Original Article

Diet quality and eating behavioural patterns in preschool children in Hong Kong

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Background and Objectives: To assess the diet quality and eating behaviour of preschool children, investigate parents' feeding practices, and obtain information on the kindergarten nutrition environment of Hong Kong children aged 30-60 months. **Methods and Study Design:** Dietary information was obtained using multiple 24-hour recalls. Questionnaires were developed to obtain information on children's eating behaviour, parents' feeding practices and preschool nutrition environment. **Results:** A total of 302 children and 23 local kindergartens from three regions of Hong Kong were surveyed. The results showed consumption of vegetable, fruit, and grain were adequate; however, consumption of meat were excessive, while milk and dairy intakes were inadequate. On average, the children consumed 1,280 kcal per day, or 92% of the Chinese Nutrition Society's energy recommendation. For macronutrients, the mean percentages of energy from carbohydrate, protein and fat were 55%, 17% and 28%, respectively, which are within the United States Acceptable Macronutrient Distribution Ranges. The mean intakes of carbohydrate and protein were 175 g and 53.4 g, respectively. For micronutrients, the mean intakes of vitamin D, calcium, iron and zinc were significantly lower than the reference nutrient intake or adequate intake ($p<0.05$), but those of sodium and niacin were significantly higher than the tolerable upper intake levels ($p<0.05$). **Conclusion:** This study showed that diet quality among children in Hong Kong needs to be improved, as some nutrients are consumed in excess whereas others are consumed in inadequate amounts. Other results on children's eating behaviour, parent's feeding practices and school nutrition environment are also reported.

Key Words: diet quality, feeding, children, eating behaviour, Hong Kong

INTRODUCTION

Promotion of optimal nutrition should begin early in life as eating behaviour becomes established during childhood, and these behaviours influence nutrient intake and diet quality.[1,2] Poor diet quality in children has been documented in a number of countries.[3-6] For example, majority of children aged 2 to 5 years in Greece needed to improve their diet to obtain optimal nutrition.[3] An analysis of the dietary intake of Swedish preschool children aged 4 years showed that 'junk food' supplied 24% of the children's energy, while 67% of children had a sucrose intake that exceeded the Nordic Nutrition Recommendations.[4] A study in Hong Kong found inadequate vegetable intake or no vegetable consumption during lunch among children aged 6 to 7 years.[5] Another study in Hong Kong used a 3-day food record to find that constipated preschool children had lower intakes of dietary fibre, vitamin C, folate and magnesium intake than non-constipated preschool children.[6] Although these two local studies investigated children's diet, information on diet quality among preschool children in Hong Kong remains limited at this point. As such, further information on diet quality and eating behavioural patterns is needed and will be useful for developing nutrition interventions and dietary guidelines for local children.

Parents' feeding practices are also an important factor in determining a child's diet quality.[3,7] A study in Chile found a significant association between feeding practices of mothers and children's body mass index.[7] Overestimation of diet quality by mothers, which can be a factor influencing children's food consumption, has also been reported.[3] Unfortunately, similar studies have not been undertaken in Hong Kong. In addition to parents' feeding practices, meals and snacks provided by preschools also contribute to the nutrition status of children. However, the lack of information regarding the types and amount of food provided to children within the preschool setting could result in poor understanding of the overall nutrition status of children.

The objectives of this study were threefold: to assess

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diet quality of preschool children in Hong Kong through 24-hour recalls; to investigate children's eating behaviour and feeding practices of parents; and to study the preschool nutrition environment, such as the types of foods and beverages commonly provided in local kindergartens.

METHODS

Study design

This was a cross-sectional study that used multiple 24-hour recalls, covering two weekdays and one day during the weekend, to collect dietary data, as well as two self-designed questionnaires to study eating behaviour of children and feeding practices of parents, and another questionnaire to study the preschool nutrition environment. The desired information was obtained from children's parents, guardians or those responsible for preparing their meals, and preschools teachers or staff. Data collection started in February 2012 and was completed in May 2013.

Ethics approval was obtained from the Survey Research Ethics Committee of the Chinese University of Hong Kong prior to initiation of the study. Written informed consent was obtained from all principals or teachers of participating preschools and parents or guardians of children who agreed to participate in the study.

Participants and recruitment

Participants were recruited from kindergartens by stratified cluster sampling. Invitation letters and study information were sent to the kindergartens, and these materials were then distributed to the parents or guardians. Induction sessions were conducted at the kindergartens to provide detailed information about the study to the parents or guardians. Inclusion criteria were: child aged 30 to 60 months, Hong Kong resident, and parent/guardian able to complete a total of three interviews within the 2-week timeframe.

Information about the preschool nutrition environment was also obtained from local kindergartens. Invitation letters and questionnaires were sent to the kindergartens. Kindergarten principals or teachers were asked to complete the self-administrated school nutrition environment questionnaire if they were willing to participate in this study. Local kindergartens were drawn in proportion to the number of kindergartens in the three geographic areas: Hong Kong Island, Kowloon, and the New Territories. Only local kindergartens in which more than 50% of students were Hong Kong residents were included.

Data collection

Interviewers were trained prior to conducting the interviews to ensure consistency and accuracy of data collection procedures. Each child's dietary data were collected through face- to-face interviews. Dietary data were obtained using the 24-hour recall method, covering two weekdays and one day during the weekend, from the parents or individuals who were responsible for preparing the children's meals, as well as the kindergarten kitchen staff or teachers for the meals consumed at preschools. A photo booklet and other measurement tools were used to assist interviewees with regard to portion size estimation and food recognition. The 20-page photo booklet contained pictures and descriptions of different types and sizes of utensils (e.g., different spoons), as well as different food types, including grains, fruits and vegetables, meat, dairy products, and others (candies, *dim sum*). Interviewees reported meal types, times and locations of food consumption, and described the cooking method of the foods consumed. Cantonese language was solely used in the interviews. No interviews were conducted 3 days before and after festivals (e.g., Halloween or Mid-autumn Festival) as these events may have affected a child's regular eating habits.

In addition to the 24-hour dietary recalls, three questionnaires were also developed for this study to access children's eating behaviour, feeding practices of parents, and school nutrition environment. Questionnaires to assess children's eating behaviour and parents' feeding practices were developed by a registered dietitian of the Food and Nutritional Sciences Programme at The Chinese University of Hong Kong, and were reviewed by local registered dietitians to ensure content validity. Pretesting of the survey questionnaires was conducted to establish their repeatability. Questionnaires on children's eating behaviour and parents' feeding practices were completed during the first interview with the aid of the trained interviewers before collection of the 24-hour dietary recall data. Information such as participants' food preferences, food colour and temperature, and the acceptance of new foods or dishes, was obtained from these two questionnaires.

The school nutrition environment survey was a self-administered questionnaire, which was completed either by the kindergarten principal or staff. The most common foods and beverages provided to children by local kindergartens were captured using open-ended questions. Preschool principals or school staff were asked to answer statements related to the school's nutrition environment, using a scale that ranged from "strongly agree" to "strongly disagree".

Data analysis

Due to the lack of a comprehensive food composition database in Hong Kong, dietary data obtained from the 24-hour recalls were analysed using the Nutrition Data System for Research (NDSR) (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA), a Windows-based, food composition database. When children consumed food that could not be found in the NDSR database, nutrient content information was entered manually into the database according to the information provided by the Hong Kong Centre for Food Safety,[8] China Food Composition Publications,[9-11] or the nutrition label on food packaging. After entering all the food items into the food composition database, food items were grouped into groups of grains, vegetable, fruit, meat and meat alternatives, and milk and dairy. Their consumption amount was converted into servings, which refers to *2000 Dietary Guidelines for Americans*, or Food and Drug Administration (FDA) serving sizes. Then, the serving size data was averaged out from the 3 days of recalls, and the result was compared to the Hong Kong Healthy Eating Pyramid for children age 2 to 5 years old. For vegetable, fruit, and milk and dairy groups, comparison can be made directly because serving sizes between NDSR and Hong Kong Pyramid are the same. However, for grain and meat group,

conversion is needed before comparison because definitions of one serving for grain and meat are different (Table 1).

For nutrient analysis, the mean 3-day food intake of each child was computed and the dietary data were then exported to the Statistical Package for the Social Sciences version 16.0 (SPSS Inc, Chicago, IL, USA) for further statistical analysis. Mean intake (percentage) of the recommended nutrients was calculated according to age-specific recommendations for each nutrient. Because Dietary Reference Intakes have not been developed for Hong Kong, intake results were compared with the Chinese Nutrition Society (CNS) recommendations;[9] recommendations of the United States (US) Institute of Medicine (IOM) and the Food and Agricultural Organization of the United Nations (FAO) were also used when CNS recommendations for some nutrients were not available.[12-14]

Data obtained from the three questionnaires were entered, verified using IBM SPSS Data Collection 6 and analysed using SPSS version 16.0. Descriptive analyses were used for results of eating behaviour and parents' feeding practices, and *t*-tests were used to compare nutrient intakes and recommendations. A *p*-value of<0.05 was considered statistically significant.

RESULTS

Participants

For 24-hour dietary recall and the two questionnaires assessing children's eating behaviour and parents' feeding practices, a total of 327 children (or their parents and guardians) were surveyed. Twenty-five children were excluded as their interviews were conducted beyond the specified 2-week time frame, or their ages were outside of the 30-to-60-month range. A total of 302 children, including 156 (51.7%) boys and 146 (48.3%) girls, were surveyed. The mean age of the participants was 47.4 (±8.09) months; it was 47.0 (±8.00) months in boys and 47.9 (±8.19) months in girls.

For the school nutrition environment questionnaire, 23 preschools were surveyed. Of these, 22% were located in Hong Kong Island, 30% in Kowloon and 48% in the New Territories. The distribution of the surveyed kindergartens in the three regions of Hong Kong was similar to the overall distribution of preschools in Hong Kong (p=0.20).

Diet quality

Consumption of food groups

It was found that a mean of 4.8 servings of grains was consumed, mostly refined grain and food with little amount of whole grain (94%). Whole grain contributed to 6% of the 4.8 servings. Vegetable, including starchy vegetable and vegetable juice, was found to be consumed at a mean of 1.54 servings, of which approximately 84% was from dark green, deep yellow and other types of vegetable, 15% was from starchy vegetable and 0.6% was from vegetable juice. Fruit was consumed at a mean of 1.08 servings, with 88% from fruit and 11% from 100% fruit juice. Fruit drinks or artificial fruit flavoured drinks were not part of the fruit group. For the meat and meat alternative group, it was consumed at a mean of 4.3 servings. Of the 4.3 servings, 25% was from beef, pork, and lamb, 16% was from poultry, 31.6% was from fish and shellfish, 8.6% was from processed meat such as sausage, 9% was from egg, and 9% was from legumes, nuts and seeds. For milk and dairy, it was consumed at a mean of 0.5 servings, of which 72% was from fresh milk, 9% was from cheese, 3.9% was from yogurt, and the remaining 12% was from flavoured milk or other types of artificially milk beverage. Other milk source was formula milk, which was at mean of 1.08 servings. Therefore, approximately 1.6 servings of milk and dairy, including formula milk, were consumed daily among these children (Table 1).

Macronutrients

Diet quality, attributed to nutrient intake from both food and supplements, was analysed (Table 2). On average, the surveyed children consumed 1,280 kcal per day or 92% of the CNS energy recommendation (p<0.001).

Mean carbohydrate intake was 175 g. Overall, the surveyed children met 135% of the IOM recommended dietary allowance (RDA) for carbohydrate (p<0.001), accounting for 55% of the total energy intake. Although energy intake from carbohydrate was within the US Acceptable Macronutrient Distribution Ranges (AMDR) of 45-65% for children aged 2.5 to5 years, this amount (175 g) exceeded the IOM RDA of 130 g.[12,13]

Mean protein intake was 53.4 g, which is 112% of the CNS recommendation (p<0.001). The majority of protein consumed was from animal sources, accounting for 62% of the total protein intake among the children surveyed. Mean protein intake accounted for 17% of the total energy intake among the children surveyed, which was within the IOM AMDR of 5-20% for children aged 2.5 to 3 years and 10-30% for those aged 4 to 5 years.[12,13]

Twenty-eight percent of total energy intake was from fat. Since both the CNS and the IOM do not have recommendations for saturated fatty acid (SFA), trans fatty acid (TFA), monounsaturated fatty acid (MUFA), and polyunsaturated fatty acid (PUFA), data were compared to FAO recommendations. The FAO recommends that the intake of SFA, TFA, MUFA, and PUFA should be ≤8%, <1%, 5–15%, and <11% of total energy per day, respectively, for individuals aged 2 to 18 years.[14] In this study, energy from SFA was 9.18%; from TFA, 0.66%; from MUFA, 14.2%; and from PUFA, 8.16%. Omega-3 fatty acid intake was 1.04 g, which is 131% of the IOM adequate intake (AI) level. The mean docosahexaenoic acid (DHA) plus eicosapentaenoic acid (EPA) intake was 248 mg; the FAO AI level is 100-150 mg for children aged 2 to 4 years and 150-200 mg for those aged 4 to 6 years for both DHA and EPA, based on age-adjusted values for infants and for chronic disease prevention.[14]

The Hong Kong Department of Health recommends that dietary fibre intake should be age plus 5 g per day.[15] The mean dietary fibre intake in this study was 117% of the AI (p<0.001). The IOM recommends an AI for total fibre of 25 g/day in children aged 4 to 8 years,[13] which is notably higher than the mean total fibre intake in this study of 9.91 g/day.

The intakes of cholesterol and added sugars are presented in Table 2. Recommendations for cholesterol and added sugars have not been established for children aged 2.5 to 5 years.

Table 1. Conversion of serving sizes and food group consumption results

	Hong Kong Healthy Eating Pyramid, for ages 2-5	Hong Kong Healthy Eating Pyramid, for ages 2-5 (after conversion)	Consumption Results	
Grain	1.5-3 bowls (1 bowl = 250-300 mL)	3-6 servings (1 serving = ½ cup cooked grain)	4.8 servings (1 serving = ½ cup cooked grain)	Adequate
Vegetable	At least 1.5 servings (1 serving = ½ cup of cooked vegetable)	---	1.54 servings (1 serving = ½ cup cooked vegetable)	Adequate
Fruit	At least 1 serving (1 serving = 1 medium size)	---	1.08 servings (1 serving = 1 medium size)	Adequate
Milk and dairy	2 glasses (1 glass = 240 mL)	---	1.6 servings (1 serving = 1 cup)	Inadequate
Meat	1.5 to 3 taels (1 tael = 38 g)	2 to 4 servings (1 serving = 1oz)	4.3 servings (1 serving = 1oz)	Excessive

Table 2. Intake results of macronutrients, with comparisons to recommendations

Nutrients	Recommendations	Overall (n=302)			
		Mean±SD	Min-Max	Mean %R±SD	*p* value*
Energy (kcal)	RNI†				
	3 y: 1,350 for men; 1,300 for women 4 y: 1,450 for men; 1,400 for women 5 y: 1,600 for men; 1,500 for women	1280±320	472-2560	92.2±22.8	<0.001
Total carbohydrate (g)	RDA‡				
	2.5-5 y: 130	175±48.7	60.9-321	135±37.4	<0.001
Protein (g)	RNI†				
	3 y: 45 4 y: 50 5 y: 55	53.4±17.0	18.6-122	112±35.4	<0.001
Animal protein (g)	Not determined	32.9±13.8	4.98-86.8	Not applicable§	Not applicable§
Vegetable protein (g)	Not determined	18.5±6.77	3.70-39.5	Not applicable§	Not applicable§
Total Fat (g)	Not determined	40.3±13.1	9.62-88.2	Not applicable§	Not applicable§
SFA (g)	Not determined	13.3±5.11	2.82-31.7	Not applicable§	Not applicable§
Trans fat (g)	Not determined	0.94±0.66	0.06-5.21	Not applicable§	Not applicable§
MUFA (g)	Not determined	14.2±5.19	2.59-35.0	Not applicable§	Not applicable§
PUFA (g)	Not determined	8.16±3.05	1.90-18.0	Not applicable§	Not applicable§
Omega-2 fatty acid (g)	AI‡				
	2.5-3 y: 0.7 4-5 y: 0.9	1.04±0.50	0.14-3.63	131.36±63.73	<0.001

%R: percentage of recommendations; AI: adequate intake; AMDR: acceptable macronutrient distribution range; DHA: docosahexanoic acid; EPA: eicosapentaenoic acid; Max: maximum; Min: minimum; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; RDA: recommended dietary allowance; RNI: recommended nutrient intake; SD: standard deviation; SFA: saturated fatty acid; UL: tolerable upper intake level; y: years of age.

*Comparison between intake and the recommendations.

†Chinese recommendation developed by the Chinese Nutrition Society.

‡Recommendations from the United States Institute of Medicine (IOM), National Academies.

§Not applicable due to no recommendations established.

¶Centre for Health Education Unit, Department of Health, HKSAR.

††Food and Agriculture Organization of the United Nations (FAO).

Table 2. Intake results of macronutrients, with comparisons to recommendations (cont.)

Nutrients	Recommendations	Overall (n=302)			
		Mean±SD	Min-Max	Mean %R±SD	*p* value[*]
DHA and EPA (mg)	AI[¶]				
	2.5-3 y: 100-150	248±263	3.67-2210	Not applicable[§]	Not applicable[§]
	4-5 y: 150-200				
Cholesterol (mg)	Not determined	195±90.4	31.1-551.5	Not applicable[§]	Not applicable[§]
% from carbohydrate	AMDR[‡]				
	45-65	55.4±6.63	32.2-78.7	Not applicable[§]	Not applicable[§]
% from protein	AMDR [‡]				
	2.5-3 y: 5-20	16.8±3.16	9.57-27.7	Not applicable[§]	Not applicable[§]
	4-5 y: 10-30				
% from total fat	AMDR[†]				
	30-35	27.9±5.47	9.23-44.3	Not applicable[§]	Not applicable[§]
% from SFA	UL[††]				
	≤8	9.18±2.47	2.60-17.4	114.80±30.86	<0.001
% from trans fat	UL[††]				
	≤1	0.66±0.41	0.05-2.77	65.51±41.20	<0.001
% from MUFA	UL[††]				
	5-15	9.86±2.45	2.31-19.4	Not applicable[§]	Not applicable[§]
% from PUFA	UL[††]				
	<11	5.63±1.52	1.66-10.5	51.20±13.81	<0.001
Added sugars (g)	Not determined	31.0±17.33	0.77-115	Not applicable[§]	Not applicable[§]
Total dietary fibre (g)	AI[¶]				
	Age + 5 g	9.91±4.21	1.57-23.4	116.53±50.06	<0.001
Soluble fibre (g)	Not determined	2.64±1.29	0.16-7.30	Not applicable[§]	Not applicable[§]
Insoluble fibre (g)	Not determined	6.93±3.04	1.19-15.6	Not applicable[§]	Not applicable[§]

%R: percentage of recommendations; AI: adequate intake; AMDR: acceptable macronutrient distribution range; DHA: docosahexanoic acid; EPA: eicosapentaenoic acid; Max: maximum; Min: minimum; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; RDA: recommended dietary allowance; RNI: recommended nutrient intake; SD: standard deviation; SFA: saturated fatty acid; UL: tolerable upper intake level; y: years of age.

[*]Comparison between intake and the recommendations.

[†]Chinese recommendation developed by the Chinese Nutrition Society.

[‡]Recommendations from the United States Institute of Medicine (IOM), National Academies.

[§]Not applicable due to no recommendations established.

[¶]Centre for Health Education Unit, Department of Health, HKSAR.

[††]Food and Agriculture Organization of the United Nations (FAO).

Micronutrients

Fat-soluble vitamins

For vitamin A, the CNS has established recommendations for retinol equivalents (RE) but not for retinol activity equivalents (RAE), therefore the IOM recommendation is used for comparison. Vitamin A intake was 149% of the IOM RDA ($p<0.001$), and the mean intake was below the tolerable upper intake level (UL) (71% of the UL). Vitamin D intake was insufficient at only 58% of the CNS Reference Nutrient Intake (RNI) among the surveyed children ($p<0.001$). The mean vitamin E intake was 165% of the CNS AI ($p<0.001$). The CNS UL for vitamin E has not been established. Therefore, the IOM UL for vitamin E of 200 mg and 300 mg for children aged 2.5 to 3 years and 4 to 5 years, respectively, were used. In this survey, vitamin E was below the UL (3% of the UL). Vitamin K was 368% of the IOM AI value ($p<0.001$). No UL has been established for vitamin K.

Water-soluble vitamins

Mean vitamin C intake was 145% of the CNS RNI ($p<0.001$). The CNS UL for vitamin C is 600 mg for children aged 2.5 to 3 years and 700 mg for those aged 4 to 5 years. At 15%, the mean intake of vitamin C was below the UL. The mean intakes of thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, folic acid and pantothenic acid all exceeded the RNIs or AIs among the surveyed children (Table 3). The intake of niacin among the surveyed children was 248% of the UL. The mean intakes of thiamin, folic acid, and vitamin B-6 were below the UL. No UL has been established for riboflavin, vitamin B-12 and pantothenic acid.

Minerals

Mean intakes of calcium, iron and zinc were found to be lower than the recommended levels, at 86%, 93% and 68% of the CNS AI, respectively ($p<0.001$) (Table 4). Sodium intake was 110% of the IOM UL ($p<0.001$). Mean intakes of phosphorus, potassium, magnesium, copper, selenium, choline and manganese were above the CNS AIs, but below the ULs in the surveyed children (Table 4). Mean intake of potassium was above the AI, but no UL for potassium has been established. Detailed information about intake of minerals can be found in Table 4.

Children's eating behaviour

Food preferences

One-third of the surveyed children (34%) indicated that fruit was the food group they liked the most, followed by milk (23%), meat and grains (15% for both), and vegetables (9%). In terms of food colour preference, red foods were the most popular (26%), followed by orange (21%), yellow (19%), green (15%) and blue/purple (7%); a preference was not indicated by 12% of children, either because they were not sure of their favourite colour or they did not have one favourite colour. Foods served warm were preferred by the majority of the surveyed children (54%), followed by foods served at room temperature (22%), cold (20%) and hot (2%).

Acceptance of a new food/dish

The majority of those surveyed (56%) indicated that they would sometimes accept new foods or dishes when served; 37% always accepted; and 7% never accepted new foods or dishes.

Duration of a meal and self-feeding capability

Nearly 60% of the surveyed children took approximately 30 minutes to 1 hour to finish a meal; 28.8% of the children needed less than 30 minutes; 10.3%, 1 to 1.5 hours; 1.7%, 1.5 to 2 hours; and 0.3%, more than 2 hours. Most parents (98%) indicated that their children were able to feed themselves.

Parental feeding behaviour

Experience with feeding difficulties

Parents were asked if they experienced difficulties relating to feeding their child, without being provided the definition of 'feeding difficulty'. Most parents (56%) reported that they sometimes experienced feeding difficulties, 21% reported that they always experienced feeding difficulties, and 23% reported that they never had feeding difficulties.

Consultation with healthcare professionals (HCPs) and confidence in establishing healthy eating behaviours

Of the 77% of parents who indicated that their child sometimes/always experienced feeding difficulties, only 30% had consulted an HCP. Among all the surveyed parents, approximately 15% had consulted with doctors, while 15% and 7% had consulted with nurses and registered dieticians or nutritionists, respectively. Although more than 70% indicated feeding difficulties, over 60% of the parents surveyed indicated that they were confident in helping their child develop healthy eating behaviours.

Dietary supplements

More than half (67.4%) of the parents reported that they provided dietary supplements to their child. Cod liver oil was the most popular supplement (40.8%), followed by vitamin C (19.0%), vitamin A+D (13.6%), multivitamins (8.2%), and vitamin A+D with calcium (4.8%).

Approximately 36% of children indicated that they were currently consuming formula milk. For those who indicated consuming formula milk regularly, cow's milk-based was the most common type of formula milk, which was consumed by over 96% of the children. Two percent consumed goat's milk-based formula.

School nutrition environment

Foods and drinks provided by kindergartens

The most common foods provided to children at schools included bread/cake/biscuits (65%), followed by rice/noodles/congee (57%), meat (35%), vegetables (30%), macaroni (22%), fruit (22%), and cereal or oatmeal (9%). Water (91%) was the most common beverage provided to students at preschools, followed by milk (52%), ready-to-mix powdered drinks (30%), juice concentrate (17%) and soymilk (8%).

All the kindergarten principals agreed with the statement, "Nutrition is important to children". Overall, 87% of the principals indicated that they would like a nutritionist or registered dietician to evaluate their school's meal plans. Similarly, 87% would like their staff to receive nu-

Table 3. Intake results of vitamins, with comparisons to recommendations

Nutrients	Recommendations		Overall (n=302)					
			Mean±SD	Min-Max	Mean %R±SD	Mean %UL±SD	*p* value*	
Vitamin A RAE (mcg)	RDA†	UL†						
	2.5-3 y: 300 4-5 y: 400	2.5-3 y: 600‡ 4-5 y: 900‡	510±258	51.2-1910	149±80.0	70.8±39.9	<0.001	AS
Vitamin D (mcg)	RNI§	UL§						
	2.5-3 y: 10 4-5 y:10	2.5-3 y: ND 4-5 y: 20	5.84±3.60	0.57-37.3	58.4±36.0	N/A¶	<0.001	I
Vitamin E alpha-TE (mg)	AI§	UL†						
	2.5-3 y: 4 4-5 y: 5	2.5-3 y: 200 4-5 y: 300	7.35±5.48	1.13-70.5	164.8±119	3.04±2.20	<0.001	AS
Vitamin K (mcg)	AI†	UL						
	2.5-3 y: 30 4-5 y: 55	2.5-3 y: ND 4-5 y: ND	145±160	11.9-1150	368±430	N/A¶	<0.001	AS
Vitamin C (mg)	RNI§	UL§						
	2.5-3 y:60 4-5 y: 70	2.5-3 y: 600 4-5 y: 700	93.0±111	8.27-1360	145±182	14.5±18.2	<0.001	AS
Thiamin (mg)	RNI§	UL§						
	2.5-3 y: 0.6 4-5 y: 0.7	2.5-3 y: 50 4-5 y: 50	1.27±0.42	0.34-3.20	196±66.1	2.54±0.84	<0.001	AS
Riboflavin (mg)	RNI§	UL						
	2.5-3 y: 0.6 4-5 y: 0.7	2.5-3 y: ND 4-5 y: ND	1.18±0.40	0.30-3.28	182±62.6	N/A¶	<0.001	AS
Niacin NE (mg)	RNI§	UL§						
	2.5-3 y: 6 4-5 y: 7	2.5-3 y: 10 4-5 y: 15	24.9±7.82	7.14-53.7	N/A¶	248±78.2	<0.001**	E
Vitamin B-6 (mg)	AI§	UL†						
	2.5-3y: 0.5 4-5y: 0.6	2.5-3 y: 30 4-5 y: 40	1.11±0.44	0.26-3.27	203±82.3	3.22±1.36	<0.001	AS
Vitamin B-12 (mcg)	AI§	UL						
	2.5-3y: 0.9 4-5y: 1.2	2.5-3 y: ND 4-5 y: ND	3.33±3.70	0.37-55.4	319±322	N/A¶	<0.001	AS
Folic acid DFE (mcg)	RNI§	UL§						
	2.5-3y: 150 4-5y: 200	2.5-3 y: 300 4-5 y: 400	341±128	103-1010	198±79.8	99.0±39.9	<0.001	AS
Pantothenic acid (mg)	AI§	UL						
	2.5-3 y: 2 4-5 y: 3	2.5-3 y: ND 4-5 y: ND	3.74±1.35	1.22-12.0	156±66.4	N/A¶	<0.001	AS

%R: percentage of recommendations of RNI, RDA or AI; %UL: percentage of tolerable upper intake level; AI: adequate intake; AS: adequate or sufficient; DFE: dietary folate equivalent; E: excessive; I: inadequate intake; Max: maximum; Min: minimum; N/A: not applicable; ND: not determined; NE: niacin equivalent; RAE: retinol activity equivalent; RDA: recommended dietary allowances; RNI: recommended nutrient intake; SD: standard deviation; TE: tocopherol equivalent; UL: tolerable upper intake level; y: years of age.

*Comparison between intake and the recommendations of RNI, RDA or AI unless otherwise indicated.

**Comparison between intake and UL.

†Recommendation from the Institute of Medicine, National Academies.

‡As preformed vitamin A only.

§Chinese recommendation developed by the Chinese Nutrition Society.

¶Not applicable due to intake below RNI, above UL or no UL established.

trition training. Overall, 61% either agreed or strongly agreed with the statement, "Your school has used food as a reward". When choosing food or food suppliers, the main factors that the principals considered were nutrition (96%), food variety (96%) and food allergies (96%), followed by price (83%) and level of preparation (83%).

DISCUSSION

Regarding children's diet quality in terms of food group consumption, the mean intake of vegetable and fruit were 1.54 and 1.08 servings, respectively, which meet the recommendation of at least 1.5 servings for vegetable and at least 1 serving for fruit. Therefore, intake of vegetable and fruit were adequate. For grain group, it was also found that consuming at 4.8 servings of grain meet the recommendation of 3 to 6 servings. For milk and dairy group (including formula milk), 1.54 servings were consumed. This reflected that milk group was consumed inadequately with the recommendation of 2 servings daily. For the meat group, it was found that 4.3 servings was consumed, which exceeded the recommendation of 2 to 4 serving daily after conversion. It should be noted that some foods, such as cream, butter, syrup, fried food items, were not included in any of these groups.

Table 4. Intake results of minerals and other substances, with comparisons to recommendations

Nutrients	Recommendations		Overall (n=302)					
			Mean±SD	Min-Max	Mean %R±SD	Mean %UL±SD	*p* value*	
Calcium (mg)	AI†	UL†						
	2.5-3 y: 600	2.5-3 y: 2,000	586±239	166-1490	85.8±39.5	N/A‡	<0.001	I
	4-5 y: 800	4-5 y: 2,000						
Phosphorus (mg)	AI†	UL†						
	2.5-3 y: 450	2.5-3 y: 3,000	845±266	220-1850	178±57.9	28.2±8.88	<0.001	AS
	4-5y: 500	4-5 y: 3,000						
Potassium (mg)	AI†	UL						
	2.5-3 y: 1,000	2.5-3 y: ND	1550±527	400-3760	128±51.5	N/A‡	<0.001	AS
	4-5 y:1,500	4-5 y: ND						
Sodium (mg)	AI†	UL§						
	2.5-3 y: 650	2.5-3 y: 1,500	1870±722	461-5610	N/A‡	110±43.2	<0.001*	E
	4-5 y: 900	4-5 y: 1,900						
Magnesium (mg)	AI†	UL†						
	2.5-3 y: 100	2.5-3 y: 200	168±56.3	49.3-446	139±56.2	69.5±28.1	<0.001	AS
	4-5 y: 150	4-5 y: 300						
Iron (mg)	AI†	UL†						
	12	30	11.1±3.72	3.66-27.9	92.5±31.0	N/A‡	<0.001	I
Zinc (mg)	RNI†	UL†						
	2.5-3 y: 9	2.5-3 y: 23	6.98±2.18	2.69-15.3	67.7±24.0	N/A‡	<0.001	I
	4-5 y: 12	4-5 y: 23						
Copper (mg)	AI†	UL†						
	2.5-3 y:0.8	2.5-3 y: 2.0	0.91±0.28	0.32-2.59	102±34.9	52.7±18.9	0.402	AS
	4-5 y: 1.0	4-5 y: 3.5						
Selenium (mcg)	RNI†	UL†						
	2.5-3 y: 20	2.5-3 y: 180	88.5±29.7	24.4-199	396±140	60.9±24.0	<0.001	AS
	4-5y: 25	4-5 y: 240						
Choline (mg)	AI†	UL†						
	2.5-3 y: 200	2.5-3 y: 1,000	224±77.0	36.1-493	101±37.2	18.6±7.70	0.720	AS
	4-5 y: 250	4-5 y: 1,500						
Manganese (mg)	AI§	UL§	2.35±0.85	0.70-5.61	175.6±67.7	97.3±41.5	<0.001	AS
	2.5-3 y: 1.2	2.5-3 y: 2						
	4-5 y:1.5	4-5 y: 3						
Lutein & Zeaxanthin (mcg)	ND	ND	1.90^{-3}±2270	53.0-22500	N/A‡	N/A‡	N/A‡	N/A‡
Lycopene (mcg)	ND	ND	1180±1780	0.00-11900	N/A‡	N/A‡	N/A‡	N/A‡

%R: percentage of recommendations of RNI, RDA or AI; %UL: percentage of tolerable upper intake level; AI: adequate intake; AS: adequate or sufficient; E: excessive; I: inadequate intake; Max: maximum; Min: minimum; N/A: not applicable; ND: not determined; RDA: recommended dietary allowances; RNI: recommended nutrient intake; SD: standard deviation; UL: tolerable upper intake level; y: years of age.

*Comparison between intake and the recommendations of RNI, RDA or AI unless otherwise indicated.

**Comparison between intake and UL.

†Chinese recommendation developed by the Chinese Nutrition Society.

‡Not applicable due to intake below RNI, above UL or no UL established.

§Recommendation from the Institute of Medicine, National Academies.

Regarding children's diet quality in terms of nutrient consumption, this study showed that while the percentages of energy from carbohydrate, protein and total fat were within the IOM AMDRs, the intakes of carbohydrate and protein in grams, and percent of saturated fat, exceeded the recommendations. This study also found that 60% of the total protein intake was derived from animal products. Although no recommendation for animal-to-vegetable protein ratio has been set, studies in adults have found that vegetable protein is associated with decreased mortality and health risks, including cancer, cardiovascular disease and obesity.[16-22] Furthermore, a German study suggested that the ages 1 year and 5 to 6 years represent critical periods when animal protein intake has an influence on later obesity risk.[23] Animal protein was also found to be associated with a higher risk of some cancers, stroke and obesity in adults and adolescents.[20,21,24-26]

This study also showed that in Hong Kong preschool children, some nutrients were consumed in inadequate amounts (i.e., vitamin D, calcium, iron and zinc) while others were consumed in excess amounts (e.g., niacin and sodium). It is widely accepted that inadequate intake of vitamin D and calcium can affect the attainment of maximum peak bone mass among children.[27] It is also known that iron insufficiency may affect learning ability, behaviour, intellectual performance and cognitive development.[28,29] Low zinc intake may lead to poor growth and development.[30] Consumption of dietary sodium that ex-

ceeds recommended levels may put a child at risk of hypertension later in life.[31] Suboptimal childhood nutrition has been established as a risk factor for chronic diseases.[32] Furthermore, dietary habits established in childhood are often carried through to adulthood; therefore, a childhood diet that is suboptimal is likely to persist into adulthood.[2,33] Thus, attention should be paid to children's intake of these nutrients.

Regarding children's eating behaviour, parents' feeding practices and kindergarten nutrition environment, this study showed that while most of the children were able to feed themselves, parents reported that feeding assistance was often required during mealtime due to children being unwilling to self-feed. Food intake may differ between children who self-feed and those who require feeding assistance. Children may not be able to make their own food choices during mealtimes when fed by their parents. Therefore, it would be worth conducting further investigations in this area. Feeding difficulties were commonly reported by parents and caregivers but consulting with HCPs to overcome these difficulties was not a common practice in Hong Kong. A few possible reasons may contribute to this phenomenon. Firstly, parents may be misled into thinking that using nutrition supplements can overcome or compensate for any feeding issues. They may, therefore, think that seeking professional assistance is unnecessary as long as their child received nutrition supplements. Secondly, some parents reported that they had no intention of consulting with HCPs for their child's feeding difficulties. Parents consulted HCPs only when their child was ill or in conjunction with routine health check-ups at Maternal and Child Care Centres. This implied that parents did not identify a need to seek assistance or professional advice for their child's feeding difficulties. Moreover, parents rarely sought help from registered dieticians or nutritionists for feeding difficulties. It may be valuable to study the reasons behind this finding.

Information on the common foods and drinks provided by kindergartens was also obtained. Although detailed information, such as the types of bread or whether the drinks were sweetened or otherwise, was not reported, the results give a snapshot of the foods and drinks children commonly consumed at schools and schools' perceptions on nutrition, providing valuable information for developing school-based nutrition promotion programmes or interventions.

This study has several strengths. It provides a comprehensive overview of Hong Kong children's nutrition intake. The study interviewed not only parents and guardians, but also all individuals responsible for the provision of the children's meals; this allowed the collection of detailed information for analysing nutrient intakes in local children. In addition, the study design, with multiple 24-hour dietary recalls covering both weekdays and weekends, provided a comprehensive view of a child's diet quality. Although detailed information on children's eating behaviour, parents' feeding practices and school nutrition environment – such as types of feeding difficulties, reasons for not consulting HCPs, and types of milk provided by preschools –were not obtained, this study provides clues for what areas are worth studying in future.

This study had some limitations. Hong Kong lacks a comprehensive nutrient composition database; as such, the survey data needed to rely on overseas databases to translate food intake into nutrient intake, potentially leading to a margin of error due to information on ethnic/local foods being unavailable in the database. Some nutrients, such as iodine, were not analysed as they were not available in the NDSR database. To date, Hong Kong does not have its own dietary reference intake; therefore, intakes were compared with various recommendations developed in other study populations and countries. Moreover, the Hong Kong government does not have an official guidance for which set (s) of dietary reference intakes to use; this made the accurate interpretation of the survey results difficult.

Conclusion

This study provided an overview of the diet quality of local preschool children, their eating behavioural patterns, parents' feeding practices, as well as their schools' nutrition environment. These results will be useful for developing nutrition interventions to improve children's diet quality. Future studies on diet and eating behaviours should be carried out to map the trends in diet and eating behaviours.

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AUTHOR DISCLOSURES

We declare no conflict of interest.

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