Cross-sectional Study

Prevalence of malnutrition and associated factors among children aged 6–24 months under poverty alleviation policy in Shanxi province, China: A cross-sectional study

Minli Zhang a,b,d, Nelbon Giloi b,* , Yang Shen c, Yan Yu c, M.Y. Aza Sherin d, Mei Ching Lim b

a College of Medicine, Xi’an International University, Xi’an, PR China
b Public Health Medicine Department, Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah, Malaysia
c School of Public Health, Health Science Center, Xi’an Jiao Tong University, PR China
d Universiti Sains Islam Malaysia, Malaysia

A R T I C L E   I N F O

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A B S T R A C T

Introduction: Child malnutrition continues to be a major public health issue, accounting for 54% of all child mortality globally. This study aimed to determine the prevalence of childhood malnutrition and its associated risk factors as well as to explore the best developmental strategy among infants and young children (IYC).

Methodology: This cross-sectional study was conducted six months after the distribution of nutritious Yin’GangBao (YYB). It involved children aged 6–24 months in Shaanxi Province, China. Data were collected via interviews with parents of IYC, followed by measurements of the children’s height and weight. Data were analyzed using Epilinfo software and SPSSv.26, which encompassed descriptive statistics, Pearson Chi-square, and multivariate logistic regression analysis. Ethics approval and parents’ informed consent were attained prior to the study.

Result: A total of 3431 data were analyzed in the study. The prevalence of stunting was highest among IYC between 12 and 18 months (3.9%). Prevalence of underweight (0.5%) and wasting (1.5%) were highest among IYC aged 18–24 months while the prevalence of overweight was highest among IYC aged 6–12 months (9.0%). Significant associating risk factors of malnutrition were IYC from Northern Shaanxi (aOR = 2.24; 95% CI:1.68–2.98) and mothers with parity ≥3 (aOR = 1.52; 95%CI:1.10–2.10). IYC with a higher educated father (aOR = 0.79; 95%CI:0.66–0.95), YYB intervention (aOR = 0.77; 95%CI:0.65–0.90), correct supplementary food time (aOR = 0.84; 95%CI:0.71–1.00) and separate supplementary food preparation (aOR = 0.79; 95% CI:0.66–0.95) were significantly associated with lower risk of malnutrition.

Conclusion: Even though the prevalence of stunting, underweight, and wasting were relatively low (<5%), there is still a need to strengthen existing policies on child nutrition.

1. Introduction

Even though malnutrition most often refers to undernutrition resulting from inadequate consumption, poor absorption, or excessive loss of nutrients, malnutrition also includes overnutrition. Underweight is a combined indicator of wasting and stunting, based on weight-for-age. It is recommended as a measure to monitor and evaluate the changes in the severity of malnutrition over time [1].

Childhood malnutrition continues to be the leading public health problem in developing countries. The effects of childhood malnutrition are long-lasting and persist to adulthood. For instance, malnutrition during early age decreases educational achievement, labor productivity, and raises the risk of chronic illnesses at later age [2]. The World Health Organization (WHO) estimates that malnutrition accounts for 54% of child mortality worldwide [3,4]. Childhood underweight accounts for 35% of all deaths worldwide for children under the age of five years [5–7]. Globally, around 1 to 2 million children die every year due to severe acute malnutrition and 20 million children live with severe acute malnutrition [8,9]. In fact, malnutrition is responsible for 60% of the 10.9 million deaths of children under 5 each year, either directly or

* Corresponding author. Public Health Medicine Department, Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah, Kota Kinabalu. 88400, Sabah, Malaysia.
E-mail address: nelbon.giloi@ums.edu.my (N. Giloi).

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indirectly [8,9]. Severe acute malnutrition (SAM) affects around 2% of children in developing countries. Over the past fifteen years, the malnutrition trend in Ethiopia has shown a reduction in stunting by 31% and underweight by 39% [10,11]. However, there was only a small decline from 12% to 9% in the prevalence of wasting over the last 15 years [12].

SAM was responsible for 24.8% of the under-five malnourished children in Bahir Dar town [12]. The prevalence of underweight and wasting was 29% and 10%, respectively [12]. In low- and middle-income countries, the prevalence of underweight is 16% in urban areas and 30% in rural areas [13]. In Timor-Leste, more than 12 million children under the age of five had SAM at some time or the other [13]. Children under one year of age typically have a higher risk of SAM [1-4]. Malnutrition is influenced by various factors including insufficient food consumption, chronic infections, psychosocial deprivation, unsanitary environment, poor cleanliness, inequality, possibly some hereditary contribution, and low income [15,16].

According to a study in Uganda, malnutrition was noted to be independently associated with cognitive impairment, older age, and perinatal feeding issues [17]. Besides that, stunting among children in China was associated with numerous risk factors including preterm birth, low birth weight, history of respiratory illnesses and diarrhea, low parental education, poor socioeconomic status, and parental employment as migrant workers [18].

The nutrition improvement project for children was carried out by China National Health in poverty-stricken areas. This project utilized the central finance to provide free nutritious food YingYangBao (YYB) to children aged 6–24 months, in an effort to prevent SAM among children in Shaanxi province in China, covering Southern Shaanxi, Northern Shaanxi, and Guan Zhong. The study was conducted in accordance with the declaration of Helsinki [19]. Ethical approval for the study was obtained from National Institute of Nutrition Improvement Projects in Poor Areas (Number: 2020–3) and reported according to the STROCSS criteria [19]. Eleven districts (comprising 109 towns) were selected from four cities. The sample districts were selected according to 20% of 56 project districts in the province, including districts that were specifically monitored under China’s poverty alleviation policy.

2. Materials and methods

2.1. Study setting

A cross-sectional study was conducted among children aged 6–24 months old in poverty-stricken areas in Shaanxi province in China, covering Southern Shaanxi, Northern Shaanxi, and Guan Zhong. The study was conducted in accordance with the declaration of Helsinki [19]. The study was registered in the Research Registry with Unique Identifying number 7893, and the link is https://www.researchregistry.com/browse-the-registry#home/registrationdetails/6278a8d96a9c23001eed3b06/) and reported according to the STROCSS criteria [19]. Eleven districts (comprising 109 towns) were selected from four cities.

2.2. Study population

The study population encompasses IYC between 6 and 24 months old. The sample size was determined according to the “Working Manual for Monitoring and Evaluation of Children’s Nutrition Improvement Projects in Poor Areas”, which was a combination of stratified and multi-stage proportional sampling. 360 children were needed per district, and further divided into 120 children per subgroups of 6–12 months old, 12–18 months old, and 18–24 months old respectively. Hence, the total number of samples required was 3960.

2.3. Data collection

Six months after the distribution of Ying Yang Bao (YYB), the assessment as implemented from 2020.09 to 2020.10. Trained maternal and child health officers conducted one-to-one interviews with parents or guardians of IYC. This included in-depth details about the questionnaire which covered general information, dietary habits, nutritional knowledge, and parents’ education level. Subsequently, measurement of the height and weight of the IYC were taken and recorded by the medical personnel in the questionnaire.

2.4. Statistical analysis

Statistical analysis was performed using EpiInfo software (version 3.1.1) and SPSS version 26.0. A description of the sampled participants was analyzed using univariate analysis and reported in terms of frequency and percentages. Pearson’s Chi-square test was performed to assess the association between categorical independent and dependent variables. The multiple logistic regression was used to generate the best-fitting and reasonable model, defining the association of the independent variables with the dependent variable (malnutrition status of children), and exploring the additional factors that influenced malnutrition. A p-value of <0.05 was considered statistically significant. The comprehensive model coefficient test results and Hosmer-Lemeshow (H&L) test showed that this regression model was meaningful, indicating a high degree of goodness of fit model.

2.5. Malnutrition indices

The dependent variable for this study was the malnutrition status of under 5-year-old children and was defined according to World Health Organization (WHO). Children whose height-for-age Z-score is below two standard deviations (−2 SD) from the median of the reference population are considered to be stunted. If the weight-for-age Z-score is below two standard deviations (−2 SD) from the median of the reference population then the child is underweight. Children whose weight for height Z-score is below two standard deviations (−2 SD) from the median of the reference population are considered as wasted (Tekile et al., 2019).

Ethical approval

Ethical approval for the study was obtained from National Institute for Nutrition and Health and the Chinese Center for Disease Control and Prevention, and from Health Center Science of Xi’an Jiao tong University (Number: 2020–1251). Approval was obtained from the Health Science Center of Xi’an Jiaotong University prior to the commencement of the study. Informed written consent was obtained from the IYC’s parents or guardians prior to their participation. The informed consent stated the purpose of the study, study confidentiality, and the voluntary right of participation in the study, as well as provided the assurance that no participant would suffer any harm as a result of his/her participation in the study.

3. Results

A total of 3960 questionnaires were collected throughout the study but only 3431 data were analyzed. In this study, 494 (29.3%) boys and 532 (30.5%) girls suffered from malnutrition. The stunting rate of IYC in Northern Shaanxi was 4.6%, followed by 3.1% in Southern Shaanxi and 1.0% in Guan Zhong. However, the proportion of overweight was more than 14% in Northern Shaanxi. In Guan Zhong area, the prevalence of underweight was less than 1% while the prevalence of overweight was 6.6%. The prevalence of underweight among IYC in the three regions accounted for less than 0.5% while prevalence for wasting was between 1% and 2%. Prevalence of stunting in IYC aged 12-18 month-age age
of malnutrition (aOR = 1.52; 95% CI:1.10–2.10) compared with those with mothers with parity less than 2.

On the other hand, supplementary food also affected the prevalence of malnutrition. IYC who took YYB, iron supplementation or other nutrients (aOR = 0.77; 95% CI:0.65–0.90), correct supplementary food time (aOR = 0.84; 95%CI:0.71–1.00) and separate supplementary food preparation (aOR = 0.79; 95%CI:0.66–0.95) were significantly associated with lower risk of malnutrition. Table 4 illustrates the multivariate logistic regression analysis of influencing factors of malnutrition.

### 4. Discussion

In developing countries, malnutrition among children is a major public health concern. It has an impact on all aspects of a child’s life, including their emotional, social and spiritual welfare in addition to their physical health [2]. Malnutrition increases the risk of adverse social, cognitive, and health outcomes, including the risk of mortality. Addressing food insecurity remains a challenge in many developing countries, leaving children with disabilities particularly vulnerable to malnutrition and its associated consequences [12].

According to the study’s findings, the prevalence of stunting in Northern Shaanxi decrease by 38.7%, from 7.5% in the same region in 2015 to 4.6% following YYB intervention in 2021. In addition, prevalence of stunting in Southern Shaanxi declined by 45.9%, from 5.8% in 2015 to 3.1% in 2021. However, the proportion of overweight increased by 20%. The prevalence of underweight and wasting noted a drastic decrease compared to 2015, from 10.7% to 1.3% and 4.9%–0.4% respectively in this study [18]. The differences of stunting for IYC between regions are statistically significant. It is considerably less than the prevalence of stunting, underweight, wasting in Iranian provinces in 2014, which were 12.4%, 10.5% and 7.8%, respectively [20]. SAM was affected by regional and national variances in about 18.1% and 35.9% of cases, respectively [21]. The prevalence of stunting was common in the Middle East and North Africa at 32% and in South Asia at 48% [22]. Additionally, a study found that 40% of children who suffered from stunting were under 42 months old [23].

Results of a study conducted in Indonesia on children under five showed that 38.4% and 18.4% of children suffered from stunting and severe stunting, respectively. The overall prevalence of malnutrition in this study was lower than global statistics. The prevalence of wasting, stunting and underweight in the world were 8, 25 and 15%, respectively on UNICEF’s annual report in 2014 [24]. The odds of an under 5 child developing SAM may increase by about 157% and 122% after moving to another neighborhood or another country [1-4]. This explained that severe malnutrition may be closely related to the area where infants and young children were located, which is similar to the results of this study.

The findings of this study provided evidence that malnourished IYC in the sampled population in Shaanxi province in China, were lower than five years ago. This was due to several interventions taken by the Chinese government and various development organizations. This study highlights the areas for future improvement of the nutritional status of 6-to-24 month-age children in China. This is closely related to the poverty alleviation policies of the Chinese government in the recent years. Under

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Table 1

| Regions              | N (%) | Stunting (N) | Not stunting (N) |
|----------------------|-------|--------------|-----------------|
|                      |       |              |                 |
| Northern Shaanxi     | 26 (4.6) | 542 (95.4) | 2 (0.4)         |
| Southern Shaanxi     | 70 (3.1) | 2169 (96.9) | 11 (0.5)        |
| Guan Zhong           | 6 (1.0)  | 618 (99.0)  | 2 (0.3)         |

According to age Group

| Age Group (months) | N (%) | Stunting (N) | Not stunting (N) |
|--------------------|-------|--------------|-----------------|
| 6-12m              | 22 (1.9) | 1117 (98.1) | 5 (0.4)         |
| 12-18m             | 44 (3.9) | 1081 (96.1) | 4 (0.4)         |
| 18-24m             | 36 (3.1) | 1131 (96.9) | 6 (0.5)         |

Table 2

| Regions              | N (%) | Stunting (N) | Not stunting (N) |
|----------------------|-------|--------------|-----------------|
|                      |       |              |                 |
| Northern Shaanxi     | 82 (14.4) | 486 (85.6) | 31.646 0.000 |
| Southern Shaanxi     | 168 (7.5) | 2071 (92.5) | 1.109 0.574 |
| Guan Zhong           | 41 (6.6)  | 583 (93.4)  | 1.00 0.4%   |
| 6-12 months          | 15 (1.3)  | 1037 (91.0) | 1.109 0.574 |
| 12-18 months         | 13 (1.2)  | 1112 (98.8) | 7.766 0.021 |
| 18-24 months         | 18 (1.5)  | 1149 (98.5) | 7.766 0.021 |

Table 3

| Regions              | N (%) | Stunting (N) | Not stunting (N) |
|----------------------|-------|--------------|-----------------|
|                      |       |              |                 |
| Northern Shaanxi     | 26 (4.6) | 542 (95.4) | 14.004 0.001 |
| Southern Shaanxi     | 70 (3.1) | 2169 (96.9) | 0.95 0.3%     |
| Guan Zhong           | 6 (1.0)  | 618 (99.0)  | 0.95 0.3%     |
| 6-12 months          | 22 (2.0)  | 1117 (98.1) | 7.766 0.021 |
| 12-18 months         | 44 (3.9) | 1081 (96.1) | 7.766 0.021 |
| 18-24 months         | 36 (3.1) | 1131 (96.9) | 7.766 0.021 |

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### 3.1. Univariate analyses

As the age increases, the percentage of malnutrition decreases. The prevalence of malnutrition among those aged 6–12 months was higher than the other age groups (p = 0.001). Similarly, malnutrition was prevalent among children from Northern Shaanxi (p < 0.01). The prevalence of malnutrition among IYC who were delivered via cesarean delivery was lower compared with IYC with vaginal delivery. Children who had history of premature birth were associated with malnutrition (p < 0.05). Children who were breastfed were less likely to have malnutrition, but no statistical difference noted (p > 0.05). As parity increases, proportion of malnutrition increases with statistical significance (p < 0.01). In addition, higher education level of children’s parents, higher family income and caregivers having more health education knowledge were associated with lower prevalence of children malnutrition (p < 0.01). IYC who took YYB and other nutrients were noted to have lower prevalence of malnutrition (p < 0.05). Univariate analysis are tabulated in Table 3.

### 3.2. Multivariate model

In order to estimate the relative contribution of each indicator variable related to malnutrition, Multivariate Logistic Regression Analysis was conducted. Compared to IYC in different regions, children in Northern Shaanxi were 2.2 times more likely to have malnutrition (aOR = 2.24; 95% CI: 1.68–2.98). In addition, children of father with higher education level (aOR = 0.79; 95% CI: 0.66–0.95) and mother with permanent jobs (aOR = 0.64; 95% CI: 0.50–0.83) were less likely to have malnutrition. IYC with mothers of parity 3 or more had a 1.5 higher odds of malnutrition (aOR = 1.52; 95% CI:1.10–2.10) compared with those with mothers with parity less than 2.
Table 3
Univariate analysis of malnutrition.

| Influencing factors         | Not Malnutrition | Malnutrition | χ²   | p    |
|-----------------------------|------------------|--------------|------|------|
|                             | n %              | n %          |      |      |
| Gender                      |                  |              |      |      |
| Male                        | 1191 70.7        | 494 29.3     | 0.543| 0.461|
| Female                      | 1214 69.5        | 532 30.5     |      |      |
| Birth weight                |                  |              |      |      |
| Underweight                 | 78 65.0          | 42 35.0      | 1.790| 0.409|
| Normal                      | 2187 70.4        | 938 30.0     |      |      |
| Overweight                  | 110 68.8         | 76 31.2      |      |      |
| Delivery method             |                  |              |      |      |
| Natural delivery            | 1355 69.8        | 574 30.2     | 0.036| 0.850|
| Caesarean section           | 1060 70.1        | 442 29.4     |      |      |
| Is it premature?            |                  |              |      |      |
| Yes                         | 97 61.6          | 48 38.4      | 4.145| 0.042*|
| No                          | 2326 70.1        | 960 29.9     |      |      |
| Month-age groups            |                  |              |      |      |
| 6-12                        | 758 66.6         | 381 33.4     | 14.795| 0.001*|
| 12-18                       | 785 69.8         | 340 30.2     |      |      |
| 18-24                       | 862 73.9         | 305 26.1     |      |      |
| Parity                      |                  |              |      |      |
| 1                           | 1075 73.2        | 415 26.8     | 23.623| <0.001*|
| 2                           | 1151 69.6        | 523 30.4     |      |      |
| >3                          | 147 58.8         | 120 41.2     |      |      |
| Region                      |                  |              |      |      |
| Guan Zhong                  | 478 76.6         | 146 23.4     | 63.994| <0.001*|
| Northern Shaanxi            | 222 56.7         | 240 43.3     |      |      |
| Southern Shaanxi            | 1605 71.7        | 634 28.3     |      |      |
| Mother’s education          |                  |              |      |      |
| Primary and below           | 192 62.7         | 114 37.3     | 21.173| <0.001*|
| Junior                      | 1173 68.2        | 547 31.8     |      |      |
| High level and above        | 1040 74.0        | 365 26.0     |      |      |
| Mother profession           |                  |              |      |      |
| Housework                   | 1900 65.4        | 576 34.6     | 36.880| <0.001*|
| Permanent job               | 449 77.3         | 132 22.7     |      |      |
| Farmer/Migrant/Workers/Others| 866 73.1       | 318 26.9     |      |      |
| Father’s education          |                  |              |      |      |
| Primary and below           | 168 62.9         | 99 37.1      | 24.707| <0.001*|
| Junior                      | 1158 67.6        | 556 32.4     |      |      |
| High level and above        | 1079 74.4        | 371 25.6     |      |      |
| Father profession           |                  |              |      |      |
| Housework                   | 171 66.5         | 99 33.5      | 3.557| 0.169|
| Permanent job               | 769 72.1         | 298 27.9     |      |      |
| Farmer/Migrant/Workers/Others| 1519 69.4       | 669 30.6     |      |      |
| Caregivers                  |                  |              |      |      |
| Parents                     | 1763 68.8        | 801 31.2     | 11.527| 0.003*|
| Grandparents                | 595 74.8         | 200 25.2     |      |      |
| Others                      | 47 65.3          | 25 34.7      |      |      |
| Caregiver’s education       |                  |              |      |      |
| Primary and below           | 452 67.7         | 216 32.3     | 9.425| 0.009*|
| Junior                      | 1184 68.9        | 535 31.1     |      |      |
| High level and above        | 769 73.7         | 275 26.3     |      |      |
| Caregiver profession        |                  |              |      |      |
| Housework                   | 1387 67.2        | 678 32.8     | 24.105| <0.001*|
| Permanent job               | 262 78.2         | 73 21.8      |      |      |
| Farmer/Migrant/Workers/Others| 756 73.3       | 275 26.7     |      |      |
| Family income               |                  |              |      |      |
| ≤30 k                       | 763 67.1         | 403 32.9     | 6.011| 0.049*|
| 30 k–50 k                   | 838 70.8         | 363 29.2     |      |      |
| >50 k                       | 764 71.7         | 300 28.3     |      |      |
| Is supplementary food made separately? |          |              |      |      |
| No                          | 690 67.4         | 333 32.6     | 4.874| 0.027*|
| Yes                         | 1715 71.2        | 693 28.8     |      |      |
| Whether breastfeeding after birth |             |              |      |      |
| No                          | 251 66.1         | 129 33.9     | 3.333| 0.068|
| Yes                         | 2154 70.6        | 897 29.4     |      |      |
| Whether to take YBY         |                  |              |      |      |
| Yes                         | 945 67.7         | 451 32.3     | 6.483| 0.011*|
| No                          | 1460 71.7        | 575 28.3     |      |      |
| The right time to add complementary food |          |              |      |      |
| Wrong                       | 842 67.4         | 407 32.6     | 6.741| 0.009*|
| Correct                     | 1563 71.6        | 619 28.4     |      |      |

*Statistically significant if p-value < 0.05.

Table 3 (continued)

| Influencing factors         | Not Malnutrition | Malnutrition | χ²   | p    |
|-----------------------------|------------------|--------------|------|------|
|                             | n %              | n %          |      |      |
| Which nutrients are lacking on anaemia |                  |              |      |      |
| Wrong                       | 725 67.5         | 349 32.5     | 5.009| 0.025*|

B = beta coefficient, S. E. = standard error, OR = odds ratio, CI = confidence interval.

The promotion of the whole society’s health industry, the health of infants and young children has been highly valued by the government, and the nutrition package intervention project in poverty-stricken areas has been successfully carried out.

From the results, this intervention was noted to be effective and promote the overall health of local infants and young children, exceeding our expected target. The current problem is that the overweight rate of infants and young children has also increased. Given that there is a statistically significant difference between northern Shaanxi and southern Shaanxi, analysis of the reasons may be related to better living conditions or local living habits. Further analysis on the dietary structure of local IYC as well as contributing factors of overweight are crucial to provide an objective theoretical basis for further intervention measures.

The prevalence of malnutrition is also statistically significant.
according to age group (p < 0.05). Infants aged 6–12 months had a lower prevalence of stunting than infants aged 12–18 months. The prevalence of stunting among the 18–24 months IYC was in between the other two groups, while the prevalence of underweight was higher among the 18–24 months. Nevertheless, these findings were lower than five years ago, and the trend of change was consistent with the results of previous studies [18,28]. The possible reasons were related to the intervention measures in recent years, which include weaning time, type, and quality of supplementary food being added in the diet of IYC. It is vital to further explore the dietary combination of IYC, particularly on supplementary food addition to determine the reasons of changes in various age groups.

Previous study indicated that the risk factors of severe acute malnutrition were large family size, low income, higher number of siblings as well as living conditions like types of house, open air defecation and inappropriate IYC feeding practices [25]. Other factors associated with child malnutrition include parents’ education level, wealth index, mother’s BMI, division, antenatal care service during pregnancy, birth interval of children and low birth weight [26]. After the age of six months, underweight and wasting in the children might be caused by improper supplemental feeding and food use techniques [27]. In addition, toxicant exposures may worsen the micronutrient status, especially during the womb-to-childhood development, and increase the risk of health disorders in adulthood [28].

Multivariate Logistic Regression analysis revealed that preparing supplementary food separately was associated with decreased odds of malnutrition (OR = 0.79; 95% CI:0.66–0.95). Parents with lower education degree can be considered as contributing factors to the prevalence of malnutrition, which is consistent with previous study [29]. IYC in Northern Shaanxi were more likely to be malnourished, which is attributed to poor geographical environment, significant temperature difference, increased wind intensity and less vegetation. On the other hand, despite having relatively good climate conditions, with mountains and water, suitable temperature and humidity, Southern Shaanxi’s economy is underdeveloped and there is limited access to information. Guan Zhong has good economic conditions but more serious pollution. Therefore, malnutrition has a certain association with geographical environment, economic conditions and air pollution factors. Additionally, it is important to focus on improving the environment by planting more trees, raising awareness of nutrition and hygiene among parents, and taking action to lessen environmental pollution along with nutritional supplement therapies.

Pro-urban inequalities were mostly affected by neighborhood socioeconomic status and wealth index which were related to SAM among under-five children [13]. The univariable analysis and multivariate model used in the study were based on the identified factors associated with malnutrition. Among the risk factors for malnutrition, the parents’ occupation, educational background and family income were consistent with previous studies [12,13]. According to the analysis of this study, parents who were more educated and affluent, were in a better position to have access to knowledge and information that could improve their decision making in providing adequate and sufficient nutritious foods to their children.

Besides, the higher propensity of the better-off parents to use health care services and more knowledge from internet could reduce the risk of malnutrition among their children. From this study, additional risk factors which included month-age, regions, parity, whether to make supplemental food separately, whether to take YBY and other nutrients, whether to add complementary food for IYC at the right time, were closely related to malnutrition. Therefore, caregivers should be encouraged to prepare separate foods for IYC in accordance with the requirements of nutritious diet and the physiological needs of IYC of different month-age groups. Food additives and junk food that not only have contribute to weight gain but also no nutritional value should be avoided. To achieve this goal, guardians and parents need to receive adequate nutritional and health education lectures, either via face-to-face or online training. In the meantime, further analysis on the dietary structure of IYC is necessary to determine the root cause of the problem so that implementation of targeted and comprehensive intervention measures can be carried out to prevent or minimize the occurrence of malnutrition in IYC.

Among the limitations noted was no baseline data were collected prior to the YYB intervention due to the impact of corona virus pandemic. Hence, no direct comparison for pre-and post intervention was available. Data were only compared from older statistics in 2015. Besides that, many forms with missing data were discarded.

5. Conclusion

The prevalence of stunting, underweight and wasting was reduced greatly under China’s poverty alleviation policy and the implementation of the nutrition project intervention. Unfortunately, prevalence of overweight among IYC is on the rise. There is a necessity to strengthen as well as advocating existing child nutrition policies and to reinforce public health prevention strategies targeted at children in poverty areas. Besides that, it is crucial to analyze IYC’s dietary structure to explore the contributing factors identified in the present study which may assist in explaining the disparities in malnutrition and potential risk factors among 6–24 month-age children residing in high-risk places. In the future, follow-up surveys on IYC need to be conducted particularly those who underwent nutritional intervention. This approach is vital to evaluate the effectiveness of the program as well as to provide source of references for the implementation of projects in other provinces, and to strive to achieve the ultimate goal of improving the malnutrition of children in poverty-stricken areas of China.

Ethical approval

Ethical approval for the study was obtained from National Institute for Nutrition and Health and the Chinese Center for Disease Control and Prevention, and from Health Center Science of Xi’an Jiao tong University (Number: 2020–1251).

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Author contribution

Minli Zhang was involved in the study design, carried out the data collection, conducted the statistical analysis and interpretation as well as drafted the manuscript. Nelbon Giloi supervised the study design, reviewed the analysis, and facilitated the manuscript writing Yang Shen, Yan Yu, and Aza Sherin M.Y were involved in designing the concept of the study. Mei Ching Lim facilitated in writing the manuscript. All authors agreed and approved the final version for publication.

Registration of research studies

Name of the registry: Research Registry.

Unique Identifying number or registration ID: researchregistry7893.

Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.researchregistry.com/browse-the-registry#home/registrationdetails/6278a8d969a9c23001edd3b06/
Declaration of competing interest

which was a great financial support for the study. We are appreciative to all the parents who agreed to participate and giving us their utmost assurance that no participant suffered any harm as a result of his/her participation in the study.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104317.

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