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Adult breakfast habits and nutritional status: a household based cross-sectional study in Zhejiang Province, China

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ABSTRACT

Background and Objectives: Although Dietary Guidelines for Chinese Residents offers advice for breakfast in China, current breakfast consumption habits are unclear. The aim of this study was to describe the frequency of breakfast consumption among adults and explore its associations with daily food consumption and daily nutrient intake. **Methods and Study Design:** A stratified cluster sampling technique was employed in this cross-sectional study. Demographic characteristics, breakfast consumption, and daily food and nutrient intake were investigated. **Results:** Dietary data were collected for 3251 adult residents through interviews. We determined that residents with an annual income of <CN¥10000 were the group with the highest rate of breakfast consumption. Among adults living at home, those who were retired had the highest proportion of breakfast eaters (92.1%), whereas among adults not living at home, commercial services and production personnel had the highest proportion of breakfast eaters (83.8%). Residents who never ate breakfast had a lower daily intake of rice, dark-colored vegetables, pork, poultry, and fish and shrimp and a higher daily intake of bean products and instant foods ($p<0.05$). Residents who never ate breakfast had a higher daily intake of energy, fat, and carbohydrates, and a lower intake of protein, retinol, vitamins A and C, carotene, Ca, P, K, Mg, Zn, Se, and Mn ($p<0.05$). **Conclusions:** Breakfast skipping may influence the daily intake of nutrients. A simple and important public health message should be delivered to target populations.

Key Words: breakfast, food, nutrition, adult

INTRODUCTION

Breakfast consumption is widely considered to be an important component of healthy eating habits because it can help ensure adequate nutrient intake and may have several health benefits.^{1,2} Breakfast habits and trends and their health implications in the Asia Pacific Region are listed in Table 1. Although country and regional differences exist, in most southeast Asian countries, grain and cereal products, such as rice, wheat, and rice noodles, are dietary staples of breakfast.³ Eating habits have changed over time, and the health implications of these changes warrant further investigation. Yoo KB reported that breakfast consumption was associated with metabolic syndromes. Eating dairy–cereal or high energy and fiber breakfasts was associated with a reduced risk of metabolic syndromes.⁴ Frequent breakfast skipping was associated with higher rates of overweight and obesity among ethnic Fijian youth.⁵ A study reported that breakfast consumption frequency was associated with grip strength in a

population of healthy Japanese adults.⁶ Uzhova I's study reported that skipping breakfast was associated with an increased odds ratio of prevalent noncoronary and generalized atherosclerosis independent of the presence of conventional cardiovascular risk factors,⁷ and it has been demonstrated to be linked to several cardiometabolic health outcomes, including blood pressure, insulin sensitivity, and dyslipidemia.⁸⁻¹¹ A high-quality diet is believed to play a functional role in promoting healthy growth and preventing several kinds of chronic degenerative diseases. The Dietary Guidelines for Chinese Residents (2016) and the Chinese Food Pagoda have recommended skipping breakfast, despite a lack of investigation into its effects and its connection to demographic characteristics. In the United States, the nationwide food consumption survey reported that breakfast consumption had decreased from 86% (1965) to 75 % (1991).¹² This trend may have adverse consequences. Skipping breakfast has become increasingly prevalent in recent years. A study in China reported that 91.1% (26 776 of 29 393) of children aged 6 to 17 years ate breakfast daily.¹³ A study on Inner Mongolia medical students in China revealed that the overall prevalence of skipping breakfast was 41.7% and 23.5% for men and women, respectively,¹⁴ yet studies among adults in mainland China are scarce. We investigated breakfast-skipping behaviors among adults explored their associations with daily food and nutrient intake.

MATERIALS AND METHODS

Study design and participants

Between 2010 and 2012, dietary data were collected from 3251 adult residents through interviews. Stratified random sampling was used to select 450 households according to household registration information, and every member of each sampled household was interviewed. The dietary survey group comprised 30 households selected among every sampling unit, and the group not administered the dietary survey consisted of the other households. All participants completed a food frequency questionnaire (FFQ), but the dietary survey group also received 3 consecutive days of 24-h dietary recall investigation. Dietary data received from the 3 consecutive days of 24h dietary recall investigation was used to analyze food and nutrition intake.

This study was approved by the Ethics Committee of Zhejiang Provincial Center for Disease Control and Prevention (Ethical approval code: T-043-R-2010). In accordance with ethical requirements, all personal information was kept confidential. Informed consent was obtained from all participants. All methods were applied in accordance with the relevant guidelines and regulations.

Definition of breakfast consumption and collection of dietary information

As the primary outcome, breakfast consumption was recorded as 1–7 times per week in the FFQ and then classified into three groups: “never” (0 days/week), “sometimes” (1–7 days/week), and “daily” (7 days/week). Consumption of oils, sugar, and salt was determined by calculating the changes in home food inventory according to weight.¹⁵ Dietary intake data were derived from 24-h recall on 3 consecutive days. These data were combined with the weights of items in the household food inventory, and then the food records were coded and calculated according to food category, including rice and its products, wheat flour and its products, bean products, dark-colored vegetables, light-colored vegetables, fruit, pork, poultry, eggs, fish and shrimp, cookies, instant foods, and beverages. Energy and nutrient intake were also calculated through 3 consecutive days of 24-h dietary recall in conjunction with the China Food Composition Table published in 2002.¹⁶ The questionnaire was administered by trained staff through door-to-door interviews. We verified the data before analysis and excluded any implausible results, such as energy intake of <500 kcal or >5000 kcal per day.

Measuring food quality

We used the dietary diversity score (DDS) to measure dietary diversity. According to the nutritional composition, the 12 principal categories of food ingredients were divided into 6 categories (grains/starchy tubers, vegetables, fruits, livestock/fish products, dairy products, and beans/eggs/nuts). If the total consumption for each food group was higher than 25 g/d (the grouping threshold value of milk is 10g/d), then the value for that group was 1, and otherwise the value was 0. DDS values ranged from 0–6.

Anthropometric measurements

Height was measured without shoes to the nearest 0.2 cm using a portable SECA stadiometer, and weight was measured without shoes and in light clothing to the nearest 0.1 kg on a calibrated beam scale. Body mass index (BMI) was calculated as weight (kg)/height (m)².

Statistical analysis

Because the continuous variables were not normally distributed, they were presented as the median and 25th and 75th percentiles. A comparison of the three breakfast consumption frequency groups (never, sometimes, daily) in terms of demographic characteristics was performed using a nonparametric test (Kruskal–Wallis H test). The distributions of demographic factor proportions were compared using the X^2 test. Data processing and

statistical analyses were performed using SAS9.2 software. All tests were two-sided, and significance was set at $p < 0.05$.

Patient and public involvement

Neither patients nor the public were involved in this study.

Ethical approval and consent to participate

This study was approved by the Ethics Committee of Zhejiang Provincial Center for Disease Control and Prevention (ethical approval code: T-043-R-2010). All personal information was kept confidential in accordance with ethical requirements. Informed consent was obtained from all participants.

RESULTS

Demographic characteristics of residents with different breakfast consumption frequencies

A total of 3251 adult residents (1585 male residents, 1666 female residents) provided demographic and dietary information. The DDSs for residents who consumed breakfast never, sometimes, and daily are presented in Table 2. Demographic characteristics are shown in Table 3 and Table 4. There was no significant difference between men and women regarding breakfast consumption ($p > 0.05$). Residents who never had breakfast were younger and had a lower BMI ($p = 0.000$). Residents with an annual income of $< \text{CN¥}10000$ were the group with the highest rate of breakfast consumption. Among the different occupations of adults living at home, retired participants had the highest rate of breakfast consumption (92.1%, $p = 0.000$). Among the different occupations of adults not living at home, commercial services and production personnel had the highest rates of breakfast consumption (83.8%, $p = 0.000$). Among adults not living at home, residents with a primary or middle school education level were less inclined to have breakfast daily ($p = 0.000$), whereas, among adults living at home, there were no significant differences among residents with different education levels ($p > 0.05$).

Daily food consumption and nutrient intake among residents with different breakfast consumption frequencies

Residents who never ate breakfast had lower daily intake of rice and its products, dark-colored vegetables, pork, poultry, and fish and shrimp compared with residents who had breakfast sometimes or daily ($p < 0.05$), whereas they had higher daily intake of bean products and instant foods ($p < 0.05$) (Table 5). Residents who never ate breakfast had higher daily

intake of energy, fat, and carbohydrates and lower intake of protein, retinol, vitamins A and C, carotene, Ca, P, K, Mg, Zn, Se, and Mn compared with residents who had breakfast sometimes or daily ($p<0.05$) (Table 6). The median daily energy intake of residents who never had breakfast, sometimes had breakfast, and had breakfast daily was 2010, 1674, and 1896 kcal, respectively ($p<0.05$), and the median daily protein/fat/carbohydrates intake were 62/82/248 g, 62/82/161 g, and 66/73/225 g, respectively ($p<0.05$).

DISCUSSION

Breakfast consumption may have several health benefits, and food diversity scores may have value in nutritional health assessments.¹⁷ A study in Taiwan suggested that for DDS, the multivariable HRs (95% CI) were 0.74 (0.55–1.00), 0.52 (0.38–0.72) and 0.50 (0.31–0.81) for people with a DDS of 4, 5, and 6, respectively, compared with participants with a DDS of ≤ 3 . Total cancer, diabetes mortality, and pneumonia rates exhibited similar improvements according to the trends.¹⁸ In this study, we found that residents who consumed breakfast daily had higher DDSs.

In 2003, Hulshof KF reported that the prevalence of obesity and skipping breakfast was higher among people with a low socioeconomic status.¹⁹ However, the current study found that residents with an annual income of $< \text{CN¥}10\,000$ had the highest rate of breakfast consumption. Our findings are consistent with those of a study conducted in Korea that determined that students who received the largest amount of spending money were also the group with the highest meal-skipping rate in both sexes.²⁰ This is consistent with the finding of a study conducted in Iran that meal frequency in lower socioeconomic regions was significantly higher than that in two other regions for the age groups of 10–13 and 10–18 years.²¹ We found that among adults living at home, those who were retired had the highest rate of breakfast consumption compared with adults who had different occupations. Differences in height, weight, and BMI were noted. Residents who never had breakfast were younger and had a lower BMI. This may be because retired adults are more likely to have regular habits of work and rest, as was reported by Gong CH.²² A longitudinal analysis revealed that skipping breakfast led to increased changes in waist-to-height ratio, weight, and BMI measures. It also led to higher risk of abdominal obesity and overweight at follow-up.²³ We also found that residents who sometimes ate breakfast were more likely to be overweight or obese. This finding is consistent with a report on healthy eating in Polish teenagers.²⁴ A study reported that insufficient sleep was associated with breakfast consumption and several important sociodemographic and lifestyle behaviors.²⁵ Lack of sleep may be the reason for the

relationship between height and breakfast consumption. We also found that among adults not living at home, commercial services and production personnel had the highest rate of breakfast consumption compared with people of different occupations. Chinese rural-to-urban migrant workers employed in the service industry are a rapidly growing population in China.²⁶ Adults who work in commercial services and factories also have routine working hours. Consequently, they must eat breakfast because they usually cannot eat again before noon. Adequate consumption of vegetables is necessary for a balanced diet and is associated with a reduced risk of chronic diseases.²⁷ High vegetable consumption is related to reduced risk of all-cause mortality.²⁸ In this study, we found that skipping breakfast was associated with low daily intake of rice, dark-colored vegetables, pork, poultry, and fish and shrimp as well as with higher daily intake of bean products and instant foods, which is consistent with the findings of other studies.²⁹⁻³¹

A study conducted in Mexico determined that compared with people who had all other breakfast dietary patterns, those who skipped breakfast had the lowest intake of several nutrients of concern regarding public health.³² Moreover, a study conducted in Australia determined that people who consumed cereal for breakfast had higher intakes of dietary fiber and most micronutrients compared with those who did not eat cereal for breakfast and those who skipped breakfast.³³ Fayet-Moore reported that breakfast consumers had significantly higher intakes of calcium and folate and significantly lower intakes of total fat compared with breakfast skippers. We discovered that residents who never consumed breakfast had higher daily intakes of energy, fat, and carbohydrates and lower intakes of protein, retinol, vitamins A and C, carotene, Ca, P, K, Mg, Zn, Se, and Mn compared with residents who consumed breakfast sometimes or daily. Mielgo-Ayuso reported that regular breakfast consumption was associated with higher blood vitamin D levels and high intakes of vitamin D and total folate.³⁴ Our findings accord with those published by Mielgo-Ayuso regarding the association between breakfast and nutrient intake. Furthermore, Lee investigated the correlations between micronutrients in the diet of family members and possible risk factors for children and adolescents consuming an inadequate diet and found that more than half of sons and daughters had insufficient intake of vitamins A and C and iron, and both mothers and fathers had insufficient intake of vitamins A, B-2, and C. The coefficient of the correlation between a poor diet in parents and poor diet in offspring was 0.17. Additionally, eating breakfast had a significant protective effect against the risk of poor nutrition in offspring.³⁵ A study conducted in Japan reported that skipping breakfast was associated with menstrual disorders and affected the physical condition of female college students who were undergoing postadolescent

maturation.³⁶ Osera reported that favoring home meals during adolescence led to the development of good eating habits such as eating breakfast.³⁷ Therefore, it is important that adults, especially parents, be encouraged to eat breakfast to improve the quality of their diet. In Japan, Shokuiku aims to support food culture, especially through school-based programs, as well as improve the food environment by providing information on appropriate diets. This practice can be introduced in nutrition education in other Asian countries.³⁸ Moreno suggested that scientists and public health authorities should raise awareness of the importance of a healthy and sustainable lifestyle as the foundation of current and future health in European populations.³⁹ From an educator's perspective, university and college represent the final opportunity to provide health and nutritional education to a large number of students.⁴⁰ A review of research on the changes in the nutrition standards of the United States Department of Agriculture child meal programs revealed that there is a critical need for policy change to enable updates to the summer food service program nutrition standards to match those of national school lunch and breakfast programs. Strategies that facilitate the development of menus for child meal programs that meet current nutrition standards must be developed. 41 Our study findings on the association of sociodemographic characteristics with breakfast consumption tendencies could inform policy development. To formulate health promotion programs, more emphasis should be placed on regular breakfast consumption. Residents with a high annual income and younger age should be targeted. Regarding anthropometric characteristics, we found that residents who never ate breakfast had lower weight and lower BMI compared with those who ate breakfast. Breakfast consumption should be especially encouraged for residents with lower weights and BMIs.

Conclusions

As demonstrated in the conceptual diagram, we revealed a high prevalence of breakfast skipping among adults and demonstrated that skipping breakfast was associated with relatively low daily intakes of rice, dark-colored vegetables, pork, poultry, and fish and shrimp as well as of protein, retinol, vitamins A and C, carotene, Ca, P, K, Mg, Zn, Se, and Mn. When formulating health promotion programs, more emphasis should be placed on regular breakfast consumption.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare no conflict of interest.

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Table 1. Summary of breakfast habits, the trends and the health implications in the Asia Pacific Region

Year	Title	Contents
1993	Breakfast habits in the Asia Pacific Region	Although country and regional differences occur, the first meal of the day, breakfast, tends to take the form of a traditional meal in most south-east Asian countries. Grain and cereal products, such as rice and wheat and rice noodles, appear to be dietary staples at breakfast. In some countries, the more traditional grain products are being replaced by alternative cereals, such as bread.
2014	Breakfast eating patterns and the metabolic syndrome: the Korea National Health and Nutrition Examination Survey (KNHANES) 2007-2009.	Breakfast consumption is associated with the metabolic syndrome. Not all breakfast consumption patterns are associated with a reduced risk of having the metabolic syndrome. Eating either a dairy-cereal breakfast or high energy and fiber breakfast are associated with a reduced risk of the metabolic syndrome.
2010	Breakfast skipping as a risk correlate of overweight and obesity in school-going ethnic Fijian adolescent girls.	The study demonstrated that greater eating pathology was associated with greater odds of both overweight and obesity.
2012	School-based “Shokuiku” program in Japan: application to nutrition education in Asian countries.	The increased obesity among them is possibly associated with inappropriate dietary habits (eg skipping breakfast, excessive fat intake and insufficient vegetable). Shokuiku’s efforts expand to support food culture, especially through school-based programs, as well as to improve food environment by providing information on appropriate diets.
2010	Skipping breakfast is associated with reproductive dysfunction in post-adolescent female college students.	The 5 annual surveys of questionnaire demonstrated that the severity of dysmenorrhea was significantly higher in the population that skipped breakfast. The incidence of irregular menses was also higher in the population that skipped breakfast. The group that skipped breakfast showed a tendency to suffer from constipation.
2005	Nutritional knowledge, food habits and health attitude of Chinese university students—a cross sectional study	The university and college arenas represent the final opportunity for the health and nutritional education of a large number of students from the educator’s perspective. Our findings suggest the need for strategies designed to improve competence in the area of nutrition.
2010	Skipping breakfast: longitudinal associations with cardiometabolic risk factors in the Childhood Determinants of Adult Health Study	Skipping breakfast over a long period may have detrimental effects on cardiometabolic health.
2015	Breakfast is associated with the metabolic syndrome and school performance among Taiwanese children.	Consuming breakfast daily is associated with better school performance, a lower risk of high blood pressure, and MetS independent of overall dietary quality. Thus, breakfast on school days is a factor in school performance and health.
2008	A global overall dietary index: ODI-R revised to emphasize quality over quantity.	A subtraction scoring approach for the overeating of protein rich foods, did not meaningfully decrease ODI-R in Taiwanese elderly or children. ODI-R provides an effective measure of dietary quality over quantity.

Table 2. Dietary diversity score among residents with different breakfast consumption frequency

Components	Never		Sometimes		Daily	
	Mean	Score	Mean	Score	Mean	Score
Grains/starchy tubers (g)	213.9	1	268.9	1	279.1	1
Vegetables (g)	182.2	1	284.6	1	309.3	1
Fruits (g)	0	0	13.6	0	73.8	1
Livestock / aquatic products (g)	66.1	1	197.7	1	184.2	1
Dairy products (g)	0	0	0	0	0	0
Beans / eggs / nuts (g)	5.6	0	30.6	1	41	1
DDS		3		4		5

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Table 3. Demographic characteristics among residents with different breakfast consumption frequency (living at home / Not living at home)

Characteristics	Breakfast			χ^2	<i>p</i> value	
	Never	Sometimes	Daily			
Gender	Male Female	26 (17.0%) / 464 (32.4%) 32 (28.8 / 451 (29%)	2 (1.3%) / 49 (3.4%) 2 (1.8%) / 46 (3.0%)	125 (81.7%) / 919 (64.2%) 77 (69.4%) / 1058 (68.0%)	5.427/4.994	0.066 / 0.082
Education	Illiterate Primary school Middle school Academic high school	1 (11.1%) / 64 (15.3%) 11 (20.8%) / 351 (35.2%) 32 (20.3%) / 471 (34.6%) 14 (31.8%) / 29 (13.7%)	0 (0%) / 14 (3.3%) 0 (0.0%) / 33 (3.3%) 2 (1.3%) / 36 (2.6%) 2 (4.5%) / 12 (5.7%)	8 (88.9%) / 340 (81.3%) 42 (79.2%) / 612 (61.4%) 124 (78.5%) / 855 (62.8%) 28 (63.6%) / 170 (80.6%)	7.538/97.888	0.274 / 0.000
Occupation	Student Housework the retired Institution Personnel Commercial services and production personnel	9 (45.0%) / 10 (32.3%) 8 (33.3%) / 311 (45.5%) 0 (0.0%) / 11 (2.1%) 14 (36.8%) / 107 (32.2%) 18 (15.4%) / 341 (30.4%)	1 (5.0%) / 3 (9.7%) 0 (0.0%) / 17 (2.5%) 1 (50%) / 30 (5.8%) 1 (2.6%) / 13 (3.9%) 1 (0.9%) / 22 (2.0%)	10 (50.0%) / 18 (58.1%) 16 (66.7%) / 355 (52.0%) 1 (50%) / 478 (92.1%) 23 (60.5%) / 212 (63.9%) 98 (83.8%) / 759 (67.6%)	22.74/366.751	0.000 / 0.000
Annual income	<10000 Yuan 10000-19999 Yuan 20000-29999 Yuan 20000-39999 Yuan >40000 Yuan	2 (1.9%) / 84 (15.0%) 19 (20.0%) / 366 (34.2%) 12 (48.0%) / 197 (30.7%) 6 (46.2%) / 86 (38.4%) 14 (87.5%) / 100 (34.2%)	0 (0.0%) / 15 (2.7%) 2 (2.1%) / 35 (3.3%) 2 (8.0%) / 29 (4.5%) 0 (0.0%) / 5 (2.2%) 0 (0.0%) / 6 (2.1%)	105 (98.1%) / 460 (82.3%) 74 (77.9%) / 669 (62.5%) 11 (44.0%) / 415 (64.7%) 7 (53.8%) / 133 (59.4%) 2 (12.5%) / 186 (63.7%)	91.218/86.829	0.000 / 0.000

Table 4. Anthropometry characteristics among residents with different breakfast consumption frequency

	Never			Sometimes			Daily			H	<i>p</i> value
	25%	50%	75%	25%	50%	75%	25%	50%	75%		
Age	38.8	48.3	57.8	43.5	56.5	66.5	39.4	53.1	63.4	20.140	0.000
Height(m)	153.0	159.1	166.5	153.0	158.0	164.5	154.1	160.0	166.2	6.926	0.001
Weight(kg)	48.2	56.4	64.5	53.0	57.1	65.0	51.9	58.8	66.4	19.034	0.000
BMI(kg/m ²)	19.4	21.9	24.5	20.8	23.6	25.5	20.7	23.0	25.2	23.939	0.000
SBP(mmHg)	107.0	115.3	131.7	112.0	121.0	131.1	110.7	122.7	137.2	0.673	0.510
DBP(mmHg)	62.7	81.3	88.3	72.0	79.0	82.7	72.2	79.3	85.0	0.300	0.741

Table 5. Daily food consumption characteristics among residents with different breakfast consumption frequency

	Never			Sometimes			Daily			H	p value
	25%	50%	75%	25%	50%	75%	25%	50%	75%		
Rice and its products (g)	117.64	186.60	259.45	150.00	181.67	267.55	150.00	207.26	282.51	38.681	0.000
Wheat flour and its products (g)	32.76	59.29	97.60	23.33	55.83	108.08	31.49	62.34	100.00	0.421	0.810
Bean products (g)	0.00	9.74	20.18	2.35	7.06	21.33	1.71	8.24	19.23	14.431	0.001
Dark colored vegetables (g)	31.17	58.34	116.66	18.72	60.01	107.09	35.50	75.54	133.33	14.767	0.001
Light colored vegetables (g)	100.00	173.35	269.98	96.39	196.67	285.42	115.37	176.67	250.59	2.896	0.235
Fruits (g)	0.00	60.00	109.08	0.00	0.00	0.00	0.00	0.00	127.25	24.974	0.000
Pork (g)	13.33	32.33	69.83	28.42	66.67	109.35	16.67	46.67	91.67	17.43	0.000
Poultry (g)	0.00	0.00	23.00	0.00	16.67	42.09	0.00	10.00	41.67	12.08	0.002
Eggs (g)	0.00	14.67	30.00	0.00	8.33	33.33	0.00	20.00	41.67	4.43	0.109
Fish and shrimp (g)	0.00	6.67	30.00	36.41	68.50	102.92	19.26	63.33	111.66	16.79	0.000
Vegetable oil (g)	26.00	39.30	58.00	22.14	37.70	50.55	21.31	34.46	49.36	16.87	0.000
Cookie (g)	0.00	0.00	33.33	0.00	0.00	16.67	0.00	0.00	16.67	25.91	0.000
Instant food (g)	40.00	66.67	120.00	0.00	0.00	16.67	0.00	0.00	8.33	58.42	0.000
Beverage (g)	0.00	0.00	66.67	0.00	0.00	0.00	0.00	0.00	0.00	44.75	0.000

Table 6. Daily energy and nutrient intake among residents with different breakfast consumption frequency

	Never			Sometimes			Daily			H	p value
	0.25	0.50	0.75	0.25	0.50	0.75	0.25	0.50	0.75		
Energy (kcal)	1636.80	2009.90	2508.94	1285.23	1673.72	2126.67	1420.47	1896.43	2445.66	16.689	0.000
Protein (g)	49.66	62.28	82.37	48.33	61.50	77.59	51.21	66.17	88.28	6.121	0.047
Fat (g)	61.14	82.36	107.18	55.98	82.00	101.84	53.37	73.80	100.24	11.680	0.003
Carbohydrate (g)	174.34	248.32	312.04	126.91	161.95	214.11	156.85	225.14	317.73	27.750	0.000
Dietary fiber (g)	6.87	9.40	14.60	5.63	7.79	12.15	6.56	9.55	14.15	3.441	0.179
Cholesterol (mg)	134.78	235.60	386.80	141.53	277.65	458.64	159.90	280.60	447.92	11.428	0.003
Vitamin A (µg RE)	196.18	295.28	502.36	189.29	285.13	517.88	214.98	366.08	590.75	8.965	0.011
Carotene (µg RE)	679.46	1104.80	2030.82	571.79	1015.57	2042.92	707.21	1274.17	2331.96	7.393	0.025
Retinol (µg RE)	36.80	75.91	142.07	33.60	93.67	181.03	48.37	93.81	170.18	8.517	0.014
Thiamin (mg)	0.57	0.78	1.06	0.51	0.68	1.03	0.58	0.81	1.11	2.486	0.289
Riboflavin (mg)	0.52	0.68	0.99	0.52	0.80	0.98	0.58	0.77	1.03	13.918	0.001
Niacin (mg NE)	11.91	15.09	19.14	10.62	14.64	20.02	11.16	14.73	19.24	0.570	0.752
Vitamin C (mg)	29.60	43.71	70.32	41.05	62.66	84.78	44.34	67.42	102.97	76.841	0.000
Vitamin E (mg)	19.25	28.75	39.36	15.17	26.24	35.42	17.02	25.22	36.87	10.760	0.005
α-tocopherol (g)	5.53	7.73	10.48	5.68	9.17	13.46	5.47	8.37	11.81	5.170	0.075
Ca (mg)	272.85	428.40	632.71	360.78	496.65	652.99	340.88	477.29	630.95	26.193	0.000
P (mg)	694.31	906.69	1241.78	831.05	1198.83	1406.19	849.81	1030.46	1266.81	6.564	0.038
K (mg)	1205.34	1749.35	2300.27	1342.16	2114.26	2665.69	1406.93	1813.88	2298.91	7.245	0.027
Na (mg)	4085.23	5208.33	7512.22	3868.85	5728.99	7182.25	4067.61	5101.03	6634.33	3.234	0.199
Mg (mg)	221.69	277.91	377.56	224.86	309.90	406.19	246.21	306.77	374.39	15.561	0.000
Fe (mg)	17.10	21.81	29.06	15.77	22.93	26.39	17.21	21.47	26.12	8.563	0.014
Zn (mg)	8.17	10.63	15.03	8.73	12.15	15.68	9.41	11.60	13.96	3.05	0.217
Se (µg)	22.09	33.26	47.76	28.94	47.62	59.24	31.82	41.42	56.78	26.72	0.000
Cu (mg)	1.55	2.12	2.87	2.12	2.79	3.05	1.77	2.21	2.84	0.49	0.784
Mn (mg)	4.79	6.47	8.50	4.63	7.58	8.81	5.41	6.69	8.12	17.34	0.000

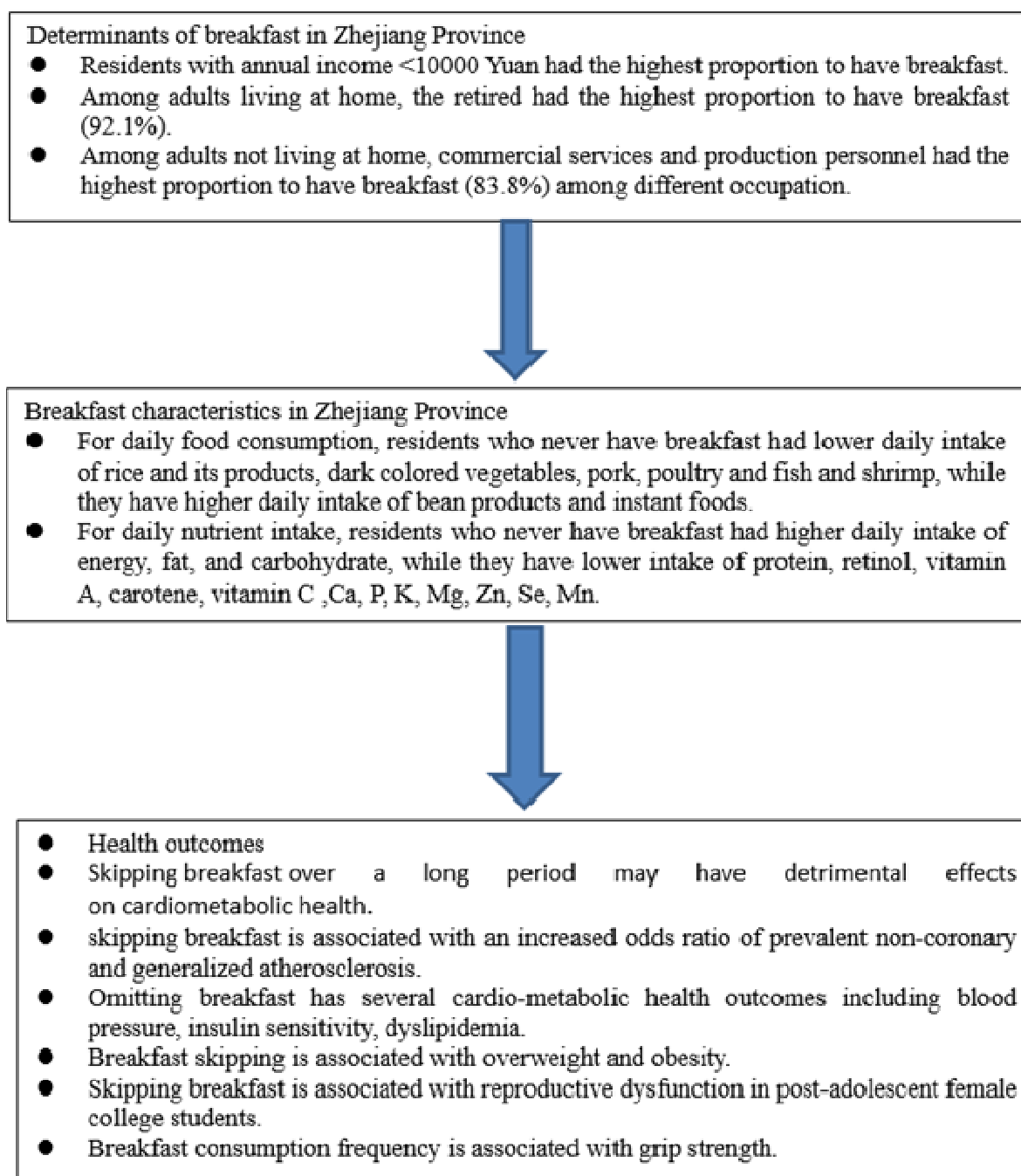


Figure 1. Conceptual diagram.