Association of the previous experience of maternal migration absence with non-suicidal self-injury (NSSI) in their children: A cross-sectional study in Anhui, China

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Abstract

Background

Non-suicidal self-injury (NSSI) emerged as an escalating health concern in youths worldwide, particularly in the vulnerable. In China, a burgeoning internal migration in human history has been tearing families apart, generating a surging number of left-behind children (LBC) with a lack of parental supervision. Despite the empirical acknowledgment of parental migration as a risk predictor of the NSSI among LBC, there remains a lack of understanding of the specific role of the maternal migration experience.

Objective

This study sought to determine the association of maternal migration experience and its characteristics in terms of age at initiation and length with 12-month NSSI among children. Participants & setting: Data were collected by a self-administrated questionnaire survey conducted among a school-based sample of students in the Anhui province, China.

Methods

A total of 2476 participants were analyzed, and the Chi-squared tests and binary logistic regression analysis were employed.

Results

Compared with children whose father is currently migrating and the mother never migrated for work (FM-MN), children whose father never migrated but the mother previously migrated for work (FN-MP, OR = 2.21, 95% CI [1.27–3.84], p < 0.01) and children whose father is currently migrating and the mother previously migrated for work (FM-MP, OR = 1.46, 95% CI [1.00-2.13], p < 0.05) evidenced greater odds of the prevalence of 12-month NSSI. And also, a significantly higher risk for 12-month NSSI was found among FN-MP and FM-MP compared with children whose parents lived in the household and neither had ever migrated for work (FN-MN). For those children with maternal migration experience, while controlling for the paternal migration characteristics, there was no difference between before and after school age at initiation of migration in the risk of NSSI, nor were there any differences across 1–3, 4–6, and more than 6 years of maternal migration length.

Conclusions

Findings suggested the potential long-term effect of the experience of maternal migration on children and provided implications for the early identification and prevention of children at risk for NSSI, particularly
within the maternal migrant family context.

1. Introduction

Non-suicidal self-injury (NSSI), identified as direct and deliberate destruction of body tissue with no observable intent to die\(^1\), has emerged as an escalating health concern worldwide, especially in youths\(^2\). Despite the lack of global data, converging evidence revealed a cross-culturally high occurrence of NSSI ranging from 20 to 30% among adolescents\(^3\) and an estimated 6.2% prevalence of lifetime NSSI endorsement in preadolescent children\(^4\). It has been acknowledged that NSSI strongly predicted later suicidality, the second leading cause of death among those aged 15–19 years, and thus served as a marker of the vulnerability to poor health among youths\(^5\)\(^6\). Undoubtedly, the need for progress in identifying the occurrence and correlates of NSSI among adolescents and children, especially those impacted disproportionately at higher risk, is all the more pressing.

For the first time in history, China experienced a great internal rural-to-urban migration, driven by rapid urbanization since the late 1970s reforms\(^7\). Massive migrant workers flowed to cities for economic opportunities without, however, converting their rural household registration (\textit{hukou}), thus failing to access housing, education, and other benefits available to urban-registered residents\(^8\). Accordingly, this fact leaves the majority of migrant parents no choice but to leave their children behind in rural areas while seeking better employment. Characterized as living in their original domicile with one or both parents migrating for over six months, left-behind children (LBC) gradually scaled up and, as of 2015, reached up to the highest record of 68.77 million in China\(^9\). Globally, the number of LBC is also rising with the ever-increased migration today, broadly capturing the attention of scholars\(^10\)\(^11\). Decades of research stressed LBC as a potentially vulnerable group at risk of a spectrum of health concerns on account of parental migration, such as mental health disorders (e.g., depression, anxiety, conduct problems)\(^12\)\(^–\)\(^14\), malnutrition\(^15\), unintentional injuries\(^16\), and suicide\(^17\).

While males used to be the majority of migrating population, in recent years, a rapid shift in migration patterns appeared in China where an increasing number of females migrated to work\(^18\). Growing studies further noted health disparities within the LBC group that pertain to specific parental migration. For instance, a study from rural China identified that among LBC, only those left by both parents presented a higher risk of emotional symptoms, hyperactivity, and psychological difficulties than non-LBC peers\(^19\). Other research further demonstrated a robust correlation between the poor mental health of children with maternal absence rather than paternal migration\(^20\). As noted, the risk of behavioral health risk (i.e., smoking, internet addiction) was significantly higher among LBC with only maternal migration (compared with non-LBC counterparts)\(^21\). Although the primary role of migrant mothers on LBC health was stressed empirically, evidence to date was available to a limited set of consequences. And also, there was a narrow focus on children with current maternal absence while neglecting ever-experienced ones.
Notably, depending upon parental migration dynamics, the children's status of being left behind may vary. In migrant families, especially those with both parents migrating, many parents would get back to their hometown because of childcare needs or worsened working conditions in cities. Also, in China, with the implementation of the Rural Revitalization Strategy at the grassroots level, the government rolled out policies to facilitate migrant workers to find jobs in local nearby areas\(^{22}\). Accordingly, new figures are seeing a burgeoning population of returning migrants and a decreasing number of LBC, with 6.97 million nowadays\(^{23,24}\). In these cases, quite a few LBC got characterized as children with previous parental migration (s). Nonetheless, studies focusing on them found a prolonged negative mark of previous parental migration on their psychosocial well-being and health-related behaviors (i.e., smoking, drinking) compared with children in the non-migrated family\(^{25,26}\). Unfortunately, little knowledge exists regarding the specific role that previous paternal or maternal migration plays. Though there was a finding suggesting that previous experience of maternal migration acted as a particular risk factor for children's mental health and suicidal ideation\(^{27}\), other underlying health consequences, however, were poorly represented in primary research.

Concerning the NSSI risks, a limited but growing body of studies has demonstrated a higher occurrence among LBC relative to non-LBC peers\(^{28}\). Recently, research suggested that the current labor migration of both parents and paternal migration only served as independent correlates to their NSSI\(^{29}\). By linking a time window for NSSI with parental migration, researchers also indicated that children initially separated from one or both migrant parents at preschool age (age six) were more likely than non-LBC to engage in NSSI\(^{29,30}\). Despite these findings, it is not clear a priori whether the NSSI among LBC is relevant for – or specific to – the occurrence of maternal migration, regardless of the previous status. And also, there remained a paucity of evidence on the nuanced characteristics of specific maternal migration or, rather, the timing and length that potentially account for NSSI. Given the rapidly dynamic migration pattern and looming health crisis regarding NSSI, understanding how NSSI engagement unfolds across high-risk children like LBC and the extent to which their specific factors predict has the potential to open earlier windows for screening and identification for NSSI prevention.

As such, here we sought to advance the knowledge base by examining whether previous maternal absence due to migration correlates to NSSI engagement of children who ever experienced it and, if so, whether the presence of NSSI among those children differs by the age at initiation of maternal migration and the duration while accounting for paternal migration characteristics.

2. Methods

2.1 Study setting and participants

Participants of the current study were recruited from a cross-sectional and school-based survey between 2018 to 2019 in Anhui, the second-largest migrant-sending province of China, based on the latest National Population Census estimate\(^{31}\). School sampling covered urban and rural areas to capture the
local urban-rural split. Ten urban schools were randomly selected from Wuhu, the second-largest city in Anhui. As rural locations, four townships in two counties (Nanling and Wuwei) of Wuhu were sampled using a random cluster method, from each of which two schools (one primary school and one middle school) were randomly chosen. Finally, 18 schools were enrolled in the study, of which all 5-8th grade students were deemed suitable for the self-administration questionnaire and invited to participate. Prior to the survey, all students, teachers, and caregivers were fully informed about the study procedures, voluntariness, and anonymity in participation. Written informed consent was obtained from all participants and their caregivers preceding the survey. Questionnaires were distributed to students in the classroom with teachers absent and completed independently under the surveyors’ supervision. More detailed procedures were described in our previous papers. Ethical approval for this study was approved by the Ethics Committee of the School of Public Health at Zhejiang University (NO. ZGL201804-2).

2.2 Measurement

2.2.1 Outcome variable

The prevalence of 12-month non-suicidal self-injury (NSSI) was assessed by a single item, in keeping with its definition, “In the past year, how often have you intentionally harmed or hurt yourself— for example, by cutting or scratching your skin, jumping from heights, drug overdose, swallowing something indigestible—without a lethal intent”. Responses were recorded with options ‘Never,’ ‘Once,’ and ‘More than once’. Consistent with prior research, a dichotomous variable was created to indicate whether the respondent engaged in NSSI within the last year preceding the survey.

2.2.2 Exposure variables

Children’s parent-child separation statuses were assessed with the following questions “Did your father ever migrate to another place for work ever since you were born for at least six months?” and “Did your mother ever migrate to another place for work ever since you were born for at least six months?”.

A set of inclusion and exclusion criteria was employed to identify participants for this study: 1) FN-MN, children whose parents lived in the household and neither had ever migrated for work; 2) FN-MP, children whose father never migrated but the mother previously migrated for work; 3) FM-MP, children whose father is currently migrating and the mother previously migrated for work; 4) FM-MN, children whose father is currently migrating and the mother never migrated for work.

Respondents were further asked to indicate when their father and mother initially migrated and for how long each of them migrated until the day of the survey. Following the commonly accepted developmental stages, age at initial paternal/maternal migration was categorized as never, preschool age (age 7), and school age (≥ age 7). The length of each parental migration was categorized as 0, 1–3, 4–6, or over 6 years.

2.2.3 Sociodemographic variables
The sociodemographic factors entailed gender, grade, urbanicity, singleton, paternal and maternal educational attainment, and perceived family economic level. The perceived family economic level was measured by the question “How would you rate your family’s economic condition at the local level” with a five-point scale ranging from ‘much better’ to ‘much worse’.

### 2.2.4 Statistical analysis

Statistics were analyzed by performing IBM SPSS Statistics for Windows (version 24.0). Data were presented as frequencies (proportions) for categorical variables to describe the characteristics of the participants. Significant differences across samples were ascertained by the Chi-squared tests. For the post hoc pairwise comparisons, Bonferroni tests were employed. Binary logistic regression analysis was used to examine associations between the prevalence of 12-month NSSI, group, age at initiation, and length of maternal migration. Adjusted odds ratio (aOR) with 95% confidence intervals (CIs) were adjusted for socio-demographic covariates, including gender, grade, perceived family economic level, parental educational attainment, singleton, and urbanicity status. Statistical significance is defined as p < 0.05 using two-sided tests.

### 3. Results

Of all 5253 participants, 2476 were included for the present study, comprising 1160 FN-MN (46.8%), 134 FN-MP (5.4%), 607 (24.5%) FM-MP, 575 FM-MN (23.2%). Participants in this study were aged 9 to 18 and consisted of more males (56.1%) than females (43.9%).

The socio-demographic characteristics across four groups are provided in Table 1. Overall, there were significant differences in grade, parental educational attainment, perceived family economic level, and urbanicity but not gender or singleton across groups. FM-MP reported a significantly lower family economic level, paternal education attainment, and maternal education attainment relative to FN-MN (all p < 0.05).
Table 1
Socio-demographics for participants stratified by groups (N = 2476)

<table>
<thead>
<tr>
<th></th>
<th>FN-MN (1)</th>
<th>FN-MP (2)</th>
<th>FM-MP (3)</th>
<th>FM-MN (4)</th>
<th>( \chi^2 )</th>
<th>P value</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>630 (55.1)</td>
<td>61 (46.2)</td>
<td>344 (57.9)</td>
<td>332 (58.3)</td>
<td>7.646</td>
<td>0.054</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>513 (44.9)</td>
<td>71 (53.8)</td>
<td>250 (42.1)</td>
<td>237 (41.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grade</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>27.461</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>5-6th</td>
<td>574 (49.5)</td>
<td>64 (47.8)</td>
<td>222 (36.6)</td>
<td>265 (46.2)</td>
<td>1 &gt; 3, 4 &gt; 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-8th</td>
<td>585 (50.5)</td>
<td>70 (52.2)</td>
<td>385 (63.4)</td>
<td>309 (53.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perceived family economic level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28.849</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Better/much better</td>
<td>341 (29.9)</td>
<td>35 (26.5)</td>
<td>132 (21.9)</td>
<td>152 (26.7)</td>
<td>1 &gt; 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>731 (64.1)</td>
<td>93 (70.5)</td>
<td>415 (68.8)</td>
<td>356 (62.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worse/much worse</td>
<td>68 (6.0)</td>
<td>4 (3.0)</td>
<td>56 (9.3)</td>
<td>61 (10.7)</td>
<td>4 &gt; 1, 4 &gt; 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Paternal education attainment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>79.877</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Primary school and below</td>
<td>167 (14.4)</td>
<td>26 (19.4)</td>
<td>126 (20.8)</td>
<td>115 (20.0)</td>
<td>3 &gt; 1, 4 &gt; 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary school</td>
<td>500 (43.1)</td>
<td>57 (42.5)</td>
<td>346 (57.0)</td>
<td>261 (45.4)</td>
<td>3 &gt; 1, 3 &gt; 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior high school or above</td>
<td>320 (27.6)</td>
<td>28 (20.9)</td>
<td>81 (13.3)</td>
<td>119 (20.7)</td>
<td>1 &gt; 3, 4 &gt; 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>172 (14.8)</td>
<td>23 (17.2)</td>
<td>54 (8.9)</td>
<td>80 (13.9)</td>
<td>1 &gt; 3, 2 &gt; 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < 0.05; ** p < 0.01; *** p < 0.001.
<table>
<thead>
<tr>
<th>Maternal education attainment</th>
<th>FN-MN (1) n (%)</th>
<th>FN-MP (2) n (%)</th>
<th>FM-MP (3) n (%)</th>
<th>FM-MN (4) n (%)</th>
<th>$\chi^2$</th>
<th>P value</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school and below</td>
<td>295(25.7)</td>
<td>39(29.1)</td>
<td>198(32.8)</td>
<td>209(36.5)</td>
<td>66.171</td>
<td>&lt; 0.001</td>
<td>3 &gt; 1, 4 &gt; 1</td>
</tr>
<tr>
<td>Secondary school</td>
<td>456(39.7)</td>
<td>59(44.0)</td>
<td>288(47.8)</td>
<td>200(35.0)</td>
<td></td>
<td></td>
<td>3 &gt; 1, 3 &gt; 4</td>
</tr>
<tr>
<td>Senior high school or above</td>
<td>223(19.4)</td>
<td>15(11.2)</td>
<td>67(11.1)</td>
<td>80(14.0)</td>
<td></td>
<td></td>
<td>1 &gt; 3, 1 &gt; 4</td>
</tr>
<tr>
<td>Unknown</td>
<td>175(15.2)</td>
<td>21(15.7)</td>
<td>50(8.3)</td>
<td>83(14.5)</td>
<td></td>
<td></td>
<td>1 &gt; 3, 3 &gt; 4</td>
</tr>
<tr>
<td>Singleton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.236</td>
<td>0.017</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>764(65.9)</td>
<td>97(72.4)</td>
<td>421(69.5)</td>
<td>420(73.0)</td>
<td></td>
<td></td>
<td>4 &gt; 1</td>
</tr>
<tr>
<td>Yes</td>
<td>395(34.1)</td>
<td>37(27.6)</td>
<td>185(30.5)</td>
<td>155(27.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urbanicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>94.397</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>268(23.1)</td>
<td>41(30.6)</td>
<td>276(45.5)</td>
<td>195(33.9)</td>
<td></td>
<td></td>
<td>3 &gt; 1, 3 &gt; 2, 3 &gt; 4, 4 &gt; 1</td>
</tr>
<tr>
<td>Urban</td>
<td>892(76.9)</td>
<td>93(69.4)</td>
<td>331(54.5)</td>
<td>380(66.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < 0.05; ** p < 0.01; *** p < 0.001.

**Abbreviations:** FN-MN, children whose parents lived in the household and neither had ever migrated for work; FN-MP, children whose father never migrated but the mother previously migrated for work; FM-MP, children whose father is currently migrating and the mother previously migrated for work; FM-MN, children whose father is currently migrating and the mother never migrated for work; NSSI, Non-suicidal self-injurious behaviors; Data are n/N (%) or mean (standard deviation, SD), unless otherwise indicated. Significant differences were ascertained by Chi-squared tests or the Kruskal–Wallis tests, appropriately; **Post hoc** indicates the significance of pairwise comparisons in the post-hoc analysis using Bonferroni tests.

The prevalence of 12-month NSSI is presented in Table 2 by groups. FN-MP (20.1%) and FM-MP (16.1%) reported a significantly higher prevalence of 12-month NSSI than FN-MN (11.4%, all p < 0.05). And of FN-
MP, the prevalence of 12-month NSSI was also significantly higher than that of FM-MN (20.1% vs. 11.0%, p < 0.05).

### Table 2
Prevalence of 12-month non-suicidal self-injurious (NSSI) by group and maternal migration experiences (N = 2476).

<table>
<thead>
<tr>
<th>Group</th>
<th>NSSI n (%)</th>
<th>( \chi^2 )</th>
<th>P value</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN-MN (1)</td>
<td>132(11.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FN-MP (2)</td>
<td>27(20.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM-MP (3)</td>
<td>98(16.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM-MN (4)</td>
<td>63(11.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.210</td>
<td>&lt; 0.01</td>
<td>2 &gt; 1, 3 &gt; 1, 2 &gt; 4</td>
</tr>
</tbody>
</table>

*, p < 0.05; **, p < 0.01; ***, p < 0.001

**Abbreviations:** FN-MN, children whose parents lived in the household and neither had ever migrated for work; FN-MP, children whose father never migrated but the mother previously migrated for work; FM-MP, children whose father is currently migrating and the mother previously migrated for work; FM-MN, children whose father is currently migrating and the mother never migrated for work; NSSI, Non-suicidal self-injurious behaviors; Data are n/N (%) or mean (standard deviation, SD), unless otherwise indicated. Significant differences were ascertained by Chi-squared tests or the Kruskal–Wallis tests, appropriately; **Post hoc** indicates the significance of pairwise comparisons in the post-hoc analysis using Bonferroni tests.

Among children with previous experience of maternal migration (counting for both FN-MP and FM-MP), as seen in Table 3, overall, the younger the age at initiation and the longer the length of previous maternal migration, the higher the prevalence of 12-month NSSI. Further details of the 12-month NSSI prevalence across socio-demographics and paternal migration characteristics, including age at initiation, and length, are reported in the supplement (**eTables1-2**).
Table 3
Prevalence of 12-month NSSI across initial age and length of maternal migration among children with previous experience (n = 741a).

<table>
<thead>
<tr>
<th>Age at initiation of maternal migration</th>
<th>NSSI n (%)</th>
<th>χ²</th>
<th>P value</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Age 7 (1)</td>
<td>83(16.2)</td>
<td>0.404</td>
<td>0.535</td>
<td></td>
</tr>
<tr>
<td>≥Age 7 (2)</td>
<td>41(18.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of maternal migration</th>
<th></th>
<th>0.926</th>
<th>0.629</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1–3 years (1)</td>
<td>59(16.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4–6 years (2)</td>
<td>29(15.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 7 years (3)</td>
<td>36(19.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*, p < 0.05; **, p < 0.01; ***, p < 0.001

Abbreviations: FN-MP, children whose father never migrated but the mother previously migrated for work; FM-MP, children whose father is currently migrating and the mother previously migrated for work; NSSI, Non-suicidal self-injurious behaviors; Data are n/N (%) or mean (standard deviation, SD), unless otherwise indicated. Significant differences were ascertained by Chi-squared tests or the Kruskal–Wallis tests, appropriately; Post hoc indicates the significance of pairwise comparisons in the post-hoc analysis using Bonferroni tests.

Table 4 illustrates the regression results of maternal migration experiences and the prevalence of NSSI, adjusting for socio-demographics. Compared with FM-MN, both FN-MP (OR = 2.09, 95% CI [1.26–3.46], p < 0.01) and FM-MP (OR = 1.53, 95% CI [1.08–2.16], p < 0.05) evidenced greater odds of the prevalence of 12-month NSSI. And also, compared with FN-MN, a significantly higher risk for 12-month NSSI was found among FN-MP and FM-MP (eTable3 in appendix).
Table 4
Regression coefficients for the prevalence of 12-month NSSI and group with adjustments for socio-demographics (N = 2476).

<table>
<thead>
<tr>
<th>NSSI (Total)</th>
<th>OR</th>
<th>aOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(95% CI)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Model 1</td>
<td>Model 2</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>FM-MN</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>FM-MP</td>
<td>1.57(1.11,2.20) *</td>
<td>1.53(1.08,2.16) *</td>
</tr>
<tr>
<td>FN-MP</td>
<td>2.05(1.25,3.37) **</td>
<td>2.09(1.26,3.46) **</td>
</tr>
<tr>
<td>FN-MN</td>
<td>1.04(0.76,1.44)</td>
<td>1.05(0.75,1.45)</td>
</tr>
</tbody>
</table>

*, p < 0.05; **, p < 0.01; ***, p < 0.001

Abbreviations: FN-MN, children whose parents lived in the household and neither had ever migrated for work; FN-MP, children whose father never migrated but the mother previously migrated for work; FM-MP, children whose father is currently migrating and the mother previously migrated for work; FM-MN, children whose father is currently migrating and the mother never migrated for work; NSSI, Non-suicidal self-injurious behaviors; aOR, Adjusted odds ratios, with adjustment for gender, grade, perceived family economic level, parental educational attainment, singleton, and urbanicity status, as necessary.

As shown in Table 5, among those children with maternal migration experience, there was no significant difference in the risk of NSSI regarding the age at initiation of maternal migration, either before or after six years old, despite the further adjustment of the paternal migration characteristics. Similarly, compared with the 1–3 years length of maternal migration, a longer length of maternal migration, regardless of 4–6 years or over six years, showed no disparities in relation to the risk of NSSI among children with maternal migration experience. Details for the regression results of paternal characteristics can be found in the supplement (eTables4-5).
### Table 5

Association of initial age and length of maternal migration with the prevalence of 12-month NSSI among participants with previous experience (n = 741).  

<table>
<thead>
<tr>
<th>NSSI (Total)</th>
<th>OR (95% CI)</th>
<th>aOR (95% CI)</th>
<th>aOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
</tr>
<tr>
<td>Age at initiation of maternal migration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;Age 7</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>≥ Age 7</td>
<td>1.14(0.76,1.73)</td>
<td>1.11(0.73,1.71)</td>
<td>1.22(0.76,1.94)</td>
</tr>
<tr>
<td></td>
<td>Model 4</td>
<td>Model 5</td>
<td>Model 6</td>
</tr>
<tr>
<td>Length of maternal migration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 1–3 years</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>4-6 years</td>
<td>0.96(0.59,1.56)</td>
<td>0.93(0.56,1.53)</td>
<td>0.96(0.58,1.61)</td>
</tr>
<tr>
<td>≥ 7 years</td>
<td>1.21(0.76,1.92)</td>
<td>1.17(0.73,1.89)</td>
<td>1.06(0.64,1.77)</td>
</tr>
</tbody>
</table>

Abbreviations: FN-MP, children whose father never migrated but the mother previously migrated for work; FM-MP, children whose father is currently migrating and the mother previously migrated for work; NSSI, Non-suicidal self-injurious behaviors; aOR, Adjusted odds ratios, with model 2 and model 5 adjusted for gender, grade, perceived family economic level, parental educational attainment, singleton, and urbanicity status; model 3 adjusted for gender, grade, perceived family economic level, parental educational attainment, singleton, urbanicity status, age at initiation of paternal migration; and model 6 adjusted for gender, grade, perceived family economic level, parental educational attainment, singleton, urbanicity status, and length of paternal migration, as necessary.

### 4. Discussion

Our results extended extant findings showing that a previous experience of maternal migration was specifically relevant to the 12-month NSSI engagement in children regardless of current paternal migration. Further, for children who had experienced maternal migration absence, there were no differences in their risk of NSSI engagement between ages at the initiation of maternal migration before and after school age (age 7), nor were there any differences in the length of 1–3 years, 4–6 years, or over 6 years.

As a proxy of migration dynamics, a substantial proportion of FM-MP in this study possibly reflected the emerging trend of internal migration patterns in China. Consistent with our expectations, we found a particular contribution of previous experience of maternal migration to the risk of NSSI among children,
either FN-MP or FM-MP. This finding highly echoed the prior assumption that the reasons for engaging in NSSI might remain stable over time\textsuperscript{36}, and indicated the potentially sustained impact of maternal migration. To the best of our knowledge, this is among the first to study maternal migration in relation to the NSSI among LBC in China. These findings also accord with a well-established interpretation that a severely distressing event, which threatens children's sense of security, tends to make children suffer an overwhelming amount of stress exceeding their ability to cope or integrate the emotions involved with that experience, and eventually generates serious, long-term negative consequences of children\textsuperscript{37}. Furthermore, although there was an earlier finding on the correlation between current paternal absence and children's NSSI performance\textsuperscript{29}, the present study derived other possible explanations by differentiating parental migration status. Specifically, we found higher odds of NSSI among FN-MP and FM-MP relative to FN-MN. And even when compared with FM-MN, these results remain robust, particularly among FN-MP. In this regard, our findings presented a compelling insight indicating that previous maternal absence due to migration appeared even more impactful than current paternal absence accounting for children's NSSI concerns.

Some theoretical claims of mother-child attachment and childhood development also provided better interpretations and support for our findings. Typically, mothers serve as the principal caregivers for their children seeking proximity and thus facilitating children's social and emotional development and, in particular, learning how to regulate their emotions and feelings\textsuperscript{38}. Notwithstanding, maternal migration tends to cause a long-distance and long-lasting mother-child separation for children who experience it, which, in turn, leads to developing children's insecure attachment and thus induces a poor range of emotional and behavioral problems\textsuperscript{39–41}. In addition, as researchers assumed, even though reunited with their mothers, children might also fall short of optimal bonds and have poor communication with their mothers\textsuperscript{42,43}. Furthermore, these children living with their left-behind mothers might also suffer psychological control while their fathers migrate\textsuperscript{44}. Altogether, these factors could further add the risk to children's NSSI engagement.

By further exploring the timing of maternal migration among those with previous experience of maternal migration, our results also extended the results of past research, demonstrating that the initiation of maternal migration in childhood, either before or after school age, had no disparity in their risk of NSSI. This might imply that the experience of maternal separation might be continuously consequential for children's health concerns, considering that whole childhood is the most sensitive and critical stage of social, emotional, and psychological development\textsuperscript{45,46}. Along with this line, we also answered the perennial call for examining the length of migration duration, suggesting that children's NSSI engagement insignificantly varied across short- and long-term maternal migration. Thus, we underscored that the negative impacts of maternal migration on NSSI might persist in the longer term. These findings impel follow-up research to examine maternal migration across all ages and duration to capture the time window that matters most during the absence.
Findings from our research carry considerable practical implications. Given the potential long-term effects of maternal separation on the presence of NSSI, it follows that additional attention would be of pertinent value to the early identification and protection of children at risk, with a particular focus on children who ever had experienced maternal migration. Besides, we provided further support for initiatives such as the Strengthening the Care and Protection of Left-behind Children in Rural Areas in China, which aims to strengthen the monitoring and intervention mechanism for this group\textsuperscript{47}. Importantly, increasing school and parental awareness of childhood NSSI risks and providing family support on optimal arrangement of parental migration could be attainable targets for early intervention and prevention strategies.

Some limitations should be noted. First, the cross-sectional nature of this study is limited for the causal interpretation. We, therefore, echo the call regarding the need for longitudinal research designs to better understand the causal directions of NSSI over maternal absence dynamics due to migration. Second, although we defined NSSI engagement as the presence of at least one episode in the past year to capture their cumulative experience throughout this period, specific characteristics of NSSI occurrence, such as the forms in which they engage and its frequency, might paint a full picture of their risks. Third, our self-report measure might introduce recalling bias and social desirability response bias due to fear of rejection and stigma of reporting NSSI behaviors, which might underestimate the exact phenomenon across the at-risk groups\textsuperscript{48,49}. Fourth, the study samples were not entirely representative of the broader population beyond Anhui, and some caution should be taken when interpreting the results with a small number of subgroups (i.e., FN-MP). Thus, the findings of this study warrant further investigation within large and diversified samples to generalize. Lastly, although paternal migration factors were considered in addition, the potential for unmeasured confounding remains, and the mechanisms and moderating factors need to be explored.

Conclusion

To conclude, the previous experience of maternal migration was independently associated with NSSI among children, regardless of the paternal current migrating status. Specifically, for children who ever had experienced maternal migration, the early onset of maternal migration, either before or after school age, and the longer duration relative to 1–3 years, regardless of whether 4–6 or longer than 6 years, showed no significant difference in their increased risk of NSSI. The findings disentangled the specific role of maternal migration on the higher risk of children's NSSI and provided a nascent implication of prevention strategies where protecting children who experienced maternal separation due to migration from NSSI risk is all the more pressing.

Declarations

Ethics approval and consent to participate
In study, ethical approval was granted by the Ethics Committee of Zhejiang University (Project Number ZGL201804-2). Informed consent was obtained from all subjects and/or their legal guardian(s). All methods were carried out in accordance with relevant guidelines and regulations.

**Consent for publication**

Not applicable

**Availability of data and materials**

Data collected and analyzed during this 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**

Li and Lu had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Akezhuoli and Guo contributed equally to this work and are considered co-first authors.

Concept and design: Akezhuoli, Guo, Lu, Zhao, Xu.

Acquisition, analysis, or interpretation of data: Akezhuoli, Guo, Lu, Zhao, Xu.

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Administrative, technical, or material support: Zhao, Xu.

Supervision: Zhou, Xie.

All authors reviewed the manuscript.

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References


**Supplementary Files**

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