled provinces or cities (Panel B). Also shown are odds ratio and its 95% confidence interval (CI) for trend of this prevalence by age and gender (Panel C), gender gap of this prevalence by age and study year (Panel D), and for the change of gender gap by age (Panel E). Odds ratio > 1 means the prevalence higher in females (Panel D) or during 2016-2018 (Panel C and E).



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Figure 2. Prevalence and trend of those who received any needed treatment or counselling from a mental health professional in China, from 2011-2012 to 2016-2018. Shown is the proportion of populations who received any needed treatment or counselling from a mental health professional in China by age and gender (Panel A) or by sampled provinces or cities (Panel B). Also shown are odds ratio and its 95% confidence interval (CI) for trend of this prevalence by age and gender (Panel C), gender gap of this prevalence by age and study year (Panel D), and for the change of gender gap by age (Panel E). Odds ratio and its 95% CI was estimated from survey-specific weighted regression models and then pooled by meta-analysis. Odds ratio > 1 means the prevalence higher in females (Panel D) or during 2016-2018 (Panel C and E).

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