**Preplanned Studies**

# Inadequate Nutrition and Associated Factors in Children Aged 6 to 24 Months — 4 Counties, Liangshan Yi Autonomous Prefecture, China, 2018

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### Summary

#### What is already known about this topic?

Symptoms of malnutrition including anemia, stunting, wasting, and being underweight among children remained one of the major public health problems in poorer areas in China. More research is needed to guide interventions to improve nutrition and health among children in low-income regions.

#### What is added by this report?

The prevalences of anemia, stunting, wasting, and being underweight were 51.9%, 25.6%, 14.6%, and 9.5%, respectively, among children aged 6 to 24 months in the poorest areas of Liangshan. Associated factors were gender, age, education level and occupation of mother, breastfeeding, and caregiver knowledge.

#### What are the implications for public health practice?

Improving caregiver knowledge of nutrition and child feeding practices is crucial to address malnutrition among children. These findings can help more precisely understand the child health needs in poorer areas in order to develop effective interventions. They also provide evidence-based information to formulate child health promotion strategies in other countries with similar situations.

Child malnutrition is an important public health challenge worldwide. The World Health Organization (WHO) reports that globally around 45% of under five deaths are linked to malnutrition (*1*). Optimal nutrition for children aged 6 to 24 months has a long-lasting impact on individuals and families (*1*). China has made great progress in achieving better nutrition among children overall, but some lower-income areas require more effort to improve child nutrition (*2*). Since July 2017, China's National Health Commission cooperated with the Bill & Melinda Gates Foundation to implement the "Child Nutrition and Health Program" in the poorest areas of Liangshan Yi

Autonomous Prefecture, a provincial-level administrative division. In 2018, a baseline study was conducted to assess the nutritional status and associated factors among children aged 6 to 24 months in order to provide evidence-based information for further interventions. The prevalences of anemia, stunting, wasting, and being underweight were 51.9%, 25.6%, 14.6%, and 9.5%, respectively. Caregiver's knowledge was one of the significantly associated factors of child malnutrition. More effective approaches are required to deliver child health information efficiently to caregivers.

Health poverty alleviation programs have been launched as part of a national strategy to accelerate the development of impoverished areas towards building a more prosperous society by 2020. Liangshan has been covered by one of the government-funded health poverty alleviation programs that distributed soybean powder-based and iron-rich food supplements, also known as Ying Yang Bao (YYB), free to children aged 6 to 24 months since 2012 (*3*). YYB packages were recommended to be consumed at no less than four bags (12 g per bag) per week in order to decrease the prevalence of anemia. In close cooperation with the "Child Nutrition and Health Program", these programs aim to improve child nutrition and health in the poorest areas of Liangshan.

The baseline study used a stratified multiple-stage random sampling. First, 9 towns were randomly selected from the 4 lowest-income counties (Zhaojue, Yuexi, Meigu, and Butuo county) implementing "Child Nutrition and Health Program". Second, 3 villages were randomly selected from each of 9 towns. Third, using the child registration sheets from each village, children aged 6 to 24 months were divided into 3 age groups as 6 to 11 months, 12 to 17 months, and 18 to 24 months. Overall, 30% of the children were randomly selected from each age group, and 1,300 children aged 6 to 24 months were selected. Informed consent was obtained from a total of 1,244 caregivers. From April to July 2018, children and their caregivers

were invited to village health stations for physical measurements and face-to-face interviews performed by trained health workers.

Weight was measured in kilograms (kg) and to the nearest 0.05 kg; height was measured in centimeters (cm) and to the nearest 0.1 cm. Portable hemoglobin analyzers (URIT-12) were used to collect blood sample and to assess hemoglobin concentrations. According to WHO recommendations, stunting was defined at length-for-age z-score of more than 2 standard deviations (SD) below the median of reference population; being underweight was defined as weight-for-age z-score more than 2 SD below the median of reference population; anemia was diagnosed at hemoglobin levels <110 g/L. Adjustments to the measured hemoglobin concentrations had been made based on the altitude and adjusted cut-offs have been described elsewhere (4). According to the Technical Specification of Child Health Examine Services, wasting was defined as weight-for-length z-score more than 2 SD below the median of reference population. Caregivers were interviewed about personal information, YYB consumption, breastfeeding practices, and complementary feeding. Questions related to nutrition and child feeding practice were asked to assess caregivers' knowledge.

Chi-square analysis was performed to determine the differences in the prevalence of anemia, stunting, wasting, and being underweight across genders and age groups. Logistic regression analysis was performed to assess the association of factors. Statistical significance was defined as $p<0.05$, and SPSS software (version 23.0; IBM) was used to conduct all analyses.

Among 1,244 children aged 6 to 24 months, there was no significant difference in child's gender across age groups ($\chi^2$=3.590, $p$=0.166). The primary caregiver was the mother for 93.9% of children (Table 1), and 95.3% of the mothers were identified as being of the Yi ethnic group. Over 90% had completed up to primary education, and 61.3% were housewives.

The prevalence of anemia was 51.9%, which was significantly higher among girls (55.6%) than boys (48.3%) ($\chi^2$=7.078, $p<0.05$) (Table 2). With a decrease in age, the prevalence among children aged 6 to 11 months was the highest at 60.4% ($\chi^2$=24.116, $p<0.05$). The prevalence of stunting, wasting, and being underweight were 25.6%, 14.6% and 9.5%, respectively. No statistically significant differences were found between genders. The prevalence of being underweight was significantly highest among children aged 18 to 24 months ($\chi^2$=8.425, $p<0.05$).

TABLE 1. Demographic characteristics of children aged 6 to 24 months and their caregivers.

| Demographic characteristic | Total (n=1,244) | |
|---|---|---|
| | No. | Percentage (%) |
| Gender | | |
| Male | 627 | 50.4 |
| Female | 617 | 49.6 |
| Age (Month) | | |
| 6-11 | 454 | 36.5 |
| 12-17 | 387 | 31.1 |
| 18-24 | 403 | 32.4 |
| Primary caregiver | | |
| Mother | 1,144 | 93.9 |
| Father | 17 | 1.4 |
| Grandparents | 57 | 4.7 |
| Mother's ethnic group | | |
| Yi | 1,060 | 95.3 |
| Han | 50 | 4.5 |
| Zang | 2 | 0.2 |
| Mother's education level | | |
| Up to primary school | 1,020 | 91.6 |
| Middle school | 64 | 5.7 |
| High school and above | 30 | 2.7 |
| Mother's occupation | | |
| Housewife | 682 | 61.3 |
| Public institution staff | 27 | 2.4 |
| Farmer | 385 | 34.6 |
| Others | 19 | 1.7 |

Overall, 83.5% of caregivers knew YYB was beneficial to child health, and 73.4% of children had no less than four bags of YYB in previous one week. An estimated 96.2% of children had been breastfed, 23.7% of caregivers believed complementary foods should be added at 3 months of age, and 26.0% believed at 6 months of age. Most caregivers (54.6%) were aware of the most suitable complementary foods to be added first, and 28.5% of caregivers knew of iron-rich foods and 47.8% knew that anemia was related to iron deficiency.

The result of logistic regression analysis showed that gender, age, mother's education level and occupation, whether child had been breastfed, whether had been breastfed continuously after 6 months of age, whether the caregiver believed "complementary foods should be added at 6 months of age", "grain puree is the most suitable complementary food to be added first", "iron-rich foods include animal blood and red meat," and

TABLE 2. Prevalence of anemia, stunting, wasting, and being underweight across genders and age groups.

| Item | Total (n) | Anemia (n, %) | Stunting (n, %) | Underweight (n, %) | Wasting (n, %) |
|---|---|---|---|---|---|
| Gender | | | | | |
| Male | 627 | 303 (48.3) | 166 (26.5) | 64 (10.2) | 87 (13.9) |
| Female | 617 | 343 (55.6) | 153 (24.8) | 54 (8.8) | 95 (15.4) |
| $\chi^2$ | | 7.078 | 0.414 | 0.766 | 0.617 |
| $p$ value | | 0.008 | 0.520 | 0.381 | 0.432 |
| Age (Month) | | | | | |
| 6−11 | 454 | 274 (60.4) | 104 (22.9) | 39 (8.6) | 72 (15.9) |
| 12−17 | 387 | 197 (50.9) | 99 (25.6) | 27 (7.0) | 58 (15.0) |
| 18−24 | 403 | 175 (43.4) | 116 (28.8) | 52 (12.9) | 52 (12.9) |
| $\chi^2$ | | 24.116 | 3.660 | 8.425 | 1.756 |
| $p$ value | | 0.000 | 0.160 | 0.015 | 0.416 |
| Total | 1,244 | 646 (51.9) | 319 (25.6) | 118 (9.5) | 182 (14.6) |

"anemia is related to iron deficiency" were factors associated with anemia, stunting, wasting, and being underweight (Table 3).

## DISCUSSION

This study reports two major findings: 1) child malnutrition remains as a major public health issue in Liangshan with relatively higher prevalences of anemia, stunting, wasting, and being underweight; and 2) the associated factors of child malnutrition were gender, age, mother's education level and occupation, breastfeeding, and caregiver's knowledge.

Compared with other low-income areas in western China, the prevalence of anemia among children aged 6 to 24 months in the 4 counties of Liangshan in 2018 was lower than that of Qinghai Province (67.8%, 2012) and Guizhou Province (57.6%, 2013), but higher than that of Chongqing Municipality(51.7%, 2013) (2,5–6). The highest prevalence occurred during 6 to 11 months of age and then decreased with age. This result was consistent with a study conducted in 5 provinces in western China (2). The key period to start transitioning from breatfeading to family foods was from 6 months of age onwards (6). Inadequate complementary feeding might result in a higher risk of developing anemia among children after 6 months of age (6).

The prevalence of stunting and being underweight were 25.6% and 9.5%, respectively, which was lower than that among children under 3 years of age in poor areas in Sichuan Province in 2001 (25.9% and 15.9%, respectively) (7). However, the National Nutrition and Health Monitoring system reported in 2013 that the average prevalence of stunting and being underweight among children under 5 years of age in poor rural China were 19.0% and 5.1%, respectively (8). Studies reported a low diversity and frequency of child feeding in western China, which might contribute to a higher prevalence of stunting and anemia (2,5). Our results indicated that stunting, wasting, and being underweight shared same influencing factors, and preventive interventions such as promotion of and support for better breastfeeding and complementary feeding might have positive impacts on all of these conditions (9).

This study showed that over 70% of children had consumed YYB, but YYB could not replace high quality complementary food and was not enough independently to improve child nutrition. Our study found caregiver's knowledge of child feeding practices was one of the significant associated factors of child malnutrition, and health education was proven to be positively associated with better breastfeeding and complementary feeding (10). Health education has been integrated into child health services at different levels in China and has provided an effective platform to deliver child health information to caregivers. However, the percentage of caregivers knowing key information related to nutrition was still low in our study, ranging from 26.0% to 54.6%. This indicated that there were still gaps between senders (health workers) and recipients (caregivers) during the dissemination of health information. Context-based and need-oriented educational activities are needed to fill these gaps and adequately inform caregivers. Also, follow-ups are required to ensure that key information is understood by caregivers.

TABLE 3. Factors associated with anemia, stunting, wasting, and being underweight among children aged 6 to 24 months.

| Associated factors | OR (95% CI) | p value |
|---|---|---|
| **Anemia** | | |
| Age | 0.80 (0.67−0.96) | 0.015 |
| Mother's education level | 0.78 (0.65−0.92) | 0.004 |
| Caregiver believes complementary foods should be added at 3 months of age | 1.87 (1.35−2.60) | <0.001 |
| Caregiver knows grain puree is the most suitable complementary food to be added first | 2.34 (1.77−3.09) | <0.001 |
| Has been breastfed continuously after 6 months of age | 0.66 (0.49−0.89) | 0.007 |
| **Stunting** | | |
| Gender | 0.69 (0.51−0.94) | 0.019 |
| Age | 1.53 (1.24−1.88) | <0.001 |
| Mother's education level | 0.52 (0.39−0.68) | <0.001 |
| Mother's occupation | 0.93 (0.87−0.99) | 0.046 |
| Caregiver believes complementary foods should be added at 3 months of age | 1.98 (1.40−2.80) | <0.001 |
| Caregiver knows that iron−rich foods include animal blood and red meet | 0.41 (0.28−0.59) | <0.001 |
| Caregiver knows anemia is related to iron deficiency | 0.48 (0.34−0.67) | <0.001 |
| Has been breastfed | 2.69 (1.26−5.75) | 0.010 |
| Has been breastfed continuously after 6 months of age | 0.52 (0.35−0.74) | <0.001 |
| **Being Underweight** | | |
| Age | 1.45 (1.09−1.92) | 0.010 |
| Mother's occupation | 0.86 (0.77−0.96) | 0.005 |
| Caregiver believes complementary foods should be added at 3 months of age | 1.85 (1.18−2.91) | 0.008 |
| Caregiver knows that iron−rich foods include animal blood and red meet | 0.39 (0.23−0.67) | 0.001 |
| Has been breastfed continuously after 6 months of age | 0.42 (0.25−0.70) | 0.001 |
| **Wasting** | | |
| Mother's occupation | 0.89 (0.83−0.96) | 0.003 |
| Caregiver believes complementary foods should be added at 6 months of age | 1.60 (1.10−2.33) | 0.014 |
| Caregiver knows that iron−rich foods include animal blood and red meet | 1.46 (1.03−2.07) | 0.034 |

This study was subjected to some limitations. First, self-reported information on YYB consumption, practices of breastfeeding, and complementary feeding might have been subjected to recall and social desirability biases, which might affect the accuracy of the information provided. Second, other variables such as dietary patterns, illnesses, and sanitation might affect child nutritional status but were not assessed in this study.

China has launched the health poverty alleviation programs as part of the national strategy. Improving child health plays an important role and contributes to lifelong health. Despite the limitations, results of this study might help understand child health needs in Liangshan in order to develop precise interventions. These findings also provide evidence-based information to formulate child health promotion strategies in other countries with similar situations.

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