

Health impacts of parental migration on left-behind children and adolescents: a systematic review and meta-analysis



Gracia Fellmeth*, Kelly Rose-Clarke*, Chenyue Zhao, Laura K Busert, Yunting Zheng, Alessandro Massazza, Hacer Sonmez, Ben Eder, Alice Blewitt, Wachiraya Lertgrai, Miriam Orcutt, Katharina Ricci, Olaa Mohamed-Ahmed, Rachel Burns, Duleeka Knipe, Sally Hargreaves, Therese Hesketh, Charles Opondo, Delan Devakumar



Summary

Background Globally, a growing number of children and adolescents are left behind when parents migrate. We investigated the effect of parental migration on the health of left behind-children and adolescents in low-income and middle-income countries (LMICs).

Methods For this systematic review and meta-analysis we searched MEDLINE, Embase, CINAHL, the Cochrane Library, Web of Science, PsychINFO, Global Index Medicus, Scopus, and Popline from inception to April 27, 2017, without language restrictions, for observational studies investigating the effects of parental migration on nutrition, mental health, unintentional injuries, infectious disease, substance use, unprotected sex, early pregnancy, and abuse in left-behind children (aged 0–19 years) in LMICs. We excluded studies in which less than 50% of participants were aged 0–19 years, the mean or median age of participants was more than 19 years, fewer than 50% of parents had migrated for more than 6 months, or the mean or median duration of migration was less than 6 months. We screened studies using systematic review software and extracted summary estimates from published reports independently. The main outcomes were risk and prevalence of health outcomes, including nutrition (stunting, wasting, underweight, overweight and obesity, low birthweight, and anaemia), mental health (depressive disorder, anxiety disorder, conduct disorders, self-harm, and suicide), unintentional injuries, substance use, abuse, and infectious disease. We calculated pooled risk ratios (RRs) and standardised mean differences (SMDs) using random-effects models. This study is registered with PROSPERO, number CRD42017064871.

Findings Our search identified 10 284 records, of which 111 studies were included for analysis, including a total of 264 967 children ($n=106\,167$ left-behind children and adolescents; $n=158\,800$ children and adolescents of non-migrant parents). 91 studies were done in China and focused on effects of internal labour migration. Compared with children of non-migrants, left-behind children had increased risk of depression and higher depression scores (RR 1.52 [95% CI 1.27–1.82]; SMD 0.16 [0.10–0.21]), anxiety (RR 1.85 [1.36–2.53]; SMD 0.18 [0.11–0.26]), suicidal ideation (RR 1.70 [1.28–2.26]), conduct disorder (SMD 0.16 [0.04–0.28]), substance use (RR 1.24 [1.00–1.52]), wasting (RR 1.13 [1.02–1.24]) and stunting (RR 1.12 [1.00–1.26]). No differences were identified between left-behind children and children of non-migrants for other nutrition outcomes, unintentional injury, abuse, or diarrhoea. No studies reported outcomes for other infectious diseases, self-harm, unprotected sex, or early pregnancy. Study quality varied across the included studies, with 43% of studies at high or unclear risk of bias across five or more domains.

Interpretation Parental migration is detrimental to the health of left-behind children and adolescents, with no evidence of any benefit. Policy makers and health-care professionals need to take action to improve the health of these young people.

Funding Wellcome Trust.

Copyright © 2018 The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY 4.0 license.

Introduction

Globally, nearly one in seven individuals are migrants. The majority are labour migrants who originate from low-income or middle-income countries (LMICs) and relocate in search of employment opportunities either internationally or internally within a country (eg, from rural to urban settings).¹ Some individuals are forced to migrate because of acute drivers such as conflict and disasters. As a result of migration, especially low-skilled labour migration, children are often left behind in the care of

other family members or carers. Among labour migrants, a key incentive for migration is the hope of improving the circumstances of their families and children through increased household income and financial stability. International migrants send an estimated US\$613 billion per year in remittances to their countries of origin.² Although the health and rights of migrant workers is recognised as a priority in the UN Sustainable Development Goals,³ the health of children of migrants has been largely overlooked in research and policy.

Lancet 2018; 392: 2567–82

Published Online
December 5, 2018
[http://dx.doi.org/10.1016/S0140-6736\(18\)32558-3](http://dx.doi.org/10.1016/S0140-6736(18)32558-3)

See [Comment](#) page 2518

*Joint first authors

National Perinatal Epidemiology Unit, University of Oxford, Oxford, UK (G Fellmeth MSc, O Mohamed-Ahmed MSc, C Opondo PhD); **Department of Global Health and Social Medicine, King's College London, London, UK** (K Rose-Clarke MBPhD); **Department of Child and Adolescent Psychiatry, New York University School of Medicine, New York, NY, USA** (C Zhao PhD); **Great Ormond Street Institute of Child Health (L K Busert MSc), Department of Clinical, Educational and Health Psychology (A Massazza MSc), and Institute for Global Health (B Eder MBChB, A Blewitt MSc, M Orcutt MBBS, R Burns MSc, Prof T Hesketh PhD, D Devakumar PhD), University College London, London, UK; Department of Social Medicine and Health Education, School of Public Health, Peking University, Beijing, China** (Y Zheng MSc); **Department of Population Science (D Knipe PhD), Faculty of Health Sciences, University of Bristol, Bristol, UK** (H Sonmez BSc); **Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand** (W Lertgrai MSc); **Institute for Medical Information Processing, Biometry and Epidemiology, Ludwig Maximilian University of Munich, Munich, Germany** (K Ricci BA Hons); **Institute for Infection and Immunity, St George's, University of London, London, UK** (S Hargreaves FRCPE); **International Health Unit, Section of Infectious Diseases**

and Immunity, Imperial College London, London, UK (S Hargreaves); Centre for Global Health, School of Medicine, Zhejiang University, Hangzhou, China (Prof T Hesketh); and Department of Medical Statistics, London School of Hygiene and Tropical Medicine, London, UK (C Opondo)

Correspondence to: Dr Delan Devakumar, Institute for Global Health, University College London, London WC1N 1EH, UK d.devakumar@ucl.ac.uk

Research in context

Evidence before this study

Migration is increasing globally, which has resulted in a growing number of children and adolescents being left behind when their parents migrate. Before starting this study, we searched the scientific literature for articles on the effect of parental migration on child and adolescent health, and found two narrative reviews: one focused on left-behind children in the Philippines and the other on mental health outcomes in left-behind children in China. These reviews suggested that children benefited from the remittances their parents sent home in terms of improved education and reduced child labour, which could result in improved health, but reported that family separation might have long-term psychological and societal costs. We also identified more than 30 studies, mainly from China, investigating the effects of parental migration on a broad range of health outcomes across different countries. On Nov 26, 2018, we did an updated search of MEDLINE for systematic reviews with no date or language restrictions, using the broad search terms "(child* OR adolescent) AND health AND (migration OR left-behind)". Although we identified 99 systematic reviews, none reviewed the key areas of health of left-behind children and adolescents across all low-income and middle-income countries (LMICs).

Added value of this study

This is the largest and most comprehensive study to date assessing the impact of parental migration on all key areas of child and adolescent health across all LMICs. Compared with children of non-migrants, left-behind children and adolescents had an increased risk of depression, suicidal ideation, and risk of anxiety. Left-behind children also had smaller increases in risk for wasting, stunting, and substance use. These results highlight a rarely discussed consequence of global migration with implications for global policy making and health-care provision in migrant-sending countries. Although a small number of individual studies found positive health effects of parental migration, overall we found no evidence of benefit across any of the health outcomes.

Implications of all the available evidence

Our findings highlight the unmet health needs of left-behind children and adolescents. Research to date has focused primarily on China and longitudinal studies in a wider range of LMICs with high rates of emigration are needed to better understand risk and resilience factors within this population, and to inform policy and practice to address unmet health needs in left-behind children, adolescents, and their carers.

No estimates are available for the number of left-behind children and adolescents globally, but the figure is thought to be in the hundreds of millions. More than a third of all children residing in rural China (61 million) are left behind by one or both migrant parents.⁴ 27% of children in the Philippines,⁵ 36% in Ecuador,⁶ and more than 40% in rural South Africa⁷ are estimated to be left behind.

Evidence about the health status of left-behind children is conflicting. On the one hand, material benefits and greater income security from remittances might be expected to confer improvements in health and facilitate access to health care and education. In Pakistan, migration had positive effects on the growth of left-behind children, with girls benefitting more than boys.⁸ However, on the other hand, some studies suggest poorer health outcomes among left-behind children. In China, where the most research has been done to date, studies have shown poorer nutritional,⁹ developmental¹⁰ and mental health outcomes¹¹ in left-behind children than children of non-migrant parents. It is unclear to what extent the health of these children is affected by parental migration, and how the impact might vary according to contextual factors, including sex and age. For example, in China, boys who were left before age 6 years were not as tall as boys whose parents left them at an older age.¹² Although adolescents might be more independent than younger children, parental absence, and lack of supervision at this crucial age has been associated with risk-taking behaviours,

including substance use and physical inactivity, with implications for long-term health.¹³ Furthermore, effects might vary according to the circumstances of parental migration. For example, maternal absence and the absence of both parents might have more pronounced effects on children's health than paternal absence alone.¹⁴ To date, to our knowledge, no studies have comprehensively examined the health status of left-behind children and adolescents across all settings and key areas of health. To address this research gap, we did a systematic review and meta-analysis to assess the impact of parental migration on child and adolescent nutrition, mental health, unintentional injuries, infectious disease, substance use, unprotected sex, early pregnancy, and verbal, physical, and sexual abuse in LMICs. We investigated whether parental migration status (one or both parents migrating), type of migration (internal or international; labour or forced) and child characteristics (age, sex) differentially influence the health of left-behind children and adolescents.

Methods

Search strategy and selection criteria

For this systematic review and meta-analysis, we searched MEDLINE, Embase, CINAHL, the Cochrane Library, Web of Science, PsychINFO, Global Index Medicus, Scopus, and Popline from database inception to April 27, 2017. Full search terms are provided in the appendix. We searched for observational studies reporting the risk of health outcomes done in LMICs

See [Online](#) for appendix

(classified according to the World Bank classification) that included children and adolescents (aged 0–19 years) with at least one migrant parent. We defined parental migration as one or more parent moving away from the place their children are living, for a minimum of 6 months. We included studies in which parents had migrated for any reason, such as employment (labour migrants) or armed conflict or disasters (forced migrants). We included internal and international parental migration, defined as migration within and beyond a country's borders, respectively. The comparator group was children of non-migrating parents. We excluded studies in which less than 50% of participants were aged 0–19 years, the mean or median age of participants was more than 19 years, fewer than 50% of parents had migrated for more than 6 months, or the mean or median duration of migration was less than 6 months.

We updated our searches to include all literature published before Sept 5, 2018, to assess whether studies published after our original search might alter the implications of our findings. We tailored search strategies to each database and used controlled vocabulary and search filters where available, or Boolean search methods and free text terms. No date or language restrictions were used. Because of the large volume of research on left-behind children available in China, we searched the China National Knowledge Infrastructure database and key Chinese public health journals. We also searched reference lists of relevant systematic reviews and grey literature published by key international organisations (UN Children's Fund, International Organization for Migration, and UN High Commissioner for Refugees). The full search strategy is detailed in the appendix. We used Covidence systematic review software (Veritas Health Innovation, Melbourne, VIC, Australia) to organise and screen articles. Two reviewers (KR-C, GF, CZ, LKB, YZ, HS, BE, AB, WL, MO, DK, or DD) independently screened each title and abstract and excluded those that were not relevant, and then independently screened the full text of remaining studies to assess eligibility. Two reviewers (GF, CZ, LKB, YZ, AM, HS, BE, RB, WL, MO, KR, or OM-A) extracted data, and assessed the risk of bias for all included studies. Discrepancies about study inclusion were resolved through discussion with a third reviewer or by contacting study authors. Studies that reported results as mean scores with SDs or as raw proportions or unadjusted odds ratios (ORs) were included in meta-analysis. When insufficient data were reported for inclusion in the meta-analysis, we contacted study authors to request further information.

This study is reported in accordance with the PRISMA guidelines¹⁵ (appendix). The study protocol is available online.

Data analysis

We extracted data on study design, participant numbers and characteristics, and exposures and outcomes using

data extraction sheets designed by the authors (appendix). When duplicate data were identified, only data for the most recent timepoint were extracted.

Outcomes of interest were risk and prevalence of the main causes of disability-adjusted life-years for children aged younger than 5 years, 5–9 years, and 10–19 years, including nutrition (stunting, wasting, underweight, overweight and obesity, low birthweight, and anaemia), mental health (depressive disorder, anxiety disorder, conduct disorders, self-harm, and suicide), unintentional injuries, substance use, physical, emotional, and sexual abuse,¹⁶ and infectious disease. Additional outcomes were unprotected sex and early pregnancy (<18 years; appendix).

We summarised outcomes from all studies included in the review diagrammatically, using adjusted estimates to classify studies according to their effect estimates and provide a visual overview of the evidence. Studies with sufficient data to examine the effect of being left behind on nutrition, mental health, injury, and substance use outcomes were included in random-effects meta-analysis. We estimated pooled risk ratios (RRs) with 95% CIs for binary outcomes and standardised mean differences (SMDs) with 95% CI for continuous outcomes. Binary categorisations indicate the presence or absence of a disorder (caseness), and continuous outcomes were associated with symptom severity. We used unadjusted study outcomes for three main reasons. First, only 15 studies reported adjusted effect estimates. Second, the adjusted effects estimates varied considerably with regard to the covariates included and effects were not directly comparable. Third, a number of studies reported adjusted ORs; due to the so-called non-collapsibility property of ORs,¹⁷ estimates from adjusted ORs can differ significantly from unadjusted estimates even in the absence of confounding. We used meta-regression to assess the effect of child age and sex on study-specific effect estimates.

Risk of bias was assessed using an adapted version of the Newcastle Ottawa Scale¹⁸ incorporating items from the National Institute for Clinical Excellence Quality Appraisal¹⁹ (appendix). Studies with a high or unclear risk of bias across five or more domains were defined as being at high risk of bias. This definition was based on consensus between the authors, which acknowledged that any such cutoffs are arbitrary.²⁰ No studies were excluded on the basis of quality. Funnel plots were used to assess publication bias.

We used the I^2 statistic to indicate the proportion of total variation between study estimates due to heterogeneity.²⁰ To identify and assess sources of heterogeneity, we planned a-priori subgroup analyses to assess migration of one versus both parents, and forced versus labour migration. We also planned to do subgroup analyses of internal versus international migration, but due to the predominance of Chinese studies, which were all on internal migration, we decided to do

For more on the **World Bank Classification of countries and economies** see <https://data.worldbank.org/country>

For the **study protocol** see https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=64871

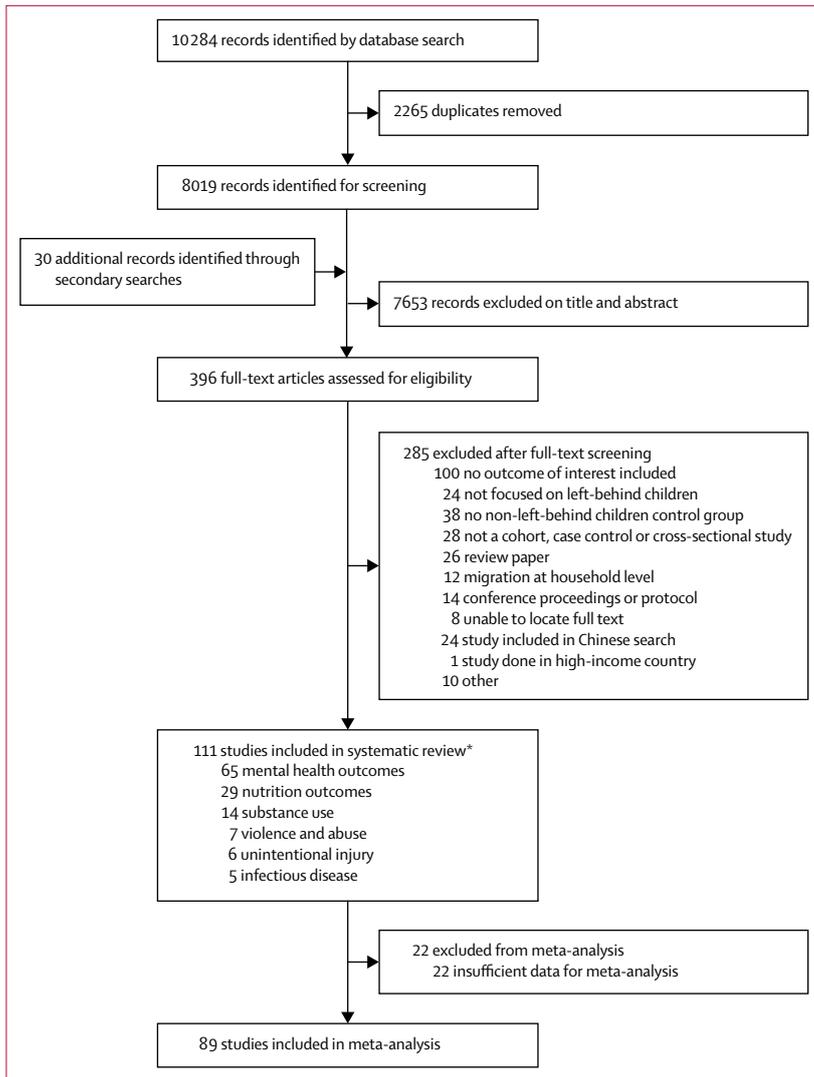


Figure 1: Study selection

*Some studies included more than one outcome.

subgroup analyses of studies in China versus the rest of the world. We did a sensitivity analysis to assess the robustness of our conclusions with regard to the assumptions underlying our analytic approach. We did fixed-effects meta-analyses and repeated analyses using only studies with low risk of bias. All statistical analyses were done using Stata (version 13.0) and MetaXL (version 5.3). The study is registered with PROSPERO, number CRD42017064871.

Role of the funding source

The funder had no role in study design, data collection, data analysis, data interpretation, writing of the report, or the decision to submit. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Our systematic search of the literature identified 10284 records, of which 2265 were duplicates (figure 1). Of the 396 full-text articles retrieved, 111 studies^{9,10,13,21–128} done between 1994 and 2017 in 16 countries (n=106167 left-behind children and adolescents; n=158800 children and adolescents of non-migrant parents) were included in the systematic review (appendix). 89 studies (n=78273 left-behind children and adolescents; n=88350 children of non-migrant parents) were included in meta-analyses. Reasons for exclusion at the full-text screening stage and characteristics of included studies are shown in the appendix. Of the 111 included studies, 91 (82%) were done in China, 58 (52%) were published in Chinese, nine (8%) were done in Asia (Thailand, Philippines, Indonesia, Vietnam, Sri Lanka, and India), six (5%) in Latin America (Mexico, Guatemala, and Peru), three (3%) in Africa (Ethiopia, Kenya, and Malawi), two (2%) in the Caribbean (Trinidad and Tobago and Jamaica), and two (2%) in eastern Europe (Romania and Moldova). 101 studies were cross-sectional, seven were cohort studies, and three were case-control studies. All studies included children of labour migrants; none included children of forced migrants. All Chinese studies examined internal migration within China, whereas studies from the rest of the world, with the exception of one study,¹⁰⁰ focused on international migration. 71 studies included children aged younger than 10 years. Among the 92 studies that reported participant sex, the proportion of male participants ranged from 13·1% to 76·3%. Study quality varied by domain assessed (figure 2). 48 (43%) of the 111 included studies were at high or unclear risk of bias across five or more domains. Funnel plots showed no evidence of publication bias (appendix).

Of the 111 studies included in the systematic review, mental disorders were the most common study outcome (n=64), followed by nutritional status (n=29), substance use (n=14), experience of violence and abuse (n=7), unintentional injury (n=6), and infectious disease (n=5; figure 3). Across all outcomes, only 12 studies reported a lower risk of adverse health outcomes among left-behind children and adolescents.

64 of 65 studies reporting mental health outcomes used self-reported screening tools. Meta-analysis showed that left-behind children and adolescents had a significantly higher risk of depression caseness (RR 1·52 [95% CI 1·27–1·82]) and symptoms (SMD 0·16 [95% CI 0·10–0·21]), anxiety caseness (RR 1·85 [1·36–2·53]) and symptoms (SMD 0·18 [0·11–0·26]), and suicidal ideation caseness (RR 1·70 [1·28–2·26]) compared with children of non-migrating parents (figures 4A, figure 4B). Left-behind children and adolescents had a higher risk of symptoms of conduct disorder (SMD 0·16 [95% CI 0·04–0·28]) but not caseness (RR 1·16 [95% CI 0·88–1·52]). Statistical heterogeneity across mental disorder outcomes was high ($I^2=67·0–96·9\%$). In subgroup analyses, no differences were identified in risk of anxiety caseness or symptoms among children and adolescents left behind by one parent

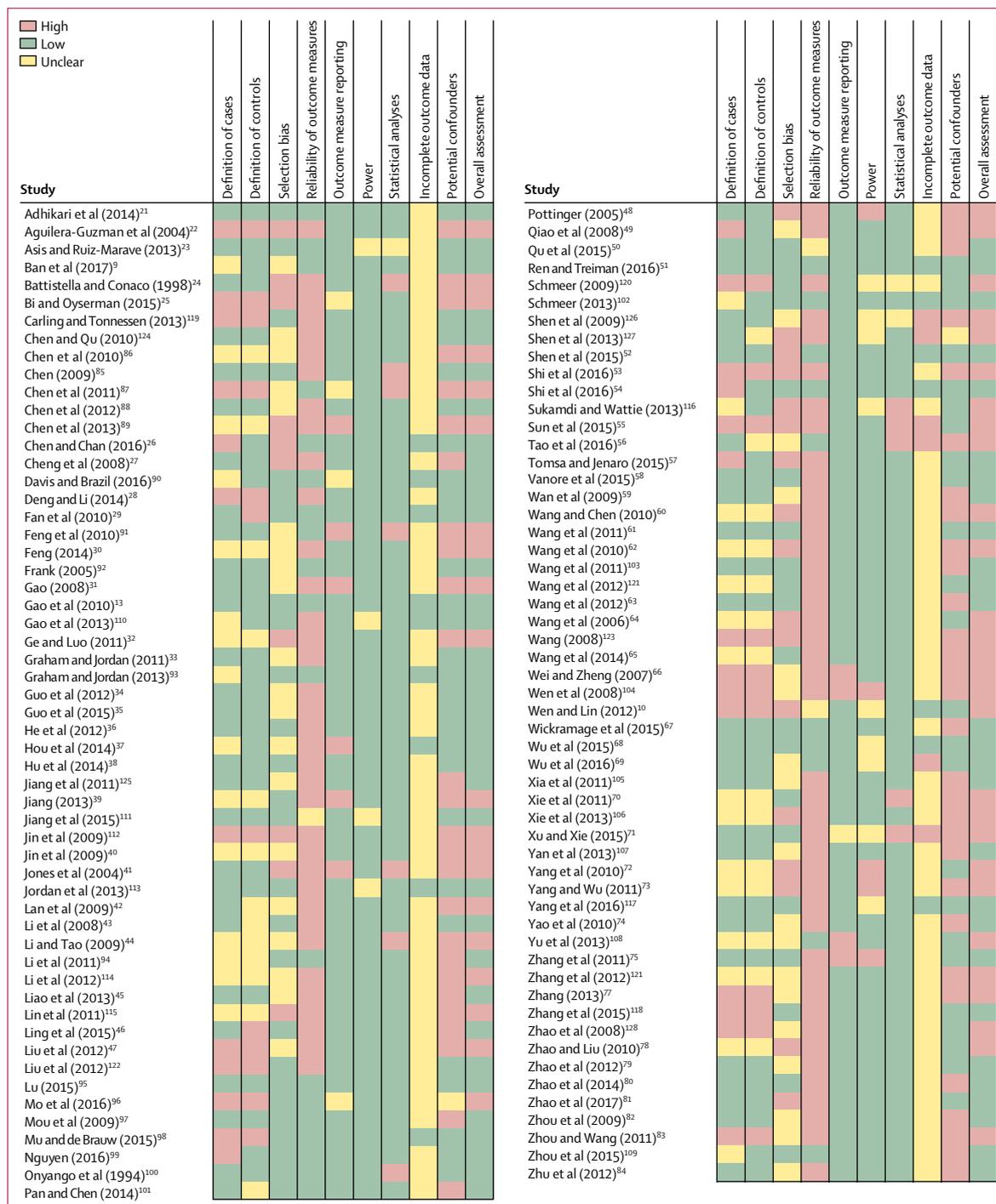


Figure 2: Quality assessment of studies included in the systematic review
 Scoring was based on an adapted version of the Newcastle Ottawa Scale¹⁸ incorporating items from the National Institute for Clinical Excellence Quality Appraisal. Studies with a high or unclear risk of bias across five or more domains were defined as being at high risk of bias overall.

or by both parents compared with children and adolescents of non-migrant parents (appendix). Children and adolescents left behind by both parents had a higher risk of depressive symptoms than did those of non-migrants (SMD 0.11 [95% CI 0.01 to 0.22]), but no differences were

identified between children or adolescents left behind by one parent compared with children or adolescents of non-migrants (0.04 [-0.03 to 0.12]; appendix). No significant differences in depression caseness were identified between children and adolescents left behind by one (RR 0.93

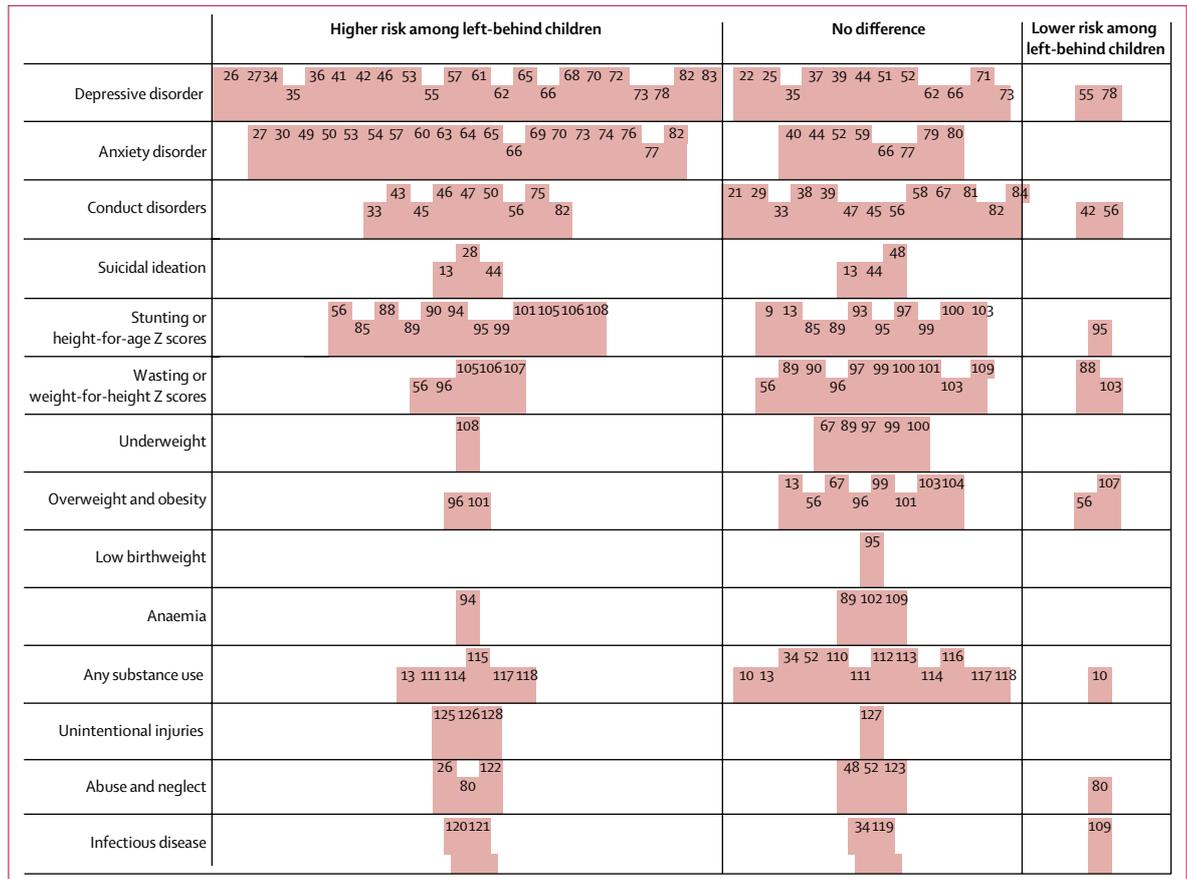


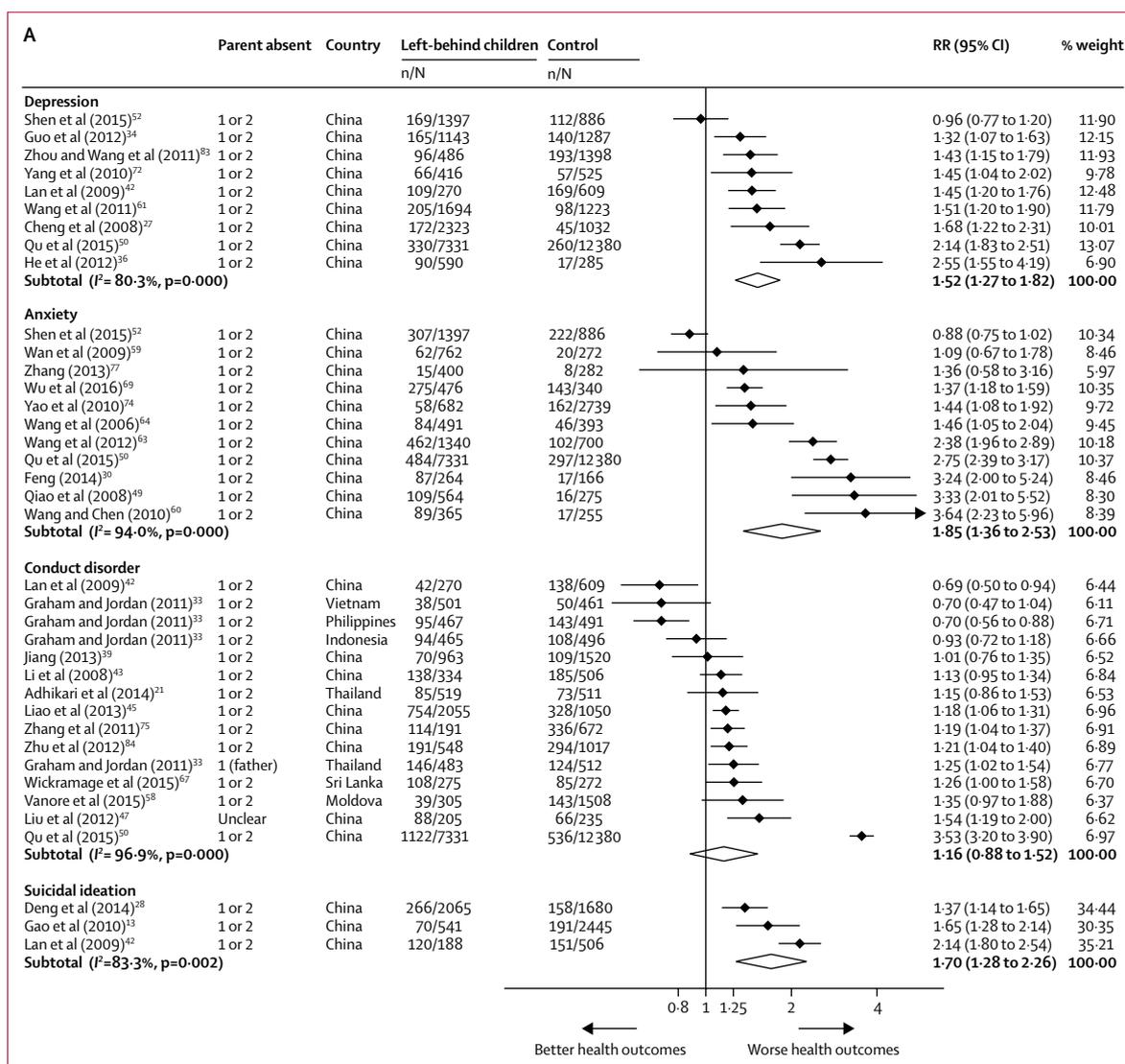
Figure 3: Harvest plot of health outcomes among left-behind children and children of non-migrant parents included in the systematic review
 Each full-height bar represents the health outcomes reported by an individual study included in the systematic review. Half-height bars represent studies which found varying directionality of health outcomes between different population subgroups (eg, a higher risk among girls who were left behind but no difference among boys who were left behind compared with children of non-migrant parents). Numbers refer to study references as cited in the reference list. Nine studies^{23,24,31,32,86, 87,91,98,124} were excluded from this plot due to the absence of significance testing reported in these studies. Two studies^{105,109} were included for those outcomes for which significance testing was reported and excluded for other outcomes.

[95% CI 0.74–1.17]) or by both parents (1.13 [0.78–1.64]) when compared with children and adolescents of non-migrant parents (appendix). In studies outside of China, no significant differences in risk of mental disorders were found among children and adolescents of international migrants compared with children of non-migrant parents. With the exception of conduct disorders, the number of studies of children of international migrants done outside of China was limited. Among children of migrants in China (all of whom were internal migrants) risks for all health outcomes were consistent with the results of the main analyses (appendix). Excluding studies at high risk of bias did not alter mental disorder outcomes. Using a fixed-effects model did not significantly alter effect estimates with the exception of conduct disorder caseness (RR 1.45 [95% CI 1.38–1.52]; appendix). We did not include any studies in the meta-analysis reporting outcomes for self-harm.

Meta-analyses showed that left-behind children had a significantly increased risk of wasting (RR 1.13 [95% CI

1.02–1.24]) and stunting (RR 1.12 [1.00–1.26]) than children of non-migrants. No differences were identified in mean height-for-age Z score (SMD -0.47 [95% CI -0.95 to 0.01]), mean weight-for-height Z score (SMD -0.02 [-0.09 to 0.05]), mean weight-for-age Z score (SMD -0.32 [-0.69 to 0.05]), risk of being underweight (RR 1.10 [0.88 to 1.38]), risk of being overweight or obese (RR 0.94 [0.74 to 1.19]), or risk of having iron-deficiency anaemia (RR 1.18 [0.91 to 1.54]) between left-behind children and children of non-migrating parents (figure 4C, figure 4D). Heterogeneity varied across nutrition outcomes ($I^2=0.0-98.1\%$), with all outcomes (with the exception of wasting and weight-for-height Z score) varying substantially between studies.

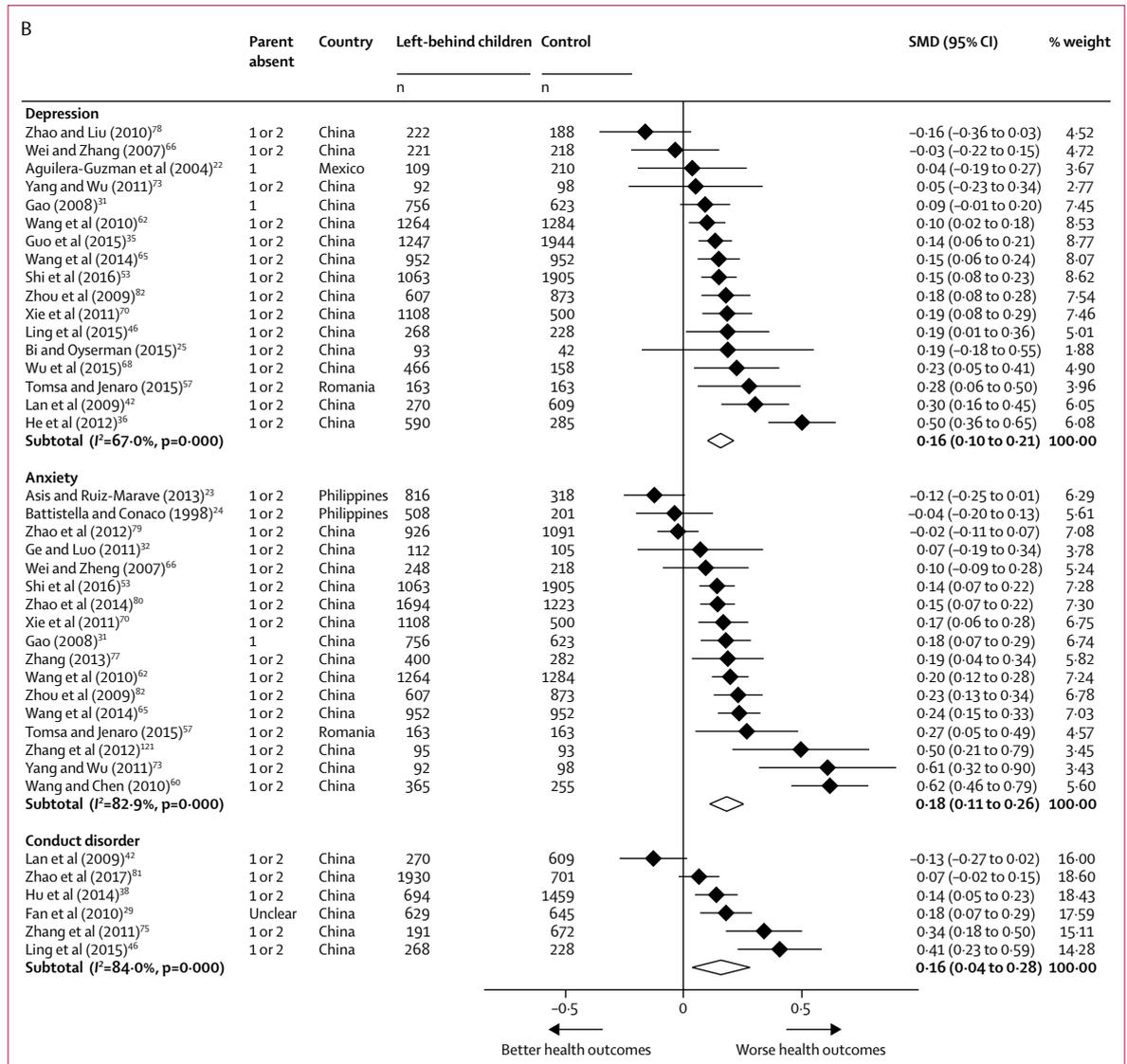
Subgroup analyses of wasting for children left behind by one parent and by both parents showed no statistical evidence of an increased risk in left-behind children compared with children of non-migrants (appendix). Subgroup analyses of stunting revealed a significant increase in risk for children left behind by one parent



(Figure 4 continues on next page)

(RR 1.28 [95% CI 1.06–1.55]) and children left behind by both parents (1.26 [1.06–1.50]; appendix) compared with children of non-migrating parents. Among studies done in China, children left behind had a higher risk of stunting than children of non-migrants, but all other nutrition outcomes remained unchanged. Of the studies done outside of China, only three^{67,93,100} reported nutrition outcomes for children who were left behind. Overall no difference was found in nutrition outcomes in studies outside of China, with the exception of wasting and weight-for-height Z scores (appendix). Excluding studies at high risk of bias did not alter nutrition outcomes. Using a fixed-effects model resulted in significantly worse height-for-age Z scores (SMD -0.23 [95% CI -0.29 to -0.17]) and weight-for-age Z scores (-0.19 [-0.25 to -0.12]) among left-behind children than children of non-migrant parents; all other outcomes remained unchanged (appendix).

Left-behind children had a marginally higher risk of substance use (RR 1.24 [95% CI 1.00–1.52]) including alcohol, smoking, and any substance use. No significant differences were identified in risk of unintentional injury (RR 1.32 [95% CI 0.97–1.78]), abuse (RR 1.09 [0.88–1.35]), or diarrhoea (RR 0.97 [0.90–1.05]; figure 4E) between left-behind children and children of non-migrant parents. Statistical heterogeneity was high across these outcomes ($I^2=82.8-83.1\%$). Pooled risk for substance use outcomes in studies outside of China and among children left behind by one parent showed no increased risk compared with children of non-migrants; however, each subgroup included only two studies (appendix). When studies at high risk of bias were excluded, no significant differences were identified in risk of substance use among left-behind children compared with children of non-migrant parents. Fixed effects meta-analysis revealed a



(Figure 4 continues on next page)

higher risk of unintentional injury among left-behind children than children of non-migrant parents (RR 1.35 [95% CI 1.21–1.52]; appendix). No studies included in the meta-analysis reported outcomes for infectious disease, with the exception of diarrhoea, or outcomes for unprotected sex or early pregnancy.

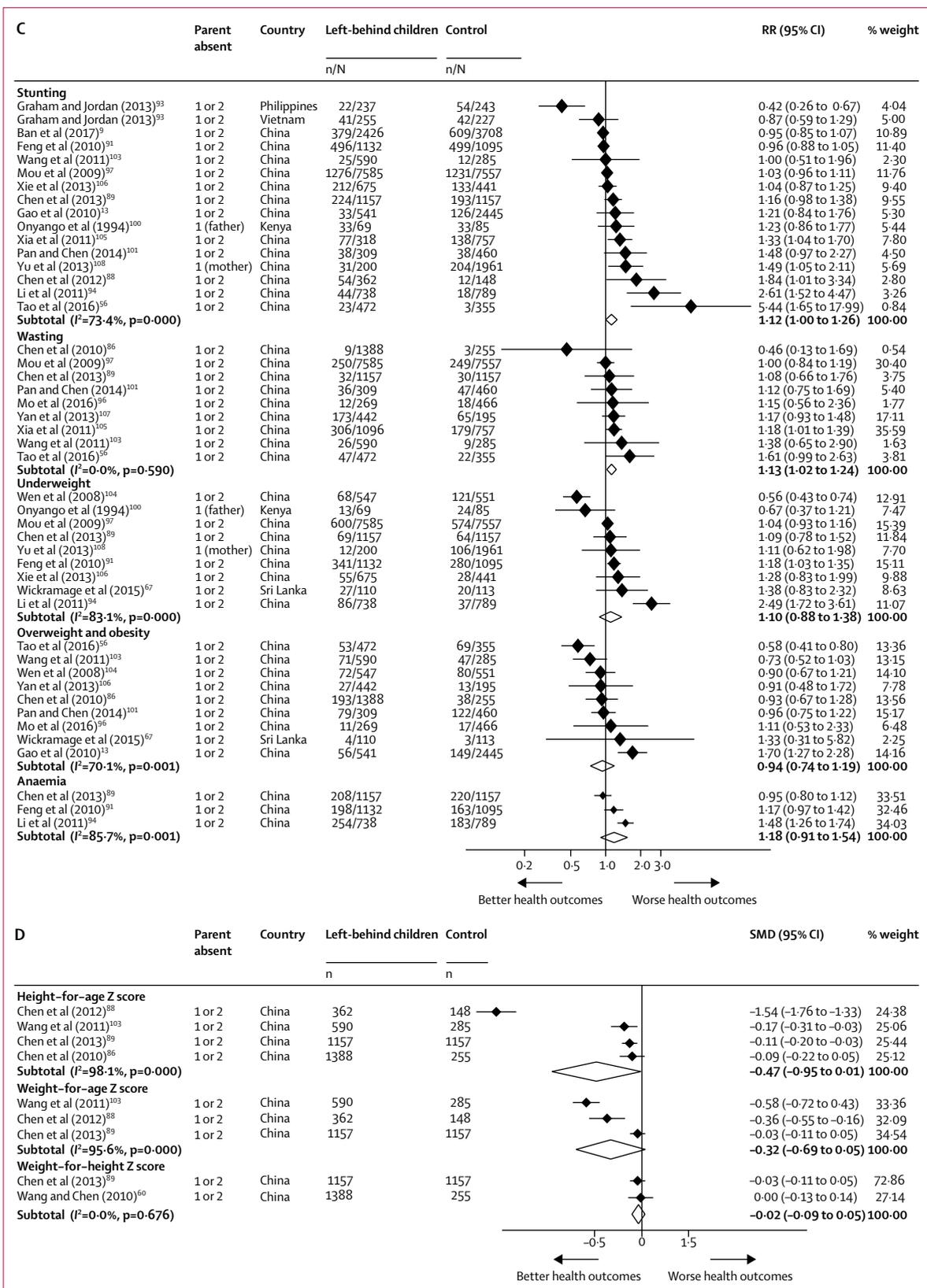
Meta-regression showed sex and mean age had no significant effects on any health outcomes (appendix).

Discussion

Although most studies identified by our systematic review focused on internal labour migration in China, our findings suggest that, as a group, left-behind children and adolescents have worse outcomes than children of non-migrant parents, especially with regard to mental health and nutrition. Compared with children of non-migrants,

left-behind children and adolescents had a 52% increased risk of depression, 70% increased risk of suicidal ideation, and an 85% increased risk of anxiety. We found smaller increases in risk for wasting (13%), stunting (12%) and substance use (24%). Left-behind children and adolescents had no increased risk of conduct disorders, being overweight or obese, anaemia, unintentional injury, diarrhoea, or abuse. Although a minority of individual studies^{10,42,55,56,78,80,88,95,103,107,109} reported beneficial health effects, no overall benefits were found across any of the outcomes assessed. We found no studies investigating the effect of forced migration, which might be explained by the fact that leaving children behind in the context of conflict or disaster is unlikely.

We updated our search from April 28, 2017, to Sept 5, 2018, using the same search terms and databases.



(Figure 4 continues on next page)

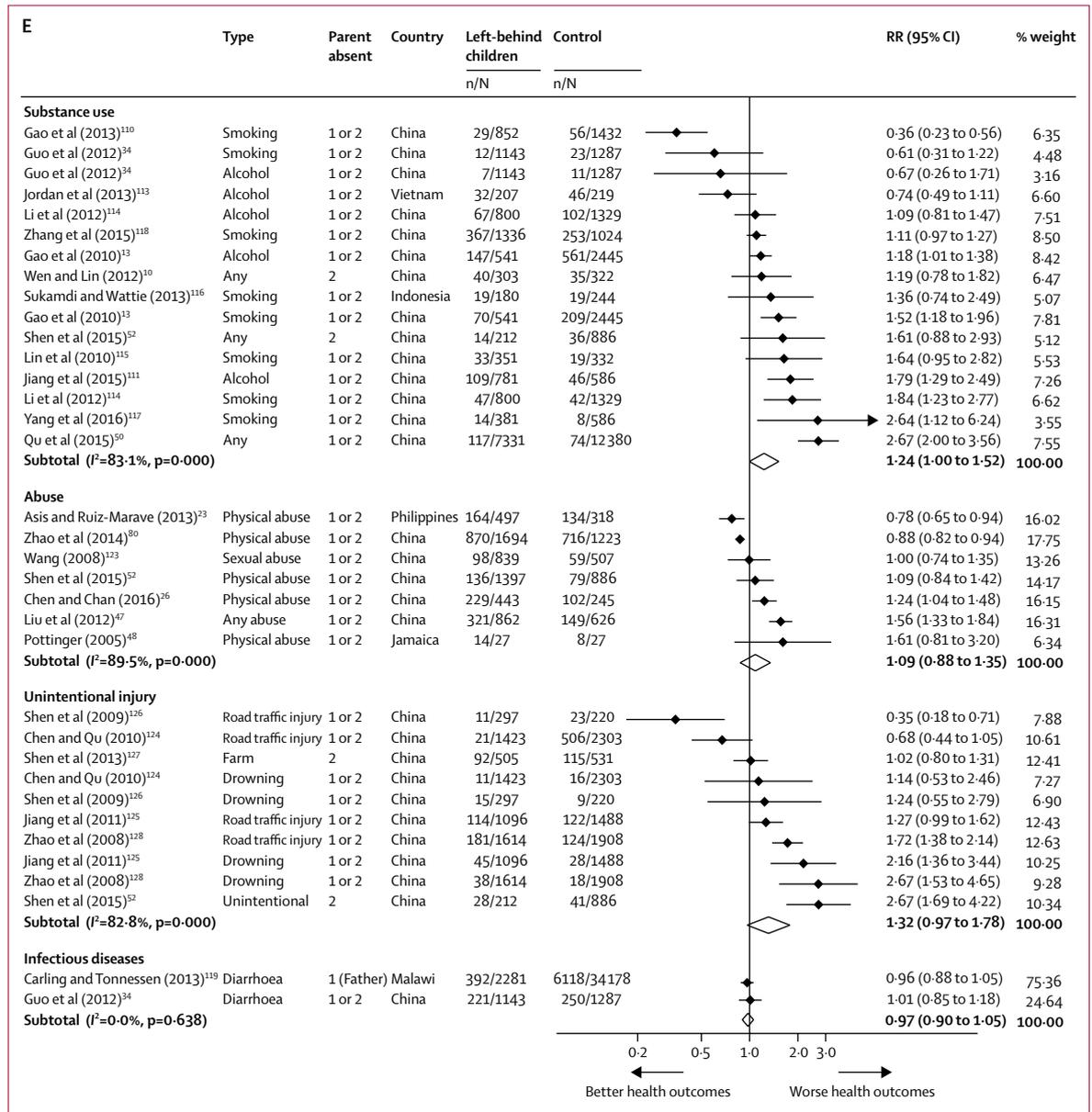


Figure 4: Forest plots of relative risks or standardised mean differences for health outcomes
 Data are presented for mental health binary outcomes (A), mental health continuous outcomes (B), nutrition binary outcomes (C), nutrition continuous outcomes (D), and substance use, abuse and injury outcomes (E). Weights were assigned by random effects analysis. RR=relative risk. SMD=standardised mean difference.

This updated search identified nine additional papers (six published in English and three published in Chinese), all of which focused on internal migration and were done in China. Findings from the studies were consistent with the results from our meta-analyses and provide no evidence of benefits of parental migration for left-behind children and adolescents and support our overall findings in terms of the negative health impact of migration on left-behind children and adolescents. Four studies reported outcomes for depression: three studies¹²⁹⁻¹³¹ found a small increase in depressive symptoms or worse depression scores among left-behind

children and adolescents and one study¹³² found no difference between left-behind children and children of non-migrant parents. Studies^{129,133} reporting anxiety outcomes similarly found increased risks among left-behind children and adolescents compared with children of non-migrants. Consistent with our findings, a large study of adolescents in China (n=13 952) found a significant increase in suicide attempts in left-behind adolescents compared with adolescents who were not left behind (3.75% vs 2.86%, p<0.01).¹³⁴ Two studies^{135,136} assessed nutrition outcomes. A cohort study¹³⁵ found that left-behind children and adolescents had lower

Panel: Next steps and future research**Clinical**

- Health-care providers should have an increased awareness with regard to mental health and nutritional disorders when dealing with left-behind children and adolescents. More focus should be placed on research to better understand the health needs of this group in a range of countries globally.

Epidemiology

- Increase in the evidence base and available data to understand the short-term and long-term health consequences of migration on left-behind children, with a particular focus on internal migration outside of China and international migration, elucidating the mechanisms by which being left behind might lead to improvements or worsening health. To do this, more work is needed on the moderating and mediating factors—for example, the number of parents migrating, the type and duration of migration, the degree of contact with parents, or age of the children and the differing family situations, including alternate family structures.

Intervention research

- Moving beyond understanding the problem, interventions are needed to improve the health or to mitigate the adverse effects of being left behind. This might involve community actions, laws, or technology to improve the connectedness of families. Research is particularly needed on interventions at an individual or community level to promote resilience and enable young people to overcome the negative aspects of parental absence due to migration.

Policy

- Both global and national policies need to consider the health needs of children who are left behind. Research is needed to identify and implement national policies to provide services for children who might not have parental support. Globally, policies for migrant workers should consider the impact on their families. Migrant workers must be allowed the time to visit and communicate with their families. Global mental health initiatives need to better consider this excluded group.

weight-for-age Z scores and height-for-age Z scores at baseline and follow-up after migration, although the effect of migration varied according to which parent migrated. Li and Zhang¹³⁶ found that a higher proportion of left-behind children had stunting and wasting than did children with non-migrant parents. One study¹³⁷ reported a higher risk of any type of unintentional injury (eg, vehicle and traffic injuries and falls) among left-behind children and adolescents than children and adolescents with non-migrant parents (adjusted OR 1.208, $p < 0.05$).

Labour migration is a global trend, shaping families and communities across the world.¹³⁸ Our findings are consistent with previous reviews^{5,11} about left-behind children in rural China and the Philippines: although parental labour migration might have economic benefits for families, it might have hidden costs for the health of children and adolescents who are left behind. A previous study¹³⁹ reported that these negative health consequences extend to other family members. The Child Health and Migrant Parents in South-East Asia study¹³⁹ showed that left-behind mothers and other carers in transnational migrant households were more likely to have poor mental health than carers in non-migrant households: mental health problems were associated with infrequent contact with the migrant and migrant destinations in the Middle East, whereas receiving remittances in the past 6 months was found to have a protective effect on the mental health of carers. With the exception of age and sex, we were unable to investigate factors mediating poor health outcomes among left-behind children and adolescents, although family structure, community social capital, living conditions, and level of caregiver supervision might be important.^{68,140} Future research should consider the circumstances of parental migration.

Children of parents migrating because of extreme poverty, disasters, or oppression are likely to have worse health outcomes than children from wealthier migrant families that are financially stable with access to adequate health care. Residing with siblings and relationships between children and their caregivers could also be important.

82% of studies included in our systematic review were done in China, an upper middle-income country where migration is mainly internal, rural-to-urban labour migration. Our study highlights a major research gap in countries beyond China, potentially limiting the generalisability of our findings to other forms of migration and to other settings, especially low-income countries. Subgroup analyses of studies done across the rest of the world showed no difference in outcomes for left-behind children and adolescents; however, with the exception of conduct disorder, few studies have been done, limiting the conclusions that can be drawn.

Addressing the needs of families who are left behind will be essential for health-care workers and policy makers.¹⁴¹ In China, the health and wellbeing of left-behind children is a priority and steps are being taken to address this. In 2013, the Chinese Government called on local authorities to take specific responsibility for the education and care of left-behind children.¹⁴² The Chinese Women's Federation has taken a lead in most provinces, but action has been inconsistent and it is unclear whether the health of left-behind children is improving as a consequence. Community-based clubs for children have been established to provide left-behind children with educational and recreational opportunities.¹⁴³ Other strategies include conditional cash transfer schemes for caregivers to encourage them to attend health education

sessions, vaccinations, and health checks.¹⁴⁴ In China until around 10 years ago, the national household registration system limited rural children's access to urban health and educational services, with children forced to attend designated migrant schools, which varied in quality. The situation is now changing, especially in smaller cities, as a result of the national household registration system restrictions being relaxed, migrant children attending mainstream schools, and using rural health insurance to access health care. These changes have led to an increase in the number of children migrating with their parents.¹⁴⁵

Next steps for research and practice require a multifaceted approach, involving clinical, epidemiological, intervention research, and policy perspectives (panel). Focusing on all levels of society, the International Organization for Migration recommends a multi-dimensional intervention framework that includes the government and business.¹⁴⁶ Clinicians, teachers, and other individuals working with left-behind children and adolescents must be aware of the potential mental health and nutritional needs of this population, and be trained to support and treat them. Increased awareness is particularly important with regard to common mental disorders and risk-taking behaviours that children or adolescents might not present with, or that might be underlying another clinical presentation. Global mental health initiatives should be encouraged to incorporate a focus on left-behind children. However, a one-size-fits-all approach to intervention is likely to be ineffective since left-behind children and adolescents will have different experiences of migration and being left behind. A study in China⁶⁸ found that children who were left behind had more depressive symptoms than children residing in rural China with both parents who had never migrated or been left behind, regardless of whether they had previously migrated or not. However, children who were previously left-behind but were now living with their parents had fewer depressive symptoms than children in rural areas without any experience of migration or being left behind.⁶⁸ Although sex was not a predictor of health outcomes among left-behind children and adolescents in our study, girls and boys might require different intervention approaches. Interventions are also needed to support caregivers, many of whom might be elderly relatives with health needs of their own. Increasing the evidence base beyond China is essential, as are longitudinal studies investigating the long-term effects of parental migration on children and adolescents. Although familial separation is acutely detrimental for health, children might go on to develop resilience and have potentially better health outcomes.

The comprehensive scope of this review is a strength, since evidence was included across all LMICs, in all languages, across multiple health outcomes, with low publication bias. However, our study has several limitations. Our original systematic search included

literature published up to April, 2017, and thus newer studies might alter the conclusions. However, when updating the searches to September, 2018, the studies were consistent with our findings. Statistical heterogeneity was high in the meta-analyses, which persisted in subgroup analyses and meta-regression. This heterogeneity suggests that, despite our use of a strict definition of left-behind children and adolescents, other mediating or moderating factors might influence the results reported in individual studies, including caregiver and contextual factors. Similarly high heterogeneity was identified in a systematic review and meta-analysis¹⁴⁷ of mental disorders among refugees resettled in western countries. Most of the studies included in our systematic review and meta-analysis were from China, focused on internal migration, and were cross-sectional, which means temporal causal inference is limited and might not generalise beyond China. Despite these limitations, our study defines and identifies a global population of young people at risk.

In summary, left-behind children and adolescents have substantial unmet mental health and nutritional needs that have not been well described outside of China. The prevalence of labour migration is increasing, thus interventions that support these young people are urgently needed to prevent long-term negative effects on their health and development.

Contributors

KR-C, DD, GF, DK, and TH conceptualised the study and developed the protocol. KR-C, BE, DD, and DK developed the search strategy. BE did the literature search. KR-C, GF, CZ, LKB, YZ, HS, BE, AB, WL, MO, DK, and DD screened titles, abstracts and full texts. GF, CZ, LKB, YZ, AM, HS, BE, RB, WL, MO, KR, and OM-A extracted data and assessed data quality. GF and CO analysed the data. GF, LKB, AM, HS, DK, RB, CO, KR-C, and DD interpreted the data. GF, KR-C, LKB, SH, and DD wrote the first draft of the manuscript. All authors reviewed, edited, and approved the final manuscript.

Declaration of interests

SH is a senior editor at *The Lancet Infectious Diseases*. SH is funded by the Wellcome Trust and the European Society for Clinical Microbiology and Infectious Diseases (ESCMID) through an ESCMID Study Group for Infections in Travellers and Migrants research grant. DK receives salary support from the Economic and Social Research Council (ESRC); Elizabeth Blackwell Institute for Health Research, University of Bristol; and the Wellcome Trust Institutional Strategic Support Fund. DD receives salary support from the National Institute for Health Research. TH reports an ESRC grant for an intervention for Left Behind Children in China (ES/L003619/1). MO is in receipt of an ESRC doctoral fellowship. All other authors declare no competing interests.

Acknowledgments

We thank the funder of the study, the Wellcome Trust (209993/Z/17/Z). We thank Heather Chesters for her advice on the database search strategies and Henry Aughterson for help with the initial reviews.

References

- 1 International Organization for Migration. World Migration Report 2018. Geneva: International Organization for Migration.
- 2 World Bank Group. Migration and remittances. Recent developments and outlook-transit migration. Washington DC: World Bank, 2018.
- 3 UN. Sustainable Development Goals. 2018. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/> (accessed Sept 1, 2018).

- 4 Yuan P, Wang L. Migrant workers: China boom leaves children behind. *Nature* 2016; **529**: 25.
- 5 Reyes MM. Migration and Filipino children left-behind: a literature review. New York: UNICEF (United Nations Children's Fund), 2008.
- 6 UN Population Fund and Facultad Lationamericana de Ciencias Sociales. Ecuador: las Cifras de la migracion internacional. Quito: UN Population Fund and Facultad Lationamericana de Ciencias Sociales, 2006.
- 7 Whitehead A, Hashim I. Children and migration. Background paper for DFID migration team. 2005. https://childhub.org/en/system/tdf/library/attachments/dfid_05_child_mig_bac_0408.pdf?file=1&type=node&id=18153 (accessed May 18, 2017).
- 8 Mansuri G. Migration, sex bias, and child growth in rural Pakistan. World Bank Policy Research Working Paper. 2006. <https://openknowledge.worldbank.org/bitstream/handle/10986/8423/wps3946.pdf?sequence=1&isAllowed=y> (accessed May 18, 2017).
- 9 Ban L, Guo S, Scherpbier RW, Wang X, Zhou H, Tata LJ. Child feeding and stunting prevalence in left-behind children: a descriptive analysis of data from a central and western Chinese population. *Int J Public Health* 2017; **62**: 143–51.
- 10 Wen M, Lin D. Child development in rural China: children left behind by their migrant parents and children of nonmigrant families. *Child Dev* 2012; **83**: 120–36.
- 11 Qin J, Albin B. The mental health of children left behind in rural China by migrating parents: a literature review. *J Public Ment Health* 2013; **9**: 4–16.
- 12 Zhang N, Becares L, Chandola T. Does the timing of parental migration matter for child growth? A life course study on left-behind children in rural China. *BMC Public Health* 2015; **2015**: 966.
- 13 Gao Y, Li LP, Kim JH, Congdon N, Lau J, Griffiths S. The impact of parental migration on health status and health behaviours among left behind adolescent school children in China. *BMC Public Health* 2010; **10**: 56.
- 14 Liu Z, Xinying L, Ge X. Left too early: the effects of age at separation from parents on Chinese rural children's symptoms of anxiety and depression. *Am J Public Health* 2009; **99**: 2049–54.
- 15 Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015; **4**: 1.
- 16 Kyu HH, Pinho C, Wagner JA, et al. Global and national burden of diseases and injuries among children and adolescents between 1990 and 2013: findings from the Global Burden of Disease 2013 Study. *JAMA Pediatr* 2016; **170**: 267–87.
- 17 Hernan MA, Clayton D, Keiding N. The Simpson's paradox unraveled. *Int J Epidemiol* 2011; **40**: 780–85.
- 18 Wells G, Shea S, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp (accessed May 17, 2017).
- 19 National Institute for Health and Care Excellence. Appendix G. Quality appraisal checklist—quantitative studies reporting correlations and associations. 2012. <https://www.nice.org.uk/process/pmg4/chapter/appendix-g-quality-appraisal-checklist-quantitative-studies-reporting-correlations-and> (accessed May 20, 2017).
- 20 Higgins JPT, Green S, eds. Cochrane handbook for systematic reviews of interventions, version 5.1.0. The Cochrane Collaboration. Oxford: Wiley-Blackwell, 2011.
- 21 Adhikari R, Jampaklay A, Chamratrithirong A, Richter K, Pattaravanich U, Vapattanawong P. The impact of parental migration on the mental health of children left behind. *J Immigr Minor Health* 2014; **16**: 781–89.
- 22 Aguilera-Guzman RM, Garcia MS, Garcia FJ. Psychometric characteristics of CES-D in a sample of Mexican rural adolescents in areas with a strong migratory tradition. *Salud Mental* 2004; **27**: 57–66.
- 23 Asis MM, Ruiz-Marave C. Leaving a legacy: parental migration and school outcomes among young children in the Philippines. *Asian Pac Migr J* 2013; **22**: 349–76.
- 24 Battistella G, Conaco CG. The impact of labour migration on the children left behind: a study of elementary school children in the Philippines. *SOJOURN* 1998; **13**: 220–41.
- 25 Bi C, Oyserman D. Left behind or moving forward? Effects of possible selves and strategies to attain them among rural Chinese children. *J Adolesc* 2015; **44**: 245–58.
- 26 Chen M, Chan KL. Parental absence, child victimization, and psychological well-being in rural China. *Child Abuse Negl* 2016; **59**: 45–54.
- 27 Cheng SG, Hao JH, Tao FB. Mental health status of left-behind adolescents in rural areas in Anhui. *Zhongguo Xue Xiao Wei Sheng* 2008; **29**: 429–41 (in Chinese).
- 28 Deng ZX, Li GY. Relationship between suicidal ideation and parental out-migration for work among left-behind children aged 14 years or younger in Guizhou province. *Zhong Guo Gong Gong Wei Sheng* 2014; **30**: 1154–56 (in Chinese).
- 29 Fan F, Su L, Gill MK, Birmaher B. Emotional and behavioral problems of Chinese left-behind children: a preliminary study. *Soc Psychiatry Psychiatr Epidemiol* 2010; **45**: 655–64.
- 30 Feng L. Investigation and comparison of psychological and behavioral characteristics of rural left-behind children and non-left-behind children and the intervention countermeasures. *Zhong Guo Fu You Bao Jian* 2014; **29**: 2027–29 (in Chinese).
- 31 Gao Y. A comparative study on mental development characteristics between non-parent-absent children and parent-absent children in different care-taking modes. *Zhong Guo Te Shu Jiao Yu* 2008; **97**: 56–61 (in Chinese).
- 32 Ge J, Luo S. The study of rural left-behind children's psychological anxiety. *Xian Dai Jiao Yu Ke Xue* 2011; **1**: 72–74 (in Chinese).
- 33 Graham E, Jordan LP. Migrant parents and the psychological well-being of left-behind children in southeast Asia. *J Marriage Fam* 2011; **73**: 763–87.
- 34 Guo J, Chen L, Wang X, et al. The relationship between internet addiction and depression among migrant children and left-behind children in China. *Cyberpsychol Behav Soc Netw* 2012; **15**: 585–90.
- 35 Guo J, Ren X, Wang X, et al. Depression among migrant and left-behind children in China in relation to the quality of parent-child and teacher-child relationships. *PLoS One* 2015; **10**: e0145606.
- 36 He B, Fan J, Liu N, et al. Depression risk of 'left-behind children' in rural China. *Psychiatry Res* 2012; **200**: 306–12.
- 37 Hou K, Liu Y, Qu Z, Jiang S. The social adjustment of left-behind children in rural China: a propensity score analysis. *Xin Li Fa Zhan Yu Jiao Yu* 2014; **30**: 646–55 (in Chinese).
- 38 Hu HW, Lu S, Huang CC. The psychological and behavioral outcomes of migrant and left-behind children in China. *Child Youth Serv Rev* 2014; **46**: 1–10.
- 39 Jiang Q. Emotional and behavioral problems among left-behind middle school children in Fujian province. *Zhong Guo Gong Gong Wei Sheng* 2013; **12**: 015 (in Chinese).
- 40 Jin YL, Wu XJ, Huang SP, Zhao HS, Sun GX, Xu JC. Comparative analysis on the mental health status of rural left-behind children in northern Jiangsu province. *Zhongguo xue xiao wei sheng* 2009; **30**: 472–73 (in Chinese).
- 41 Jones A, Sharpe J, Sogren M. Children's experiences of separation from parents as a consequence of migration. *CJSW* 2004; **3**: 89–109.
- 42 Lan YL, Li Y, Tan XJ, Zhang YY, Tan JY. Personality and emotion and behavior status of children left behind in rural areas. *Zhong Hua Xing Wei Yi Xue Yu Nao Ke Xue* 2009; **18**: 343–45 (in Chinese).
- 43 Li XY, Tang JL, Wu D, Xu WM, Yang L, Jin L. Study on behavioral problems among 5,973 middle-school students in an area. *Anhui Yi Ke Da Xue Xue Bao* 2008; **43**: 108–10 (in Chinese).
- 44 Li GY, Tao FB. Survey on mental health status and suicidal ideation among rural children left-behind. *Chin J Publ Health* 2009; **25**: 905–07.
- 45 Liao ZG, Chen ZH, Wang SH, Xi BR, Liu H, He SJ. Study and comparison of behavioral problems of left-behind children and non-left behind children in rural area of Jiangxi province. *Zhong Guo Fu You Bao Jian* 2013; **28**: 4501–3 (in Chinese).
- 46 Ling H, Fu E, Zhang JR. Effects of separation age and separation duration among left-behind children in China. *Soc Behav Pers* 2015; **43**: 241–54.
- 47 Liu XH, Yang YY, Ha LN, Wang X, Li Q, Dai X. Relationship between emotional problem behavior and social support in left-behind children. *Zhong Guo Quan Ke Yi Xue* 2012; **28**: 3287–90 (in Chinese).
- 48 Pottinger AM. Children's experience of loss by parental migration in inner-city Jamaica. *Am J Orthopsychiatry* 2005; **75**: 485–96.

- 49 Qiao L, Chen XN, Yuan P. Status of mental health of the left-behind children in certain regions of Sichuan. *Xian Dai Yu Fang Yi Xue* 2008; **16**: 3108–11 (in Chinese).
- 50 Qu Y, Jiang H, Zhang N, Wang D, Guo L. Prevalence of mental disorders in 6-16-year-old students in Sichuan province, China. *Int J Environ Res Public Health* 2015; **12**: 5090–107.
- 51 Ren Q, Treiman DJ. The consequences of parental labor migration in China for children's emotional wellbeing. *Soc Sci Res* 2016; **58**: 46–67.
- 52 Shen M, Gao J, Liang Z, Wang Y, Du Y, Stallones L. Parental migration patterns and risk of depression and anxiety disorder among rural children aged 10–18 years in China: a cross-sectional study. *BMJ Open* 2015; **5**: e007802.
- 53 Shi J, Chen Z, Yin F, Zhao J, Zhao X, Yao Y. Resilience as moderator of the relationship between left-behind experience and mental health of Chinese adolescents. *Int J Soc Psychiatry* 2016; **62**: 386–93.
- 54 Shi YJ, Bai Y, Shen YN, Kenny K, Rozelle S. Effects of parental migration on mental health of left-behind children: evidence from Northwestern China. *China World Econ* 2016; **24**: 105–22.
- 55 Sun XJ, Tian Y, Zhang YX, Xie XC, Heath MA, Zhou Z. Psychological development and educational problems of left-behind children in rural China. *SPI* 2015; **36**: 227–52.
- 56 Tao S, Yu L, Gao W, Xue W. Food preferences, personality and parental rearing styles: analysis of factors influencing health of left-behind children. *Qual Life Res* 2016; **25**: 2921–29.
- 57 Tomsa R, Jenaro C. Children left behind in Romania: anxiety and predictor variables. *Psychol Rep* 2015; **116**: 485–512.
- 58 Vanore M, Mazzucato V, Siegel M. 'Left behind' but not left alone: parental migration & the psychosocial health of children in Moldova. *Soc Sci Med* 2015; **132**: 252–60.
- 59 Wan YM, Wang SF, Ma XH. Mental health condition of the left-behind children in rural area of Anhui province. *Zhongguo Xue Xiao Wei Sheng* 2009; **10**: 911–12 (in Chinese).
- 60 Wang XD, Chen X. A comparative study of social anxiety and cognitive deviation between home-staying and non-home-staying children. *Sichuan Shi Fan Da Xue Xue Bao* 2010; **37**: 57–61 (in Chinese).
- 61 Wang TZ, Chen MC, Sun YH, et al. Research on children's depression and the influence of left-behind status in rural area. *Zhongguo xue xiao wei sheng* 2011; **32**: 1445–47 (in Chinese).
- 62 Wang SM, Deng DH, Zhou ZH. Mental health of the left-behind children in different types in rural Hanchuan. *Zhongguo xue xiao wei sheng* 2010; **6**: 005 (in Chinese).
- 63 Wang RX, Zhu LQ, Niu SX. Investigation on mental health of left-behind primary and secondary school students in northern remote rural of Hebei Province. *Jilin Da Xue Xue Bao* 2012; **6**: 065 (in Chinese).
- 64 Wang LF, Zhang S, Sun YH. Social anxiety and the influencing factors among pupils in rural areas in Anhui. *Zhongguo Xue Xiao Wei Sheng* 2006; **10**: 014 (in Chinese).
- 65 Wang W, Zhao HW, Guo Y, Duan ZY. Study on the mental health status and the influencing factors of left-behind children in rural areas. *Xian Dai Yu Fang Yi Xue* 2014; **41**: 994–99 (in Chinese).
- 66 Wei J, Zheng H. Negative influence of the absence of parental rearing among middle school students left in rural areas. *Zhong Guo Xin Li Wei Sheng* 2007; **21**: 83 (in Chinese).
- 67 Wickramage K, Siriwardhana C, Vidanapathirana P, et al. Risk of mental health and nutritional problems for left-behind children of international labor migrants. *BMC Psychiatry* 2015; **15**: 39.
- 68 Wu Q, Lu D, Kang M. Social capital and the mental health of children in rural China with different experiences of parental migration. *Soc Sci Med* 2015; **132**: 270–77.
- 69 Wu YL, Zhao X, Li YF, et al. The risk and protective factors in the development of childhood social anxiety symptoms among Chinese children. *Psychiatry Res* 2016; **240**: 103–09.
- 70 Xie QH, Yang YP, Zhong L. Mental health status of rural left-behind children in Sinan county, Guizhou province. *Zhongguo xue xiao wei sheng* 2011; **32**: 468–69 (in Chinese).
- 71 Xu HW, Xie Y. The causal effects of rural-to-urban migration on children's well-being in China. *Eur Sociol Rev* 2015; **31**: 502–19.
- 72 Yang YJ, Tao FB, Wan YH. Depressive symptoms and the influencing factors among left-behind children. *Zhongguo xue xiao wei sheng* 2010; **3**: 321–23 (in Chinese).
- 73 Yang XM, Wu YW. A survey on the mental health status of rural left-behind children in Gansu. *Zhong Guo Fu You Bao Jian* 2011; **26**: 2165–67 (in Chinese).
- 74 Yao YS, Kang YW, Jin YL, et al. A prevalence survey on the mental health of left behind adolescents in Anhui province. *Zhong Hua Liu Xing Bing Xue* 2010; **31**: 1359–62 (in Chinese).
- 75 Zhang L, Luo XR, Li FF. Behavior problems in left-behind children living in rural areas of Changzhi City. *Zhong Hua Jian Kang Guan Li Xue* 2011; **5**: 50–53 (in Chinese).
- 76 Zhang JP. Analysis on the assessment results of family cohesion and adaptability of left-behind children. *Qian Yan* 2012; **15**: 126–28 (in Chinese).
- 77 Zhang YL. Investigation on the mental health status of rural left-behind children. *Jiao Yu Xue Shu Yue Kan* 2013; **2013**: 83–90 (in Chinese).
- 78 Zhao JX, Liu X. Rural left-home-children's depression and antisocial behavior: the protective role of daily pleasures. *Xin Li Fa Zhan Yu Jiao Yu* 2010; **6**: 013 (in Chinese).
- 79 Zhao M, Li H, Li J, et al. Study on the influence of migrant parents on mental health of their left-behind children in rural China. *Zhong Guo Wei Sheng Shi Ye Guan Li* 2012; **283**: 60–63 (in Chinese).
- 80 Zhao X, Chen J, Chen MC, Lv XL, Jiang YH, Sun YH. Left-behind children in rural China experience higher levels of anxiety and poorer living conditions. *Acta Paediatr* 2014; **103**: 665–70.
- 81 Zhao C, Wang F, Li L, Zhou X, Hesketh T. Long-term impacts of parental migration on Chinese children's psychosocial well-being: mitigating and exacerbating factors. *Soc Psychiatry Psychiatr Epidemiol* 2017; **52**: 669–77.
- 82 Zhou JY, Luo XR, Wei Z, et al. Characteristics of behavioral and emotional problems of left-behind children in rural areas of Changsha. *Shi Yong Er Ke Lin Chuang Za Zhi* 2009; **24**: 1901–03 (in Chinese).
- 83 Zhou Z, Wang J. Analysis on the depression symptoms and associated factors in rural primary and middle school students. *Anhui Yi Ke Da Xue Xue Bao* 2011; **46**: 976–78 (in Chinese).
- 84 Zhu Y, Wang F, Li FH. Health condition of left-behind children in Dingxi county of Guizhou province. *Zhong Guo Gong Gong Wei Sheng* 2012; **4**: 45 (in Chinese).
- 85 Chen ZY. The health status of the left-behind children in rural China. *Zhong Guo Ren Kou Ke Xue* 2009; **5**: 11 (in Chinese).
- 86 Chen L, Wang XH, Qu ZY. An analysis of the growth and nutritional status of migrant children and left-at-home children. *Zhong Guo Te Shu Jiao Yu* 2010; **122**: 48–54 (in Chinese).
- 87 Chen C, He W, Wang Y, Deng L, Jia F. Nutritional status of children during and post-global economic crisis in China. *Biomed Environ Sci* 2011; **24**: 321–28.
- 88 Chen JY, Zhou H, Cao X, Zhou HY, Zhang S, Ma Y. Analysis on growth status of children in Ziyang, Sichuan province. *Zhongguo xue xiao wei sheng* 2012; **33**: 236–37 (in Chinese).
- 89 Chen SH, Liao ZG, He SJ. Analysis on the nutritional status of unattended children under 7 years in rural area of Jiangxi province. *Zhong Guo Fu You Bao Jian* 2013; **28**: 68–70 (in Chinese).
- 90 Davis J, Brazil N. Migration, remittances and nutrition outcomes of left-behind children: a national-level quantitative assessment of Guatemala. *PLoS One* 2016; **11**: e0152089.
- 91 Feng H, Zhang Y, Xian Y, Li Y. Analysis on the physical growth and nutrition status of children under 7 years old in Guizhou. *Zhong Guo Fu You Bao Jian* 2010; **25**: 2407–09 (in Chinese).
- 92 Frank R. International migration and infant health in Mexico. *J Immigr Health* 2005; **7**: 11–22.
- 93 Graham E, Jordan LP. Does having a migrant parent reduce the risk of undernutrition for children who stay behind in south-east Asia? *Asian Pac Migr J* 2013; **22**: 315–48.
- 94 Li CM, Yang N, Zhang JN. Investigation of physical development among left-behind children in rural areas in western Hunan province. *Zhong Guo Quan Ke Yi Xue* 2011; **9**: 26 (in Chinese).
- 95 Lu Y. Internal migration, international migration, and physical growth of left-behind children: a study of two settings. *Health Place* 2015; **36**: 118–26.
- 96 Mo X, Xu L, Luo H, Wang X, Zhang F, Gai Tobe R. Do different parenting patterns impact the health and physical growth of 'left-behind' preschool-aged children? A cross-sectional study in rural China. *Eur J Public Health* 2016; **26**: 18–23.

- 97 Mou JS, Luo JY, Li YP, Shuai ZR, Liu XH. Study on the nutritional status and determinants among rural stranded children in China. *Zhonghua Liu Xing Bing Xue Za Zhi* 2009; **30**: 439–43 (in Chinese).
- 98 Mu R, de Brauw A. Migration and young child nutrition: evidence from rural China. *J Popul Econ* 2015; **28**: 631–57.
- 99 Nguyen CV. Does parental migration really benefit left-behind children? Comparative evidence from Ethiopia, India, Peru and Vietnam. *Soc Sci Med* 2016; **153**: 230–39.
- 100 Onyango A, Tucker K, Eiseimon T. Household headship and child nutrition: a case study in western Kenya. *Soc Sci Med* 1994; **39**: 1633–39.
- 101 Pan CM, Chen XR. Growth and nutritional status among rural left-behind children. *Zhong Guo Gong Gong Wei Sheng* 2014; **6**: 004 (in Chinese).
- 102 Schmeer KK. Family structure and child anemia in Mexico. *Soc Sci Med* 2013; **95**: 16–23.
- 103 Wang YJ, He BY, Fang LH, Li HJ. Preliminary study on the health status among the “left-behind” children in the Xiantao rural area of Hubei Province. *Zhongguo Dang Dai Er Ke Za Zhi* 2011; **13**: 977–80 (in Chinese).
- 104 Wen YF, Wang JQ, Liu RQ. Study on the health condition of the ‘left behind’ children in rural areas of south Anhui province. *Xian Dai Yu Fang Yi Xue* 2008; **4**: 038 (in Chinese).
- 105 Xia YQ, Qing ZG, Su SH, Liu GH, Tang J. Physical growth and nutrition status among left-behind students in Guangdong. *Zhongguo Xue Xiao Wei Sheng* 2011; **32**: 1521–22 (in Chinese).
- 106 Xie Q, Long H, Shen XH, Tang WJ, Xie LX, Huang YC. Study on the food intake and medium and severe malnutrition in poor rural primary students in Guangxi. *Zhongguo Xue Xiao Wei Sheng* 2013; **34**: 979–80 (in Chinese).
- 107 Yan MH, Wang JS, Xin ZH. Investigation and research on physical health of the left-behind and the non left-behind children in north Jiangsu. *Anhui Nong Ye Ke Xue* 2013; **41**: 359–61 (in Chinese).
- 108 Yu D, Liu A, Yu W, et al. Malnutrition status and influencing factors in children with migrant worker mothers in poor areas in China. *Wei sheng yan jiu* 2013; **42**: 429–32 (in Chinese).
- 109 Zhou C, Sylvia S, Zhang L, et al. China’s left-behind children: impact of parental migration on health, nutrition, and educational outcomes. *Health Aff (Millwood)* 2015; **34**: 1964–71.
- 110 Gao Y, Li L, Chan EY, Lau J, Griffiths SM. Parental migration, self-efficacy and cigarette smoking among rural adolescents in south China. *PLoS One* 2013; **8**: e57569.
- 111 Jiang S, Chu J, Li C, et al. Alcohol consumption is higher among left-behind Chinese children whose parents leave rural areas to work. *Acta Paediatr* 2015; **104**: 1298–304.
- 112 Jin CC, Qu ZY, Wang XH. The characteristics and influence factors of smoking behavior of migrated children and unattended children. *Zhong Guo Te Shu Jiao Yu* 2009; **113**: 70–74 (in Chinese).
- 113 Jordan LP, Graham E, Vinh ND. Alcohol use among very early adolescents in Vietnam: what difference does parental migration make? *Asian Pac Migr J* 2013; **22**: 401–19.
- 114 Li GY, Luo TM, Tao FB. Effects of parental working out-of-home on health risk behavior and psychological status among left-behind children. *Zhong Guo Gong Gong Wei Sheng* 2012; **7**: 16–21 (in Chinese).
- 115 Lin D, Xu Y, Li X, Fan X. On the risk to and the future trend of the family environment and their relationship with rural children’s smoking behavior. *Zhong Guo Te Shu Jiao Yu* 2011; **131**: 74–49 (in Chinese).
- 116 Sukamdi, Wattie AM. Tobacco use and exposure among children in migrant and non-migrant households in Java, Indonesia. *Asian Pac Migr J* 2013; **22**: 447–64.
- 117 Yang TT, Li C, Zhou C, et al. Parental migration and smoking behavior on left-behind children: evidence from a survey in rural Anhui, China. *Int J Equity Health* 2016; **15**: 127.
- 118 Zhang F, Zhang T, Xiong J, Zhang L, Chen J. Analysis on prevalence and influence factors of smoking and drinking among middle school students of Tujia and Miao in Xiangxi Area. *Wei Sheng Yan Jiu* 2015; **44**: 750–55 (in Chinese).
- 119 Carling J, Tonnessen M. Fathers’ whereabouts and children’s welfare in Malawi. *Dev South Afr* 2013; **30**: 724–42.
- 120 Schmeer K. Father absence due to migration and child illness in rural Mexico. *Soc Sci Med* 2009; **69**: 1281–86.
- 121 Wang Z, Zhang JY, Chen J, Tan L, Fan H, Gan HP. Analysis of prevalence status and influence factors of diarrhea among children under 5 years in rural areas of Sichuan province. *Xian Dai Yu Fang Yi Xue* 2012; **39**: 4069–75 (in Chinese).
- 122 Liu CY, Zhong ZH, Pan JP, et al. Analysis on the current situation of neglected rural children aged 0–6 years and its impact factors in the western areas of China. *Zhong Hua Liu Xing Bing Xue* 2012; **33**: 145–49 (in Chinese).
- 123 Wang JX. Investigation on safe sex issues among adolescent left-behind children. *Qing Nian Yan Jiu* 2008; **2008**: 7–14 (in Chinese).
- 124 Chen L, Qu ZY. Character and impact factors of injuries among left-behind children and migrant children. *Zhongguo xue xiao wei sheng* 2010; **31**: 332–34 (in Chinese).
- 125 Jiang W, Huang H, Wei J, Shi H, Zhu W, Zhang D. Epidemiological investigation on unintentional injuries of left-behind children in rural area of Nanning. *Zhong Guo Fu You Bao Jian* 2011; **26**: 563–65 (in Chinese).
- 126 Shen M, Yang S, Han J, et al. Non-fatal injury rates among the “left-behind children” of rural China. *Inj Prev* 2009; **15**: 244–47.
- 127 Shen M, Wang Y, Yang S, Du Y, Xiang H, Stallones L. Agricultural exposures and farm-related injuries among adolescents in rural China. *Inj Prev* 2013; **19**: 214–17.
- 128 Zhao KF, Su H, Fang XH, et al. Study on the distribution and risk factors of injuries among home-stranded children in rural areas of Anhui province. *Zhong Hua Liu Xing Bing Xue* 2008; **29**: 338–42 (in Chinese).
- 129 Man Y, Mengmeng L, Lezhi L, Ting M, Jingping Z. The psychological problems and related influential factors of left-behind adolescents (LBA) in Hunan, China: a cross sectional study. *Int J Equity Health* 2017; **16**: 163.
- 130 Zhou M, Sun X, Huang L, et al. Parental migration and left-behind children’s depressive symptoms: estimation based on a nationally-representative panel dataset. *Int J Environ Res Public Health* 2018; **15**: 1069.
- 131 Tang W, Wang G, Hu T, et al. Mental health and psychosocial problems among Chinese left-behind children: a cross-sectional comparative study. *J Affect Disord* 2018; **241**: 133–41.
- 132 Wang XQ, Huo JY, Zhang DJ, Liu PJ. The relationship between mental health and child abuse and the difference between left-at-home children and those living with their parents in rural areas: an analysis based on the two-dimensional four-factor mental health structure. *Zhong Guo Te Shu Jiao Yu* 2018; **211**: 58–64 (in Chinese).
- 133 Li GY, Ran Y. Investigation into the social anxiety of left-behind children under 14 living alone in Guizhou province. *Zhongguo xue xiao wei sheng* 2018; **39**: 1176–78 (in Chinese).
- 134 Chang H, Yan Q, Tang L, et al. A comparative analysis of suicide attempts in left-behind children and non-left-behind children in rural China. *PLoS One* 2017; **12**: e0178743.
- 135 Tian X, Ding C, Shen C, Wang H. Does parental migration have negative impact on the growth of left-behind children? New evidence from longitudinal data in rural China. *Int J Environ Res Public Health* 2017; **14**: E1308.
- 136 Li P, Zhang TC. Comparison of nutritional status between Han and Yao ethnic left-behind children aged 7–14 years in rural Yongzhou. *Zhongguo xue xiao wei sheng* 2018; **39**: 364–71 (in Chinese).
- 137 Hu H, Gao J, Jiang H, et al. A comparative study of behavior problems among left-behind children, migrant children and local children. *Int J Environ Res Public Health* 2018; **15**: 655.
- 138 Patton GC, Sawyer SM, Santelli JS, et al. Our future: a Lancet Commission on adolescent health and wellbeing. *Lancet* 2016; **387**: 2423–78.
- 139 Graham E, Jordan LP, Yeoh BS. Parental migration and the mental health of those who stay behind to care for children in south-east Asia. *Soc Sci Med* 2015; **132**: 225–35.
- 140 Mazzucato V, Cebotari V, Veale A, White A, Grassi M, Vivet J. International parental migration and the psychological well-being of children in Ghana, Nigeria, and Angola. *Soc Sci Med* 2015; **132**: 215–24.

- 141 Abubakar I, Aldridge RW, Devakumar D, et al. The UCL-Lancet Commission on Migration and Health: the health of a world on the move. *Lancet* 2018; published online Dec 5. [http://dx.doi.org/10.1016/S0140-6736\(18\)32114-7](http://dx.doi.org/10.1016/S0140-6736(18)32114-7).
- 142 Government of China. Announcement on the care and education for rural school aged left-behind children by Ministry of Education and four other agencies. 2013. http://www.gov.cn/zwggk/2013-01/10/content_2309058.htm (accessed Nov 26, 2018).
- 143 Zhao C, Zhou X, Wang F, Jiang M, Hesketh T. Care for left-behind children in rural China: a realist evaluation of a community-based intervention. *Child Youth Serv Rev* 2017; **82**: 239–45.
- 144 Zhang Y, Ji M, Zou J, et al. Effect of a conditional cash transfer program on nutritional knowledge and food practices among caregivers of 3-5-year-old left-behind children in the rural Hunan Province. *Int J Environ Res Public Health* 2018; **15**: 525.
- 145 National Bureau of Statistics of China, UNICEF China, UNFPA China. Population status of children in China in 2015: facts and figures. 2017. <http://www.unicef.cn/en/uploadfile/2017/1009/20171009112814506.pdf> (accessed Nov 13, 2017).
- 146 International Organization for Migration. Health of families left behind. <https://www.iom.int/health-families-left-behind> (accessed Nov 26, 2018).
- 147 Fazel M, Wheeler J, Danesh J. Prevalence of serious mental disorder in 7000 refugees resettled in western countries: a systematic review. *Lancet* 2005; **365**: 1309–14.