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This article by Jiayou Luo et al. reminds us that even in countries with a large population, children with very traditional values end up being the victims of changes in work patterns, migration, and social norms. This article suggests that children who are attended by nonparents—either grandparents or other relatives—face less care and many nutrition problems, such as low intake of some nutrients and poor physical development related to nutritional status. The authors suggest that nutrition is the key factor and recommend nutritional intervention programs to improve the children's living conditions. However, in Spain, work by Bel et al.[1] showed an important proportion of children with significant growth retardation upon entering a foster home, although significant catch-up growth was observed at the end of their stay. Growth failure in this population did not appear to be related to nutritional status.

While this article does make the case for nutrition being most affected by the setting upon being left behind, it also raises the important issue of how a society like China, which is changing so rapidly, overlooks some of the basic tenets of family life. It also highlights how ill-prepared China seems to be in safeguarding its most vulnerable citizens from such basic rights as a healthy diet and a safe and nurturing environment.[2] Changes in labor patterns directly affect social patterns, and traditional villages and small cities are not immune from their direct effects on children's well-being.

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THE STATUS OF CARE AND NUTRITION OF 774 LEFT-BEHIND CHILDREN IN RURAL AREAS IN CHINA

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Left-behind children are a special population in Chinese rural areas that refers to the children who are living with one parent or extended family while the other parent(s) is/are absent from home. Since China's reform and opening to the outside world, the restriction of population floating between urban and rural areas has been broken. The scale of spare labor force transferring from rural areas to cities is expanding persistently. Until 2005, the number of floating populations in China had reached nearly 147 million.[1] At the same time, the number of left-behind children has also been increasing. According to the 2000 China Census, the number of left-behind children aged 14 years and younger in China was estimated at 22.9 million, which suggests that left-behind children have become a huge population, especially in rural areas.[2]

When parents are unable to take care of their children, the responsibility falls to the grandparents.[3] One study reported that in 2002, 59% of children in kinship care lived with grandparents, 19% lived with aunts and uncles, and 22% lived with other relatives in America.[4] Another study reported that in 2000, only 43.8% of the observed children lived with one biological parent when the other was out of home in the total number of the studied subpopulation, while 56.2% of the children lived with their grandparents.[2]

Recently, the number of studies on the education, mental health, behavior, and personality of children in kinship care has increased. It has been reported that children in kinship care are more likely to feel indifferent, introverted, inferior, and unsociable; more likely to have psychological problems, learning disabilities, and difficulties getting along with others; more likely to smoke, drink excessively, abuse drugs, and skip school; and even more likely to commit crimes.[5–8]

In China, many studies have suggested that left-behind children have substantial needs. It was reported

that more than 50.0% of left-behind children were unsatisfied with their present living conditions. They exhibited poor academic performance, were unsocial and vulnerable, and hungered for affection.[9] Another study reported that 55.5% of left-behind children were self-willed, indifferent, introverted, and lonely.[10] Among these children, 27.4% were anxious, 27.6% were depressed, 24.5% were scared, 22.7% had a bad temper, 57.6% were delinquent, 35.2% lied, 7.4% were thieves, 30.6% exhibited aggressive behavior, and 41.3% were destructive.[11]

Grandparents are dependent on the economy, as there is no proper financial aid from social welfare; therefore, it affects the wellness of the children if the grandparents are financially unstable. The health status of grandparents is also an important influence on the care of children.[12,13] However, only some of the research focuses on lack of care and the nutritional status of left-behind children.

The purpose of this study was to investigate the lack of care and the nutritional status of left-behind children younger than 7 years of age in some rural places in China, and analyze the differences between left-behind children and the children who live with parents at home.

SUBJECTS AND METHODS

Study population

In this study, left-behind children are defined as those whose parents or mothers had been peasants but were now working out of home for at least three months up to the interviewing day. All of the subjects were younger than 7 years of age and had been living in local areas for more than three months, regardless of household registration.

A two-stage stratified cluster and random sampling were adopted. First, four representative counties (Ningxiang, Nanxian, Yizhang, and Zixing) were selected randomly according to the rural population floating condition based on statistical data published in China. Second, three towns were selected randomly from each chosen county on the basis of economic status, which is typical of good, fair, and poor economic conditions, respectively. Next, 102 villages were randomly selected from chosen towns, and all left-behind children in these villages were interviewed.

Children in a control group were selected at the ratio of 1:1. Inclusive criteria included: the same residential area as the left-behind children (the same village or an adjoining village), the same gender, close age (with age gap less than two or three months), and such other conditions as similar birth weight and birth situation.

Ethical committees from the Health Department of Hunan Province and all four chosen counties approved the research protocol, and informed, oral consent was obtained from the parent or guardian of each subject.

Questionnaire

The authors developed the questionnaire, and a team of research assistants completed the questionnaires through face-to-face interviews with the children's parents or guardians. The questionnaire's contents included the children's nutritional and health history, such as birth weight, premature delivery (<37-week gestational age), feeding type, duration of breastfeeding, guardians' ability to ensure proper nutrition, status of care, and nutritional attendance of the children. It also contained questions on the family's education and income.

Anthropometry

Length of the infants was measured in a recumbent position to the nearest 0.1 cm using a board with an upright wooden base and a movable headpiece. The height of children older than 2 years of age (accurate to within 0.1 cm) was measured with a stadiometer. The weight of lightly clothed infants (within 10g) was measured using a metal beam seat balance. Weight for the other children (within 50g) was measured with a digital electronic scale. The scales were calibrated each morning and checked at regular intervals throughout the day. All measurements were made by a highly trained research anthropometrist. Meanwhile, a repeated measurement for 10% of the children randomly selected each day was conducted. If the two measurements differed by more than 0.5 cm, a third measurement was taken. When the two measurements were similar, their mean was calculated. When a third measurement was required, the mean of the third measurement and the closest to it of the first two measurements was calculated.

Dietary intake

A simplified food-frequency questionnaire (FFQ) was adapted. The FFQ has the advantage of providing information on long-term nutritional habits, which is conceptually more important than intake on a few specific days and is the most commonly used method in epidemiologic studies. The FFQ included 20 food items, and each food item was not the actual food item (e.g., apple) but rather a type of food (e.g., fresh fruit). Some foods had a standard weight and volume that could be described using typical portions. For example, the weight of one standard bowl of rice is 75g

(the diameter of the bowl is 12 cm), and the weight of an egg is 60g. Some food without standard weight or volume would be given approximate information by recalling the daily eating habit.

For each food item, participants indicated the average frequency of consumption of their children over the past year in terms of the weight consumed per day/week/month/year, or never. The selected frequency category for each food item was converted to a daily intake. Finally, some classes with similar properties were grouped together. For example, poultry, pork, beef, mutton, meat products, and animal viscera were put together into one food group: meat. Then meat, fish, shrimp, and eggs were combined into one group.

Laboratory examination

All children underwent the hemoglobin examination with a uniform detector HB-2000 in the same day. The following procedure was used: collect blood in the tip of the fourth finger by using blood-taking needle after sterilization, swab the first drop of blood, then collect 20 microliters from the second drop of blood when it naturally formed a big one; erase the blood out of the pipette, then blow the blood into the bottom of the test tube, backiphonaging several times, and cleaning the pipette; mix vigorously; wait 5 minutes, then put the test tube on the HB-2000 to do the colorimetric determination; and, finally, read directly and record the outcome. The hemoglobin level (g/L) below which anemia is present in children is 110 g/L for children aged 6 to 59 months and 115 g/L for children aged 5 to 11 years.[14]

Definition of Z-scores

To assess nutritional status, an algorithm developed by the World Health Organization (WHO) and the Centers for Disease Control and Prevention's anthropometrical program were adopted. Raw anthropometric data were transformed into Z-scores, and the National Center for Health Statistics/WHO reference data were a global criteria used to evaluate the nutritional status. In China, the nation collected a national representative sample of 79,154 children younger than 7 years of age in nine cities, including urban and rural areas, in 1995.[15] We chose the domestic data as a reference in this study, but they don't provide the weight-for-height Z-scores (WHZ). The Z-score is calculated as: Z-score = (individual value − median value of reference population)/standard deviation (SD) value of reference population. Abnormal anthropometry is defined as an anthropometric value below −2 SD or above +2 SD. These cutoffs define the central 95% confidence interval of the reference distribution as the normal range. A height-for-age Z-score (HAZ) below −2 SD (<−2 HAZ) represents growth retardation. A weight-for-age Z-score (WAZ) <−2 SD represents underweight (low body weight).[16,17]

Statistical analysis

SPSS 11.0 for Windows was used to analyze the outcomes of the survey.[18] A Chi-square test was used for categorical variables and a *t* test was used for continuous variables. The value of p takes the probability of two sides, and α takes 0.05 as a test standard.

RESULTS

A total of 1,580 questionnaires were returned, but only 1,548 (774 pairs) were valid. Thirty-two questionnaires were rejected because of absence of the left-behind children or control group. The sample showed good homogeneities in age, gender, birth weight, and birth situation between the two groups, except feeding type and duration of breastfeeding (Table 1). The mean age of subjects was 3.51 years (SD=1.59, range = 0.33 to 6.92). Mean ages of the left-behind children and control group were 3.51 years (SD=1.60) and 3.50 years (SD=1.59), respectively, without significant difference.

There were 435 boys (56.2%) and 339 girls (43.8%). The majority of children were full-term at birth (>37-week gestational age) and had normal birth weights (>2,500g). The mean birth weight of the left-behind children and children in the control group was 3.33 kg (SD=0.47) and 3.35kg (SD=0.45), respectively, and no significant difference was found. Mothers of the control group were more likely to breastfeed their children ($p<0.05$), and the duration of breastfeeding in left-behind children was significantly shorter than with children in the control group ($p<0.01$).

Guardians of left-behind children

The Figure shows that in rural areas, it has become a common phenomenon that when children must be removed from their parents' care, grandparents would be the first choice to care for the children. In this study, it was found that 91.9% of left-behind children were cared for by grandparents, 1.8% were attended by the father, 2.2% by an uncle and aunt, and 4.1% by friends or others.

Care of left-behind children and children in the control group

As shown in Table 2, the situation of daily food care given by guardians in left-behind children (78.7% as full-time care, 20.2% as part-time care, and 1.2% as no

Table 1. Demographic characteristics and feeding history of left-behind children and children in the control group in rural areas in China

	Left-behind children (n=774) (percent)	*Control group (n=774) (percent)*	χ^2 *value*	P-*value*
Age (in years)	Mean = 3.51±1.60	Mean = 3.50±1.59	0.091[a]	0.932
Gender				
Boy	435 (56.2)	435 (56.2)	0.000	1.000
Girl	339 (43.8)	339 (43.8)		
Birth weight (in kilograms)	Mean = 3.33±0.47	Mean = 3.35±0.45	−1.070[a]	0.282
Gestational age				
<37 weeks	4 (0.5)	2 (0.3)	0.673	0.451
≥37 weeks	770 (99.5)	772 (99.7)		
Feeding type				
Bottle feeding	162 (20.9)	127 (16.4)	5.051	0.031[b]
Breastfeeding[c]	609 (78.7)	641 (82.8)		
Duration of breastfeeding (in months)[d]	Mean = 9.48±3.58	Mean = 10.70±3.26	−7.201[a]	0.001[e]

[a]*t*-test

[b]$p<0.05$

[c]Including breastfeeding and mixed feeding

[d]Including breastfeeding and complementary food

[e]$p<0.001$

care) was inferior to that of the control group (83.5% as full-time care, 16.0% as part-time care, and 0.5% as no care) ($p<0.05$). The situation of special attending given by guardians in left-behind children (78.3% as full-time attending, 17.7% as part-time attending, and 4.0% as no attending) was also inferior to that of the control group (85.0% as full-time attending, 13.4% as part-time attending, and 1.4% as no attending) ($p<0.01$).

Figure. The distribution of guardians of left-behind children in rural areas in China

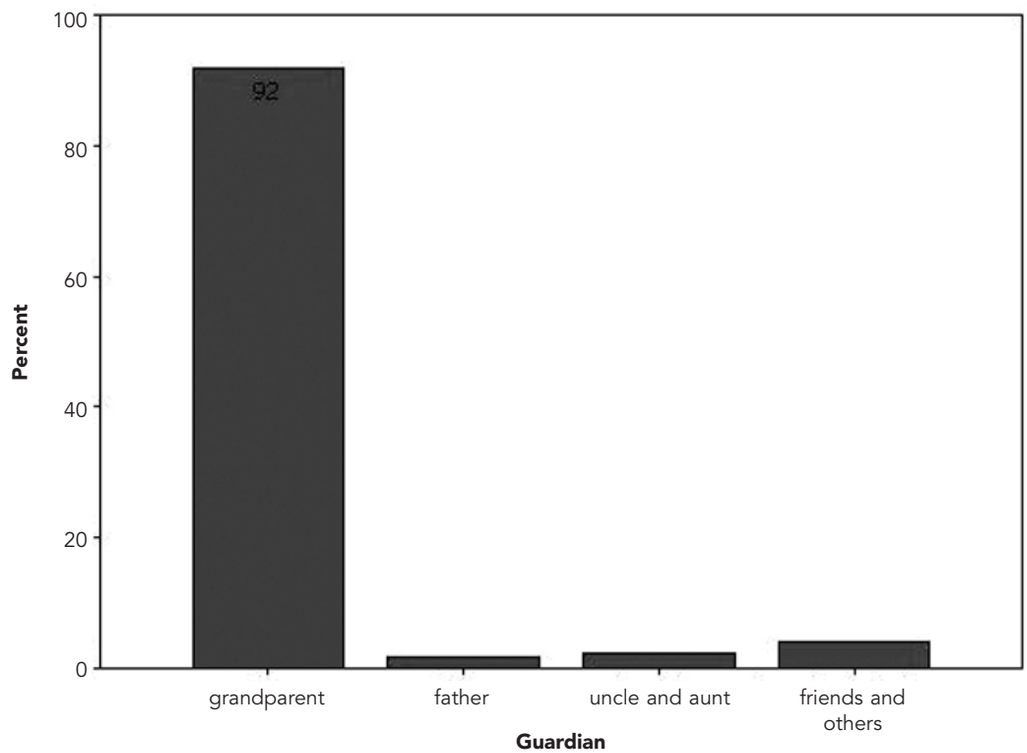

Table 2. The percentage of living care given by guardians of left-behind children and children in the control group in rural areas in China

	Left-behind children (n=774) (percent)	*Control group (n=774) (percent)*	χ^2 *value*	P-*value*
Daily food care				
Full-time	609 (78.7)	646 (83.5)	6.671	0.036[a]
Part-time	156 (20.2)	124 (16.0)		
No	9 (1.2)	4 (0.5)		
Special attending				
Full-time	606 (78.3)	658 (85.0)	15.053	0.001[b]
Part-time	137 (17.7)	104 (13.4)		
No	31 (4.0)	12 (1.6)		

[a]$p<0.05$

[b]$p<0.01$

Food intake

The mean total food intake was 744.4g (SD=295.2) in the group of left-behind children and 777.7g (SD=365.7) in the control group, and significant differences were found ($p<0.05$) (Table 3). The 20 food classes in the FFQ were grouped into four major food groups, including (*1*) cereals, (*2*) vegetables and fruits, (*3*) meat, fish, and eggs, and (*4*) milk and beans. The mean intake of cereals in the two study groups was 218.5g (SD=100.9) for the left-behind children and 217.2g (SD=105.6) for the control group. The mean intake of vegetables and fruits was 219.0g (SD=157.2) for the left-behind children and 233.3g (SD=242.9) for the control group. The mean intake of meat, fish, and eggs was 142.9g (SD=101.1) for the left-behind children and 157.0g (SD=135.9) for the control group. The mean intake of milk and beans was 163.9g (SD=177.5) for the left-behind children and 170.2g (SD=167.9) for the control group. In the four food groups, a significant difference was found between the two groups regarding the intake of meat, fish, and eggs ($p<0.05$).

Health status related to nutrition

As shown in Table 4, the mean WAZ score was −0.28 (SD=1.12) for left-behind children and −0.24 (SD=1.11) for the control group. The mean HAZ score was −0.24 (SD=1.87) for the left-behind children and −0.15 (SD=1.66) for the control group. There were no significant differences in WAZ and HAZ scores in the two study groups. The proportion of underweight children (WAZ <-2 SD) in the two groups was 4.5% and 4.0%, respectively, while 8.9% and 6.7% of children in the two groups, respectively, exhibited growth retardation (HAZ <-2 SD), both without significant difference. The prevalence of anemia was somewhat high in both study groups, and the situation of left-behind children was worse than for the control group (31.1% vs. 26.2%, $p<0.05$).

DISCUSSION

Left-behind children are a large and special population in the rural areas of China, particularly in poor areas, and their healthy development could benefit

Table 3. The daily food intake of each type of food (percentage of the total food intake) of left-behind children and children in the control group (in grams/day) in rural areas in China

	Left-behind children (percent)	*Control group (percent)*	T-*value*[a]	P-*value*
Cereals	Mean = 218.5±100.9 (30.6)	Mean = 217.2±105.6 (31.6)	0.252	0.801
Vegetables and fruits	Mean = 219.0±157.2 (28.6)	Mean = 233.3±242.9 (28.7)	−1.372	0.170
Meat, fish, and eggs	Mean = 142.9±101.1 (19.4)	Mean = 157.0±135.9 (19.8)	−2.321	0.021[b]
Milk and beans	Mean = 163.9±177.5 (21.1)	Mean = 170.2±167.9 (19.8)	−0.723	0.471
Total	Mean = 744.4±295.2	Mean = 777.7±365.7	−1.972	0.049[b]

[a]*t*-test

[b]$p<0.05$

Table 4. Z-scores of the left-behind children and children in the control group in rural areas in China

	Left-behind children (n=774) (percent)	*Control group (n=774) (percent)*	χ^2 *value*	P-*value*
Weight-for-age Z-scores				
Mean (SD)	0.28 (1.12)[a]	0.24 (1.11)[a]	−0.492[a]	0.622
<−2 SD	35 (4.50)	31 (4.00)	0.413	0.813
Height-for-age Z-scores				
Mean (SD)	0.24 (1.87)[a]	0.15 (1.66)[a]	0.303[a]	0.303
<−2 SD	69 (8.90)	52 (6.70)	2.591	0.107
Hemoglobin (g/L)	Mean = 112.90±7.35	Mean = 113.80±7.31	−2.670[a]	0.008[b]
Anemia				
Yes	241 (31.10)	203 (26.20)	4.560	0.033[c]
No	533 (69.90)	571 (73.80)		

[a]*t*-test

[b]$p<0.01$

[c]$p<0.05$

SD = standard deviation

g/L = grams/liter

millions of families and contribute to the harmonious advancement of rural areas. To some extent, the nutritional status of left-behind children reflects the comprehensive level of agricultural production, resources, environment, health services, and economic incomes of rural areas in China.

With the increasing intensity in social structure transformation and the urbanization process in China, more and more young adults are floating into cities, resulting in the problem of left-behind children. As a result, more attention should be paid to the status of care and nutrition among rural left-behind children.

In a current study, 90.0% of rural left-behind children lived with their grandparents, so the percentage of distant-generation upbringing is quite high. This number is consistent with reports by Duan and Liu, which show that 83.0% and 82.5% of left-behind children lived with their grandparents, respectively.[19,20] One study reported that children in kinship care included 59.0% fostered by grandparents, 19.0% by aunts and uncles, and 22.0% by other relatives in 2002 in the U.S.[4] So the percentage of left-behind children living with grandparents in China may be higher than in the U.S. Thus, it could be seen as a very common phenomenon in China for left-behind children to be raised by grandparents while the parent(s) is/are absent from home.

Many studies have suggested that grandparents wouldn't be good caregivers.[11–13] Our study shows that some left-behind children can get basic living care while their parent(s) is/are absent from home. For example, 78.7% of them received good attending in daily food care, and 78.3% had special attending. But there still exists a certain gap between the two groups; that is, the conditions of daily food care and special attending in left-behind children were both inferior to that in the control group (Table 2). The results are consistent with the findings of the investigation conducted by Ye, whose study discovered that the situations were relatively inferior in those left-behind children guarded by their grandparents.[21] There are several possible reasons. On the one hand, most guardians of left-behind children can't give deliberate attending and scientific management because of old age, valetudinarianism, limited education level, and a general lack of scientific knowledge of children's nutrition. On the other hand, most families of left-behind children were often in worse economic condition; while parent(s) is/are absent from home, they can't get special living expenses. So grandparents were not capable of taking the responsibility to look after the left-behind children wholeheartedly. What's more, the mother who is working out of her home may negatively influence the breastfeeding of left-behind children. In this study, the rate of breastfeeding of left-behind children (78.7%) was significantly lower than in the control group (82.8%); and the weaning age of left-behind children (9.48 months) was earlier than that in the control group (10.7 months).

It was found that the total food intake of left-behind children was less than that of the control group, the rates of growth retardation and low body weight were both higher than that of the control group even though there was no significance, and the prevalence of anemia was significantly higher than that of the control group. Thus, it could be seen that the nutrition level and health condition related to nutrition of left-behind children were both inferior to those in the control group.

Our finding was consistent with what was reported by Chen.[22] She pointed out that children who were not cared for by their mothers was an essential factor in the malnutrition of children younger than 5 years of age, so malnutrition may occur more frequently in children guarded by grandparents.

Nutritional status in childhood plays a basic, important role in a person's life.[23] Popkin reported that one-third of coronary heart diseases and one-tenth of diabetes and strokes in 1995 in China could be attributed to malnutrition in childhood. Meanwhile, low body weight and growth retardation in childhood could lead to reduced labor productivity in adults.[24] In short, the status of nutrition and health of left-behind children is not optimistic. The question now is how to further analyze the influential factors of nutrition and health of left-behind children. It should be a united effort coming from society (community), families (including parasitic families), and parents working out of home to create a good living environment for left-behind children.

Limitations

There are some limitations in our study. One, we only received information on 774 rural left-behind children younger than 7 years of age, so the comparison couldn't be conducted between the two groups of different ages. Also, the conclusion dependent on left-behind children younger than age 7 couldn't apply generally to children older than 7 years of age. And recalling deviation was unavoidable in the retrospective investigation of the diet of left-behind children.

CONCLUSION

This study demonstrates that it is necessary to improve the conditions of daily food and drink and special caregivers of left-behind children. In addition, the level of nutritional intake of left-behind children is relatively low, and their health status related to nutrition is not good. In conclusion, great concern is needed from society, and effective measures should be taken to improve the quality of life of rural left-behind children.

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