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Development of a Food Frequency Questionnaire to Assess Dietary Intake for the Residents of the Northern Region of India

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Abstract

Background: Food frequency questionnaires (FFQ) are the most common dietary assessment tools across the world to evaluate the long-term customary dietary intake in a population. FFQ developed in India lack easy scoring standardized methods, correlating commonly used measures (e.g., a bowl) with the amount of nutrients in them. *Objective:* The objective of this study was to develop a quantitative, interviewer-administered, easily scored food frequency questionnaire (FFQ) to assess the nutrient intake of individuals in northern India except the north-east and upper most part of the northern region. *Methods:* The present FFQ was developed with a simplified scoring method specifically for use in the north Indian population. The nutrient value of the food items was calculated using standard food conversion tables for ingredients mentioned in the guidelines provided by the National Institute of Nutrition, Hyderabad, India. *Conclusion:* This study presents the development of a FFQ and the related nutrient composition for north Indian populations.

Keywords: Food Frequency Questionnaire; Dietary Intake; North India.

Introduction

Food frequency questionnaires (FFQs) are the most common dietary assessment tools used in epidemiological studies across the world to evaluate the long-term customary food intake in a population because they are relatively simple in construct and easy to administer (1, 2).

There has been an increase in the prevalence of obesity, type 2 diabetes, hypertension and cardiovascular disease in India (3, 4, 5, 6) and it is widely recognized that an unhealthy diet is a major risk factor for many chronic non-communicable diseases (7). Modifying the diet has an important role in the primary prevention of such diseases (8). In epidemiological studies, when assessing the relationship between diet and disease, an accurate assessment of the dietary intake is essential. A tool that has been used extensively in epidemiological research to assess diet-disease relationships is the food frequency questionnaire (FFQ) (9).

National dietary surveys provide valuable information about dietary habits and the nutritional status (2). Accurate assessment of the diet of any population is important for policy-making and planning regarding food, nutrition, health promotion and disease prevention activities for any country or a specific part of that country (9). However, it is difficult to assess the dietary habits of a region because of variation in individual food preferences and availability, socio-economic factors, cultural considerations and knowledge about nutrition (10). A number of reference methods such as multiple-day diet recall, food record and diet history have been employed for dietary assessment (11). Diaries are not suitable all over India because the level of literacy varies. A FFQ was considered the most suitable method to use for a mixed population (12).

India is a land of varied foods and food habits. Packaging of food items with definite portion sizes is not a common practice in India and labels on food products are not always informative (9). In India, wide variations in dietary habits make it necessary to use a separate FFQ validated for each region (9, 13).

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The Food Safety and Standards Authority of India (FSSAI) has been established under the Food Safety and Standards Act, 2006 which consolidates various acts and orders that have hitherto handled food related issues in various Ministries and Departments [www.fssai.gov.in]. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.

FFQs had been developed for specific regions of India (14, 15, 16, 17, 18), but to the best of our knowledge, no FFQ had been devised with a simplified scoring method specifically for use in the north Indian population. To evaluate the usual dietary intake of a population to be studied, the food items included in the FFQ should reflect the food consumption of the population (19).

A deficiency of most FFQ is that common measures (e.g., a cup or bowl) are not standardized and correlated with quantities (e.g., 100 g) given in standard manuals.

Keeping these points in mind, a FFQ consisting of 98 food items was developed for the north Indian population. The aim was to develop a quantitative, interviewer-administered, easily scored food frequency questionnaire to assess nutrient intakes of individuals in northern India except the north east and upper most part of the northern region. This questionnaire is intended to be easily filled in by a lay person. It has a scoring key developed with specific inputs (such as manuals of the National Institute of Nutrition, Hyderabad, India [www.ninindia.org].

Materials and Methods

Development of the FFQ

The development of the present FFQ is based on the list of foods mentioned in a FFQ (15). In the original FFQ (15), there were a total of 92 items while the present food list contains 98 items commonly eaten by the majority of north Indians including most of the food items consumed in the target areas which are mentioned in Table I. While developing the present FFQ fifteen items have been removed from the original FFQ (15),and twenty-one new items have been added. The reference period for the present FFQ is over the preceding / past month on any typical day (excluding fasting, festivals and other 'special' days) while the reference period for the earlier FFQ was over the past year.

Categorizing the Items

The present food list has 17 categories (mentioned in alphabetical order) with 98 items: Alcoholic beverages = 2, Chutneys = 3, Fried snacks (all types) = 9, Fruits = 17, Leafy vegetable preparations = 4, Liquids = 4, Milk and milk products = 7, Miscellaneous = 5, Non-vegetarian cooked food preparations = 3, Other vegetable cooked preparations = 10, Pickles = 6, Pulse preparations = 4, Rice preparations = 5, Roots and tubers preparations = 3, Vegetables eaten in the raw form = 7, Wheat preparations = 8 and Water.

Quantifying Common Measures

To obtain an estimate of portion sizes / utensils, we have taken commonly used glasses, bowls, and spoons of three different sizes. In the original FFQ (15) quantities were numbers or a specific utensil such as a spoon, bowl, or glass. However spoons, bowls, and glasses are of different sizes. Hence we took the weight of three sizes of spoons, three sizes of bowls and three sizes of glasses and then took the average of them. The utensils used for this study were obtained from a cafeteria where more than 1000 people are served every day. This was done for each of the 98 items separately. The weight of the utensils ranged between 56.5 and 105 g for glasses; 66 and 100 g for bowls; and 14 and 20 g for spoons.

For all items listed as raw ingredients in the food list, the edible portion of each was weighed separately on a balance whose minimum capacity was 5 g. For any item the three weights were noted (depending on if it was mentioned as a glass or a spoon or a bowl). For example, for tea the weight for a small-sized glass, a middle-sized glass, and a large-sized glass was noted. Then the average was obtained as [small + medium + large] / 3. Hence the equivalent weights of all ingredients estimated as volumes or weights were obtained and, from this, the proportional weight of each raw ingredient in each preparation was derived. For items reported in numbers, the weight of the item was averaged, again from three samples. For fruits, equivalent weights were computed from three different sizes.

To calculate the scoring key the values were computed from the nutrient value in the nutrient database. For example if the measure was one bowl (the average weight of three sizes was noted in grams); if the nutrient database described the contents present in 100 g of the food item, this was derived by a simple calculation. In case of certain food items more than one nutrient database had to be referred to. For each food item the average portion size (in terms of number or utensil, that is bowl, spoon or glass) are mentioned in Table II.

Table 1: Sample of the Food Frequency Questionnaire

Name:..... Gender:..... Age:.....

Over the past month, on a typical day (excluding fasting, festivals etc.), how often have you eaten [specific food item] and what was the average portion size that you consumed [prompting from models and standard portion sizes]?

S. no.	*Item*	*Unit*	*Amount eaten in a day*
	Liquid		
1	Tea with milk	Glass	----------
2	Coffee with milk	Glass	----------
3	Lime water with sugar	Glass	----------
4	Butter Milk	Glass	----------
	Baked/fried wheat/grain bread		
5	Chapati	No.	----------
6	Parantha	No.	----------
7	Stuff parantha	No.	----------
8	Puri	No.	----------
9	Bread	No.	----------
10	Sandwich	No.	----------
11	Daliya with milk	Bowl	----------
12	Sweet biscuit	No.	----------
	Rice preparations		
13	Khichadi	Bowl	----------
14	Rice plain	Bowl	----------
15	Idli	No.	----------
16	Dhosa	No.	----------
17	Pulaw	Bowl	----------
	Pulse preparations		
18	Black Gram dal	Bowl	----------
19	Chana dal	Bowl	----------
20	Masoor dal	Bowl	----------
21	Green Gram dal	Bowl	----------
	Leafy vegetable preparations		
22	Fenugreek leaves	Bowl	----------
23	Tanjalia bhaji	Bowl	----------
24	Spinach	Bowl	----------
25	Cabbage	Bowl	----------
	Roots and tubers preparations		
26	Elephant Yam	Bowl	----------
27	Potato	Bowl	----------
28	Sweet potato	No.	----------
	Other vegetable preparations		
29	Tomato	Bowl	----------
30	Parval	Bowl	----------
31	Pink beans	Bowl	----------
32	Brinjal	Bowl	----------
33	Bottle gourd	Bowl	----------
34	Kovai	Bowl	----------
35	Cluster bean	Bowl	----------
36	Ladies finger	Bowl	----------
37	Cauliflower	Bowl	----------
38	Drumstick	Bowl	----------
	Vegetables eaten in raw form		
39	Mixed Salad	Bowl	----------
40	Onion	No.	----------
41	Carrot	No.	----------
42	Cabbage	No.	----------
43	Chillies	No.	----------
44	Radish	No.	----------
45	Cucumber	No.	----------
	Non-Veg. food preparations		
46	Meat curry (mutton)	Bowl	----------
47	Fish	Bowl	----------
48	Eggs	No.	----------
	Chutnies		
49	Coriander	Spoon	----------
50	Garlic	Spoon	----------
51	Mint	Spoon	----------

	Pickles		
52	Bitter gourd	Spoon	----------
53	Mango sweet	Spoon	----------
54	Mango hot	Spoon	----------
55	Carrot	Spoon	----------
56	Amla	Spoon	----------
57	Chilli	Spoon	----------
	Milk and milk products		
58	Milk	Glass	----------
59	Curd	Bowl	----------
60	Ghee	Spoon	----------
61	Butter	Spoon	----------
62	Cottage cheese / Paneer	Bowl	----------
63	Kadhi	Bowl	----------
64	Sweet Kadhi	Bowl	----------
	Miscellaneous		
65	Moramba	Spoon	----------
66	Jaggery	No.	----------
67	Ganthia	Bowl	----------
68	Chivda	Bowl	----------
69	Bhajia	Bowl	----------
	Fried snacks (all types)		
70	Papad	No.	----------
71	Laddu	No.	----------
72	Barfi	No.	----------
73	Halwa	Bowl	----------
74	Kheer	Bowl	----------
75	Dhokla	No.	----------
76	Kachodi	No.	----------
77	Groundnut	Bowl	----------
78	Poha	Bowl	----------
	Fruits		
79	Apple	No.	----------
80	Banana	No.	----------
81	Guava	No.	----------
82	Custard apple	No.	----------
83	Orange	No.	----------
84	Grapes	No.	----------
85	Pomegranate	No.	----------
86	Mango	No.	----------
87	Dates	No.	----------
88	Sapota	No.	----------
89	Zizyphus / Jujube	No.	----------
90	Papaya	No.	----------
91	Sugarcane	No.	----------
92	Pineapple	No.	----------
93	Tender coconut	No.	----------
94	Sweet lemon	No.	----------
95	Jamun	No.	----------
	Alcohol consumption		
96	Beer	Glass	----------
97	Whisky	Glass	----------
	Water		
98	Amount of water	Glass	----------

Converting Common Measures to Standard Measures

Raw ingredients for each item were weighed, and volume to weight conversions measured for the cooked food item. The nutrient value of the food item was calculated using standard food conversion tables for the ingredients mentioned in the guidelines provided by the NIN, Hyderabad, India and ICMR (20, 21, 22). In conventional compilations of the NIN, Hyderabad the nutrients are mentioned for 100 g. If the average obtained (small + medium + large / 3) was (for example) 220 g then with 100 g as the reference, the scoring key was developed. Where the nutrient composition was not available in these books, data from different websites were used (23-44).

Method of Administration

As the population has varied levels of literacy, the

Table 2: Average weight and nutritive values of the food items as a scoring key

S. no.	Items	Amount	Average weight (g)	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Calcium (mg)	Phosphorus (mg)	Iron (mg)
	Liquid									
1	Tea with milk	1 Glass	115.84	9.27	0.46	0.46	0.58	0	0	0
2	Coffee with milk	1 Glass	188	9.27	0.46	0.46	0.58	0	0	0
3	Lime water with sugar	1 Glass	253.67	65.95	0.99	0.00	22.58	0	0	0
4	Butter Milk	1 Glass	265.67	39.85	2.13	2.92	1.33	79.70	79.70	0.27
	Baked/fried wheat/grain bread									
5	Chapati	1 No.	42.33	85.00	3.00	0.45	17.50	12.00	105.50	2.85
6	Parantha	1 No.	44.5	109.47	2.40	4.76	14.51	17.80	65.42	1.38
7	Stuff parantha	1 No.	90	213.00	4.80	6.90	35.00	31.50	166.00	4.50
8	Puri	1 No.	32.33	103.46	2.63	3.62	15.09	10.43	96.13	2.50
9	Bread	1 No.	18.67	51.34	1.51	0.88	9.34	4.85	40.51	0.90
10	Sandwich	1 No.	32.5	97	1.6	7.05	7	7.15	21	0.25
11	Daliya with milk	1 Bowl	145	211	4.2	7.4	32	115.2	119	0.9
12	Sweet biscuit	1 No.	18.75	67.15	2.15	0.4	12.85	0	0	0
	Rice preparations									
13	Khichadi	1 Bowl	290	864.2	11.31	41.76	115.42	69.6	211.7	2.9
14	Rice plain	1 Bowl	148.5	513.81	9.50	0.59	117.32	13.37	212.36	1.49
15	Idli	1 No.	50	149.5	2.9	9.4	13.4	42	80	1.4
16	Dhosa	1 No.	227.33	818.39	14.32	46.83	84.57	75.02	304.62	6.59
17	Pulaw	1 Bowl	150	179	4.75	5.15	28.5	28.45	104.5	1.6
	Pulse preparations									
18	Black Gram dal	1 Bowl	209.67	727.55	50.32	2.94	124.96	322.89	807.23	7.97
19	Chana dal	1 Bowl	209.67	673.04	46.13	1.05	119.93	601.75	652.07	14.19
20	Masoor dal	1 Bowl	209.67	371.42	23.21	6.14	55.41	98.54	278.56	4.79
21	Green Gram dal	1 Bowl	209.67	729.65	51.37	2.52	125.59	157.25	849.16	8.18
	Leafy vegetable preparations									
22	Fenugreek leaves	1 Bowl	219.67	107.64	9.67	1.98	13.18	867.70	112.03	4.24
23	Tanjalia bhaji	1 Bowl	219.67	98.85	8.79	1.10	13.40	872.09	182.33	7.67
24	Spinach	1 Bowl	219.67	57.11	4.39	1.54	6.37	160.36	46.13	2.50
25	Cabbage	1 Bowl	223.33	60.30	4.02	0.22	10.27	87.10	98.27	1.79
	Roots and tubers preparations									
26	Elephant Yam	1 Bowl	154	121.66	1.85	0.15	28.34	77.00	52.36	0.92
27	Potato	1 Bowl	200.67	194.65	3.21	0.20	45.35	20.07	80.27	0.96
28	Sweet potato	1 No.	130.67	156.80	1.57	0.39	36.85	60.11	65.34	0.27
	Other vegetable preparations									
29	Tomato	1 Bowl	120	118.59	2.96	4.80	15.53	53.08	163.76	1.84
30	Parval	1 Bowl	183.33	36.06	3.61	0.54	3.97	54.09	72.12	3.07
31	Pink beans	1 Bowl	188.67	83.01	5.85	0.75	13.21	101.88	132.07	2.83
32	Brinjal	1 Bowl	180	43.20	2.52	0.54	7.20	32.40	84.60	0.68
33	Bottle gourd	1 Bowl	185	22.20	0.37	0.19	4.63	37.00	18.50	0.85
34	Kovai	1 Bowl	183.33	33.00	2.20	0.18	5.68	73.33	55.00	0.70
35	Cluster bean	1 Bowl	188.67	30.19	6.04	0.75	20.38	245.27	107.54	2.04
36	Ladies finger	1 Bowl	151.67	53.08	2.88	0.30	9.71	100.10	84.94	0.53
37	Cauliflower	1 Bowl	223.33	107.20	10.05	0.22	16.08	111.67	142.93	3.13
38	Drumstick	1 Bowl	188.67	49.05	4.72	0.19	6.98	56.60	207.54	0.34
	Vegetables eaten in raw form									
39	Mixed Salad	1 Bowl	100	17.00	1.52	0.24	3.20	0	0	0
40	Onion	1 No.	54.67	27.34	0.66	0.05	6.07	25.64	27.34	0.33
41	Carrot	1 No.	79.67	22.31	0.48	0.24	4.54	0	0	0
42	Cabbage	1 No.	545	147.15	9.81	0.55	25.07	212.55	239.80	4.36
43	Chillies	1 No.	3	0.87	0.09	0.02	0.09	0.90	2.40	0.13
44	Radish	1 No.	153.33	26.07	1.07	0.15	5.21	53.67	33.73	0.61
45	Cucumber	1 No.	150.67	19.59	0.60	0.15	3.77	15.07	37.67	0.90
	Non-Veg. food preparations									
46	Meat curry (mutton)	1 Bowl	230.67	272.19	49.36	8.30	0.00	27.68	445.19	0.00
47	Fish	1 Bowl	128	164.07	20.48	2.91	13.96	205.85	283.93	9.77
48	Eggs	1 No.	54.67	94.58	7.27	7.27	0.00	32.80	120.27	1.15
	Chutnies									

49	Coriander	1 Spoon	20	47.00	0.60	4.20	1.70	6.00	27.00	0.60
50	Garlic	1 Spoon	23	33.35	1.45	0.02	6.85	6.90	71.30	0.28
51	Mint	1 Spoon	18	7	0.3	0	1.5	11.4	8	0.6
	Pickles									
52	Bitter gourd	1 Spoon	13	14.22	0.23	0.91	1.26	0	0	0
53	Mango sweet	1 Spoon	13.67	21.46	0.25	1.61	1.50	0	0	0
54	Mango hot	1 Spoon	13.67	35.54	0.40	2.99	1.04	0	0	0
55	Carrot	1 Spoon	15	23.55	0.27	1.77	1.65	0	0	0
56	Amla	1 Spoon	18.17	20.85	0.51	1.27	1.82	0	0	0
57	Chilli	1 Spoon	4	4.37	0.16	0.28	0.29	0	0	0
	Milk and milk products									
58	Milk	1 Glass	266.67	312.00	11.47	17.33	13.33	560.01	346.67	0.53
59	Curd	1 Bowl	221.33	132.80	6.86	8.85	6.64	329.78	205.84	0.44
60	Ghee	1 Spoon	4.33	38.97	0	4.33	0	0	0	0
61	Butter	1 Spoon	16.67	121.52	0	13.50	0	0	0	0
62	Cottage cheese / Paneer	1 Bowl	196.67	684.41	47.40	49.36	12.39	1553.69	1022.68	4.13
63	Kadhi	1 Bowl	186	186	5.39	9.49	27.9	0	0	0
64	Sweet Kadhi	1 Bowl	186	120.80	6.42	4.79	13.14	0	0	0
	Miscellaneous									
65	Moramba	1 Spoon	23	68.18	0.02	0.00	17.02	0	0	0
66	Jaggery	1 No.	73.33	280.85	0.29	0.07	69.66	58.66	29.33	1.94
67	Ganthia	1 Bowl	75.67	384.40	13.32	26.86	24.06	0	0	0
68	Chivda	1 Bowl	59.33	249.19	2.49	16.02	23.85	13.65	79.50	2.31
69	Bhajia	1 Bowl	76.33	480.88	3.82	38.17	30.53	0	0	0
	Fried snacks (all types)									
70	Papad	1 No.	20	74.2	5.20	0.66	12	28.6	77	1.56
71	Laddu	1 No.	45.67	178.11	2.57	10.80	18.74	0	0	0
72	Barfi	1 No.	60	405	7.6	25.4	35	23	124	3.3
73	Halwa	1 Bowl	207	666.54	4.55	32.91	86.94	8.49	99.36	2.28
74	Kheer	1 Bowl	223.33	314.90	9.16	10.05	47.12	178.66	218.86	2.23
75	Dhokla	1 No.	71.33	87.02	3.00	1.50	14.98	60.63	66.34	0.71
76	Kachodi	1 No.	143	715	10.58	50.77	53.91	50.05	117.26	2.43
77	Groundnut	1 Bowl	94.67	539.62	24.80	37.68	25.28	72.90	350.28	2.93
78	Poha	1 Bowl	100	198.67	2.47	8.73	27.33	22.13	96.00	5.13
	Fruits									
79	Apple	1 No.	206.67	121.94	0.41	1.03	27.69	20.67	28.93	1.36
80	Banana	1 No.	148	171.68	1.78	0.44	40.26	25.16	53.28	0.53
81	Guava	1 No.	105.33	53.72	0.95	0.32	11.80	10.53	29.49	0.28
82	Custard apple	1 No.	179.6	186.78	2.87	0.72	42.21	30.53	84.41	7.74
83	Orange	1 No.	190	91.20	1.33	0.38	20.71	49.40	38.00	0.61
84	Grapes	1 No.	7.16	5.08	0.04	0.02	1.18	1.43	2.15	0.04
85	Pomegranate	1 No.	178.5	116.03	2.86	0.18	25.88	17.85	124.95	3.20
86	Mango	1 No.	257.33	190.42	1.54	1.03	43.49	36.03	41.17	3.35
87	Dates	1 No.	5.5	17.44	0.14	0.02	4.17	6.60	2.75	0.40
88	Sapota	1 No.	60	58.8	0.42	0.66	12.84	16.8	16.2	0.75
89	Zizyphus / Jujubi	1 No.	12.67	9.38	0.10	0.04	2.15	0.51	1.14	0.06
90	Papaya	1 No.	810.33	259.31	4.86	0.81	58.34	137.76	105.34	4.05
91	Sugarcane	1 No.	907.33	3611.17	0.91	0.00	901.89	108.88	9.07	1.41
92	Pineapple	1 No.	998.33	459.23	3.99	1.00	107.82	199.67	89.85	24.16
93	Tender coconut	1 No.	875	3097.50	28.88	293.04	133.26	122.5	988.75	21.26
94	Sweet lemon	1 No.	127.17	54.68	1.02	0.38	11.83	50.87	38.15	0.89
95	Jamun	1 No.	4.83	2.99	0.03	0.01	0.68	0.72	0.72	0.06
	Alcohol consumption									
96	Beer	1 Glass	274.5	117.97	1.26	0	9.75	10.79	38.55	0.05
97	Whisky	1 Glass	59.15	122.44	0	0	0	0	0	0
	Water									

Abbreviations used:
No. = Number
Kcal = Kilo calories
g = Gram
mg = Milligram

questionnaire was designed to be interviewer-administered. From this FFQ, the mean nutrition derived from the intake of food items consumed by persons of north India can be determined. Here north India is taken to mean the six north Indian states of Punjab, Jammu & Kashmir, Delhi, Haryana, Himachal Pradesh, Uttarakhand and the Union Territory of Chandigarh. Four other states which are not formally part of North India, but which are traditionally, culturally and linguistically, seen to be so, are Rajasthan, Uttar Pradesh, Bihar and Madhya Pradesh (45). These four states were included in considering the food items for this questionnaire.

The FFQ is very easy to administer. It can be administered to an individual or to a group of 5 to a maximum of 10 persons, to ensure the accuracy of the responses. The instructions are also easy to understand. For each food item on the FFQ, the average frequency of consumption over the past month (on any typical day excluding fasting, or festivals) and the normal portion size typically eaten by the respondent is ascertained. It has a detailed scoring key to measure nutritive values in terms of energy, protein, fat, carbohydrate and other micronutrients of each item. Hence the amount of energy, fat, carbohydrate, protein and other micronutrients in each food item can be calculated based on norms from the National Institute of Nutrition (NIN), Hyderabad, India and other sources (23-44).

Computation of Food and Nutrient Intakes

For any FFQ it is essential to have food composition values to convert information from an FFQ into macronutrient and micronutrient values. Developing a food composition database is very expensive due to costs of chemical analysis for many foods and many nutrients. Therefore we compiled information from the guidelines provided by the NIN, Hyderabad, India (20, 21, 22) and from different websites (23-44) to develop a comprehensive and new nutrient composition database mentioned in Table II.

Limitations

A limiting factor is that the FFQ is limited to a specific part of India and even then may not be entirely comprehensive. A detailed survey of foods consumed in each region would be essential for a comprehensive FFQ.

Conclusion

This study presents the development of a FFQ and the related nutrient composition database for a north Indian population. The present form of the FFQ is like a bridge between the earlier version of the FFQ (15) and the guidelines provided by the National Institute of Nutrition, Hyderabad, India.

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