Original Article

Takeaway food in Chengdu, Sichuan province, China: Composition and nutritional value

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Background and Objectives: The popularity of takeaway has caused health problems. To analyse the basic nutrients and composition of popular takeaway meals in Chengdu, China. **Methods and Study Design:** We randomly collected 105 takeaway meals from takeaway platforms. The quality of ingredients such as grains, vegetables, and meat were assessed and weighed. The samples were then homogenised, and the nutrients were detected following the AOAC Official Methods of Analysis. **Results:** Compared with Chinese and US dietary reference intakes, the average energy, protein, salt, fat, vitamin, and available carbohydrate contents exceeded dietary recommendations for one takeaway meal. By contrast, the whole grain, vegetable, fruit, dairy product, egg, mineral, and dietary fibre contents were insufficient. Food compositions and basic nutrients differed among takeaway meals prepared with various cooking methods and meats. Fried rice had the lowest nutritional value. The fried dish set meal had high energy density. The nutrient content of poultry takeaway meals was more balanced compared with other meals assessed, and salt and fat were excessive in mixed meat meals. In addition, meatless takeaway meals tended to have high fat content because of excess vegetable oil added for better taste. **Conclusions:** Takeaway meals should have lower contents of energy, fat, carbohydrate, and salt and higher contents of whole grains, vegetables, fruits, dairy products, and eggs. Attention should be paid to the high energy density of the fried dish set meal to prevent resultant health problems such as obesity. Consumers, takeaway outlets, and government agencies need to work together to address the health problems.

Key Words: takeaway meals, nutritional value, nutritional composition, China, nutritional evaluation

INTRODUCTION

The traditional dietary pattern of people has changed with the development of the Internet and mobile applications, the combination of which has increased the purchase of takeaway meals ('takeout' in the US and 'bento' in Japan).[1,2] In recent years, the rapid development of the takeaway industry has aroused business and public interest in China. The frequency of takeaway food consumption has markedly increased in Europe, Australia, and the United States.[3-8] Approximately 27% of adults and 19% of adolescents in the United Kingdom eat takeaway meals at least once a week.[9] Similar dietary habits have been observed in other Western countries.[3,4,10] The predominant methods for obtaining takeaway meals are to call a food outlet to order food directly or to purchase them through mobile applications. Takeaway meals tend to have higher energy, fat, sugar, and salt contents and fewer vitamins and minerals than meals prepared at home.[11-17] Takeaway food consumption has been positively associated with adiposity in the United States, Australia, and Europe.[5,18-20] Takeaway foods are classified as out-of-home foods,[21] and their increased consumption is associated with many negative health outcomes, including hypertension, coronary heart disease, cancer, diabetes mellitus, adiposity, and cardiovascular disease (CVD).[2,5,14,22-32] Although some studies on takeaway foods have been conducted in developed countries such as Australia, the United Kingdom, and the United States, similar health problems have also been noted in developing regions going through a 'nutrition transition', including Asia, Africa, and Latin America.[33] China, as the largest developing country, has experienced rapid economic growth, and numerous developed cities have emerged, such as Beijing, Shanghai, Guangzhou, Shenzhen, Chengdu, and Chongqing. Economic development has led to the rise of health issues resulting from the change to the Western diet. In the last decade, some takeaway platforms have emerged in China, such as Meituan, DiDi, and Baidu takeaways. With the development of online payment systems, the order frequency on takeaway platforms has rapidly increased. Ac-

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cording to the 2016–2017 Online Catering Takeaway Market Research Report in China released by iiMedia Research, the online ordering industry in China has steadily grown since 2011. In 2016, the scale of the takeaway market reached USD 24.80 billion, and the number of online orders was approximately 256 million. Compared with 2015, the growth rate of online ordering in 2016 reached 22.5%. According to the 2017 China Takeaway Development Research Report released by the Meituan Review Institute, the scale of the online ordering market reached approximately USD 30.63 billion, and the number of online orders was approximate 300 million in 2017. The 2019 43rd Statistical Report on Internet Development in China, issued by the China Internet Network Information Center, revealed that by December 2018, the number of online orders had reached 406 million, an increase of 18.2% compared with the end of 2017. The development of the takeaway industry has also led to problems concerning food safety, environmental protection, traffic safety, and employment. In addition, the unfavourable nutrient content of takeaway foods can negatively impact a population's health. Studies on the relationship between takeaway food and diseases such as obesity and diabetes have usually been conducted using survey-based epidemiological methods. However, it is better to combine these results with first-hand laboratory data for more reliable conclusions. Suggestions and intervention measures have been implemented in some countries to eliminate the negative impact of takeaway food. The UK government has taken steps to reduce the adverse outcomes of takeaway consumption, including cooperating with the takeaway industry and decreasing the availability of takeaway foods near schools using planning regulations. In Australia, some local governments have placed restrictions on fast food advertisements and imposed high taxes on high-fat snacks and sugary drinks. Finland has a law requiring food labelling; for example, manufacturers are required to add the warning label 'high salt product' on food packaging if the salt content exceeds the recommended limits. Similarly, in Denmark, the trans fatty acid (TFA) content of all foods produced industrially is limited to 2% of the maximum total fat content.[34] Alternative recommendations and interventions are also available in the United States,[35] but few have been published in China. Moreover, research on the nutrient analysis of takeaway foods in China is scarce. Given the annual growth of takeaway food consumption and limited data on the nutritional composition of takeaway food in China, we quantitatively assessed various nutrient contents of takeaways, including energy values, crude protein, total fat, selected minerals, water, ash, salt, available carbohydrates (hereinafter referred to as collectively carbohydrates), dietary fibre, and vitamins to evaluate the nutritional equilibrium. These data enable us to make objective recommendations to serve as a reference for governments, consumers, and takeaway vendors seeking suitable strategies for reducing the negative health impact of increasing takeaway meal consumption.

METHODS

Sampling and analysis of takeaway meals

In the present study, chemical analysis was employed to investigate the energy value and content of various nutrients in takeaway meals that were purchased from various outlets where takeaway services are available. Fast food brands such as Kentucky Fried Chicken (KFC), McDonald's, and Dicos, available on takeaway platforms, were also included in this study. In all, 105 takeaway meals were collected between January 2019 and May 2019 in Chengdu, China. After weighing the contents of meat, fruit, egg, vegetables, and grains, the samples were homogenised with a machine and analysed immediately to determine the contents of crude protein, total fat, selected minerals, water, ash, salt, carbohydrates, and dietary fibre.

Crude protein, total fat, carbohydrates, water, ash, and total dietary fibre were detected following Association of Official Analytical Chemists (AOAC) Official Methods of Analysis (2019). The energy values were calculated using the Atwater energy equivalents.[36] Protein (crude) analysis was performed by the copper catalyst Kjeldahl method, and the conversion coefficient of 6.25 was used in calculations. The solvent extraction (submersion) method was used to detect total fat. The adjuncts air oven method (103–104 °C) was utilised to determine water content. After carbonising the sample, ashing was conducted at 550 °C. The enzymatic–gravimetric method was adopted to detect total dietary fibre. Carbohydrates were calculated by mass difference. Microwave digestion (HNO_3) followed by inductively coupled plasma mass spectrometry was used to determine the concentrations of sodium and selected minerals.[37] The salt content was calculated as the sodium content, with the conversion factor of 2.54. The Na/K ratio was molar, which was related to hypertension.[38] The vitamin content was calculated based on the Chinese Food Composition Table (Second Edition) according to the quality of various raw materials.

Statistical analysis

The data were analysed using SPSS version 21.0 (SPSS, Chicago, IBM, US), and p-values <0.05 (2-sided) was considered statistically significant. Normality of distribution was tested using Kolmogorov–Smirnov and Shapiro–Wilk tests. Nutrient contents were described as mean ± standard deviation, median (interquartile range), total range, and coefficient of variation (CV). Nonnormally distributed data were expressed as median (interquartile range), and normally distributed data were expressed as mean (range).

The nutrient content data were compared with the dietary reference intakes (DRIs) in the Chinese Dietary Reference Intakes 2013 guidelines (Appendix 4, participants aged 18–49 years) and 2015–2020 Dietary Guidelines For Americans (DGA; aged 19–30 years, Appendix 7) to evaluate the nutritional equilibrium of the takeaway meals. Most people eat three meals a day. Compared with the reference value, the daily recommended intake of various nutrients was divided by 3 to determine the recommended value per meal.

The consumption of takeaway meals is especially prevalent among young adults (19–29 years).[9] Thus, the recommended intake of US and Chinese adults aged 19–30 years was selected as the guide in the present study, excluding special populations such as pregnant women, lactating mothers, children, and people in special cir-

cumstances.

The chi-squared test or a one-sample t test was used to compare the recommended intake and the measured value. Analysis of variance (ANOVA), the chi-squared test, and the least significant difference (LSD) t test were employed to analyse differences in basic nutrients and food composition in the following groups of takeaway meals. This study did not involve human or animal participation or samples, so ethical approval was not needed.

RESULTS

General analysis

Overall, the results revealed considerable variation in the nutritional profiles of the takeaway meals, but most of them were excessively nutritious compared with DRIs. Tables 1, 2, and 3 summarise the food composition and nutrient contents of the takeaway meals. Table 4 demonstrates that the difference between the measured value and the recommended intake per meal was significant. The CV of the nutrients per 100 g in the investigated meals ranged from 7.40% (water) to 618% (retinol) and that of nutrients per meal varied from 25.0% (carbohydrates) to 625% (retinol). Among the selected minerals, the content of selenium was extremely low; vitamins had the largest CV.

As presented in Table 1, the mean weight of the takeaway meals was 617 g, with 119 g of vegetables, 400 g of cereal, and 74.3 g of meat. Thirty-one (29.5%) takeaway meals contained eggs. The largest CV was found for the content of eggs, followed by meat, vegetables, and cereal. None of the surveyed meals contained fruits or dairy products, and the cereal was mainly refined rice. The DGA recommend that at least half the cereal one consumes be whole grains. Whole grain cereals protect against coronary heart disease (CHD), probably because they are sources of phytochemicals such as phytate and phytoestrogens.[24] Whole grain or high-fibre grain should be supplemental to takeaway meals. Moreover, the variety of meat and vegetables in the surveyed meals was relatively low, with most meals containing only one type of meat and an average of 2.80 types of vegetables. These values are incompatible with the principle of diversification of food types for healthy eating patterns.

Energy

The energy of the surveyed meals ranged from 111 to 302 kcal/100 g (mean: 169 kcal/100 g, equivalent to 708 kJ/100 g), which was 34.7% more than the recommended healthy diet for the British (525 kJ/100 g). It is difficult for most individuals to calculate directly the energy density of one meal to judge whether their diet is reasonable to regulate and maintain a healthy energy balance; most people tend to eat the same amount of food regardless of the density.[39-42] In the DGA, the daily energy requirement of adult women and men is 1600–2400 kcal and 2000–3000 kcal, respectively, which is similar to the Chinese DRIs (2013) and the Eatwell Guide for the British (both 1750–2100 kcal for women and 2200–2600 kcal for men). The mean energy in surveyed takeaway meals was 1.04×10^3 kcal ($608–2.4\times10^3$), with approximately half of the meals containing >1000 kcal, accounting for approximately 33.3–64.7% of the daily energy requirement (vide supra). Therefore, consuming takeaway meals leads to an intake of more energy than is necessary, and overconsumption of takeaway meals can thus increase the risk of obesity, hypertension, diabetes and other diseases.[5,10,15]

Crude protein content

The mean crude protein content in takeaway meals was 4.74 g/100 g (0.15–12.7) and 28.9 g per meal (2.49–103), accounting for 51.7% and 62.9% of the recommended daily allowance (RDA) in the DGA for men and women (56 g and 46 g, respectively), and 44.5% and 52.6% of the daily recommended nutritional intake (RNI) in the Chinese DRIs (65 g and 55 g, respectively). The average protein content of the takeaway meals was higher than one-third of the DRI. Protein in the surveyed takeaway meals provided 14% of total energy, which is slightly higher than the lower limit of the acceptable macronutrient distribution range (AMDR; 10%–35%) in the DGA. Therefore, the amount of protein in the surveyed takeaway meals was considered sufficient. Jaworowska et al found that the average protein content of Chinese takeaways in the UK was 6.9 g/100 g and 58.2 g/portion, which was almost twice the value in the present study and also sufficient for US and Chinese adults.[2] Proteins are indispensable for many structures and functions; therefore, adequate dietary protein intake is crucial.[24]

Total fat content

The mean total fat content in the takeaway meals was 5.19 g/100 g (0.82-20) and 29.5 g per meal (18.8-38.7). The AMDR of total fat for an individual aged ≥19 years should be 20%-35% according to the DGA and 20%-30% if over ≥4 years old per the Chinese DRIs (2013). In our samples, it was 24.5%, which was within both ranges, thus indicating a sufficient proportion of energy being provided by fat in the takeaway meals. However, in terms of content, the fat content was high. Taking the 2000-kcal Healthy U.S.-Style Eating Pattern as an example, the average fat content was 16.7-29.2 g per meal, calculated by the AMDR of total fat (20–35%), which was lower than that of the takeaway meals (29.5 g, 18.8-38.7 g per meal). A diet high in fat, especially a diet high in saturated fatty acids, may raise the likelihood of developing obesity and cause other adverse health effects.[34,41] The fat content in takeaway meals should therefore be reduced.

Total dietary fibre content

The mean total dietary fibre content in the takeaway meals was 0.45 g/100 g (0.15, 0.92 g/100 g) and 2.80 g per meal (0.54 g, 6.12 g), equivalent to 2.7 g of dietary fibre per 1000 kcal of energy-much lower than the 14 g/1000 kcal recommended by the DGA; see Appendix 7. Chinese DRIs have no clear recommendations for dietary fibre intake. The daily dietary fibre intake for an individual aged ≥19 years should be 25.2-33.6 g according to the DGA. Therefore, the dietary fibre content was considerably low in the takeaway meals, which may be due to the low content of fruits, vegetables, and whole grains; the meal with the highest content contained only 6 g of fibre. Fibre is essential because it affects the composition of the intestinal microbiota, deficiencies and disturbances of which are associated with diseases such as bowel disease,

Table 1. The weight of meals, meat, eggs, vegetables, and cereals

Items	N	Mean	Interquartile range		Median	SD	Min	Max	CV, %
			25%	75%					
Weight†	105	618	528	690	600	119	355	1079	19.3
Vegetables†	105	119	79.9	151	108	57.2	0	280	48.2
Cereals†	105	401	334	459	392	89.4	179	646	22.3
Meat†	105	74.3	44.0	98.2	69.5	43.6	0	237	58.7
Potato‡	105	24.0	0.00	30.7	0.00	48.1	0	246	200
Egg‡	105	11.5	0.00	21.6	0.00	24.9	0	204	217

†Normal distribution.
‡Non-normal distribution.

Table 2. Nutritional composition and minerals of takeaway meals per 100 g

Items	N	Mean	Interquartile range		Median	SD	Min	Max	CV, %
			25%	75%					
Energy (kcal) †	105	169	145	186	163	29.8	111	302	17.6
Protein (g) †	105	4.74	3.51	5.99	4.63	2.16	0.15	12.7	45.5
Fat (g) †	105	5.19	3.21	6.44	4.95	3.02	0.82	20.0	58.2
Moisture (g) †	105	63.5	60.7	66.7	63.4	4.70	47.3	76.5	7.40
Ash (g) †	105	0.92	0.70	1.17	0.88	0.35	0.20	1.85	37.5
Dietary fiber (g) †	105	0.45	0.35	0.54	0.41	0.14	0.15	0.92	31.7
Carbohydrate (g) †	105	25.2	22.9	28.4	25.9	4.86	4.59	36.8	19.3
Salt (mg) †	105	753	548	929	722	292	156	165	38.9
Sodium (mg) †	105	296	215	366	284	115	61.6	649	38.9
Magnesium (mg) ‡	105	11.1	9.04	13.1	10.7	3.11	3.58	22.1	27.9
Potassium (mg) †	105	102	75.8	122	99.6	37.5	36.3	241	36.6
Na/K ratio†	105	5.50	3.37	7.07	5.17	2.80	1.14	13.5	50.9
Calcium (mg) ‡	105	18.7	10.5	21.9	15.5	13.5	3.01	84.4	72.2
Manganese (mg) †	105	0.47	0.40	0.53	0.46	88.8	0.30	0.70	19.0
Copper (μg) ‡	105	183	122	202	150	106	40.1	675	58.1
Zinc (μg) ‡	105	1,011	827	1,138	947	319	567	3,050	31.6
Selenium (μg) ‡	105	2.10	1.07	2.64	1.86	1.38	0.00	7.76	65.8
Vitamin A (μgRE) ‡	105	194	34.1	112	54.6	823	6.82	7,046	423
Carotene (μg) ‡	105	321	41.3	360	144	478	0.00	2,216	149
Retinol (μg) ‡	105	133	5.84	33.1	16.9	819	0.00	7,040	615
Thiamine (mg) ‡	105	0.31	0.16	0.38	0.26	0.29	0.07	2.57	93.5
Riboflavin (mg) ‡	105	0.32	0.21	0.32	0.25	0.35	0.11	3.04	109
Niacin (mg) ‡	105	4.11	1.96	5.17	3.49	3.42	0.00	21.2	83.2
Vitamin C (mg) ‡	105	25.9	6.63	40.6	18.1	24.6	0.00	107	95.1
Vitamin E (mg) ‡	105	1.97	0.46	1.66	0.96	5.58	0.00	57.4	283

†Normal distribution.
‡Non-normal distribution.

Table 3. Nutritional composition of takeaway meals per portion

Items	N	Mean	Interquartile range		Median	SD	Min	Max	CV, %
			25%	75%					
Energy (kcal) †	105	1038	869	1,174	981	268	608	2,397	25.8
Protein (g) †	105	28.9	20.3	36.7	27.1	14.3	2.49	103	49.4
Fat (g) ‡	105	32.7	18.8	38.7	29.5	22.4	4.56	134	68.5
Moisture (g) †	105	392	329	441	398	86.3	200	626	22.0
Ash (g) †	105	5.67	3.83	6.98	5.34	2.45	1.48	17.6	43.1
Dietary fiber (g) †	105	2.80	1.98	3.34	2.83	1.05	0.54	6.12	37.6
Carbohydrate (g) †	105	154	129	174	152	38.5	37.2	245	25.0
Salt (mg) †	105	4,611	3,167	5,868	4,239	1,946	868	11,517	42.2
Sodium (mg) †	105	1,813	1,245	2,307	1,666	765	341	4,528	42.2
Magnesium (mg) ‡	105	68.4	54.5	76.1	63.84	23.6	23.8	164	34.6
Potassium (mg) ‡	105	631	461	743	576	272	215	1,719	43.1
Calcium (mg) ‡	105	117	65.2	133	91.4	91.7	18.6	614.	78.6
Manganese (mg) †	105	2.86	2.35	3.29	2.84	702	1.46	5.05	24.5
Copper (mg) ‡	105	1.12	0.69	1.32	0.937	704	0.266	5.25	62.7
Zinc(mg) †	105	6.16	4.94	7.23	5.80	1,860	2.88	15.5	30.2
Selenium (μg) †	105	12.5	6.89	15.7	11.7	7.62	0.00	38.4	61.1
Vitamin A (μgRE) ‡	105	1,319	196	662	314	5,805	34.9	45,830	439
Carotene (μg) ‡	105	2,102	248	2,362	845	3,259	0	15,495	155
Retinol (μg) ‡	105	921	39.8	185	99.1	5,756	0	45,790	625
Thiamine (mg) ‡	105	2.06	0.93	2.36	1.65	2.76	0.34	27.8	134
Riboflavin (mg) ‡	105	2.06	1.15	2.31	1.56	2.53	0.56	19.8	123
Niacin (mg) ‡	105	26.3	11.3	32.1	21.3	24.2	0	138	92.4
Vitamin C (mg) ‡	105	167	35.3	242	119	171	0	768	102
Vitamin E (mg) ‡	105	14.9	2.68	10.7	6.46	59.3	0	620	398

†Normal distribution.

‡Non-normal distribution.

Table 4. Comparison of nutrients in takeaway food with the reference intake per meal

Items	N	Mean/Median	Chinese		American		*p*-value	
			Male	Female	Male	Female	Male	Female
Energy (kcal)†	105	1,038	866 (120%)	700 (149%)	867 (120%)	667 (120%)	<0.001	<0.001
Protein (g)†	105	28.9	21.7 (129%)	18.3 (158%)	18.7 (120%)	15.3 (154%)	<0.001	<0.001
Fat (g)‡	105	29.5	19.2 (154%)	15.6 (189%)	21.6 (137%)	16.7 (177%)	<0.001	<0.001
Dietary fiber (g)†	105	2.8	-	-	9.3 (120%)	11.2 (120%)	<0.001	<0.001
Carbohydrate (g)†	105	154	40 (385%)		43 (358%)		<0.001	
Salt (g)†	105	4.6	2 (230%)		2 (230%)		<0.001	
Sodium (mg)†	105	1,813	500 (363%)		767 (237%)		<0.001	
Magnesium (mg)‡	105	63.8	110 (58.0%)		133 (47.9%)	103 (61.9%)	<0.001	<0.001
Potassium (mg)‡	105	576	667 (86.8%)		1567 (36.8%)		<0.001	
Calcium (mg)‡	105	91.4	267 (34.2%)		333 (27.4%)		<0.001	
Manganese (mg)†	105	2.9	1.5 (193%)		0.8 (362%)	0.6 (483%)	<0.001	<0.001
Copper (mg)‡	105	0.94	0.27 (348%)		0.3 (313%)		<0.001	
Zinc (mg)†	105	5.8	4.2 (138%)	2.5 (232%)	3.7 (157%)	2.7 (215%)	<0.001	<0.001
Selenium (μg)†	105	12.5	20 (62.5%)		18.3 (68.3%)		<0.001	
Vitamin A (μgRE)‡	105	314	267 (118%)	233 (135%)	300 (105%)	233 (135%)	<0.001	<0.001
Thiamine (mg)‡	105	1.65	0.47 (351%)	0.40 (413%)	0.40 (413%)	0.37 (446%)	<0.001	<0.001
Riboflavin (mg)‡	105	1.56	0.47 (332%)	0.40 (390%)	0.43 (363%)	0.37 (422%)	<0.001	<0.001
Niacin (mg)‡	105	21.3	5 (425%)	4 (532%)	5.3 (401%)	4.6 (462%)	<0.001	<0.001
Vitamin C (mg)‡	105	119	33 (362%)		30 (398%)	25 (477%)	<0.001	<0.001
Vitamin E (mg)‡	105	6.46	4.7 (137%)		5 (129%)		<0.001	

Normal adult Americans and Chinese with moderate physical activity were used as reference intakes for energy. The AMDR lower limit was used for fat. RNI of Chinese reference intakes were used for Vitamin a, carotene, retinol, thiamine, riboflavin, niacin, Vitamin c, Vitamin e, calcium, magnesium, zinc, copper, and selenium. Adequate intake (AI) of Chinese reference intakes were used for sodium and manganese. The reference intakes for Americans were based on Appendix 7 aged (19-30 years) in DGA.

†Normal distribution, one sample t-test.

‡Non-normal distribution, chi-squared test.

() is the ratio of the mean/median to the reference.

obesity, and diabetes.[43] Fibre can also improve satiety and therefore may affect energy metabolism.[44] Coffey et al found that dietary fibre in Australia's fast food is also less than the local recommended dietary intakes.[45]

Carbohydrate content

The mean carbohydrate content of the takeaway meals was 25.2 g/100 g (4.59-36.8) and 154 g per meal (37.2-245). The DGA recommend that the RDA and AMDR of carbohydrates for all individuals should be 130 g and 45%–65%, respectively, and the corresponding Chinese DRI values are 120 g and 50%–65%. The energy provided by carbohydrates was approximately 59.6% of the total energy, which is within the range specified by both recommendations. However, the assessed takeaway meals contained an average carbohydrate content of 154 g per meal, which was more than the DRI. Excessive carbohydrates are converted into fat, leading to obesity and diabetes.46 Liu et al found that a high intake of carbohydrates increases the risk of CHD.[47]

Water content

The mean water content in the takeaway meals was 63.5 g/100 g (47.3-76.5) and 393 g per meal (200-626). Chinese DRIs recommend that the total daily water intake for men and women should be approximately 3.0 L (1.7 L from drinking water) and 2.7 L (1.5 L from drinking water), respectively. Therefore, the supplementary amounts obtained from foods were 1.3 L and 1.2 L for men and women, respectively, or roughly 0.4 L per meal. Therefore, the water content in the takeaway meals was roughly in line with requirements.

Mineral content

The contents of the selected minerals in the takeaway meals are presented in Table 2 and Table 3. The salt content ranged from 156–1651 mg/100 g and 868–11 517 mg/meal (calculated in the form of sodium chloride). The sodium content ranged from 61.6-649 mg/100 g and 341-4529 mg per meal. The salt content in takeaway meals is significant for those individuals who have been recommended to limit their intake of sodium. Daily sodium intake should be <2300 mg (an average of <767 mg per meal) according to the DGA. However, only four of the 105 takeaway meals met this recommendation. The average salt content was 4161 mg in one takeaway meal, and 12.5 g of salt would be ingested if three meals a day were consumed as takeaway, findings consistent with the results of Afshin et al.[48] This content was almost twice the daily salt intake for adults (6 g/d) recommended by the Dietary Guidelines for Chinese 2013 and the Eatwell Guide for the British. High sodium intake can lead to hypertension,[49] CHD, stroke,[50] and other harmful effects, including kidney disease, gastric carcinoma, and osteoporosis.[51]

The calcium content ranged from 3.01 to 84.4 mg/100 g and 18.6 to 614 mg per meal (median: 91.4 mg per meal), and only six takeaway meals contained >300 mg of calcium. The DGA recommend that calcium intake for an individual ≥19 years should be 1000-1200 mg/d and the Chinese DRIs (2013) recommend that the calcium intake for an individual >18 years of age should be 800-1000 mg/day. Thus, the calcium content in the takeaway meals was insufficient, necessitating calcium supplementation by other means to meet the guideline requirements.

The magnesium content varied between 3.58 and 22.1 mg/100 g and 23.8 and 163 mg per meal, and only 10 takeaway meals contained >100 mg of magnesium. The median magnesium content in takeaway meals was 63.8 mg per meal, accounting for 15.2%-20.6% of both the DGA and Chinese DRIs (2013).

The potassium content ranged from 36.3 to 241 mg/100 g and 215 to 1719 mg per meal. The median potassium content in takeaway meals was 576 mg, accounting for 12.3% and 28.8% of the recommended American and Chinese daily intake. Thus, potassium intake from the takeaway meals was also insufficient.

The selenium content ranged from 0.00 to 7.76 μg/100 g and 0.00 to 38.4 μg per portion. The DGA recommend that selenium intake for an individual aged ≥14 years should be 55 μg/day, and the Chinese DRIs recommend that the selenium intake for an individual >14 years old should be 60 μg/day. The mean selenium content in the takeaway meals was 12.5 μg, accounting for 22.7% and 21.5% of the American and Chinese daily appropriate intake content, respectively. Thus, the selenium content was also insufficient.

The manganese content ranged from 3.58 to 22.1 μg/100 g and 1.46-5.05 mg per meal. The DGA recommend that the appropriate intake of manganese for an individual ≥19 years old should be 1.8-2.3 mg/day, and Chinese DRIs (2013) recommend that the appropriate intake of manganese for an individual aged >18 years should be 4.5 mg/day (tolerable upper limit: 11 mg/day). The mean manganese content in the takeaway meals was 2.86 mg, which was higher than the DGA and 63.5% of the Chinese DRIs. Therefore, the manganese content of the takeaway meals was sufficient for the population, but people should be aware of excessive intake.

The zinc content varied between 0.567 and 3.05 mg/100 g and 2.88 and 15.5 mg per portion. The DGA recommend that zinc intake for an individual aged ≥19 years should be 8-11 mg/day, and the Chinese DRIs (2013) recommend that the zinc intake for a population ≥18 years old should be 7.5-12.5 mg/day. The median zinc content in takeaway meals was 6.16 mg per portion, accounting for 52%-82.1% of the two recommended intakes, indicating sufficient zinc content. In addition, the tolerable upper intake content of zinc in the Chinese DRIs (2013) is 40 mg/day, which is 6.5 times the measured value. This value is unlikely to be surpassed.

An analogous situation was noted in the case of copper content. The copper content of the takeaway meals ranged from 0.04 to 0.67 mg/100 g and 0.266 to 5.24 mg per portion. The DGA recommend that copper intake for an individual aged ≥19 years should be 0.9 mg/day, and the Chinese DRIs (2013) recommend that the appropriate intake of copper for an individual >18 years old should be 0.8 mg/day. The median copper content in takeaway meals was 0.94 mg, which was higher than both recommendations. The tolerable upper intake content of copper in the Chinese DRIs (2013) is 8.0 mg/day, which is 10 times that of Americans and Chinese daily appropriate intake.

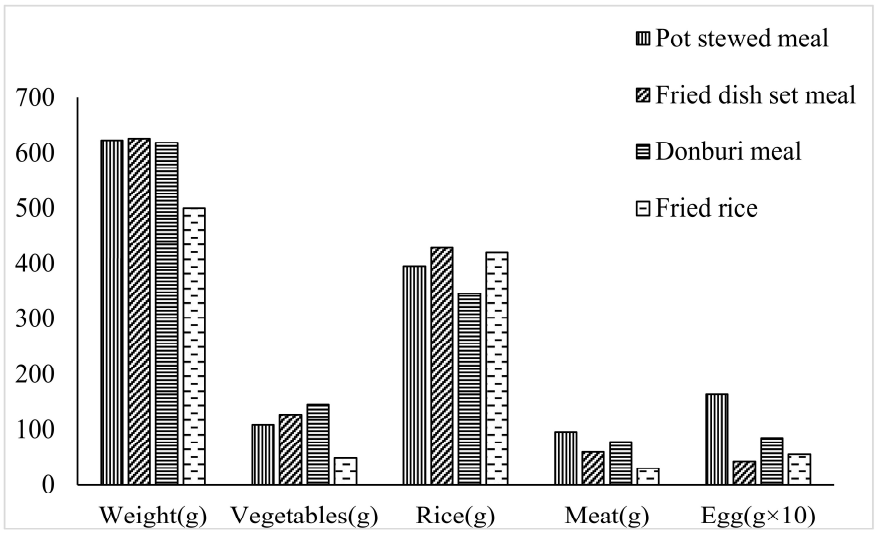

Figure 1. The food composition for takeaway food of different cooking methods.

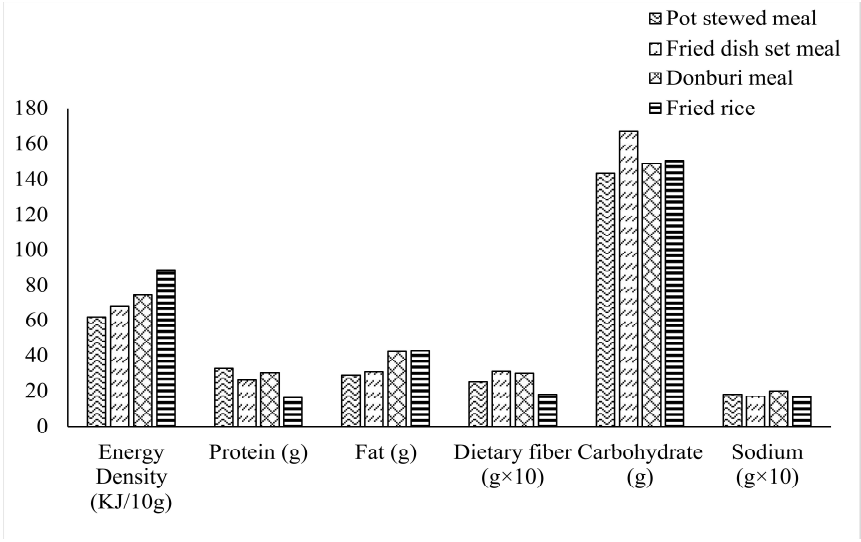

Figure 2. The basic nutrients for takeaway food of different cooking methods.

Vitamin content

Because vitamins are lost during cooking, the data were only used to make the best estimate. The medians of total vitamin A, carotene, retinol, vitamin B-1, vitamin B-2, niacin, vitamin C, and vitamin E were 54.6 μgRE (retinol equivalent), 144 μg, 16.9 μg, 0.26 mg, 0.25 mg, 3.70 mg, 18.1 mg, and 0.96 mg/100 g, respectively, and 314 μgRE, 845 μg, 99.1 μg, 1.65 mg, 1.56 mg, 21.3 mg, 119 mg, 6.46 mg per portion, respectively. Although vitamin E content per meal exceeded the Chinese RNI, the contents of other vitamins per meal exceeded the daily RNIs for both guidelines.

Comparative analysis

Comparison of nutrients in takeaway food with the reference intake per meal

Table 4 indicates a significant difference in the nutrient content in takeaway food compared with the recommended intake per meal (p<0.001).

Comparison of takeaway meals prepared using various cooking methods

Depending on cooking method, takeaway meals can be divided into donburi (donburi is a special preparation in which cooked meat and vegetables are poured over steamed rice), fried rice (meat, vegetables, rice, eggs, and other ingredients are fried together), pot-stewed meals (used to improve taste and can increase sodium usage), and fried dish set meals (a set meal consists of [fried] meat, vegetables, and rice placed in separate little boxes). Food composition and basic nutrients were compared among these categories, and the results are illustrated in Figure 1 and Figure 2.

No significant difference was observed in total weight of meals among the takeaway meal types (Table 5). The weight of rice was the lowest in fried dish set meals, followed by pot-stewed meals, fried rice, and donburi meals, and the difference between the fried dish set meals and pot-stewed meals was significant. The vegetable content of fried rice was significantly lower than that of the other three groups, and the difference between pot-stewed meals and fried dish set meals was also significant. The weight of meat in fried rice was significantly lower than that in fried dish set meals and pot-stewed meals, and that in pot-stewed meals was significantly higher than that in donburi meals. The order of egg weight from lowest to

Table 5. The difference of food composition for takeaway food of different cooking methods

Food composition	Takeaway food of different cooking methods	Pot stewed meal	Donburi meal	Fried dish set meal	Fried rice
Rice weight (0.001*)	Pot stewed meal	-	0.08	0.04*	0.59
	Donburi meal	0.08	-	0.00*	0.84
	Fried dish set meal	0.04*	0.00*	-	0.12
	Fried rice	0.59	0.84	0.12	-
Vegetable weight (0.007*)	Pot stewed meal	-	0.14	0.02*	0.04*
	Donburi meal	0.14	-	0.23	0.01*
	Fried dish set meal	0.02*	0.23	-	0.00*
	Fried rice	0.04*	0.01*	0.00*	
Meat weight (0.002*)	Pot stewed meal	-	0.00*	0.11	0.00*
	Donburi meal	0.00*	-	0.09	0.14
	Fried dish set meal	0.11	0.09	-	0.02*
	Fried rice	0.00*	0.14	0.02*	-
Egg weight (0.002*)	Pot stewed meal	-	0.00*	0.07	0.18
	Donburi meal	0.00*	-	0.32	0.87
	Fried dish set meal	0.07	0.32	-	0.73
	Fried rice	0.18	0.87	0.73	-

*$p<0.05$, the difference was significant.

highest was as follows: donburi meals, fried rice, fried dish set meals, and pot-stewed meals, and a significant difference was noted between pot-stewed meals and donburi meals.

The energy density of the pot-stewed meals was significantly lower than that of fried dish set meals and fried rice (Table 6). The order of protein content from lowest to highest was as follows: fried rice, donburi meals, fried dish set meals, and pot-stewed meals, and a significant difference was noted among pot-stewed meals and fried rice and fried dish set meals. The dietary fibre content of pot-stewed meals and fried rice was significantly less than that of donburi meals and fried dish set meals. The carbohydrate content of donburi meals was significantly higher than that of pot-stewed meals. No significant difference was observed in sodium and fat contents between groups.

Comparison of takeaway foods containing various meats

According to the presence and type of meat, the takeaway meals were divided into pork, beef, poultry (mainly chicken, duck, and goose), meatless, and mixed meat (at least two types of meat and giblets) groups. The results of food composition and basic nutrients are illustrated in Figure 3 and Figure 4.

Regarding food composition (Table 7), the rice weight in the pork group was significantly higher than that in the poultry and mixed meat groups. The order of meat weight from lowest to highest was as follows: beef group, pork group, mixed meat group, poultry group; the meat weight in the poultry group was significantly higher than that in beef and pork groups. No significant difference was observed in vegetable weight between any two groups. No egg was provided in the pork, beef, and poultry groups, and the egg provided in the mixed meat group was not

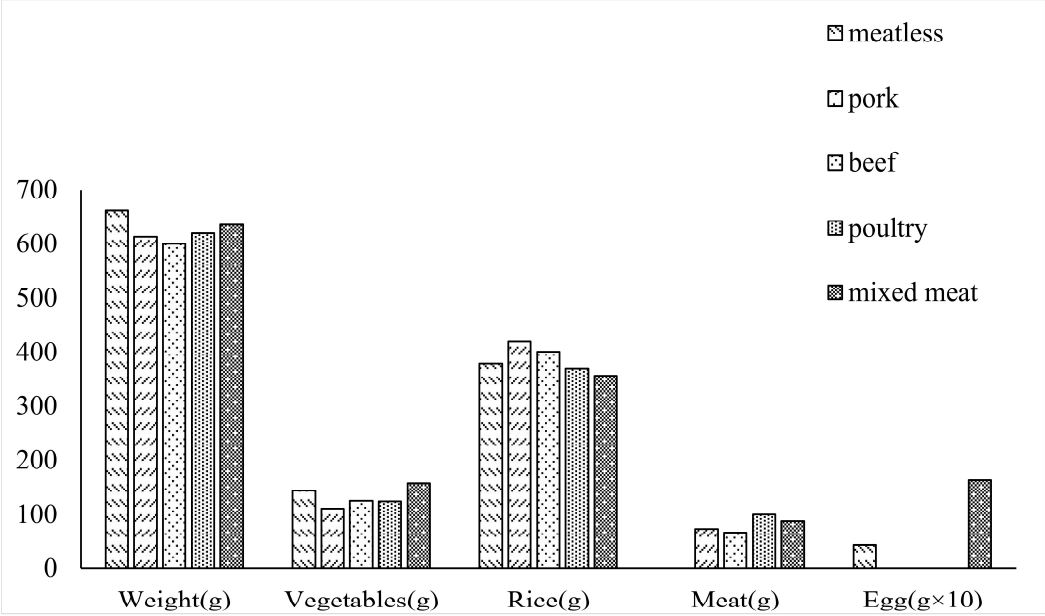

Figure 3. The food composition for takeaway food with different meat.

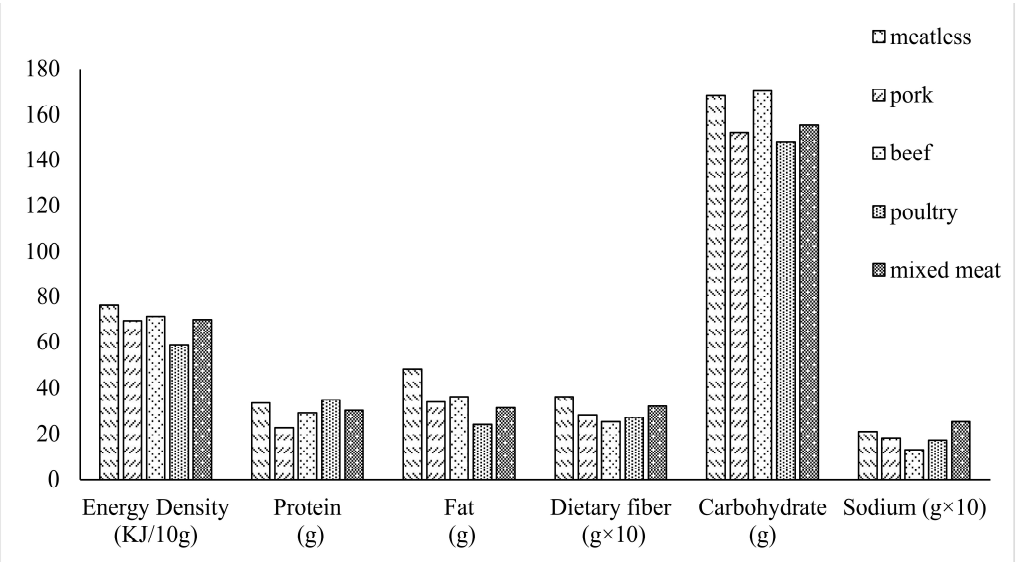

Figure 4. The basic nutrients for takeaway food with different meal.

Table 6. The difference of basic nutrients for takeaway food of different cooking methods

Food composition	Takeaway food of different cooking methods	Pot stewed meal	Donburi meal	Fried dish set meal	Fried rice
Energy density (0.001*)	Pot stewed meal	-	0.004*	0.055	0.001*
	Donburi meal	0.004*	-	0.16	0.098
	Fried dish set meal	0.055	0.16	-	0.014*
	Fried rice	0.001*	0.098	0.014*	-
Protein (0.048*)	Pot stewed meal	-	0.544	0.03*	0.03*
	Donburi meal	0.544	-	0.253	0.076
	Fried dish set meal	0.03*	0.253	-	0.204
	Fried rice	0.03*	0.076	0.204	-
Fat (0.128)	Pot stewed meal	-	0.053	0.700	0.249
	Donburi meal	0.053	-	0.062	0.997
	Fried dish set meal	0.700	0.062	-	0.320
	Fried rice	0.249	0.997	0.320	-
Carbohydrate (0.042*)	Pot stewed meal	-	0.617	0.006*	0.716
	Donburi meal	0.617	-	0.083	0.926
	Fried dish set meal	0.006*	0.083	-	0.411
	Fried rice	0.716	0.926	0.411	-
Sodium (0.486)	Pot stewed meal	-	0.265	0.604	0.874
	Donburi meal	0.265	-	0.123	0.473
	Fried dish set meal	0.604	0.123	-	0.952
	Fried rice	0.874	0.473	0.952	-
Dietary fiber (0.006*)	Pot stewed meal	-	0.044*	0.005*	0.198
	Donburi meal	0.044*	-	0.824	0.025*
	Fried dish set meal	0.005*	0.824	-	0.014*
	Fried rice	0.198	0.025*	0.014*	-

*$p<0.05$, the difference was significant

significantly different than that in the meatless group.

Regarding basic nutrients (Table 8), the energy density of the poultry meal group was significantly lower than of the meatless, pork, and beef groups. The protein content in the pork group was significantly lower than that in the poultry group. The sodium content in the mixed meat meal was significantly higher than that in the pork, beef, and poultry groups, and that in the beef group was significantly lower than that in the meatless, pork, and mixed meat groups. No significant intergroup difference was observed for fat, dietary fibre, and carbohydrates.

Correlation analysis

The correlation analysis was performed on the ingredients and nutrients in different takeaway meals. Strong positive correlations were noted between (1) the content of rice and energy ($p<0.001$), (2) carbohydrates ($p<0.001$), and (3) weight of vegetables and dietary fibre content ($p<0.001$); a strong negative correlation ($p<0.001$) was noted between the weight of vegetable and meat contents. The result indicated that rice was the main material providing energy in the takeaway meals, whereas vegetables were the critical source of dietary fibre. Moreover,

Table 7. The difference of food composition for takeaway food with different meat

Food composition	Takeaway food of different cooking methods	Meatless	Pork	Beef	Poultry	Mixed meat
Rice weight (0.042*)	Meatless	-	0.319	0.648	0.835	0.633
	Pork	0.319	-	0.505	0.032*	0.043*
	Beef	0.648	0.505	-	0.355	0.256
	Poultry	0.835	0.032*	0.355	-	0.69
	Mixed meat	0.633	0.043*	0.256	0.69	-
Vegetable weight (0.83)	Meatless	-	0.201	0.526	0.472	0.679
	Pork	0.201	-	0.436	0.37	0.052
	Beef	0.526	0.436	-	0.958	0.204
	Poultry	0.472	0.37	0.958	-	0.145
	Mixed meat	0.679	0.052	0.204	0.145	-
Meat weight (0.035*)	Meatless	-	0.001*	0.010*	0.000*	0.001*
	Pork	0.001*	-	0.606	0.014*	0.297
	Beef	0.010*	0.606	-	0.032*	0.229
	Poultry	0.000*	0.014*	0.032*	-	0.487
	Mixed meat	0.001*	0.297	0.229	0.487	-
Egg weight (0.808)	Meatless	-	0.515	0.478	0.699	0.192
	Pork	0.515	-	0.807	0.679	0.232
	Beef	0.478	0.807	-	0.618	0.439
	Poultry	0.699	0.679	0.618	-	0.186
	Mixed meat	0.192	0.232	0.439	0.186	-

*$p<0.05$, the difference was significant.

Table 8. The difference of basic nutrients for takeaway food with different meat

Food composition	Takeaway food of different cooking methods	Meatless	Pork	Beef	Poultry	Mixed meat
Energy density	Meatless	-	0.35	0.544	0.032*	0.474
	Pork	0.35	-	0.722	0.014*	0.919
	Beef	0.544	0.722	-	0.044*	0.858
	Poultry	0.032*	0.014*	0.044*	-	0.09
	Mixed meat	0.474	0.919	0.858	0.09	-
Protein	Meatless	-	0.312	0.565	0.833	0.682
	Pork	0.312	-	0.624	0.030*	0.498
	Beef	0.565	0.624	-	0.273	0.856
	Poultry	0.833	0.030*	0.273	-	0.409
	Mixed meat	0.682	0.498	0.856	0.409	-
Fat	Meatless	-	0.167	0.311	0.051	0.174
	Pork	0.167	-	0.763	0.09	0.745
	Beef	0.311	0.763	-	0.15	0.632
	Poultry	0.051	0.09	0.15	-	0.412
	Mixed meat	0.174	0.745	0.632	0.412	-
Carbohydrate	Meatless	-	0.37	0.929	0.291	0.549
	Pork	0.37	-	0.157	0.664	0.815
	Beef	0.929	0.15	-	0.128	0.396
	Poultry	0.291	0.664	0.128	-	0.625
	Mixed meat	0.549	0.815	0.396	0.625	-
Sodium	Meatless	-	0.428	0.046*	0.27	0.36
	Pork	0.428	-	0.031*	0.477	0.015*
	Beef	0.046*	0.031*	-	0.165	0.001*
	Poultry	0.27	0.477	0.165	-	0.009*
	Mixed meat	0.36	0.015*	0.001*	0.009*	-
Dietary fiber	Meatless	-	0.111	0.056	0.113	0.527
	Pork	0.111	-	0.374	0.838	0.271
	Beef	0.056	0.374	-	0.531	0.129
	Poultry	0.113	0.838	0.531	-	0.271
	Mixed meat	0.527	0.271	0.129	0.271	-

*$p<0.05$, the difference was significant.

Figure 5. Takeaway delivery.

Figure 6. The street food in Chengdu.

too many meats in a meal may lower the dietary fibre intake.

DISCUSSION

Shifts in consumption from traditional dine-in and street food to takeaway

Chengdu is well known for many types of street foods. Almost all these street foods are available on takeaway platforms, even including beverages, noodles, bao, hot pot, local cooking, and beef guokui. In addition, people in Chengdu like to eat spicy food, and the use or nonuse of spices is a critical food choice and health consideration.[52] When people order takeaway on a platform, merchants generally provide a choice of spice level, such as not spicy, slightly spicy, medium spicy, and super spicy, similar to the in-store dining experience. The actual difference between takeaway and street food lies not in the content of the meal but in the manner in which the meal is consumed.

First, people often eat takeaway alone. They choose takeaway set meals that are decided by the merchants, and thus, such meals are typically not assembled exactly per consumers' wishes. For example, if a consumer wants A+B+C, but only A+B and A+C options are available on the takeaway platform, this limits people's access to diversified foods and results in an unbalanced diet and nutrition. Even if they order the dishes individually, only one or two dishes are enough. While eating in a restaurant or at home, people often eat with friends or relatives, and consequently, they usually get a larger variety of dishes such as vegetables and various meats. Furthermore, takeaway meals decrease interpersonal communication.

Second, takeaway food may lose some nutrients and flavour during transportation, which causes a loss of appetite. Therefore, it is necessary to keep the takeaway food fresh. For example, various dishes are packed

separately, and fresh food is transported on ice.

Third, most people tend to consume takeaway meals due to their convenience compared with the traditional in-store dining mode. However, this reduces people's exercise before/after a meal because they need not go out or cook at home. Therefore, takeaway foods should have lower energy value and fat content as compensation for the lack of movement and energy expenditure. In addition, an appropriate amount of exercise, such as more than 6000 steps a day or 30 min of moderate-intensity exercise, is indispensable for people eating takeaway.

Recommendations for takeaway food consumption

As mentioned, frequent consumption of takeaway meals should be accompanied with more exercise to burn the extra energy consumed to reduce the risk of obesity and other overconsumption-induced diseases. In addition, takeaway meals should be consumed no more than once a day to avoid incurring a deficiency of certain minerals and dietary fibre. Takeaway meals have high salt and carbohydrate contents and should thus be avoided by individuals with conditions such as hypertension, diabetes mellitus, and cardiovascular disorders. Although the calculation results revealed that some vitamins were adequately available in takeaway meals, the Chinese diet may cause considerable loss of vitamins during cooking and heating. Furthermore, more than 15% of the meals did not contain carotene and vitamin C, and approximately 10% did not have retinol. Therefore, if takeaway meals were consumed frequently, fruits, dark colour vegetables, nuts, and whole grains would need to be supplemented.

The fried rice type of takeaway meal was found to have the lowest nutritional value, and its consumption should therefore be infrequent. More vegetables should be added to or supplemental to donburi and fried dish set meals; however, attention needs to be paid to the high energy density of fried dish set meals. The pot-stewed meal type had low energy density and fat content and high protein content, and it can therefore be consumed moderately with a dietary fibre supplement.

Takeaway meals with poultry meat were found to have the most balanced nutrition among the meals surveyed. The pork rice meals were low in protein, which can be increased by adding eggs. A mixed meat meal requires the addition of more salt and fat to improve its taste, making it unsuitable for frequent consumption. Notably, meatless takeaway meals were high in fat, probably due to the addition of more vegetable oil to meet cooking and taste requirements—they need to be eaten in moderation.

According to Appendix 2 of the Chinese People's Dietary Guidelines 2016 Science Edition edited by the Chinese Nutrition Society, the recommended diet for an adult man contains 150 g of rice, 200 g of vegetables, 75 g of meats (50 g of chicken and 25 g of pork), 15 g of nuts, and 10 g of eggs for lunch and 250 g of vegetables, 100 g of potatoes, 200 g of fruits, 125 g of cereals, 75 g of soybean products, and 75 g of aquatic products for dinner. However, the takeaway meals assessed included an average of 401 g of cereals (mainly rice), 74.3 g of meat (mainly pork, beef, poultry), 119 g of vegetables, 24.0 g potatoes, and 11.5 g of eggs (section 3.1). Compared with the recommendations for lunch and dinner, the rice content was too high and the vegetable content was insufficient. Nuts and fruits were hardly available in takeaway meals and needed to be purchased separately. Consequently, frequent consumption of takeaway meals should involve supplementation with vegetables, fruits, and nuts and a reduced amount of rice in the meal.

Recommendations for policymakers

In China, takeaway is an emerging and popular food consumption model. Therefore, the laws and regulations related to takeaway still need to be improved. Existing laws and regulations focus on the safety of takeaway foods, and balanced nutrition has not yet received sufficient attention. Few recommendations and interventions have aimed at ameliorating the effects of consuming unhealthy takeaway meals in China. However, in the United States, the United Kingdom, Australia, and other countries, laws, regulations, and interventions have been introduced to avoid health problems caused by long-term consumption of takeaway food. Policymakers should pay attention to the nutrition balance of takeaway food and accordingly modify the relevant laws and regulations. For example, the display of a warning label to dissuade consumers from purchasing takeaway meals with high salt, fat, and carbohydrates could be made compulsory. Also, a warning label should prominently indicate when the nutrition is dangerously unbalanced. Economic measures should be taken to curb the consumption of high salt and sugar foods such as increasing the price of high-salt and high-sugar food.

Recommendations for takeaway providers

A recent study indicated that compliance with Chinese dietary guidelines was associated with better self-reported health status.[53] In our study, takeaway meals had excessive energy, salt, fat, and carbohydrate contents and insufficient whole grain, vegetable, fruit, dairy product, egg, mineral, and dietary fibre contents. Thus, the takeaway food patterns fail to comply with the Chinese dietary guidelines and may result in bad self-reported health status.

First, steps should be taken to reduce the energy density (usually by reducing the content of fat, added sugar, and other high-energy raw materials) and the content of salt in the meals, in line with the recommended guidelines, and to increase the amount of fruits, whole grains, and vegetables. Second, a food label should be attached to each takeaway meal package providing detailed information about food composition and nutrient content. For takeaway meals with high energy density, a warning label should be used to remind consumers to choose cautiously. Finally, other measures that can be adopted include reducing advertising spending on high-energy meals, improving the taste of low-energy meals, and controlling prices to encourage consumers to choose healthier takeaway meals.

Comparison with other studies

To the best of our knowledge, this is the first report on nutrition content in takeaway meals in China, and thus, it was difficult to compare our data with previous research. Nevertheless, some researchers have conducted similar

research in other countries. Jaworowska et al investigated the nutritional components of takeaway meals in the United Kingdom,[2] of which 123 were Chinese takeaway meals, and the energy value (1161 kcal/portion), carbohydrate content (145 g/portion), and total fat content (36.9 g/portion) were similar to those in the present study (Table 3), whereas protein content (58.2 g/portion), salt content (6.43 g/portion), and weight of meals (821 g/portion) were 2 times, 1.4 times, and 1.3 times higher, respectively, than those in our study (Tables 2, 3). This might be due to differences in the availability of raw materials in the United Kingdom and China. The authors also found energy density and total fat per 100 g of Chinese takeaway meals were the lowest of all groups, and the energy per portion was higher than only that in kebabs. The protein and carbohydrate contents were moderate, whereas the salt content was very high. The authors concluded that if the salt content can be successfully reduced, the nutritional quality of Chinese takeaway meals would be significantly improved in the United Kingdom. Afshin et al found that a diet with a high intake of takeaway meals, low whole grains, and fruit would increase the risk of death and disability worldwide.[48] The results of the present study (Tables 1 and 3) indicate that the frequent consumption of takeaway food was in line with the diet mentioned above extremely. Prentice et al reported that fast food contributed to high Na intake by consumers in New Zealand and that fast food should be targeted for reformulation to reduce Na content.[54] Studies have demonstrated that the interaction between excess sodium and insufficient potassium in the body, rather than the role of hypernatremia alone, was a key factor in the pathogenesis of hypertension. A higher dietary Na/K ratio is associated with a higher risk of hypertension and CVD events.[38,55,56] In the present study, the mean molar ratio of Na/K in the collected takeaway meals was approximately 5.50, which is more than twice as high as that of the participants (2.19) with a significantly increased risk of CVD.[38] Thus, long-term consumption of takeaway meals might increase the risk of CVD. Taher et al concluded that frequent consumption of takeaway meals might negatively affect consumer health.[57] Schröder et al found that consuming fast food more than once a week increased the risk of obesity by 129%.[58] Our experimental data were consistent with the above conclusions and findings.

Study limitations

First, we separated the meat, vegetables, eggs, and rice of the takeaway meal as completely as possible to accurately weigh them, but a few of them may not have been absolutely separated, thus resulting in measurement errors. Second, A deviation would be present when calculating the intake per meal by dividing the recommended daily intake by 3. Third, many different types of Chinese foods are available at outlets, and 105 samples might not reflect the diversity of all takeaway meals. Fourth, further research is required to analyse the quality of saturated fatty acids (SFAs), TFAs, other fatty acids, and certain amino acids in the takeaway meals. Davies et al detected SFAs and TFAs in UK takeaway food,[65] and the results revealed that the Chinese group was the lowest in SFAs (0.93 g/100g, 7.97 g/portion) and TFAs (0.03 g/100 g, 0.93 g/portion), as well as the percentage of total energy of the meal (SFAs 5.9%, TFAs 0.20%) and the energy total of fat (SFAs 19.4%, TFAs 1.20%). SFA and TFA intake are both associated with the risk of coronary heart, cerebrovascular, and other diseases.[15] Finally, because the necessary detection methods have not been established in our laboratory, the results for vitamins were obtained by calculation instead of measurement. Further research is warranted to obtain detailed vitamin information.

Conclusions

The present study indicated an undesirable nutrition composition of takeaway meals in Chengdu, China. Frequent consumption of takeaway meals might increase the risk of diseases such as obesity, CHD, and diabetes. The contents of energy, protein, salt, fat, and carbohydrates in the assessed takeaway meals were relatively high, whereas those of whole grains, vegetables, fruits, dairy products, eggs, certain minerals, and dietary fibre were insufficient. We recommend that takeaway food should not be consumed more than once a day. Consumers, takeaway outlets, and government agencies need to work together to address the health problems caused by unbalanced nutrition in takeaway meals.

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AUTHOR DISCLOSURES

The authors declare no conflict of interest.

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