ORIGINAL ARTICLE

Vegetable dishes, dairy products and fruits are key items mediating adequate dietary intake for Japanese adults with spinal cord injury

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Study design: This is a cross-sectional study.

Objectives: The objective of this study was to ascertain the essential items mediating adequate dietary intake based on the Japanese Food Guide in common among the transtheoretical model (TTM), self-efficacy (SE) and outcome expectancy (OE).

Setting: Members of the organization Spinal Injuries Japan.

Methods: We posted a questionnaire survey to 2731 community-dwelling Japanese adults with spinal cord injury (SCI), and responses from 841 individuals were analyzed. Food intake was assessed as the frequency scores of 10 food items eaten in a daily diet in Japan. The correlations between the frequency scores of food intake and TTM, SE and OE were determined by binominal logistic regression analysis.

Results: The frequency scores of food intake were significantly associated with 'To eat vegetable dishes (dishes made mainly from vegetables or potatoes) not less than twice a day', 'To eat green/yellow vegetables not less than twice a day', 'To eat dairy products not less than once a day' and 'To eat fruits not less than once a day' in TTM. 'To eat vegetable dishes (dishes made mainly from vegetables or potatoes) not less than twice a day', 'To eat dairy products not less than once a day' and 'To eat fruits not less than once a day' were significantly associated with the frequency scores of food intake in SE. In OE, no differences were shown.

Conclusion: This study finds that vegetable dishes, dairy products and fruits are the key items mediating adequate dietary intake. Dietary guidelines promoting the intake of these dishes for SCI individuals are needed.

INTRODUCTION

Approximately 100 000 Japanese currently live with spinal cord injury (SCI), and SCIs occur at a frequency of 5000 every year.[1] Many patients with SCI are discharged to private residence,[2,3] and they live a long life. Although they have to take care of their own health for all that time, it is well known that the physiologic and metabolic changes that accompany SCI result in an increased risk of chronic diseases at rates higher than those for the able bodied.[4] Adequate diet must be essential for people with SCI to minimize chronic disease risks. However, dietary guidelines for these individuals are absent.

The Japanese diet has attracted considerable attention because of the long life expectancy in Japan. The diet has a unique pattern that consists of grain dishes (mainly rice), main dishes (such as fish, soybeans, egg and meat), side dishes (such as seaweed, vegetables and potatoes), dairy products and fruits. This Japanese dietary pattern is different from the Western dietary pattern based on wheat and meat, and the Japanese Food Guide Spinning Top[5] is based on the Japanese dietary pattern. In this food guide, the categories of grain dishes, fish and meat dishes (main dishes), vegetable dishes (side dishes), fruits and dairy products were adopted. In comparison with the Western dietary pattern, the Japanese dietary pattern is found to be lower in total energy, total fat and omega-6/omega-3 fatty acid ratio,[6] and it was associated with a decreased risk of chronic diseses.[7,8] Diets based on the Japanese Food Guide have also produced the benefit of reducing future mortality in Japanese women.[9]

The purpose of this study was to ascertain the key items or categories based on the Japanese Food Guide mediating adequate dietary intake. Adequate dietary intake has been conceptualized as involving a progression through five phases of change, which are precontemplation, contemplation, preparation, action and maintenance based on the transtheoretical model (TTM).[10] These behavioral changes are predicted by self-efficacy (SE) and outcome expectancy (OE). SE and OE are major elements of the social contextual theory,[11] and SE represents the subjects' level of confidence in maintaining adequate dietary intake across a number of tempting situations. Therefore, we examined the essential items or categories that are common among TTM, SE and OE.

MATERIALS AND METHODS

Subjects and procedures

We used a cross-sectional design. The subjects were community-dwelling Japanese adults with chronic SCI, who were registered members of the

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organization Spinal Injuries Japan (Tokyo, Japan). With permission from the organization director, we posted a study information sheet with a questionnaire to 2731 members in September 2011. The study information sheet explained the aims and purpose of the study, methods, advantages and disadvantages of participating in the study and the management and publication of data, including that the survey was anonymous and to regard a returned questionnaire as a consent form. We received responses from 1000 individuals, but excluded those responses missing crucial data such as sex, age and lesion type. Finally, the responses from 841 individuals were analyzed. The response rate was 30.8%. We did not collect the race of surveyed persons with SCI. However, foreign residents in Japan are only 1.6% of the Japanese population.[12] It is considered that the surveyed SCI population is mirroring the Japanese population and that the rate of foreign residents with SCI also is low. In fact, the rate of female individuals with SCI was 15% in this study, almost mirroring the Japanese SCI population (20%).[13]

Questionnaire

The questionnaire was based on a framework of the modified PRECEDE–PROCEED model.[14,15] The original questionnaire included eight items on quality of life, health status, food intake, dietary and health behavior, TTM, preparation factor (knowledge, attitude, skill, SE and OE), dietary environment and attributes. In this study, we analyzed the association between food intake, TTM and preparation factor: SE and OE. Before using this questionnaire, it was evaluated whether the questions and answers were adequate for the assessment of one's dietary life by two registered dietitians, the director of the organization Spinal Injuries Japan, a former staff member of the Tokyo metropolitan facility for the handicapped persons and an administration officer of the association for the handicapped persons. Furthermore, it was checked for suitability and clarity by the former staff member of the Tokyo metropolitan facility for the handicapped persons, the administration officer of the association for the handicapped persons and two community-dwelling SCI individuals who were registered members of a sports club.

Food intake

Food intake was assessed as the frequency of intake in 1 day or 1 week of 10 food items. The 10 food items were rice, meat, fish, egg, soybeans/soybean products, dairy products, green/yellow vegetables, other vegetables, potatoes and fruits. These foods are eaten in a daily diet in Japan and are major components of the Japanese diet, which consists of grain dishes, fish and meat dishes, vegetable dishes, dairy products and fruits. The frequency of intake in 1 day was assessed for rice, green/yellow vegetables and other vegetables, and that in 1 week was for other food items. Response choices comprised a four-item Likert scale scored in decreasing order of frequency (score $0-3$). The frequency score of food intake was calculated as the sum of each score for the 10 food items (total scores ranged from 0 to 30). These frequency scorings were previously confirmed to relate to the nutritional intakes calculated from the dietary records of middle-aged and elderly persons.[16]

TTM, SE and OE

In the TTM, SE and OE, participants were asked about seven items: 'To have a meal consisting of grain dishes, fish and meat dishes, and vegetable dishes not less than twice a day', 'To eat rice (rice or dishes using a rice) not less than twice a day', 'To eat fish dishes at an equal or higher frequency than meat dishes', 'To eat vegetable dishes (dishes made mainly from vegetables or potatoes) not less than twice a day', 'To eat green/yellow vegetables not less than once a day', 'To eat dairy products not less than once a day' and 'To eat fruits not less than once a day'. These questions were based on the Japanese Food Guide Spinning Top, which consists of five categories.[5] Although vegetables and fruits are often combined into a single category in Western countries, in Japan fruits are often consumed as an after-meal dessert or as a snack rather than as part of the meal. Therefore, fruits were categorized separately from vegetable dishes. Participants were asked to answer the following items in the TTM: 'I continue to eat for more than 6 months', 'I continue to eat for less than 6 months', 'I eat sometimes or consider to eat within the next 30 days', 'Although I do not eat, I consider to start eating within the next 6 months' or 'I do not eat and I do not consider to start eating within the next 6 months'; in OE 'I think it to be very important',

'I think it to be quite important', 'I think it to be a little important', 'I do not think it to be very important', 'I think it to be little important' or 'I do not think it to be important at all'; and in SE 'I have a lot of confidence in eating', 'I have quite confidence in eating', 'I have a little confidence in eating', 'I do not have a lot of confidence in eating', 'I have little confidence in eating' or 'I do not have any confidence in eating'.

Statistical analysis

Nominal scales were expressed as the number of subjects (rate). Interval scales were expressed as the mean (s.d.) or median. The associations between the attributes and the frequency scores of food intake were analyzed by the χ^2-test. The correlations between the frequency score of food intake and TTM, SE and OE were determined by binominal logistic regression analysis. The dependent variables were the frequency scores of food intake, and the independent variables were TTM (model 1), SE (model 2) and OE (model 3). On the basis of the median, the frequency scores of food intake were divided into subgroups, which were the superior group (>16) and the subordinate group ($\leqslant16$). The former was scored as 1 and the latter was scored as 0. In addition, the positive answers in TTM, SE and OE were scored as 1 and the negative answers were scored as 0 in consideration with the distribution. Variables were applied by compulsive injection to the calculation of univariate and multivariate analyses. These analyses were adjusted by sex, classification of age, time after injury, lesion type, living alone or with other persons, having a job or not, receiving of public nursing care services or not and social participation. All statistical analyses were performed using IBM SPSS Statistics v.21 (IBM Japan Inc., Tokyo, Japan). Statistical significance was set at $P<0.05$ for two-tailed tests.

Statement of ethics

This study was approved by the ethical committee of Tokyo Metropolitan University.

RESULTS

The subjects' mean age was 61.6 (s.d. 11.5) years in men and 57.8 (s.d. 13.1) years in women. Mean time after injury was 27.6 (s.d. 12.8) years in men and 25.9 (s.d. 14.4) years in women. Other subject characteristics are shown in Table 1. About one half of the subjects (51.6%) had thoracic cord injury, and 29.1% had cervical cord injury.

The mean and median frequency scores of food intake were 16.3 (s.d. 5.1) and 16.0, respectively. The frequency scores of food intake between the superior group and the subordinate group were significantly different in sex, classification of age, living alone or with other persons and receiving public nursing care services or not. The mean frequency scores were 16.0 (s.d. 5.2) among men and 17.6 (s.d. 4.8) among women; 15.2 (s.d. 5.5) in subjects up to 49 years old, 15.2 (s.d. 4.9) in subjects aged $50-59$ years, 16.1 (s.d. 5.0) in subjects aged $60-69$ years and 18.1 (s.d. 4.9) in subjects aged 70 years or older; 14.2 (s.d. 5.5) among subjects living alone and 16.6 (s.d. 5.0) among subjects living with other persons; and 16.9 (s.d. 5.2) among subjects receiving public nursing care services and 15.8 (s.d. 5.2) among subjects not receiving public nursing care services.

The correlations between the frequency score of food intake and TTM, SE and OE were determined by binominal logistic regression analysis (Table 2). In the univariate analysis, the associations of all the variables were significant and all odds ratios were >1. On the other hand, in the multivariate analysis, the frequency scores of food intake were significantly associated with 'To eat vegetable dishes (dishes mainly from vegetables or potatoes) not less than twice a day', 'To eat green/yellow vegetables not less than twice a day', 'To eat dairy products not less than once a day' and 'To eat fruits not less than once a day' in TTM and 'To eat vegetable dishes (dishes made mainly from vegetables or potatoes) not less than twice a day', 'To eat dairy products not less than once a day' and 'To eat fruits not less than once a day' in SE. There were no differences with regard to OE.

Table 1 Characteristics of Japanese individuals with spinal cord injuries as a whole and by frequency scores of food intake subgroups

Variables[a]	Groups	Frequency scores of food intake subgroups						P-value[b]
		Whole sample n = 841		Superior group[c] n = 413		Subordinate group[c] n = 428		
		n	(%)	n	(%)	n	(%)	
Sex	Men	718	85.4	337	81.6	381	89.0	0.002
	Women	123	14.6	76	18.4	47	11.0	
Classification of age	⩽49 Years	150	17.8	66	16.0	84	19.6	<0.001
	50–59 Years	176	20.9	62	15.0	114	26.6	
	60–69 Years	301	35.8	144	34.9	157	36.7	
	⩾70 Years	214	25.4	141	34.1	73	17.1	
Lesion type	Cervical cord injury	245	29.1	121	29.3	124	29.0	0.951
	Thoracic cord injury	434	51.6	211	51.1	223	52.1	
	Lumbar cord injury	162	19.3	81	19.6	81	18.9	
Time after injury	⩽9 Years	78	9.8	43	11.0	35	8.5	0.244
	10–19 Years	162	20.2	71	18.2	91	22.2	
	20–29 Years	178	22.2	79	20.3	99	24.1	
	30–39 Years	219	27.4	112	28.7	107	26.1	
	⩾40 Years	163	20.4	85	21.8	78	19.0	
Living alone or with other persons	Alone	99	11.8	34	8.2	65	15.2	0.002
	With other persons	742	88.2	379	91.8	363	84.8	
Social participation	Presence	536	68.9	267	71.8	269	66.3	0.104
	Absence	242	31.1	105	28.2	137	33.7	
Having a job or not	Yes	224	28.4	98	25.8	126	30.7	0.134
	No	566	71.6	282	74.2	284	69.3	
Receiving public nursing care services or not	Receiving	287	37.8	158	42.7	129	33.2	0.007
	Not receiving	472	62.2	212	57.3	260	66.8	

[a]Missing answers were excluded.
[b]The associations between the attributes and the frequency score of food intake were analyzed by the χ^2-test.
[c]Response choices of 10 food items (rice, meat, fish, egg, soybeans/soybean products, dairy products, green/yellow vegetables, other vegetables, potatoes and fruits) comprised a four-item Likert scale and were scored in decreasing order of frequency (score 0–3). The frequency score of food intake was calculated as the sum of each score for the 10 food items (total score ranged from 0 to 30). On the basis of the median, the frequency score of food intake was divided into subgroups, which were the superior group (>16) and the subordinate group (⩽16).

DISCUSSION

Our results suggest that vegetable dishes (containing green/yellow vegetables), dairy products and fruits are the key items or categories based on the Japanese Food Guide mediating favorable dietary intake. There are still few reports defining the items or categories mediated with adequate food intake. Therefore, our results can support an attempt to make a dietary guide for individuals with SCI.

Vegetable dishes and fruits are shown to be important items in this study. The focus area for 'Nutrition and Diet' in Health Japan 21 (the second term)[17] shows that increasing the consumption of these items is important to prevent chronic diseases and to maintain health, and also to control weight in Japan or other countries.[18,19] However, few longitudinal studies have shown these results for individuals with SCI. Only a few surveys of dietary intake have been performed for individuals with SCI. In a study conducted in 75 men and women with SCI in Canada (mean age: 42.4±11.8 years), one-quarter (26.7%) of participants were adherent to the vegetables and fruit, and grain products recommendations of Eating Well with Canada's Food Guide. One-third (34.7%) were adherent to the milk and alternative recommendations and two-thirds (65.3%) were adherent to the meat and alternative recommendations.[20] In a study of 100 adults aged 38–55 years with SCI and 100 age-matched able-bodied adults in USA, participants with SCI consumed fewer servings of dairy

products, fruits and vegetables and whole-grain foods compared with able-bodied persons.[21] In addition, the SCI and able-bodied participants who met the 2010 Dietary Guideline recommendations were as follows: 22% versus 54% for dairy, 39% versus 70% for fruits and vegetables and 8% versus 69.6% for whole-grain foods, respectively. In a study of 95 community-dwelling men with paraplegia aged 20–59 years in USA, <35% of the participants met the recommendations of the 1995 Dietary Guidelines for fruit servings and vegetable servings, and only 16% were within the guideline for dairy servings.[22] In these studies, vegetables, dairy products and fruits intakes were less adherent to recommendations. Although the dietary guidelines are food based in Canada and USA, the Japanese Food Guide is dish based. Consequently, vegetables are the similar components as vegetable dishes (side dishes) in Japan. The key items in this study are consistent with the foods that had shown dietary inadequacy in the previous studies in Canada and USA. This fact supports the validity of our results.

The frequency score of food intake was significantly related to TTM and SE; however, there was no significant association with OE. In OE, about 50% of the participants in our study answered 'I think it to be very important' and 80–90% answered 'I think it to be very/quite important'. On the other hand, 'I have a lot of/quite confidence in eating' was answered by 40–70% of participants in SE. These results

Table 2 Correlations between frequency score of food intake subgroups and the TTM, SE and OE among Japanese adults with spinal cord injuries

Variables[a]	Groups	Whole sample n = 841		Superior group[c] n = 413		Subordinate group[c] n = 428		Univariate analysis[b]		Multivariate analysis[b]	
		n	(%)	n	(%)	n	(%)	OR (95% CI)[d]	P-value	OR (95% CI)[d]	P-value
TTM (model 1)											
To have a meal consisting of grain dishes, fish and meat dishes and vegetable dishes	Maintenance[e]	562	69.4	336	84.4	226	54.9	3.84 (2.59–5.69)	<0.001	1.00 (0.57–1.77)	1.00
	Other	248	30.6	62	15.6	186	45.1	1		1	
To eat rice	Maintenance	639	78.2	351	88.0	288	68.9	2.55 (1.68–3.86)	<0.001	1.31 (0.77–2.25)	0.33
	Other	178	21.8	48	12.0	130	31.1	1		1	
To eat fish dishes at an equal or higher frequency than meat dishes	Maintenance	598	73.9	340	85.2	258	62.9	3.06 (2.06–4.55)	<0.001	1.02 (0.61–1.72)	0.94
	Other	211	26.1	59	14.8	152	37.1	1		1	
To eat vegetable dishes	Maintenance	506	62.5	329	83.3	177	42.8	5.89 (4.05–8.59)	<0.001	2.76 (1.57–4.85)	<0.001
	Other	303	37.5	66	16.7	237	57.2	1		1	
To eat green/yellow vegetables	Maintenance	526	64.9	334	83.9	192	46.5	5.71 (3.90–8.37)	<0.001	2.29 (1.33–3.94)	0.003
	Other	285	35.1	64	16.1	221	53.5	1		1	
To eat dairy products	Maintenance	485	58.9	305	75.7	180	42.9	3.84 (2.73–5.40)	<0.001	2.75 (1.85–4.08)	<0.001
	Other	338	41.1	98	24.3	240	57.1	1		1	
To eat fruits	Maintenance	454	55.4	294	73.5	160	38.2	3.76 (2.65–5.33)	<0.001	1.87 (1.24–2.83)	0.003
	Other	365	44.6	106	26.5	259	61.8	1		1	
SE (model 2)											
To have a meal consisting of grain dishes, fish and meat dishes and vegetable dishes	A lot of/quite confidence	457	55.8	289	71.5	168	40.5	3.25 (2.31–4.56)	<0.001	0.98 (0.56–1.71)	0.95
	Other	362	44.2	115	28.5	247	59.5	1		1	
To eat rice	A lot of confidence	347	41.9	206	50.6	141	33.4	1.93 (1.39–2.68)	<0.001	1.26 (0.85–1.87)	0.25
	Other	482	58.1	201	49.4	281	66.6	1		1	
To eat fish dishes at an equal or higher frequency than meat dishes	A lot of/quite confidence	543	65.8	312	76.5	231	55.4	2.55 (1.79–3.64)	<0.001	1.04 (0.65–1.64)	0.88
	Other	282	34.2	96	23.5	186	44.6	1		1	
To eat vegetable dishes	A lot of/quite confidence	408	49.6	278	68.3	130	31.3	4.08 (2.90–5.74)	<0.001	2.12 (1.22–3.68)	0.008
	Other	414	50.4	129	31.7	285	68.7	1		1	
To eat green/yellow vegetables	A lot of/quite confidence	449	54.9	287	70.7	162	39.3	3.63 (2.58–5.11)	<0.001	1.48 (0.91–2.40)	0.12
	Other	369	45.1	119	29.3	250	60.7	1		1	
To eat dairy products	A lot of/quite confidence	473	57.5	292	72.1	181	43.3	3.32 (2.38–4.64)	<0.001	1.91 (1.30–2.79)	0.001
	Other	350	42.5	113	27.9	237	56.7	1		1	
To eat fruits	A lot of/quite confidence	465	56.2	297	72.8	168	40.1	3.74 (2.66–5.24)	<0.001	1.97 (1.31–2.95)	0.001
	Other	362	43.8	111	27.2	251	59.9	1		1	
OE (model 3)											
To have a meal consisting of grain dishes, fish and meat dishes and vegetable dishes	Very important	441	54.1	267	67.1	174	41.7	2.71 (1.95–3.75)	<0.001	1.62 (0.88–2.96)	0.12
	Other	374	45.9	131	32.9	243	58.3	1		1	
To eat rice	Very important	425	51.8	239	59.8	186	44.3	1.61 (1.17–2.22)	0.004	0.86 (0.56–1.31)	0.47
	Other	395	48.2	161	40.2	234	55.7	1		1	
To eat fish dishes at an equal or higher frequency than meat dishes	Very important	413	50.6	241	60.4	172	41.2	2.05 (1.49–2.83)	<0.001	0.96 (0.59–1.56)	0.86
	Other	403	49.4	158	39.6	245	58.8	1		1	
To eat vegetable dishes	Very important	374	45.7	230	57.5	144	34.4	2.58 (1.86–3.58)	<0.001	1.21 (0.69–2.13)	0.50
	Other	444	54.3	170	42.5	274	65.6	1		1	
To eat green/yellow vegetables	Very important	463	56.7	273	68.6	190	45.5	2.76 (1.98–3.85)	<0.001	1.47 (0.86–2.53)	0.16
	Other	353	43.3	125	31.4	228	54.5	1		1	
To eat dairy products	Very important	408	50.1	245	61.7	163	39.1	2.28 (1.65–3.14)	<0.001	1.46 (0.96–2.23)	0.08
	Other	406	49.9	152	38.3	254	60.9	1		1	
To eat fruits	Very important	368	44.9	224	56.0	144	34.4	2.14 (1.55–2.96)	<0.001	1.06 (0.67–1.67)	0.81
	Other	451	55.1	176	44.0	275	65.6	1		1	

Abbreviations: CI, confidence interval; OE, outcome expectancy; OR, odds ratio; SE, self-efficacy; TTM, transtheoretical model.
[a]Missing answers were excluded.
[b]Binominal logistic regression analysis was performed. The dependent variables were the frequency scores of food intake, and the independent variables were TTM (model 1), SE (model 2) and OE (model 3). Variables were applied by compulsive injection to the calculation of univariate and multivariate analyses. These analyses were adjusted by sex, classification of age, time after injury, lesion type, living alone or with other persons, having a job or not, receiving of public nursing care services or not and social participation.
[c]Response choices of 10 food items (rice, meat, fish, egg, soybeans/soybean products, dairy products, green/yellow vegetables, other vegetables, potatoes and fruits) comprised a four-item Likert scale and were scored in decreasing order of frequency (score 0–3). The frequency score of food intake was calculated as the sum of each score for the 10 food items (total score ranged from 0 to 30). On the basis of the median, the frequency score of food intake was divided into subgroups, which were the superior group (>16) and the subordinate group (⩽16). The former was scored as 1 and the latter was scored as 0. In addition, the positive answers in TTM, SE and OE were scored as 1, and the negative answers were scored as 0 in consideration with their distribution.
[d]'Other' is a reference. An odds ratio >1 indicates a higher frequency score of food intake.
[e]'Maintenance' means continuing to eat for more than 6 months.

may possibly suggest that the individuals in our study do not have enough confidence to recognize the importance of adequately patterned food intake. Therefore, enhancing their SE is thought to be a key approach in dietary education to encourage desirable food intake.

This study has several limitations. First, it should be noted that we did not obtain data for the levels of injury defined by the America Spinal Injury Association classification A or B (motor complete SCI). It is not clear whether the level of injury would influence the correlations between the frequency score of food intake and TTM, SE and OE, and more research is needed. Second, SCI participants were recruited from members of the organization Spinal injuries Japan. Therefore, our findings may not be representative of the overall chronic SCI population in Japan. Third, the frequency scores of food intake used in this study cannot estimate the quantities of food intake. Even though the food pattern is adequate, an excessive quantity of food intake can cause obesity, dyslipidemia and other conditions. The quantity of categories based on the Japanese food pattern to prevent the chronic diseases and to maintain health for individuals with SCI needs to be confirmed in further studies. Fourth, the response rate in our study was low (30.8%). In the surveys carried out in a single center, the high response (more than 60%) was reported.[23,24] However, response rate was 31.8% in Lavelle's study,[25] or 35.8% in FluB's study[26] using a similar method to our study. Considering these results, the response rate in our study was not necessarily low. Edwards et al.[27] found out several ways to increase response: prenotification, follow-up contact, shorter questionnaires and so on. Further study to which these ways will be applied may achieve higher response rate.

In conclusion, this study finds that vegetable dishes, dairy products and fruits are the key items or categories based on the Japanese Food Guide leading to adequate dietary intake for community-dwelling Japanese people with SCI. Dietary guidelines promoting the intake of these dishes for individuals with SCI should be produced immediately to support health maintenance.

DATA ARCHIVING
There were no data to deposit.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

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