Mental health and its influencing factors among left-behind children in China: a cross-sectional study

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Abstract
Background With rapid development of China’s economy, there were over 68.7 million left-behind children (LBC) in China whose mental health has become a problem of public concern. The present cross-sectional study aimed to investigate the status of mental health and its associated factors of LBC aged 3-16 years old in both rural and urban areas.

Methods A total of 4187 children (aged 3-16), including 1471 LBC and 2716 non-left-behind children (NLBC), were recruited from 50 communities (22 in urban areas and 28 in rural areas) in Guangdong, China in August, 2014. The mental health problems were assessed using the Strength and Difficulties Questionnaire (SDQ).

Results No statistically significant difference of SDQ subscales scores about difficulties were found between LBC and NLBC on the whole participants as well as in rural areas or in urban areas within the same age group after adjustments were made (all p>0.05). However, compared with NLBC in the same areas, urban LBC tended to have higher prosocial behaviours scores, while rural LBC had the lowest prosocial behaviours scores not only in the whole age group but also in different age subgroups (p<0.05). Besides, compared with urban LBC, rural LBC were not worse in SDQ subscales scores except for prosocial behaviour at 7-9 age group (p=0.003). Furthermore, longer duration of parental absence (β=-0.184 to -0.103) and lower communication frequency (β=0.085 to 0.121) were associated with less difficulties in both rural and urban LBC. Higher paternal educational level (β=-2.736 to -0.085) and longer duration of talk per-time (β=-0.183 to -0.113) were associated with less difficulties in rural LBC.

Conclusions The present study demonstrated that in general, no difference of mental health problems were found between LBC and NLBC. The finding reinforce the importance of the stability of caregivers and the effective parent-child communication for Chinese rural LBC.

Background
Since the reform and opening-up policy in late 1970s in China, the rapid economic growth has resulted in the urban-rural income inequality in China. A large number of surplus rural labour swarmed into cities seeking for better employment opportunities, leaving their children at home with
a single parent, or relatives [1]. Meanwhile, with the increasing frequency of the talent flow, the
count of urban children with one or two migrant parent has been increasing dramatically in recent
decades [1]. Those who were younger than 17 years old, left behind at home by one or two migrant
parents for at least 6 consecutive months were called Left-behind children (LBC) [2]. In 2015, there
were over 68.7 million LBC in China, of which over 54.9 million lived in rural areas, and nearly three
quarters aged under eleven. The number of LBC living in urban areas has increased dramatically—
nearly 5.7 folds since 2000, reaching 13.8 million [1].
Long-term separation from parents also means a weakened family social function, and instability of
main caregivers. These two adverse impacts on LBC were found damaging LBC’s physical and
psychological well-being consequently [3], and results were quite consistent in all age groups [4].
Numerous studies have found higher prevalence of psychological and behavioural problems in LBC
than in non-left-behind children (NLBC) [3]. For example, LBC at older age were more likely to suffer
from negative emotional experiences like depression [5], anxiety [6], loneliness [7] and neglect [8, 9],
and have more conduct problems, including smoking [10] and alcohol consumption [11]. Besides,
increasing number of left-behind adolescents were also reportedly sensitive, hostile and paranoid in
their interpersonal relationship [12]. Rural LBC in pre-school were found to have lower level of
socialization development than that of rural NLBC and children lived in urban areas [13]. As they grow
up, all of these may cause various troubles when facing the changing society.
Additionally, series of studies have demonstrated that child age, sex, family monthly income, age of
separation, duration of parental absence, migration type (father only, mother only, both parents) and
number of siblings, etc., were associated with LBC’s emotional and behavioural development [14, 15].
For example, Liu Z, etc. [16] revealed that children, separated from parents at a younger age, were
more likely to be anxious or depressive, especially those left-behind by either mother or both parents.
Besides, urban LBC were reported to have higher rate of internet-addiction than urban NLBC [17].
However, most existing studies failed to cover the whole age range including pre-schooler (under the
age of six) and school-aged LBC (aged 7–17), as well as the urban LBC.
Taking all the above into consideration, the present study aimed at investigating the status of mental
health and its influencing factors among LBC aged 3 to 16 years by comparing LBC with NLBC within a large sample, and examining whether place of residence (rural and urban) would influence LBC’s mental health development differentially.

Methods

Participants

With the help of Guangdong Women’s Federation (a government administration in China) in August 2014, participants were enrolled from 50 communities in Guangdong, a province with the largest number of LBC in South China [1]. Inclusion criteria for the experimental subjects included 1) aged 3–16 years; 2) with the experience of separate from one or two migrant parents for at least six months; 3) living in the registered permanent residence. Inclusion criteria for the control group included 1) aged 3–16 years; 2) living with both parents in the registered permanent residence. Exclusion criteria for all participants contained: 1) with a history of serious neurological systemic or mental disease; 2) with obvious physical defects. Questionnaires were obtained from 4334 children, among which 127 questionnaires were invalid and therefore eliminated. Finally, the sample size fell to 4187, including 1471 LBC (765 boys and 687 girls) and 2716 NLBC (1463 boys and 1230 girls) (Table 1).

Sample size calculation

The aim of the present study is to explore the status of mental health among LBC aged 3 to 16 years in China. A $\alpha$ error of 0.05 and a power of 90% (two-sided test) were adopted in statistical analysis. For linear regression, the minimum number of cases included in the study was calculated by the formula $N = \left[ \left( t_{\alpha/2} + t_\beta \right) S/\delta \right]^2$ [18]. $\delta$ was the admissible error, and 0.3S was established; S was the population standard deviation. The final calculated sample size of per group was approximately 117. Considering the age range (3–16 years of age), place of residence (rural areas and urban areas) of children and the non-response rate of 20%, the population recruited in the present study was suggested to be more than 4095.

The sample size in the present study ($N = 4187$) was slightly larger than the calculated result ($N = 4085$), and it was enough to observe the group differences between LBC and NLBC.

Recruitment Procedures

A two-step process was conducted to identify the communities. First, 50 communities (22 urban
communities and 28 rural communities) were selected from 21 prefecture-level cities. In each prefecture-level city, at least two communities were selected (one in rural areas and other in urban areas), to achieve geographical representativeness and population coverage. All of these rural communities were in similar economic levels, and the urban communities as well. Finally, 10 LBC and 18 NLBC in each age group were randomly selected from each community. This study was approved by the institutional research ethics committee of Sun Yat-sen University. Participants were guaranteed that their responses in the questionnaire were anonymous and confidential. Before the survey, written informed consent were obtained from a parent or their current legal guardians of all participants. Besides, all data were collected through home visit by Local Women’s Federation staffs who had years of experiences of field investigation and were trained uniformly in two weeks before the study started.

Measures
Children’s mental health was measured by either self-reported or parent-reported version of Strengths and Difficulties Questionnaire (SDQ) [19], which aims to assess the behaviour, emotion and relationship in children aged 3–17 years [20]. SDQ consists of 25 items, which were divided into five subscales including emotional symptoms, conduct problems, hyperactivity-inattention, peer problems and prosocial behaviours, with five items in each subscale. Each item scores from zero to two. The aggregate score of all subscales except for prosocial behaviours drive the score of a total difficulties score (TDS) ranging from 0–40. Generally, a high score indicates greater difficulties, except prosocial behaviours. It has been proved that the SDQ has good reliability and validity in different cultures [20], including Chinese [21]. In the present study, parent-reported version SDQ was used in 3–9 year-old LBC, and the self-reported version in 10–16 year-old LBC.

Statistical Analysis
The data were entered through Epidata 3.1 software and analysed with SPSS 22.0 statistical software. Chi-square test and the unpaired Student t-test were used to describe the difference in demographics between LBC and NLBC. Secondly, analysis of covariance (ANCOVA) were adopted to evaluate the difference of SDQ scores between LBC and NLBC. Besides, in order to better understand the
difference between LBC and NLBC within each age group, participants were divided into three age groups (3–6, 7–9 and 10–16 years) for analysis. That is because children in China usually start primary school at the age of seven, and begin puberty at the age of 10, resulting in significant differences among the three age groups [22]. Furthermore, we stratified the participants into two groups based on place of residence (rural and urban areas), then analysed the difference between LBC and NLBC within the same areas separately. An α error of 0.05 and a power of 90% (two-sided test) were used in the present study. Finally, stepwise multiple linear regression analysis was used to explore the association between the demographics or the characteristics of being left-behind and the LBC’s emotional, behavioural and relationships problems.

Results
Baseline characteristics of LBC and NLBC
Table 1 presents the baseline demographic characteristic of the participants. Nearly one-third of participants were LBC, in which 86.7% of them lived in rural areas, and 13.3% lived in urban areas (p<0.001). The percentage of only child in LBC and NLBC were 21.0% and 46.9% (p<0.001). The percentages of paternal or maternal educational level at middle school or below in LBC and NLBC were over 70% and 45% (both p<0.001). LBC’s family monthly income were lower than that of NLBC (p<0.001). Additionally, table S1 showed that 26.9% of LBC had a previous experience of being left-behind and were living with both parents during the investigation, while 73.1% of LBC were currently being left-behind. Over 77.8% of LBC were separated from their migrant parents under the age of six. And 52.1% of them were taken care of by grandparents, 35.7% by mother when they were being left-behind.

Mental health problems in LBC and NLBC according to age groups
The comparison of mental health problems (assessed by SDQ subscales score) between LBC and NLBC was presented in Table 2. Overall, LBC tended to have more difficulties than NLBC, which can been inferred by the higher score of TDS, emotional symptoms, hyperactivity-inattention, peer problems and lower score of prosocial behaviours in LBC (all p<0.05). The participants were next stratified into three age groups (3–6, 7–9 and 10–16 years) to explore the differences within age
groups separately. We found that compared with NLBC, LBC scored significantly higher on TDS, peer problems and lower on prosocial behaviours (all \( p < 0.001 \)) in 3–6 years; and higher on hyperactivity-inattention in 7–9 and 10–16 years (both \( p < 0.05 \)). However, no such difference was found after adjusting place of residence, sex, age, only child, average monthly income and both parents’ educational level.

**Multiple comparison of mental health problems between LBC and NLBC in rural and urban areas**

Considering the possible effects of place of residence on the mental health problems, we further stratified the children into rural and urban group, then analysed the difference between LBC and NLBC after adjustment for sex, age, only child, average monthly income, and both parents’ educational level (Table 3). We found that in rural areas, compared with NLBC, LBC tended to have significantly lower score on prosocial behaviours in whole ages except for 7–9 years (3–16 years, \( p = 0.007 \); 3–6 years, \( p = 0.030 \); 10–16 years, \( p = 0.025 \)), higher score on hyperactivity-inattention in 10–16 years (\( p = 0.030 \)), and lower score on conduct problems in 7–9 years (\( p = 0.050 \)). Additionally, in urban areas, LBC had significantly higher emotional symptoms score in 7–9 years group (\( p = 0.029 \)) and higher prosocial behaviour score among the whole samples except for 3–6 years (3–16 years, \( p < 0.001 \); 7–9 years, \( p = 0.002 \); 10–16 years, \( p = 0.001 \)).

Furthermore, when we compared the difference of SDQ scores between rural LBC and urban LBC after the same adjustment (Table 3). Results showed that rural LBC had higher TDS score in 3–16 years (\( p = 0.003 \)) and lower prosocial behaviours score at 7–9 years (\( p = 0.003 \)).

**Influence factors of mental health problems in rural and urban LBC**

Influence factors of mental health problems in rural and urban LBC were analysed by multiple regression (Table 4). For rural LBC, TDS score were significantly negatively associated with age, paternal educational level, duration of talk per time and duration of parental absence (\( \beta = -0.169 \) to -0.129); while positively associated with mother’s educational level, communication frequency and visit frequency (\( \beta = 0.042 \) to 0.100). And those rural LBC with siblings (\( \beta = 0.077 \)), lower communication frequency (\( \beta = -0.272 \)) and at older age (\( \beta = 0.201 \)) tended to have more prosocial behaviours. However, for urban LBC, TDS were only positively associated with maternal educational
level ($\beta = 0.178$). Besides, average monthly income ($\beta = 0.242$) and duration of parental absence ($\beta = 0.220$) were positively associate with prosocial behaviours.

Discussion

Combined with the booming economy and speedy urbanization of China, millions of children have the experience of being left behind by their parents at a young age, which has been reported to have negative impacts on their psychosocial and physical development [23, 24]. The present study investigated the mental health and its influencing factors in both rural and urban LBC aged 3–16 years. The results of the present study showed no statistically significant difference in the difficulties of mental health problems between LBC and NLBC on the whole participants as well as in rural areas and in urban areas within the same age after adjustments were made. However, urban LBC tended to have more prosocial behaviours, while rural LBC had the least prosocial behaviours not only in the whole age group but also in different age subgroups. Furthermore, we also found that longer duration of parental absence and lower communication frequency were associated with less mental health problems in both rural and urban LBC, while higher paternal educational level and longer duration of talk per time were found associated with less mental health problems in rural LBC.

The present study displayed no significant differences in mental health problems between NLBC and LBC (aged 3 to 16 years) in terms of total difficulties (emotional symptoms, conduct problems, hyperactivity-inattention and peer problems) and prosocial behaviours. Similar results were also found within the same age groups, respectively. Tao XW, etc. also reported similar findings in 3–5 year-old rural LBC with two migrant parents [25]. However, contradicting with most of the existing studies, less positive emotional functioning, lower self-confidence [12], poorer social functioning and school functioning [23] were found in LBC, compared with NLBC. The population- and demographic-limitation of the prior studies might contributed to the inconsistence. Prior studies were mostly conducted at school communities of rural areas, failing to control the confounders [14, 15] such as family backgrounds (family income, parental educational level, only-child, etc.), living environments, and social relationships. Meanwhile, given the difference of the overall strength and development between rural and urban areas, participants in the present study were recruited from both rural and
urban communities. Thus, considering the complex process of child development and the effects of these confounding factors, the present study tried to make them controlled as far as possible in analysis. Another explanation is that, according to the attachment theory, the child who has a stable relationship with a primary caregiver (anyone who provides the child most of the care and related social interaction) are more prone to secure attachment [26] which can support the development of their cognitive skills, emotional [27] and social competence [28]. Studies also found that a good relationship with grandparents can help children reduce the risk of depression [29]. Though LBC had the experience of being separated from one or two parents, they might be well taken care of by alternate caregivers (mostly were grandparents). Shalhevet etc. found that great grandparent involvement was associated with better social skills and less emotional or behaviour problems [30]. And the construction of secure attachment relationship with alternate caregivers was the foundational support for their development of mental health [28].

Meanwhile, when it comes to the subscales of the mental health problems, interesting result was observed. Compared with NLBC in the same place, LBC were not always the vulnerable groups, they also had some strengths: rural LBC tended to have less conduct problems in 7–9 years and urban LBC had more prosocial behaviours in 7–16 years, after adjusting for parental educational level and factors of family environment. The possible explanation might be that the development of human being is a lifelong process of change in the abilities to adapt to the situations one selected [29], and many elements like living environments, the person/cognition and education during childhood [31] are related to maturation. Thus, we speculate that the effects of separation from migrant parents might be mitigated by other factors in children’s life, which still needs further investigation.

Furthermore, the present study also showed that paternal educational level was negatively correlated with the problems of rural LBC’s mental health, which was in line with the previous studies that paternal education level was unique for children’s language and cognitive development [32, 33]. In Chinese culture, it is believed that fathers are responsible for economic support and discipline maintenance, while mothers for nurturing. And this concept is far more popular in rural China [34]. However, urbanization and maternal employment are changing these attitudes. Fathers, especially
those college-educated, are better understand the importance of intimate relation between father and children, and are more involved in their children’s life [33, 35]. Fathers’ frequent and positive involvement with children can promote the well-being of children’s cognitive and social development [36]. Additionally, Huang WH etc. found that the educational attainment in rural is lower than that in urban areas in China [37], the educational level of LBC’s parents in rural areas are lower as well. That might be the one of the reason why the correlation were only found in rural areas.

Besides, we also found that longer duration of parental absence and less frequency but longer duration of talk per time with migrant parents had close relationship with LBC’s less mental health problems, including less emotional symptoms, conduct problems and peer problems. These findings highlight the importance of stability of caregivers and high quality of parent-child communication on children’s development. To LBC, longer duration of parent absence means they spent more time with the alternate caregiver. Raikes [38] found that the more time infants spent with the same caregiver, the more secure attachment relationship with caregiver will be formed. Additionally, Howes, etc. [39] found that children with more caregivers at the age of one to four were more likely to be aggressive with peers than those with fewer caregivers. Every time the migrant parent came home, LBC needed to construct a new child-parent relationship instead of continuing the previous one [27]. When parent left again, they would not only suffer from separation anxiety, but also experienced more instability one more time [27], making them more likely to have persistent problems with the formation of positive relationship [40]. Furthermore, our results also emphasized the importance of high quality of communication by migrant parents and LBC on the development of mental health, especially for rural LBC. This result partly supports the findings presented by Yu Guang etc. [41] that communication with migrant parents for over 5 min with suitable topics could significantly decrease the depressive symptoms in rural LBC.

There are some limitations in the present study. First, as a cross-sectional survey, the results can only show correlations instead of causations. Longitudinal design should be applied in future study to explore and analyse the causal relationship between mental health and other influence factors. Second, the present study did not focus much on the mechanism of how the details of being left-


behind interfere with mental health of LBC. Thus, further studies are needed to find out the essential characteristics which influence it in left-behind children.

Conclusion
The present study demonstrated that in general, no difference of mental health problems were found between LBC and NLBC. According to our results, longer duration of parental absence, less communication frequency, longer duration of talk per time and higher paternal educational level were associated with better development of mental health in rural LBC. Thus, we suggest that more attention should be paid on improving the stability of caregivers and the effectiveness of parent-child communication of Chinese rural LBC when making policies in the future.

Declarations
Abbreviations
LBC = left-behind children; NLBC = non-left-behind children;
SDQ = the Strength and Difficulties Questionnaire; TDS = total difficulties score.

Ethics approval and consent to participate
The ethics review board of Sun Yat-sen University approved the form of current legal guardian consent to participate as well as the form of this study.
Written informed consent were obtained from a parent or their current legal guardians of the participants for all participants under 16 years old. Participants aged 14 to 16 years also need to provide a written informed consent signed by themselves.

Consent for publication
Not applicable.
Availability of data and material
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests
The authors declare that they have no competing interests.

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Authors’ contributions
All authors have read and approved the manuscript. In addition, the authors contributed to this work in the following ways. LG and YZ was project leaders and contributed to all aspects of this work. LG was the main coordinator of the project and was responsible for the study design. ML and YZ contributed to funding application and manuscript revision. XZ and ML were involved in the supervising of data collection. XZ contributed to data assembly and analysis, and drafted the manuscript of the present paper.

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Tables
Table 1 Baseline characteristics of LBC and NLBC
| Variables                              | LBC (n=1471) | NLBC (n=2716) | all (n=4187) | P  |
|----------------------------------------|--------------|--------------|-------------|----|
| Sex, n(%)                              |              |              |             |    |
| boys                                   | 765(52.7)    | 1463(54.3)   | 2228(53.2)  | 0.312 |
| girls                                  | 687(47.3)    | 1230(45.7)   | 1917(45.8)  |    |
| Age (years) mean(SD) a                 |              |              |             |    |
| 3-16 years                             | 8.46(3.50)   | 8.52(3.66)   | 8.50(3.60)  | 0.611 |
| 3-6 years                              | 5.04(1.12)   | 4.87(1.17)   | 4.93(1.16)  |    |
| 7-9 years                              | 8.41(0.84)   | 8.36(0.82)   | 8.38(0.82)  |    |
| 10-16 years                            | 12.70(1.88)  | 12.78(1.86)  | 12.75(1.87) |    |
| Place of residence, n(%)              |              |              |             |    |
| rural                                  | 1276(86.7)   | 1503(55.3)   | 2779(66.4)  | <0.001 |
| urban                                  | 195(13.3)    | 1213(44.7)   | 1408(33.6)  |    |
| Only child, n(%)                       |              |              |             |    |
| yes                                    | 309(21.0)    | 1274(46.9)   | 1583(37.8)  | <0.001 |
| no                                     | 1162(79.0)   | 1442(53.1)   | 2604(62.2)  |    |
| Father's educational level, n(%)       |              |              |             |    |
| primary school or below                | 185(12.7)    | 111(4.2)     | 296(7.1)    | <0.001 |
| middle school                          | 833(57.4)    | 908(34.1)    | 1741(41.6)  |    |
| high school                            | 303(20.9)    | 889(33.4)    | 1192(28.5)  |    |
| junior college or bachelor             | 125(8.6)     | 707(26.5)    | 832(19.9)   |    |
| master or higher                       | 5(0.3)       | 49(1.8)      | 54(1.3)     |    |
| Mother's educational level, n(%)       |              |              |             |    |
| primary school or below                | 210(14.8)    | 193(7.2)     | 403(9.6)    | <0.001 |
| middle school                          | 876(61.7)    | 966(36.2)    | 1842(44.0)  |    |
| high school                            | 237(16.7)    | 847(31.7)    | 1084(25.9)  |    |
| junior college or bachelor             | 94(6.6)      | 635(23.8)    | 729(17.4)   |    |
| master or higher                       | 3(0.2)       | 27(1.0)      | 30(0.7)     |    |
| Marital status, n(%)                   |              |              |             |    |
| spinsterhood                           | 9(0.6)       | 17(0.6)      | 26(0.6)     | 0.081 |
| married                                | 1369(95.1)   | 2581(96.6)   | 3950(94.3)  |    |
| divorced                               | 29(2.0)      | 40(1.5)      | 69(1.6)     |    |
| widowed                                | 17(1.2)      | 16(0.6)      | 33(0.8)     |    |
| remarried                              | 16(1.1)      | 17(0.6)      | 33(0.8)     |    |
| Monthly income (RMB) , n(%)            |              |              |             |    |
| <2000                                  | 375(26.2)    | 307(11.5)    | 682(16.3)   | <0.001 |
| 2000-5000                              | 698(48.8)    | 1131(42.4)   | 1829(43.7)  |    |
| 5001-8000                              | 160(11.2)    | 696(26.1)    | 856(20.4)   |    |
| 8001-12000                             | 45(3.1)      | 219(8.2)     | 264(6.3)    |    |
| >12000                                 | 17(1.2)      | 102(3.8)     | 119(2.8)    |    |
| unknown                                | 134(9.4)     | 215(8.1)     | 349(8.3)    |    |

Note. LBC= left-behind children  NLBC= non-left-behind children  
P<0.05 LBC vs. NLBC assessed by chi-square test for categorical variables unless otherwise indicated.  
a Assessed by the unpaired Student t-test.

Table 2 Comparison of child mental health (SDQ outcomes) between LBC and NLBC by age groups. a

| Scores of SDQ subscales            | LBC         | NLBC        | p1 | p2 |
|------------------------------------|-------------|-------------|----|----|
| 3-16 years                         | n=1444      | n=2683      |    |    |
| Total difficulties score           | 12.87(6.01) | 12.26(6.05) | 0.011 | 0.907 |
| Emotional symptoms                 | 2.79(2.14)  | 2.55(2.19)  | 0.001 | 0.482 |
| Conduct problems                   | 2.47(1.99)  | 2.45(1.92)  | 0.862 | 0.257 |
|                          | LBC    | NLBC   | P1     | P2     |
|--------------------------|--------|--------|--------|--------|
| Hyperactivity-inattention| 4.12(2.11) | 3.96(1.99) | 0.015  | 0.620  |
| Peer problems            | 3.50(1.65) | 3.31(1.65) | <0.001 | 0.809  |
| Prosocial behaviours     | 5.99(2.29) | 6.17(2.11) | 0.002  | 0.443  |
| 3-6 years                | n=568  | n=1050 |        |        |
| Total difficulties score | 13.66(5.91) | 12.64(5.70) | <0.001 | 0.924  |
| emotional symptoms       | 3.01(2.12) | 2.65(2.10) | 0.001  | 0.827  |
| conduct problems         | 2.50(1.96) | 2.44(1.82) | 0.548  | 0.181  |
| hyperactivity-inattention| 4.58(2.08) | 4.37(1.90) | 0.052  | 0.834  |
| peer problems            | 3.58(1.69) | 3.17(1.64) | <0.001 | 0.246  |
| prosocial behaviours     | 5.45(2.35) | 5.85(1.99) | <0.001 | 0.141  |
| 7-9 years                | n=414  | n=707  |        |        |
| Total difficulties score | 12.39(5.84) | 11.98(5.92) | 0.256  | 0.495  |
| emotional symptoms       | 2.66(2.10) | 2.42(2.17) | 0.071  | 0.768  |
| Conduct problems         | 2.32(1.99) | 2.28(1.90) | 0.773  | 0.506  |
| Hyperactivity-inattention| 4.07(2.09) | 4.09(1.94) | 0.019  | 0.166  |
| Peer problems            | 3.34(1.57) | 3.18(1.64) | 0.108  | 0.716  |
| Prosocial behaviours     | 6.26(2.23) | 6.17(2.10) | 0.511  | 0.280  |
| 10-16 years              | n=462  | n=926  |        |        |
| Total difficulties score | 12.32(6.20) | 12.06(6.52) | 0.335  | 0.753  |
| emotional symptoms       | 2.61(2.18) | 2.53(2.32) | 0.504  | 0.790  |
| Conduct problems         | 2.55(2.02) | 2.60(2.03) | 0.709  | 0.879  |
| Hyperactivity-inattention| 3.61(2.05) | 3.38(1.97) | 0.038  | 0.115  |
| Peer problems            | 3.53(1.66) | 3.56(1.63) | 0.773  | 0.378  |
| Prosocial behaviours     | 6.42(2.15) | 6.54(2.19) | 0.488  | 0.474  |

Note. LBC= left-behind children NLBC= non-left-behind children

a Mental health was assessed by SDQ, which includes five subscales and have been detailed described in method. Date are the mean (SD). P1<0.05 LBC vs. NLBC assessed by independent-samples Student’s t-test; P2<0.05 LBC vs. NLBC assessed by one-way ANOVA, adjusted place of residence, sex, age, only child, average monthly income, father’s educational level and mother’s educational level.

Table 3 Multiple comparison of child mental health (SDQ outcomes) between LBC and NLBC in rural and in urban areas a
### Table 4 Regression coefficients for SDQ outcomes on rural and urban LBC.

|                    | Rural        |          | Urban        |          |          |          |          |
|--------------------|--------------|----------|--------------|----------|----------|----------|----------|
|                    | LBC          | NLBC     | LBC          | NLBC     |          |          |          |
| 3-16 years         |              |          |              |          |          |          |          |
| Total difficulties | n=1276       | n=1503   | n=195        | n=1213   |          |          |          |
| Score              | 12.97(5.91)  | 12.75(6.05) | 12.17(6.5)   | 11.66(6.0) | 0.85        | 2        | 0.003     | 0.003     |
| Emotional symptoms | 2.80(2.11)   | 2.72(2.18) | 2.67(2.37)   | 2.32(2.19) | 0.11        | 0.853     | 0.00      | 0.00      |
| Conduct problems   | 2.46(1.95)   | 2.53(1.93) | 2.52(2.19)   | 2.36(1.90) | 0.96        | 0.405     | 0.61      | 0.61      |
| Hyperactivity-     | 4.17(2.11)   | 4.05(2.06) | 3.76(2.08)   | 3.83(1.88) | 0.38        | 0.155     | 0.13      | 0.13      |
| inattention        |              |          |              |          |            |          |          |          |
| Peer problems      | 3.54(1.63)   | 3.44(1.66) | 3.22(1.71)   | 3.14(1.61) | 0.58        | 0.104     | 0.03      | 0.03      |
| Prosocial behaviours| 5.86(2.28)  | 6.20(2.16) | 6.85(2.19)   | 6.15(2.04) | <0.0       | 0.251     | 0.02      | 0.02      |
| 3-6 years          |              |          |              |          |          |          |          |
| Total difficulties | n=13.9(5.82) | 13.57(5.55) | 11.77(6.3)   | 11.56(5.6) | 0.69        | 0.101     | <0.0      | <0.0      |
| Score              |              |          |              |          |            |          |          |          |
| Emotional symptoms | 3.09(2.08)   | 2.94(2.09) | 2.38(2.37)   | 2.31(2.05) | 0.68        | 0.081     | <0.0      | <0.0      |
| Conduct problems   | 2.53(1.94)   | 2.66(1.80) | 2.31(2.13)   | 2.18(1.81) | 0.94        | 0.396     | 0.00      | 0.00      |
| Hyperactivity-     | 4.64(2.11)   | 4.60(1.89) | 4.05(1.75)   | 4.10(1.89) | 0.54        | 0.150     | 0.00      | 0.00      |
| inattention        |              |          |              |          |            |          |          |          |
| Peer problems      | 3.65(1.69)   | 3.36(1.70) | 3.03(1.60)   | 2.96(1.55) | 0.80        | 0.405     | 0.01      | 0.01      |
| Prosocial behaviours| 5.33(2.37)  | 5.72(2.06) | 6.36(1.96)   | 6.00(1.90) | 0.11        | 0.092     | 0.65      | 0.65      |
| 7-9 years          |              |          |              |          |          |          |          |
| Total difficulties | n=12.35(5.73) | 12.79(5.73) | 12.63(6.5)   | 11.05(6.0) | 0.10        | 0.220     | 0.02      | 0.02      |
| Score              |              |          |              |          |            |          |          |          |
| Emotional symptoms | 2.65(2.09)   | 2.66(2.10) | 2.77(2.18)   | 2.15(2.21) | 0.02        | 0.163     | 0.08      | 0.08      |
| Conduct problems   | 2.26(1.92)   | 2.40(1.91) | 2.67(2.38)   | 2.15(1.90) | 0.06        | 0.130     | 0.84      | 0.84      |
| Hyperactivity-     | 4.08(2.07)   | 4.33(2.02) | 4.02(2.26)   | 3.82(1.80) | 0.89        | 0.649     | 0.00      | 0.00      |
| inattention        |              |          |              |          |            |          |          |          |
| Peer problems      | 3.36(1.55)   | 3.40(1.67) | 3.18(1.72)   | 2.92(1.58) | 0.50        | 0.862     | 0.04      | 0.04      |
| Prosocial behaviours| 6.08(2.19)  | 6.12(2.11) | 7.33(2.17)   | 6.23(2.10) | 0.00        | 0.003     | 0.41      | 0.41      |
| 10-16 years        |              |          |              |          |          |          |          |
| Total difficulties | n=12.40(6.08) | 11.93(6.66) | 11.82(6.8)   | 12.26(6.2) | 0.47        | 0.378     | 0.18      | 0.18      |
| Score              |              |          |              |          |            |          |          |          |
| Emotional symptoms | 2.59(2.12)   | 2.57(2.31) | 2.75(2.49)   | 2.47(2.33) | 0.25        | 0.262     | 0.93      | 0.93      |
| Conduct problems   | 2.57(2.01)   | 2.49(2.08) | 2.47(2.05)   | 2.76(1.95) | 0.12        | 0.168     | 0.04      | 0.04      |
| Hyperactivity-     | 3.67(2.02)   | 3.30(2.04) | 3.29(2.19)   | 3.49(1.87) | 0.21        | 0.105     | 0.04      | 0.04      |
| inattention        |              |          |              |          |            |          |          |          |
| Peer problems      | 3.57(1.63)   | 3.58(1.61) | 3.31(1.78)   | 3.54(1.66) | 0.29        | 0.285     | 0.78      | 0.78      |
| Prosocial behaviours| 6.33(2.11)  | 6.74(2.19) | 6.91(2.36)   | 6.24(2.14) | 0.00        | 0.107     | <0.0      | <0.0      |

Note. LBC= left-behind children NLBC= non-left-behind children

a Mental health was assessed by SDQ, which includes five subscales and has been detailed described in method. Date are the mean (SD). P1<0.05 LBC vs. NLBC in rural areas, P2<0.05 LBC vs. NLBC in urban areas, P3<0.05 rural LBC vs. urban LBC, P4<0.05 rural NLBC vs. urban NLBC all assessed by one-way ANOVA, adjusted sex, age, only child, average monthly income, father’s educational level and mother’s educational level.
|                  | B | B | B | B | B | B | B | B | B | B | B |
|------------------|---|---|---|---|---|---|---|---|---|---|---|
|                  | a | a | a | a | t | t | t | t | t | t | t |
| Age              | .0| .0| .0| .0| .0| .0| .0| 91| 98| .98| .87|
| Sex (ref: boys)  |   |   |   |   |   |   |   |   |   |   | 0.20 |
| Only child (ref: yes) | 0.01 | 0.00 | 0.80 |   |   |   |   |   |   |   | 77 |
| Monthly income   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 42 | 64 | 0.64 | 0.64 |
| Age at separation|   |   |   |   |   |   |   |   |   |   |   |
| Father's education level | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9 | 9 | 9 | 9 |
| Mother's education level | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 8 | 7 | 1 | 1 |
| Duration of parent absence | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6 | 2 | 2 | 2 |
| Communication frequency | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 8 | 5 | 5 | 5 |
| Duration of talk per time | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6 | 6 | 6 | 6 |
| Visit frequency   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 72 | 95 | 95 | 95 |
|       | Father |    |       |       |       |
|-------|--------|----|-------|-------|-------|
| absent | 0.00   | 0. | 0.00  | 1     |       |
| (ref: no) | 00 | 81 | 16 |       |       |

|       | Mother |    |       |       |       |
|-------|--------|----|-------|-------|-------|
| absent | 0.04  | 0. | 0.03  | 0     |       |
| (ref: no) | 4 | 3  | 2    |       |       |

* Data are Beta assessed by stepwise multiple linear regression analysis.

**Note.** Beta are standardized regression coefficients. *p*<0.05 **p**<0.01 ***p***<0.001.