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Evaluation of a kindergarten-based nutrition education intervention for pre-school children in China

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Abstract

Objective: To evaluate the impact of nutrition education in kindergartens and to promote healthy dietary habits in children.

Design: Prospective cohort study. Four kindergartens with 1252 children were randomized to the intervention group and three with 850 children to the control group. The personal nutritional knowledge, attitudes and dietary behaviours of the parents were also investigated. Each month, children and parents in the intervention group participated in nutrition education activities. The main outcome measures were anthropometrics and diet-related behaviours of the children and the nutritional knowledge and attitudes of the parents at baseline, 6 months (mid-term) and 1 year (post-test). Baseline demographic and socio-economic characteristics were also collected.

Setting: Seven kindergartens from Hefei, the capital city of Anhui Province, eastern China.

Subjects: Two thousand one hundred and two 4- to 6-year-old pre-schoolers from seven kindergartens participated.

Results: The prevalence of children's unhealthy diet-related behaviours decreased significantly and good lifestyle behaviours increased in the group receiving nutrition education compared with controls. Parental eating habits and attitudes to planning their children's diets also changed appreciably in the intervention group compared with the control group ($P < 0{\cdot}05$). However, there were no statistically significant differences in children's height, weight, height-for-age *Z*-score or weight-for-age *Z*-score between the two groups.

Conclusions: Kindergarten-based nutrition education improves pre-schoolers' lifestyle behaviours and brings about beneficial changes in parents' attitudes to planning their children's diets and their own personal eating habits.

Keywords
Nutrition education
Pre-school children
Parents
Diet-related behaviour
Nutritional knowledge
Attitudes and behaviour

Children develop many food- and nutrition-related attitudes, behaviours and preferences during the pre-school years[1]. Research suggests that, with the exception of a seemingly innate preference for sweet tastes and rejection of bitter tastes, people acquire and modify their food preferences based on individual experience, primarily during early childhood[2]. About two decades ago, the majority of Chinese people were more concerned with the quantity rather than the quality of food, because of low incomes and supply shortages. The initiation of economic reform in the late 1970s generated sudden wealth and the average family income increased sharply. Generous and varied food supplies became available on the market and, with the high purchasing power, meal patterns became more varied. The traditional diet is disappearing rapidly and being replaced by a much more diverse diet. On the other hand, the prevalence of obesity among adults and children indicates that the dietary pattern associated with an affluent lifestyle is to be blamed for the increasing prevalence of health problems associated with overnutrition. As a result of the improving economic status, consumers are gradually placing greater emphasis on food quality. However, this has not led to a healthy diet, and intake is still restricted by some traditional habits and food availability. Chinese catering tends to address the colour, smell, taste and appearance of cooked food rather than the balance of nutrients. Parents in China indulge their children's appetites as a result of the one-family/one-child population policy. Unhealthy snacks, fast foods and beverages frequently serve as rewards for children from families that are no longer short of money.

The development of the family's dietary environment plays an important role in the health of the next generation. At present, both malnutrition and overeating are problems

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for Chinese children. The morbidity rate from malnutrition is high in indigent areas, while the rate of excess nutrition in children is increasing in both rural and urban environments. A report from nine Chinese provinces uncovered a phenomenon of inadequate nutrition and excessive weight gain coexisting within the same household[3]. The 2002 China National Nutrition and Health Survey showed that the nutritional status of children in China has improved significantly in the last 10 years, but that morbidity and mortality in children have not changed[4]. With the increasing prevalence of obesity, diet-related diseases and problematic eating behaviours in children[5,6], it is worth teaching healthy diet behaviours during early childhood by implementing nutrition education programmes in kindergartens.

Many unhealthy behaviours that develop in early childhood are due mainly to parental influences as they are responsible for their children's diets. Parents have a strong influence on food availability and dietary practices from infancy through to adolescence[7,8]. Previous research has shown that young children will increase the variety of foods they eat if given the opportunity to experience new foods in a positive environment, although it may take eight to fifteen exposures before a child is willing to eat a new type of food[9]. However, it is common for parents or grandparents to indulge their child; for example, serving a child who is able to serve him/herself (designated here as 'adult assistance during meals'). Parents require adequate nutritional knowledge to be able to provide regular opportunities for their children to try new foods.

It is crucial that both children and parents are educated in good dietary practices when the children are 4–6 years of age: the pre-school period is an essential time for young children to learn and develop good dietary habits because behaviours formed at this time will persist and therefore benefit children until they fully grown[10]. Parents and kindergarten teachers play key roles in helping pre-schoolers to develop positive dietary behaviours[11,12]. The existing literature provides educators with excellent tools and examples of nutrition education programmes for children of pre-school age[13–20]. However, few reports have been published on the nutrition education of pre-school children in China, where economic expansion and population increase have occurred rapidly within the last two to three decades. In 2001, we started a project to explore the effectiveness of kindergarten-based nutritional education for children so that they can begin to practise healthy dietary behaviours as soon as they are exposed to social engagement.

Methods and materials

Study objectives

This study was performed in Hefei, the capital city of Anhui Province, eastern China. The city is divided into three administrative districts: east urban, central urban and west urban, which have been built around seventeen kindergartens (totalling 8752 children) to which residents take their children in the morning and collect them in the evening. We randomly sampled two kindergartens each from east urban and west urban, and three from central urban, according to the population density in each area. Randomization was stratified by administrative district in order to achieve heterogeneity in location, the kindergartens were then randomized to either an intervention group (one in each of east urban and west urban, the remaining two in central urban; total of four kindergartens and 1252 child–parent pairs) or a control group (one in each of east urban, west urban and central urban; total of three kindergartens and 850 child–parent pairs) using computer-generated numbers within each district. A total of 2102 children aged 4 to 6 years in the second grade and third grade and their parents were recruited from selected kindergartens in September 2001. By re-checking the questionnaires, we excluded incomplete data and retained a qualified sample of 1237 children in the intervention group (IG) and 831 in the control group (CG). The response rates for the IG and CG were 98·8% and 97·7%, respectively. Because of loss to follow-up, there were 1092 pairs in the IG and 727 in the CG at mid-term, and 1042 pairs in the IG and 713 pairs in the CG at post-test.

Informed consent was obtained from all parents and the study was reviewed and approved by the ethical committee of Anhui Medical University.

Intervention design

In the four intervention kindergartens, monthly nutrition education sessions were held over two semesters in the 2001/2 school year (totalling 10 months, with the exception of 2 months of summer and winter vacation during the year). Both the education approach and the content of other activities were uniform across the IG kindergartens. The intervention content was as follows.

1. A flexible curriculum for in-kindergarten education delivered monthly to children and parents by trained nutrition graduate students and research assistants. The curriculum was developed by nutrition professionals and included basic nutrition information, National Dietary Guidelines for China (NDGC; the major nutrients were arranged into five groups after revision of the Guidelines by the Chinese Nutrition Society in 1997), skills for food arranging and cooking, and the benefits of physical activities. Parents were informed of the events by their children's teachers and training took place within the kindergartens. At least eight lectures or activities were implemented in each IG kindergarten during the 1-year intervention period. The monthly curricula had an overall theme but in general the classes were not related to previous

classes. Each class's material was relatively independent of the other lecture material.

2. An illustrated book was distributed by teachers to all of the children. The IG received a book with a nutritional theme while the CG received a book of general picture stories. As teachers told the stories related to the content of the book, the IG children received significant amounts of information regarding nutrition and healthy dietary behaviours.
3. Pamphlets giving nutritional information and describing healthy lifestyle behaviours were delivered to each IG child's parents at the beginning of the intervention since the parents arrange the daily diet for their child. Parents were instructed to read the pamphlet and were periodically checked by our research assistants. The nutritional prejudices of the parents were addressed directly in a series of activities.
4. Two series of promotional pictures providing information concerning nutrition, the most common unhealthy dietary behaviours and good lifestyle behaviours were displayed in the IG kindergartens throughout the intervention, one series per semester. Both children and their parents readily accepted the nutritional education.

Data collection

To determine the intervention effects, pre-test (baseline), mid-term (6 months) and post-test (1 year) assessments were carried out for both the control and intervention groups of children and parents. Because there was no standard technique available for evaluating children's lifestyle behaviours or parents' nutritional knowledge, attitude and behaviours, we used a self-administered questionnaire designed by the authors to collate changes in these areas.

In addition, at baseline, social and demographic information (e.g. age, gender, parental education, family income) were collected. All questionnaires were completed by the children's parents. For the main survey, parents were requested by kindergarten staff to attend the class rooms at specified times other than lecture hours. A self-administered questionnaire was distributed to all 2102 parents who were invited to participate in the research between September 2001 and July 2002 in Hefei. Parents were asked to answer the questionnaire voluntarily. In the cover letter, it was made clear that the questionnaire was research-related, completely voluntary and that all respondents would be treated anonymously. All questionnaires were collected by the research assistants.

Measures

Parents reported nutrition-related eating behaviours in a questionnaire containing fourteen items and there was a 3-point scale answer for each item: 'frequently', 'occasionally' and 'no'. During analysis, the response item 'occasionally' was merged with 'no' because there were very few 'no' answers. Questions about unhealthy and healthy lifestyle behaviours were used to determine children's behaviours in the week preceding each test. By repeated measures of two levels of response and analysis of two groups, we calculated the marginal probabilities for assessing the main effects of the intervention. Because of missing results from subjects lost to follow-up, the effective sample of repeated-measures analysis was equal to that of the post-test.

The parental nutrition knowledge scale contained twenty items with a choice of three answers, including the most satisfactory answer based on the NDGC and the option of saying 'I don't know'. If the question was answered correctly, the score was 1; otherwise it was 0. Total scores ranged from 0 to 20. The content validity of the scale was established by a group of ten health professionals. Cronbach's α coefficient was calculated to be 0·771.

Parents' attitudes refer to the factors that they considered essential in arranging their children's diets (details in Table 5). During the intervention, parents' attitudes to arranging family diets based primarily on their child's preferences, nutritional value of foods, nutritional needs of the child, their own eating habits or cost of food (food price at market) were investigated. Also, investigation of the dietary behaviours of parents included the frequency of consumption of certain foods during the week preceding the study, for example miscellaneous grain crops (more than once per week, mainly various types of beans), milk (almost every day), meat (more than once per week), seafood (more than once per week), laver (more than once per week, laver is any type of dried, edible seaweeds of the genera *Porphyra* and *Ulva* which are abundant in iodine), fast food (more than once per week) and Western-style high-energy foods (more than once per week).

Body weight and body height were assessed in all kindergarten children at baseline, mid-term and post-term by trained graduate student research assistants using a standard technique[21]. Body weight was measured in light clothing without shoes with an empty bladder and at the same time of the day using digital scales. Body height was measured in centimetres with a portable stadiometer. Positioning of the body was standardized by asking the subject to stand straight, without shoes and with the heels together. Both weight and height were measured twice, and the mean value of the two measurements was computed. BMI was calculated by dividing the measured body weight by the square of measured body height (kg/m^2). All measurements were recorded by a single trained research assistant. The nutritional status of the children was determined from the *Z*-scores for height-for-age (HAZ) and weight-for-age (WAZ), according to the WHO Child Growth Standards.

Statistical analysis

All analyses were carried out using the SAS for Windows statistical software package version 8·2 (SAS Institute,

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Cary, NC, USA). The χ^2 test was conducted to compare enumeration data, such as gender, parents' education, behaviours and attitudes, between the two groups at baseline. The Student *t* test was used to compare measurement data between the two groups, including height, weight and mean scores of parents' nutritional knowledge. Repeated-measures analysis using the general linear model (GLM) was conducted to detect pre-test, mid-term and post-test variations in height, weight, HAZ and WAZ, to evaluate nutritional status in children and diet-related attitudes and behaviours of the parents. Statistical significance was set at $P < 0{\cdot}05$ for all measures.

Table 1 Comparison of the demographic and socio-economic characteristics of the intervention group (IG) and control group (CG) children at baseline: 4- to 6-year-old pre-schoolers from seven kindergartens, Hefei, Anhui Province, eastern China

	IG (*n* 1237)		CG (*n* 831)			
	Mean or *n*	SD or %	Mean or *n*	SD or %	Statistic	*P* value
Age (years)	4·6	0·6	4·6	0·6	0·47†	0·6419
Height (cm)	108·7	6·1	108·6	5·6	0·28†	0·7791
Weight (kg)	18·6	3·2	18·4	3·0	1·43†	0·0766
BMI (kg/m^2)	15·6	1·7	15·5	1·6	1·34†	0·0898
Gender						
Male	647	52·30	465	55·96	2·6880‡	0·1024
Female	590	47·70	366	44·04		
Father's age (years)	33·6	2·9	33·3	2·3	1·87†	0·0612
Mother's age (years)	31·5	2·6	31·4	2·1	0·95†	0·3428
Father's education						
Elementary school	6	0·49	7	0·84	3·5974‡	0·4632
Junior middle school	177	14·31	128	15·40		
Senior middle school	400	32·34	288	34·66		
College	395	31·93	247	29·72		
Graduate	259	20·94	161	19·37		
Mother's education						
Elementary school	15	1·21	13	1·56	2·8696‡	0·5799
Junior middle school	275	22·23	166	19·98		
Senior middle school	480	38·80	316	38·03		
College	339	27·41	249	29·96		
Graduate	128	10·35	87	10·47		
Family income per capita (RMB/month)						
<400	173	13·99	121	14·56	4·5533‡	0·103
400–800	711	57·48	508	61·13		
>800	353	28·54	202	24·31		

†Statistic by *t* test.
‡Statistic by χ^2 test.

Table 2 Dietary and lifestyle behaviours (%) among the intervention group (IG) and control group (CG) children at baseline and follow-up: 4- to 6-year-old pre-schoolers from seven kindergartens, Hefei, Anhui Province, eastern China

	Baseline		Mid-term		Post-test		Statistic (χ^2)		
Behaviour	IG (*n* 1237)	CG (*n* 831)	IG (*n* 1092)	CG (*n* 727)	IG (*n* 1042)	CG (*n* 713)	Between groups	Among terms of intervention	Interaction of group × term
Unhealthy behaviour									
Unhealthy snacks	38·5	36·9	39·1	41·4	31·7	41·8	4·53*	46·42**	25·42**
Western-style high-energy foods	6·4	6·0	5·2	8·7	6·7	5·0	0·78	807·80**	8·05*
Preference for salty foods	30·4	33·0	32·3	28·4	30·1	32·1	0·35	225·87**	7·23*
Monophagia	21·4	21·5	20·3	20·0	16·8	18·7	6·75*	478·05**	33·68**
Adult assistance during meals	18·4	16·5	9·7	8·6	9·5	12·5	16·56*	476·35**	72·86**
Playing during dinner	24·3	21·0	18·9	18·2	17·5	25·2	11·06*	16·07*	3·28
Watching television during dinner	26·5	23·5	21·8	24·6	19·3	17·8	9·21*	381·68**	6·49*
Eating candy before meal	15·5	13·0	12·4	12·6	10·5	15·0	0·52	250·55**	25·23**
Eating candy before going to bed	8·3	7·5	6·1	7·3	4·3	6·1	1·49	391·89**	9·59*
Healthy lifestyle behaviour									
Eating breakfast	91·0	91·1	91·7	93·0	92·3	87·2	57·44**	116·65*	36·17*
Take part in outdoor activities	62·5	61·7	60·6	65·2	63·0	60·0	4·23*	21·48*	7·10*
Eating at table	80·6	78·6	82·9	79·4	81·9	77·2	0·02	258·06*	24·03**
Eating a fixed quantity at a particular time	51·8	50·6	52·4	49·3	51·3	47·2	0·02	0·61	12·06*
Helping with household duties	4·5	5·4	7·1	4·1	5·0	4·5	5·27*	153·51*	6·28*

Repeated measures of two levels of response and two groups: *$P < 0{\cdot}05$, **$P < 0{\cdot}0001$. The analysis of the marginal probabilities is directed at assessing the main effects of the repeated measurement factor and the independent variable (group), as well as their interaction. Because of missing results due to subjects lost to follow-up, the effective sample of repeated-measures analysis is equal to the post-test sample.

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Results

Demographic and socio-economic characteristics

There were no statistically significant differences between IG and CG children in age, gender, parents' education or family income. The demographic and socio-economic characteristics of IG and CG children are presented in Table 1.

Children's diet-related behaviours

Changes in unhealthy lifestyle behaviours in IG and CG children between pre-test and post-test are shown in Table 2. The results suggested that unhealthy diet-related behaviours involving unhealthy snacks, monotonous diet, adult assistance during meals, playing during dinner and watching television during dinner were significantly different between the IG and CG children following the intervention ($P < 0{\cdot}05$), while Western-style high-energy food, preference for salty foods, eating candy before meals and eating candy before going to bed were not significantly different.

Healthy lifestyle behaviours, such as eating breakfast, taking part in outdoor activities and helping with household duties, improved markedly in IG children ($P < 0{\cdot}05$). However, variables such as eating at the table and eating a fixed quantity at a particular time did not change statistically.

Anthropometry of children

Height and weight data are shown in Table 3. Repeated-measures ANOVA indicated that height, weight, HAZ and WAZ varied significantly with time for both IG and CG children. However, there were no statistically significant differences between IG and CG children in any of the above indices in pre-test, mid-term and post-test assessments.

Nutritional knowledge of parents

Data on parents' nutritional knowledge are shown in Table 4. Nutritional knowledge among IG parents increased significantly during the follow-up period. Repeated-measures analysis indicated that the mean scores for nutritional knowledge among IG parents rose significantly from pre-test to post-test ($F = 13{\cdot}51$, $P < 0{\cdot}0001$). However, the nutritional knowledge of CG parents varied little during the same period of time, and there were no significant differences in the mean scores of CG parents' nutritional knowledge between pre-test, mid-term and post-test evaluations ($F = 0{\cdot}27$, $P = 0{\cdot}7604$). Comparison of nutritional knowledge between IG and CG parents indicated that IG parents performed better than CG parents, especially at mid-term and post-test.

Parents' attitudes to managing their children's diet and eating behaviours

Parents' attitudes to managing their children's diet and eating behaviours at baseline, mid-term and post-test are shown in Table 5. Attitudes regarding management of the diet changed in some aspects during the intervention. In

Table 3 Physical growth status of the intervention group (IG) and control group (CG) children at baseline and follow-up: 4- to 6-year-old pre-schoolers from seven kindergartens, Hefei, Anhui Province, eastern China

	Baseline				Mid-term				Post-term				Statistic (F value)		
	IG (n 1237)		CG (n 831)		IG (n 1092)		CG (n 727)		IG (n 1042)		CG (n 713)				
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Between groups	Among terms of intervention	Interaction of group × term
Height (cm)	108·7	6·1	108·6	5·7	111·9	5·8	111·7	6·1	115·2	6·0	115·2	6·3	0·01	5090·85**	3·78*
Weight (kg)	18·6	3·2	18·4	3·0	19·8	3·1	19·4	3·3	21·0	3·3	21·0	3·5	1·57	2100·94**	12·93**
HAZ	−0·086	0·940	0·008	1·014	−0·084	0·891	−0·086	1·049	−0·073	0·892	−0·047	1·045	1·41	3·86*	8·48*
WAZ	−0·077	1·078	−0·136	1·091	−0·027	0·958	−0·135	1·108	0·005	0·942	0·017	1·030	0·79	48·23**	11·90**

HAZ, height-for-age Z-score; WAZ, weight-for-age Z-score.
Student t tests showed no significant differences between IG and CG groups at baseline, mid-term and post-term tests within the same term. The results showed no significant differences in height, weight, HAZ and WAZ between IG and CG children. There were significant differences for all indices among intervention terms and their interaction by repeated-measures analysis: $^{*}P < 0{\cdot}05$, $^{**}P < 0{\cdot}0001$.

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Table 4 Comparison of nutritional knowledge between the intervention group (IG) and control group (CG) parents at baseline and follow-up: Hefei, Anhui Province, eastern China

	Baseline			Mid-term			Post-term		
		Score			Score			Score	
Group	*n*	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
IG	1237	10·5	3·25	1092	10·2	3·3	1042	11·9	3·6
CG	831	10·1	3·4	727	10·0	3·2	713	10·0	3·4
	$t = 2·03$, $P = 0·0427$			$t = 3·37$, $P = 0·0008$			$t = 4·74$, $P < 0·0001$		

Repeated-measures tests using the general linear model (controlled by education level, gender and pre-test scores) showed that nutritional knowledge among IG parents increased significantly during the follow-up period ($F = 13·51$, $P < 0·0001$), while that of CG parents varied little during the same period of time ($F = 0·27$, $P = 0·7604$).

Table 5 Comparison of attitude and behaviour (%) between the intervention group (IG) and control group (CG) parents at baseline and follow-up: Hefei, Anhui Province, eastern China

	Baseline		Mid-term		Post-term		Statistic (χ^2)		
Dietary attitude and behaviour	IG (*n* 1237)	CG (*n* 831)	IG (*n* 1092)	CG (*n* 727)	IG (*n* 1042)	CG (*n* 713)	Between groups	Among terms of intervention	Interaction of group × term
Attitude to organizing diet according to:									
Child's tastes	45·3	44·0	40·3	46·9	38·2	44·4	4·84*	5·45	2·13
Nutrition of foods	38·2	34·1	39·9	43·8	43·9	36·9	6·56*	16·95*	2·13
Nutritional needs of child	54·7	53·6	56·6	54·6	58·0	58·2	0·10	120·17**	0·39
Own eating habits	8·4	12·0	10·3	8·7	10·4	8·4	2·97	92·83**	0·68
Money spent on foods	1·5	3·3	2·3	1·7	2·7	3·1	0·07	109·61**	0·66
Behaviour regarding consumption of:									
Miscellaneous grain crops	18·3	17·1	17·3	17·3	22·8	21·2	0·11	29·91**	1·35
Milk	30·1	32·3	34·8	29·8	37·9	30·7	7·00*	81·84**	2·32
Animal meat	90·6	91·8	89·7	80·7	87·4	78·2	34·25**	163·51**	0·53
Aquatic products	71·2	71·1	71·2	68·6	68·8	62·2	34·12**	23·82**	19·70**
Laver	37·9	35·7	47·5	41·2	52·7	45·0	13·44*	24·04**	0·62
Fast foods	24·6	29·1	32·0	38·4	30·5	34·2	14·94**	60·90**	19·39**
Western-style high-energy foods	13·1	12·4	16·6	15·3	24·7	28·8	1·33	28·62**	2·82

Repeated measures of two levels of response and two groups: *$P < 0·05$, **$P < 0·001$. The analysis of the marginal probabilities is directed at assessing the intervention effects of the repeated measurement factor and the independent variable (group), as well as their interaction. Because of missing values due to subjects lost to follow-up, the effective sample of repeated-measures analysis is equal to post-test sample.

the IG, parents paid more attention to the nutritional value of foods and less to their children's taste. However, items concerning children's nutritional needs, parents' own eating habits and money spent on food were not significantly different between the two groups.

Parents appeared to improve their lifestyle behaviours during the intervention. The consumption frequency of milk, meat, seafood and laver increased significantly in the IG; consumption of miscellaneous grain crops did not change significantly. Although the disadvantages of excess consumption of fast foods by children were emphasized during the intervention, the frequency of consuming fast foods and Western-style high-energy foods nevertheless increased from 24·6 % and 13·1 % at pre-test to 30·5 % and 24·7 % at post-test, respectively.

Discussion

Children's growth and development depends mainly on two groups of factors: genetic and environmental. Nutrition has a major impact on the early development of morphology and function. Adequate nutrition can promote children's physical development and learning abilities[18]. Childhood is gradually being recognized as the critical period during which eating habits and behaviours are established. Nutritional education using kindergartens to reach children, parents and teachers as targets will be integrated into elementary education.

Nutrition education improves children's dietary habits and behaviours, particularly by reducing some unhealthy behaviours[19]. Kindergarten is a time of dramatic change for parents and children. Kindergarten-based education is a popular method for conducting nutrition intervention for pre-schoolers, and parental involvement influences the effects of any intervention in a positive manner. Because parents are responsible for planning, shopping and preparing their children's meals, their nutritional knowledge, attitudes and behaviours have an impact on the development of their children's eating behaviours[22]. Parental influence is especially crucial in developing healthy nutritional behaviours in children[23,24].

The present study is one of the first to investigate a kindergarten-based nutrition education programme in

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China, and is also one of the few studies conducted in developing countries[18]. The results indicate that a one-year intervention programme produces beneficial behavioural changes among children, decreasing unhealthy dietary behaviours and increasing healthy lifestyle behaviours. An earlier study indicated that following an intervention programme which included two meals per day, nutritional education for parents and training for supervisors, children's nutritional status improved with a decrease in the percentage of underweight, stunted and wasted children[25]. Another study that employed nutritional education alone reported no changes in anthropometric data[26]; this may due to the differences in the intervention measures and/or the time periods involved. Likewise, we failed to detect a significant effect on height and weight which are markers of the nutritional status of children.

Nutrition education involves changes in parental knowledge, attitudes and behaviours. After one year of nutritional education, in general all parents in our IG showed a statistically significant improvement in their general nutrition-related knowledge. Improving nutrition knowledge facilitates the leap from advocating good nutrition to first changing attitudes and then altering behaviours. Teaching parents can improve their own eating habits as well as those of their children. Our findings indicate that nutritional education can improve knowledge about healthy nutrition and lifestyle choices[26,27]. The results suggest that nutrition education not only leads to beneficial changes in parents' attitudes to managing their children's diet, but also brings about direct benefits for themselves in terms of the foods they consume.

Despite the fact that some children dropped out during the observation period, our study clearly indicates that kindergarten-based nutrition education can improve preschoolers' lifestyle behaviours especially by reducing their unhealthy dietary behaviours. It can also bring about beneficial changes in parents' attitudes to managing their children's diets and in altering the eating behaviours of families. In view of the child malnutrition and overeating that coexist in many families especially in a country that is in the throes of rapid economic development, nutrition education and promotion of child growth and development should be the focus of pre-school education to encourage children to develop good dietary habits. Parents not only need to have reliable information about balanced diets, but should also be aware of the potential guide to good dietary behaviours being provided to children by kindergarten teachers.

In conclusion, the key findings from the present study are: (i) nutritional knowledge and some dietary behaviours improved significantly in the intervention group, although physical growth did not necessarily improve; and (ii) these findings are important because few such nutrition interventions have been carried out in China or other developing countries.

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