

Dietary Intakes and Nutritional Status Among Migrant Children in Primary Schools: A Cross-Sectional Study

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Research

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Abstract

Background: Nutrition plays a crucial role in children's growth and development, migrant children have their own characteristics in nutrition. The current study aims to assess the dietary status of migrant school-age children and underlying factors.

Methods: A cross-sectional survey was carried out on migrant children in 25 classes with the 3rd to 6th grades from two primary schools by cluster sampling. Children's 3-day 24-hour diet were recorded, the dietary intake of calories and nutrients were calculated by using the China Food Composition for each day, and were presented the average intake of the 3 day period. The assessment of energy and nutrient intakes by estimated energy requirement (EER) and estimated average requirement (EAR), respectively. The Dietary Guidelines for Chinese Residents and Chinese Dietary Reference Intakes were used as evaluation standards to assess the dietary intakes and nutritional status of these children.

Results: Participants included 752 migrant children aged 9-12y (430 boys and 322 girls). Deficiency proportions of energy and protein were 46.1% and 40.1% for boys, 44.4% and 65.1% for girls. Energy supply proportions of macronutrients (protein, fat, and carbohydrate) in boys were 12.4%–28.8%–58.8%, those of girls were 11.1%–28.6%–60.3%. The insufficiency proportions of vitamin A, B vitamins, calcium, zinc and selenium were considerably serious (>60%). In dietary pattern, intakes of cereal, poultry and edible oil were relatively adequate, but milk, fish, eggs and soybean products were seriously inadequate.

Conclusions: Characteristics such as unreasonable dietary pattern, relative lack of energy and nutrients, and excess snack intake coexist, it is necessary to carry out nutrition intervention to help migrant children to balance the diet and rectify the deficiencies.

Background

According to the official documents of the state education commission, migrant children were defined as the children aged 6-16y, achieving the mandatory age for compulsory education, and living in a place, rather than registered permanent residence for at least 6 months [1]. The parents of these children are usually rural labours who flock to big cities in search of employment opportunities and a better life.

The nutritional status of Chinese children has steadily improved in the last few decades [2]. Although a remarkable improvement of childhood nutrition in China has been achieved, there remains considerable malnutrition among children in some regions and subpopulations [3]. Migrant children is one of the special populations, without local registered residence, they faced with different health challenges compared with the local populations, such as adverse social conditions, lack of access to social services and increased exposure to health risks [4]. The number of migrant children has increased dramatically within last few decades, and it is anticipated to grow continuing. According to Chinese sixth census data, it showed that the number of migrant children aged 0–17 years old was 35.81 million, including 22.91 million migrant children who under the age of 15 years old [5].

Migrant children in China may have their own characteristics in nutrition. They followed their parents to the city, most migrant children's parents are engaged in labor-intensive careers and are busy with their livelihood all year round, which makes them unable to take good care of their children's life [6]. At the same time, the economic conditions and the food supply of most migrant children are relatively better than that of rural left-behind children. As a result, their situation may be more complex, some children maybe under-nutrition with resulting from a lack of life care, while others maybe easily get overweight or obesity due to improved economic condition, easily food availability and lacking of discipline from their busy parents [7].

In foreign countries, especially developed countries, migrant children mainly refer to the children of immigrants or seasonal farmworkers, among them, the children of seasonal workers have much common with migrant children in China [8]. A comparison of the nutritional status of migrant children in north Africa with that of native European children shows that the risk of overweight and obesity among migrant children is much higher than that of local children [9]. As a large immigrant country, the United States also faces high detection rate of malnutrition, dental caries, parasitic diseases and other diseases of the children of immigrants and seasonal farmworkers [10]. Meanwhile, quiet a few studies indicate migrant children have overweight and obesity rates exceeding other children [11]. Some researchers think such results are related to the poor diet quality due to economic constraints, migratory lifestyle, and others [12].

The literature demonstrates that studies of migrant children in China are focused on the psychology, education, immunization, et al. [13–16]. Few studies have focused on the nutritional status. Sporadic studies have been done on the health of migrant children but mostly just data analysis on physical development, some results indicated that there is a significant gap between migrant children and local children, the prevalence rates of underweight, stunting and wasting of migrant children were higher than that of local children [17, 18]; some studies have shown that the problem of overweight and obesity in migrant children became severe [19, 20]. However, the research focus on the nutrition intake of migrant school-children has not been reported.

Therefore the aim of the current study was to assess the dietary status of migrant school-age children and underlying factors. A cross-sectional survey was carried out on migrant children in 25 classes with the 3rd to 6th grades from two primary schools in Wuhan city, Hubei province of China in April 2016. The results may contribute to future intervention policy in this population on malnutrition prevention.

Methods

Participants

In this article, when we refer to migrant children, we focus mainly on children aged between 9 and 12. 25 classes of two primary schools were selected by cluster sampling in Hongshan district of Wuhan city. They are both public schools, which are equal in teaching facilities and teacher resources. Through previous interview of the responsible person of the schools, we knew that children's breakfast and lunch

were provided by schools, and dinner was provided by their parents. Given the cognitive limits of younger students, we only selected pupils between the grades of 3rd to 6th. A total of 1099 pupils signed the informed form and took part in this survey, after excluded local children and some cases with incomplete data, 752 migrant children's data were received.

Dietary survey

Dietary survey was carried out in two primary schools in April 2016. The survey team consisted of teachers and students from Wuhan University of Science and Technology. All investigators were trained systematically and were familiar with the essentials and procedures of the dietary review method. For three consecutive schooldays, investigators went into the classroom after lunch, conducted dietary survey with the help of the class teacher. Every class had 2 investigators who worked together, in addition, there were 2 supervisors in charge of the whole scene. Firstly, every student was distributed a dietary record form and a diagram. Then, investigators instructed the children to fill out the form one by one. Finally, data of the name, volume (cup, bottle, bag et. al.), amount (bowl, dish, piece, et. al.) and meal location (school, home, restaurant etc.) of various types of food which they ate at the last 24 hours were collect under the help of class teacher. After handed in, the forms were checked by the investigators, if the questionnaire isn't fully completed or the student failed to recall the diet, the investigators will use one-to-one guided questioning to assist the students to fill the questionnaire as complete as possible. The estimate of food weight was referred to a *retrospective dietary survey map*, which was developed by Wang ZX of Nanjing Medical University [21].

Evaluation criterion

The standards of the intakes of energy and nutrients were evaluated according to *Chinese Dietary Reference Intakes (DRIs, WS/T 578.1–2017)* [22]. Energy intakes were evaluated according to estimated energy requirement (EER), while nutrients were according to estimated average requirement (EAR). In view of pupils spent most time in the class, the meditation time is long, a light physical activity level (PAL) was chosen. When the daily energy was greater than or equal to 90% EER showed that the individual consumed "sufficient" while less than 90% EER indicated that the individual intake was "insufficient". As for protein, individual consumed less than EAR will be regarded as "insufficient". The evaluation standard of food intake is the lower limit of each kind of food in *Dietary Guidelines for Chinese Residents 2016* [23], when the intakes reached the minimum value showed that the individual consumed "sufficient".

Children's weight and height were obtained from the data of physical examination made by Wuhan ChangeDong Hospital. Height was measured with a precision of 0.1 cm and weight was measured with a precision of 0.1 kg. Children's Body Mass Index (BMI) was calculated, the overweight and obesity was defined according to the BMI cutoffs points on the Screening For Overweight And Obesity Among School-age Children And Adolescents (WS/T586–2018) [24].

Wasting screening was based on the Screening Standard For Malnutrition Of School-age Children And Adolescents (WS/T456-2014) [25].

Data analysis

The nutrients database were established by Microsoft excel 2010, the dietary intake of calories and nutrients for each day were calculated by using the *China Food Composition 2004*, and were presented the average intake of the 3 day period. Mean value \pm standard deviation or percentage were used to describe the baseline characteristics and dietary intakes of participants. Median and interquartile range were used to describe the data that was not normally distributed. As data was normally distributed, the comparison of the mean between the two groups adopted t test. Data were processed and analyzed using IBM SPSS Statistics software package, version 26.0. A *P* value < 0.05 was considered statistically significant.

Results

Socio-demographic characteristics of the respondents

Table 1 shows the socio-demographic characteristics of the studied children. Excluding 347 unqualified children, a total of 752 migrant children were investigated, including 430 boys and 322 girls. The number of children in each age group is in the range of 20%~30%. The participants included 285 (37.9%) only children and 467 (62.1%) non-only children. The educational levels of migrant children's parents were generally low. Only a few parents have a college degree, most parents only have a junior or high school diploma. 6.5% of the children were wasting and more than 20% of them were overweight or obese.

Table 1
Socio-demographic characteristics of the respondents

characteristic	n	%
Gender		
Male	430	57.2
Female	322	42.8
Age		
9~	166	22.1
10~	209	27.8
11~	192	25.5
12~	185	24.6
Only child ^a		
Yes	285	37.9
No	467	62.1
Father's educational level		
Primary school or below	52	6.9
Junior high school	408	54.3
Senior high school	236	31.4
University or above	56	7.4
Mother's educational level		
Primary school or below	173	23.0
Junior high school	344	45.7
Senior high school	198	26.3
University or above	37	5.0
Weight status		
Underweight	49	6.5
Normal	540	71.8
Overweight	97	12.9

^a Children who have no brothers or sisters

characteristic	n	%
Obesity	66	8.8
^a Children who have no brothers or sisters		

Intakes and proportions of energy supply of macronutrient

The average intakes of energy, protein, fat, and carbohydrate were 1796.0 kcal, 53.1 g, 54.6 g, and 251.0 g for boys; 1699.2 kcal, 47.2 g, 53.8 g, and 255.4 g for girls. The proportion of high-quality protein (the protein founded in animal foods and soybeans) of boys and girls were 43.3% and 32.2%, respectively. Inadequate proportions of energy and protein were 46.1% and 40.1% for boys, 44.4% and 65.1% for girls. The proportions of energy supply from macronutrients (protein, fat, and carbohydrate) in boys were 12.4%, 28.8%, and 58.8%, in girls were 11.1%, 28.6%, and 60.3%, compared to the recommended values (protein 13%~15%, fat 20%~30%, and carbohydrate 55%~65%), the energy from protein was lower (Table 2).

Table 2
Average intakes of macronutrient and proportions of energy supply in boys and girls.

Macronutrients	Mean \pm SD	P25 ^a	P75 ^a	Number of less than 90% of EER/EAR(%) ^b	Proportions of energy supply (mean \pm SD)
Boys (n = 430)					
Food energy (kcal)	1796.0 \pm 248.4	1613.4	1948.9	199(46.3)	—
Protein (g)	53.1 \pm 9.1	46.6	58.6	173(40.2)	12.4 \pm 1.2
Fat (g)	54.6 \pm 9.5	48.0	59.7	—	28.8 \pm 3.4
carbohydrate (g)	251.0 \pm 37.1	222.0	276.7	—	58.8 \pm 3.6
Girls (n = 322)					
Food energy (kcal)	1699.2 \pm 245.7	1513.5	1864.9	142(44.1)	—
Protein (g)	47.2 \pm 8.8	40.6	53.4	208(64.6)	11.1 \pm 1.2
Fat (g)	53.8 \pm 10.0	46.8	58.8	—	28.6 \pm 3.7
carbohydrate (g)	255.4 \pm 37.6	228.8	281.4	—	60.3 \pm 3.9
^a Interquartile range, it was used to describe the tendency of dispersion for the dietary data was disperse.					
^b EER = estimated energy requirement; EAR = estimated average requirement.					

Energy distribution ratios of three meals and snacks

For boys, energy distribution ratios of breakfast, lunch, supper, and snacks were 23.2%, 32.0%, 36.3%, and 8.5%, respectively; for girls, those were 22.7%, 32.8%, 34.7%, and 9.8%, respectively. Energy ratios of breakfast were all less than the lower limit of recommendation with no statistically difference between boys and girls. There were statistically significant differences in the proportions of energy from lunch, supper and snacks among genders. The energy intakes from lunch were close to the lower limit of the recommendation, while energy intakes from supper were close to or exceed the upper limit of the recommendation. The energy intakes from snacks of girls' was higher than that of boys', and the difference was statistically significant (Table 3).

Table 3
Energy distribution ratios of three meals and snacks between different genders.

Meals	Recommendation (%)	Boys (n = 430)	Girls (n = 322)	t	P
Breakfast	25 ~ 30	23.2 ± 4.2	22.7 ± 3.9	1.801	0.072
Lunch	30 ~ 40	32.0 ± 4.2	32.8 ± 4.3	3.225	0.001
Supper	30 ~ 35	36.3 ± 4.5	34.7 ± 4.5	6.072	0.001
Snacks		8.5 ± 5.7	9.8 ± 5.8	3.691	0.001

Intakes of micronutrients

Table 4 shows intakes of micronutrients of the study participants. In terms of vitamins, the proportions of insufficiency of vitamin A, vitamin B1, vitamin B2, vitamin B3, and vitamin C were relatively high (47.9%-89.8%), among which, vitamin B1 is the most insufficient, followed by vitamin B2. In terms of mineral, the situation of the insufficiency of calcium was more worse, and followed by the zinc and selenium. The situation of iron is relatively good, the proportion of insufficiency for boys and girls were 25.9% and 28.1%. But the vast majority of iron came from non-heme iron, the proportions of heme-iron were relatively low (12.6% for boys and 12.2% for girls, data is not provided in the results).

Table 4
Average intakes of micronutrients between different genders.

Micronutrients	Boys (n=430)		Girls (n=322)			
	Mean±SD	less than EAR		Mean±SD	less than EAR	
		n	%		n	%
Vitamin A (ugRE)	443.4±227.7	261	60.7	490.7±206.9	153	47.5
Vitamin B1 (mg)	0.5±0.1	351	81.6	0.5±0.1	287	89.1
Vitamin B2 (mg)	0.7±0.2	333	77.4	0.7±0.2	242	75.2
Vitamin B3 (mg)	8.4±4.0	263	61.2	8.5±3.9	182	56.5
Vitamin C (mg)	53.8±20.7	271	63.0	60.5±26.6	163	50.6
Calcium (mg)	218.2±15.8	430	100.0	242.0±23.5	319	99.1
Iron (mg)	12.9±2.9	112	26.0	13.1±3.4	90	28.0
Zinc (mg)	5.4±2.1	300	69.8	5.4±1.9	211	65.5
selenium (ug)	34.6±7.3	308	71.6	33.2±6.2	238	73.9

Food intakes

The results of food intakes of boys and girls were presented in Table 5. Except cereals, meat and oil, the rest of the food intakes were all not meet the recommendation. The shortage of milk, fish and beans are particularly serious. The consumptions of cereals, vegetables, fruits and milk of girls were more than that of boys, however, the intakes of meats and oils were opposite.

Table 5
Average intakes of food between different genders.

Category	Recommendation	Boys (n = 430)			Girls (n = 322)		
		Mean \pm SD/M ^a	P25 ^b	P75 ^b	Mean \pm SD/M ^a	P25 ^b	P75 ^b
Cereal (g)	250 ~ 400	277.2 \pm 47.8	240.0	307.1	280.2 \pm 49.5	240.0	310.0
Vegetables (g)	300 ~ 500	167.9 \pm 40.1	137.9	186.7	184.9 \pm 47.0	150.0	206.7
Fruits (g)	200 ~ 350	147.5	60.0	259.5	160.0	84.2	257.7
Meat (g)	40 ~ 75	52.8 \pm 18.5	33.1	66.7	45.8 \pm 13.3	28.3	58.3
Shrimp (g)	40 ~ 75	10.0	0.0	23.3	10.0	0.0	21.4
Egg(g)	40 ~ 50	15.0	0.0	30.0	15.0	0.0	30.0
Soybeans and nuts (g)	25 ~ 35	6.7	0.0	16.7	6.7	0.0	16.7
Milk and dairy products (g)	300	0.0	0.0	133.3	66.7	0.0	150.0
Oil (g)	25 ~ 30	28.4 \pm 6.0	22.4	35.8	24.0 \pm 5.3	22.2	31.5
^a Median, it was used to describe the central tendency for the data was not normally distributed.							
^b Interquartile range, it was used to describe the tendency of dispersion.							

Discussions

Our study provides a insight about the dietary intakes and nutrition status of the migrant children in Wuhan and other cities with similar economic level to Wuhan. Overall, the subjects in the present study confirms the characteristics what we assumed. Migrant children's parents were generally with lower education levels, most parents only have a junior or high school diploma. Most migrant child was not the only child in the family. There is a higher incidence of overweight and obesity among them. In 2015, the overweight rate of children aged 6 ~ 17 in China was 9.6%, and the obesity rate was 6.4% [26], while in the current study, 12.9% of children are overweight and 8.8% are obese, which is higher than the general level. The prevalence of wasting among these children was 6.5%, which was lower than the detection rate of

9.2% for school-age children aged 7 ~ 18 in 2014 Chinese National Surveys on Students Constitution and Health [27]. So the results confirms what we assumed that migrant children maybe easily get overweight or obesity due to improved economic condition, easily food availability and lacking of discipline from their busy parents.

Insufficient energy intake and unreasonable energy distribution

In terms of energy intake, 46.1% of boys and 44.4% of girls didn't meet the recommendation. It may be related to the inadequate amount of food intake. China Society of Nutrition recommend the proportions of energy supply from three macronutrients were 13%~15% from protein, 25%~30% from fat, 55%~65% from carbohydrate for the school-aged children. While the present study indicated that the energy from protein was relatively low (11.1% for girls, 12.4% for boys), but the energy from fat was slightly higher, which was similar to Yang's results [28]. Intakes of animal and soybean protein (32.2% for girls, 43.3% for boys) were lower than that of Zhu's research [29]. With regard to food choice, respondents consumed fewer food of animal protein, such as fish, shrimp and eggs, while oil consumption was exceed, it suggested that schools and parents should moderately increase protein-rich food and reduce the use of cooking oil for pupils.

Unreasonable energy supply proportion of three meals and snacks

The Chinese Society of Nutrition recommends that the proportions of energy supplied by breakfast, lunch, and dinner for children are 25%-30%, 30%-40%, and 30%-35%, respectively [30]. In the present study, the proportion of breakfast were lower than the recommendation value, while the proportion of supper were higher than that. This could be because that some children has the habit of skipping breakfast. On the field investigation, we found that some of the children said they didn't eat anything at morning. In view of the frequent occurrence of the phenomenon, teachers should take action to promote the habit of breakfast consumption and increase awareness of nutritional quality of school breakfast programs [31]. The vast majority of children eat supper at home, compare to the insipid meals in school canteens, the food prepared by parents are much more diverse and suit their taste, so children are prone to overeating. The results also confirmed that the energy proportion of dinner was over the recommended value. On the one hand, parents should pay attention to change the unreasonable eating regimen, and guide kids to eat more at breakfast and lunch but less at dinner. On the other hand, the school should make lunches more palatable under the conduction of a professional dietitian.

Snacks are an unavoidable part in children's diet [32]. However, there are two extreme phenomena in public awareness of snacks. Some parents believe that children should not eat any snacks [33], while some other parents let their children indulge in snacks [34]. In view of above two misconceptions, "Guidelines on snacks for Chinese children and adolescents (GSCCAs)" [35] classified snacks into three ranks: rank 1 included snacks that were suitable for regular consumption, such as yogurts, fruits, soybeans and

sweet potatoes; rank 2 was assigned to snacks that were suitable for moderate consumption, such as cookies and desserts; rank 3 items were suitable for limited consumption, such as instant noodles, candy, and deep-fried versions of puffed foods. According to the survey, the all-day energy ratios from snacks of boys and girls were 8.5% and 9.8%, which were lower than that of Huai'an city (10.5% for boys and 14.4% for girls) [36]. We found that some children ate fried chips, instant noodles, spicy strip and drank beverages frequently which all were suitable for limited consumption by GSCCAs (not more than once a week). Consumption of junk foods for long period will lead to obesity, dental caries and nutritional deficiencies, and may also lead to underlying health risks for the future.

Inadequate intake of micronutrients

The most serious nutritional concern of the studied children was inadequate intake of micronutrients. Vitamins and minerals are essential for the growth and development of children. Lack of micronutrients will reduce the immunity, chronic deficiency will lead to malnutrition and micronutrient deficiencies, resulting in increased morbidity and mortality [37]. Only few of these children whose daily intake of minerals and vitamins reached the EAR, which was similar to the other researches [38]. More than 80% of children are deficient in vitamin B1, which may be related with a long-term consumption of over-refining white rice or flour and low consumption of grains, beans and nuts [39]. The intake of vitamin B2, vitamin B3, and vitamin C were also relatively inadequate, which was closely related to the unreasonable dietary patterns of children. Girls were better than boys in the field of intake of vitamin A, but the proportion of insufficiency was still high (47.9% for girls and 60.4% for boys). Vitamin A deficiency can lead to dark adaptation extension or nyctalopia in some severe cases. Children are advised to increase take vitamin A-rich foods, such as animal liver, dark green vegetables, and carrots [40].

Inadequate calcium intake was the most serious, and the average mean value was only 20% of the RNI (1 200 mg), almost none child meet the recommendation (85% of RNI). The results were lower than that of children in Nanjing (741.4 mg) [41]. The phenomenon of calcium deficiency is comparatively common among Chinese children. These data confirmed the study which had done by Liu [42]. This could be attributed to the consumption of fewer milk and dairy products. In addition, the current study showed insufficient intake of zinc and selenium, which were important for prevent malnutrition, stunting, low immunity and mental retardation. Iron is one of the most essential micro-elements but easily to lack for human. Iron-deficiency anemia is the most common type of anemia in children [43]. In the present study, the data showed that children's total iron intake was relatively good, but the composition was questionable. The proportion of heme-iron is too low (12.6% of boys and 12.2% of girls), which is in agreement with recent study by Yu et al. [44]. Children should be encouraged to take sufficient lean meat, fish and poultry to ensure the supply of heme-iron. And if the child not refuse, animal liver and blood will be a better choice.

Limited kinds of foods and unreasonable dietary patterns

It was showed that intakes of grains, meat and oils of migrant children met the recommendation of Dietary Guidelines for Chinese Residents. However, the intakes of all other kinds of food were not. More

than 95% of children choose to have breakfast and lunch at school canteen from the investigation, so it implied that school shouldered important responsibilities of children's nutritional status. But in fact, the breakfast and lunch provided by school were relatively simple and lack variety, which makes it common that students had very little appetite and unable to finish the food, just throw the leftovers into the trash, it is consistent with the other research [23]. Deficiency of vegetables may be related to the poor habit of picky eating, for example, over 60% of participants don't like to eat vegetables in this survey, especially green leaf vegetables. The situation of milk drinking was the worst, the average milk intakes were far away from the recommendation (300 ml), which were similar to the other domestic research results [28]. In view of the problems of migrant children's dietary pattern, it is essential to correct the children's unhealthy eating behavior by health education, parents and schools should work together to improve the quality of children's diet.

Limitations of the study

A few limitations to the present study should be acknowledged. The 24-hour recall was used to collecting the dietary data, as a self-report method, it contain inherent dietary reporting errors. In other words, the recalled data of food intake in the past 24 hours maybe higher or lower than the actual intakes. Additionally, the three days which were surveyed were all school days, which may overestimate the insufficiency of intakes. Therefore the results can't be used to represent completely the dietary status of migrant children. But despite these shortcomings, the study on energy and nutrient intake of the group still provide the basic data of migrant children, it can be referenced by other cities with similar economic level to Wuhan.

Conclusions

There is a higher incidence of overweight and obesity among these migrant children, characteristics such as unreasonable dietary pattern, relative lack of energy and nutrients, and excess snack intake coexist, it is necessary to carry out nutrition intervention programs to help migrant children to balance the diet and rectify the deficiencies. Children should be encouraged to eat more vegetables and fruits, and enough lean meat, fish, poultry, and animal liver. Parents should reduce the use of cooking oil, guide their children to develop a reasonable diet and help them to choose the right snacks. Schools should enrich the variety of food under the guidance of professional nutritionists and improve the cooking methods to make school lunch more nutritious and delicious.

Abbreviations

RMB: Renminbi; RNI: Recommended Nutrient Intake; AI: Adequate Intake; DRIs: Dietary Guidelines for Chinese Residents; GSCCAs: Guide-lines on Snacks for Chinese children and Adolescents.

Declarations

Ethics approval and consent to participate

The study was approved by Ethics Committee of Wuhan University of Science and Technology (No. 201519). All pupils participated signed the informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

GC and JZ formulated the research question; GC and JZ designed the study; JZ, LS, YL, and MY carried it out; YL, LS, and BX analyzed the data; JZ, LH, and XY wrote the article. All authors read and approved the final manuscript.

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