Spinal Cord (2017) 55, 788–793

www.nature.com/sc

ORIGINAL ARTICLE

The association between health-related quality of life/dietary satisfaction and perceived food environment among Japanese individuals with spinal cord injury

K Hata[1,2], T Inayama[1] and N Yoshiike[2]

Study design: Cross-sectional.
Objectives: To examine the association between health-related quality of life (HRQOL)/dietary satisfaction and perceived food environment in community-dwelling individuals with spinal cord injury (SCI).
Setting: Members of the Spinal Injuries Japan organization.
Methods: Subjects were 2007 Japanese individuals with SCI. A questionnaire conducted in 2015 included items addressing sociodemographic characteristics, HRQOL, dietary satisfaction and eight perceived food environment items. Responses from 506 individuals were analyzed (valid response rate = 25%). Dependent variables were the physical and mental summary scores of the HRQOL and dietary satisfaction. The independent variable was the perceived food environment. We used a univariate analysis (in Model 1) and a multivariate analysis (in Models 2 and 3) as part of a binominal logistic regression analysis. In Model 3, we divided and analyzed the perceived food environment variable into 'access to food' and 'access to information'.
Results: Both physical and mental summary scores were related to 'dietary information acquisition in the community'. Dietary satisfaction was related to 'balanced meals in the household', 'food and health information available from family' and 'right health and dietary information acquisition from the media'.
Conclusion: HRQOL and dietary satisfaction were differentially associated with perceived food environment factors in community-dwelling individuals with SCI. HRQOL was positively related to dietary information of perceived food environment in the community. Dietary satisfaction was positively related to perceived food environment in the household.
Spinal Cord (2017) **55,** 788–793; doi:10.1038/sc.2017.11; published online 21 February 2017

INTRODUCTION

Approximately 100 000 Japanese individuals currently live with spinal cord injury (SCI), and SCIs occur at a rate of approximately 5000 every year.[1] In Japan, it is expected that the number of individuals with SCI will increase as the population's average lifespan increases.[2] Many patients with SCI are discharged to private residences,[3,4] participate socially (e.g., through study or work) and live a long life. However, because of inactivity, individuals with SCI are more likely to have preventable health-risk factors, such as non-communicable diseases, relative to individuals without disabilities.[5,6] Therefore, self-management and health support require more consideration in this population than in able-bodied individuals. As care and rehabilitation are the main policy points for people with disabilities (i.e., the disability synthesis support law), health promotion aimed at improving quality of life (QOL) is critical.

One of these critical elements is the support needed to promote healthy dietary habits. Food environment improvement, such as the expansion of food choices and appropriate meal information, is purported to promote healthy dietary habits. When the local food environment is positive, so too will be the dietary habits of the residents.[7] In our country, 'food environment' is defined as having 'access to food', 'access to information' and the 'unification of both'.[8] As the environment has interpersonal, organization, local and policy levels,[9] the improvement of the food environment at all of these levels is necessary.

The food environment is enhanced by community members having access to wholesome foods, including healthy restaurant options, reliable and safe grocery stores and nutritionally balanced foods at appropriate prices, as well as correct dietary information provided by the media.[10] Previous studies have reported that food environment workplace interventions influenced an increase in vegetable intake[11,12] and that dietary behavior positively improved following this intervention.[13]

To address effectively the issue of dietary improvement, both the point of view of community residents receiving services and those providing services should be considered.[14] It is also crucial that individuals with SCI be provided a desirable dietary environment for their health. An important factor related to this issue is how the food environment is perceived,[15] specifically that food is readily available and easily accessible.[16] Previous research has revealed that community

[1]Department of Health Promotion Sciences, Graduate School of Human Health Sciences, Tokyo Metropolitan University, Tokyo, Japan and [2]Department of Nutrition, Aomori University of Health and Welfare, Aomori, Japan
Correspondence: Dr T Inayama, Department of Health Promotion Sciences, Graduate School of Human Health Sciences, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji, Tokyo 192-0397, Japan.
E-mail: tinayama@tmu.ac.jp
Received 19 July 2016; revised 16 December 2016; accepted 5 January 2017; published online 21 February 2017

residents who perceived adequate access to food and information exhibited healthier dietary intake and behavior.[17] However, few studies have examined the association between the perceived food environment and health-related quality of life (HRQOL) or dietary habits. To facilitate food environment improvement, it is necessary to accumulate evidence on precisely which perceived food environment factors are related to HRQOL and dietary habits. To our knowledge, no study has examined this perception in community-dwelling individuals with SCI, who are thought to have their HRQOL affected by the food environment. To clarify the associations between HRQOL measurements, perceived food environment and health promotion, we chose to examine the perceived food environment from the viewpoint of the community residents, rather than of those providing the environment. Therefore, this study examined the association between HRQOL/dietary satisfaction and type of perceived food environment in community-dwelling individuals with SCI.

MATERIALS AND METHODS

Participants and procedures

The target group included community-dwelling individuals with SCI. We acquired the assistance of Spinal Injuries Japan (SIJ), which is an organization that deals with SCIs across the entire country. SIJ has 45 branch offices across the country, and performs activities, such as reporting on SCI and offering peer support. Among registered members, the average age is ~65 years; 80% are men, and the most common lesion type is a thoracic SCI, followed by cervical and lumbar spinal cord injuries. The significance and methods of the current study was first explained to the chief director of SIJ, and consent was received. A total of 2007 eligible subjects were identified. SIJ's employees and company members were excluded from participating.

We posted a questionnaire for our cross-sectional study in August 2015. Participants were provided with a study information sheet that explained the purpose of the study and its methods and advantages. In addition, they were informed about the data publication process including that the survey was anonymous and that a returned questionnaire would be regarded as consent to participate.

Questionnaire

Sociodemographic variables. Data regarding sex, age (⩽49, 50–59, 60–69 or ⩾70 years), years since injury (⩽9, 10–19, 20–29, 30–39, or ⩾40 years), lesion type (cervical, thoracic or lumbar), living status (living alone or living with others), current employment status (yes or no) and current use of welfare services and support (yes or no) were obtained from completed questionnaires.

HRQOL. HRQOL was assessed using the validated Japanese version of the Medical Outcomes Study 8-Item Short-Form Health Survey (SF-8).[18] Similar to the longer 36-item survey,[19] the SF-8 is divided into eight health profile dimensions: physical function, role functioning physical, bodily pain, general health perception, vitality, social functioning, role functioning-emotional and mental health. The SF-8 produced two separate scores of HRQOL—physical health and mental health. SF-8 scales and summary measures were scored using norm-based scoring methods. The license for the use of SF-8 instrument was acquired through iHope International in Japan. A normal distribution was not confirmed for the physical and the mental summary scores.

Dietary satisfaction. Dietary-related QOL asked about dietary satisfaction in a manner identical to a previous study.[20] The question regarding dietary satisfaction was, 'How would you describe your satisfaction with your current diet?' Responses were provided using the following scale: (1) high, (2) moderate, (3) low or (4) very low.

Perceived food environment. We adopted questions about the perceived food environment from Takemi.[21] The questions addressed access to food (household and community) and access to information (household, community and society) using eight items. Access to food questions addressed balanced meals in home (household, one item), the availability of balanced meals in the neighborhood at an appropriate price and safe, reliable places to shop for food (community, three items). Access to information questions addressed food and health information available from family (household, one item), acquiring dietary information within the community and nutrition labels at nearby restaurants and grocery stores (community, two items) and correct dietary information acquired from the media (society, one item). Responses were provided using the following scale: (1) strongly agree, (2) agree, (3) neutral, (4) disagree and (5) strongly disagree.

Statistical analysis

We received responses from 576 individuals (response rate = 29%). However, responses where crucial data such as sex, age, lesion type or type of disability were missing, and data from institution residents and those with disabilities other than SCI were excluded. Ultimately, responses from 506 individuals were analyzed (valid response rate = 25%).

The analysis consisted of univariate and multivariate analyses by binominal logistic regression analysis. The dependent variables were physical summary score, mental summary score and dietary satisfaction. We dichotomized the physical and mental summary scores with their median scores. Physical summary score—⩾40 points was high group and ⩽39 points was low group. Mental summary score—⩾46 points was high group and ⩽45 points was low group. For dietary satisfaction, those who responded with a (1) or (2) were defined as having high dietary satisfaction, and those who responded with a (3) or (4) were defined as having low dietary satisfaction. The independent variables were perceived food environment. For this variable, those who responded with a (1) or (2) were defined as having a positive perception of the food environment, and those who responded with a (3), (4) or (5) were defined as having a negative perception of the food environment. In the univariate analysis, the eight items of perceived food environment were introduced one by one (Model 1). The multivariate analysis performed two patterns (Models 2 and 3). These analyses were adjusted by sex, age, years since injury, lesion type, living status, current employment status, current use of welfare services and support. The eight items were also introduced one by one in Model 2. In Model 3, access to food (four items) and access to information (four items) were separated and analyzed. We used a simultaneous method in Models 1 and 2, and a stepwise method in Model 3.

All statistical analyses were performed using IBM SPSS Statistics 21 (IBM Japan Inc., Tokyo, Japan), and the level of significance was set at 5% for two-tailed tests.

Ethical approval

Our study was approved by the ethical committee of Tokyo Metropolitan University (certification number: 27–37).

RESULTS

Table 1 shows the HRQOL scores, dietary satisfaction scores and the sociodemographic characteristics of participants. The median (25–75 percentile values) of the physical summary score was 40.7 (34.7–46.9). The median of the mental summary score was 46.4 (40.3–51.4). The study population was predominantly men (83%), aged over 60 years (65%), with thoracic cord injury (53%), over 20 years since injury (73%), moderate in dietary satisfaction (65.3%) and living with others (85%).

Physical summary score

Table 2 shows the relationship between physical summary score and perceived food environment. In Model 2, after adjusting for sociodemographic variables, the odds ratio was higher for 'nutritionally balanced foods at an appropriate price' and 'existence of a store to get safe and reliable food' for access to food, and 'acquiring dietary information in their community' and 'acquiring accurate health and dietary information from the media' for access to information. In Model 3, the odds ratio was higher for 'existence of a store to get safe and reliable food' (odds ratio (OR) = 1.61; 95% confidence interval

Table 1 Descriptive characteristics of the study population

Variables	*Group*	n = *506*[a] *(%)*
Sex	Men	424 (83.8)
	Women	82 (16.2)
Age group	⩽49years	81 (16.0)
	50–59years	98 (19.4)
	60–69years	175 (34.6)
	⩾70 years	152 (30.0)
Lesion type	Cervical cord injury	147 (29.1)
	Thoracic cord injury	270 (53.4)
	Lumbar cord injury	89 (17.6)
Years since injury	⩽9years	39 (7.8)
	10–19years	92 (18.3)
	20–29years	114 (22.7)
	30–39years	122 (24.3)
	⩾40 years	136 (27.0)
Living status	Living alone	75 (14.8)
	Living with others	431 (85.2)
Current employment status[b]	Yes	155 (31.2)
	No	342 (68.8)
Current use of welfare services and support	Yes	204 (40.7)
	No	297 (59.3)
SF-8	Median (25–75th percentile range)	
Physical dimension		40.7 (34.7–46.9)
Mental dimension		46.3 (40.3–51.4)
Dietary satisfaction	High	65 (12.9)
	Moderate	328 (65.3)
	Low	94 (18.7)
	Very low	15 (3.0)
Perception of food environment		
Balanced meals in household	Strongly agree	111 (22.0)
	Agree	239 (47.3)
	Neutral	109 (21.6)
	Disagree	33 (6.5)
	Strongly disagree	13 (2.6)
Balanced meals being available in the neighborhood	Strongly agree	30 (6.1)
	Agree	126 (25.7)
	Neutral	219 (44.7)
	Disagree	71 (14.5)
	Strongly disagree	44 (9.0)
Nutritionally balanced foods at an appropriate price	Strongly agree	42 (8.4)
	Agree	203 (40.6)
	Neutral	182 (36.4)
	Disagree	42 (8.4)
	Strongly disagree	31 (6.2)
Existence of a store to get safe and reliable food	Strongly agree	53 (10.7)
	Agree	203 (41.1)
	Neutral	171 (34.6)
	Disagree	42 (8.5)
	Strongly disagree	25 (5.1)
Food and health information available from family	Strongly agree	62 (12.4)
	Agree	212 (42.2)
	Neutral	128 (25.5)
	Disagree	62 (12.4)
	Strongly disagree	38 (7.6)
Acquiring dietary information in their community	Strongly agree	21 (4.2)
	Agree	101 (20.3)
	Neutral	183 (36.8)
	Disagree	86 (17.3)
	Strongly disagree	106 (21.3)
Nutrition labels at nearby restaurants and grocery stores	Strongly agree	34 (6.9)
	Agree	180 (36.4)
	Neutral	167 (33.8)
	Disagree	66 (13.4)
	Strongly disagree	47 (9.5)
Acquiring accurate health and dietary information from the media	Strongly agree	56 (11.2)
	Agree	238 (47.8)
	Neutral	160 (32.1)
	Disagree	29 (5.8)
	Strongly disagree	15 (3.0)

[a]Missing values were excluded for each item.
[b]For current employment status, yes = self-employed, office worker, public employee, a part timer and others.

(CI): 1.09–2.37) for access to food, and 'acquiring dietary information in their community' (OR = 1.67; 95% CI: 1.04–2.69) and 'acquiring accurate health and dietary information from the media' (OR = 1.74; 95% CI: 1.15–2.62) for access to information.

Mental summary score

Table 3 shows the relationship between mental summary score and perceived food environment. In Model 2, the odds ratio was higher for 'balanced household meals', 'nutritionally balanced foods at an appropriate price' and 'existence of a store to get safe and reliable food' for access to food, and 'acquiring dietary information in their community' and 'nutrition labels at nearby restaurants and grocery stores' for access to information. In Model 3, the odds ratio was higher for 'balanced household meals' (OR = 1.86; 95% CI: 1.22–2.85) and 'nutritionally balanced foods at an appropriate price' (OR = 1.62; 95% CI: 1.10–2.39) for access to food and 'acquiring dietary information in their community' (OR = 2.30; 95% CI: 1.47–3.60) for access to information.

Dietary satisfaction

Table 4 shows the relationship between dietary satisfaction and the perception of the food environment. In Model 2, the odds ratio was higher for perceived food environment except for 'nutrition labels at nearby restaurants and grocery stores' for access to information. In Model 3, the odds ratio was higher for 'balanced household meals' (OR = 6.50; 95% CI: 3.95–10.70) for access to food, and 'food and health information available from family' (OR = 2.70; 95% CI: 1.65–4.43) and 'acquiring accurate health and dietary information from the media' (OR = 1.75; 95% CI: 1.08–2.83) for access to information.

DISCUSSION

HRQOL and dietary satisfaction were differentially associated with perceived food environment factors in community-dwelling individuals with SCI. Acquired dietary information in their community was related to both physical and mental summary scores. On the other hand, dietary satisfaction was typically related to families or neighborhoods with access to food and information, and did not coincide with the variable that explained HRQOL. To our knowledge, this is the first

Table 2 Association between physical summary score and perceptions of food environment

Variables		*Group*	*Physical summary score*[a]				*Model 1*[b]	*Model 2*[b]	*Model 3*[b]
			High		*Low*		*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*
			n	*(%)*	n	*(%)*			
Access to food									
Household	Balanced meals in household	Positive	190	(73)	146	(67)	1.32 (0.89–1.95)	1.31 (0.85–2.03)	—
		Negative	71	(27)	72	(33)	1	1	
Community	Balanced meals being available in the neighborhood	Positive	86	(34)	66	(31)	1.11 (0.75–1.64)	1.00 (0.66–1.53)	—
		Negative	170	(66)	145	(69)	1	1	
	Nutritionally balanced foods at an appropriate price	Positive	142	(55)	92	(42)	1.65 (1.15–2.37)*	1.56 (1.06–2.30)*	—
		Negative	117	(45)	125	(58)	1	1	
	Existence of a store to get safe and reliable food	Positive	148	(57)	97	(46)	1.60 (1.11–2.30)*	1.66 (1.12–2.47)*	1.61 (1.09–2.37)*
		Negative	110	(43)	115	(54)	1	1	1
Access to information									
Household	Food and health information available from family	Positive	151	(58)	110	(51)	1.35 (0.94–1.94)	1.43 (0.96–2.11)	—
		Negative	109	(42)	107	(49)	1	1	
Community	Acquiring dietary information in their community	Positive	77	(30)	39	(18)	1.93 (1.25–2.99)*	2.02 (1.27–3.24)*	1.67 (1.04–2.69)*
		Negative	181	(70)	177	(82)	1	1	1
	Nutrition labels at nearby restaurants and grocery stores	Positive	117	(46)	88	(41)	1.19 (0.82–1.71)	1.01 (0.68–1.51)	—
		Negative	140	(54)	125	(59)	1	1	
Society	Acquiring accurate health and dietary information from the media	Positive	168	(65)	112	(52)	1.73 (1.20–2.51)*	1.94 (1.30–2.89)*	1.74 (1.15–2.62)*
		Negative	90	(35)	104	(48)	1	1	1

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]Missing values were excluded for each item.
[b]Binominal logistic regression analysis was performed. In the univariate analysis, the eight perceptions of food environment items were introduced one by one (Model 1). The multivariate analysis performed two patterns (Models 2 or 3); these analyses were adjusted by sex, age, years since injury, lesion type, living status, current employment status and current use of welfare services and support. We used the simultaneous method in Models 1 and 2 and the stepwise method in Model 3.
*$P<0.05$.

Table 3 Association between mental summary score and perceptions of food environment

Variables		*Group*	*Mental summary score*[a]				*Model 1*[b]	*Model 2*[b]	*Model 3*[b]
			High		*Low*		*OR (95% CI)*	*OR (95% CI)*	*OR (95% CI)*
			n	*(%)*	n	*(%)*			
Access to food									
Household	Balanced meals in household	Positive	196	(78)	140	(62)	2.17 (1.46–3.24)*	2.09 (1.36–3.21)*	1.86 (1.22–2.85)*
		Negative	56	(22)	87	(38)	1	1	1
Community	Balanced meals being available in the neighborhood	Positive	87	(36)	65	(29)	1.33 (0.90–1.96)	1.28 (0.85–1.93)	—
		Negative	158	(65)	157	(71)	1	1	
	Nutritionally balanced foods at an appropriate price	Positive	143	(57)	91	(40)	1.95 (1.35–2.81)*	1.86 (1.27–2.72)*	1.62 (1.10–2.39)*
		Negative	108	(43)	134	(60)	1	1	1
	Existence of a store to get safe and reliable food	Positive	147	(59)	98	(44)	1.81 (1.25–2.61)*	1.70 (1.16–2.49)*	—
		Negative	102	(41)	123	(56)	1	1	
Access to information									
Household	Food and health information available from family	Positive	144	(57)	117	(52)	1.25 (0.87–1.80)	1.39 (0.94–2.03)	—
		Negative	107	(43)	109	(48)	1	1	
Community	Acquiring dietary information in their community	Positive	78	(31)	38	(17)	2.22 (1.43–3.45)*	2.33 (1.47–3.69)*	2.30 (1.47–3.60)*
		Negative	172	(69)	186	(83)	1	1	1
	Nutrition labels at nearby restaurants and grocery stores	Positive	122	(50)	83	(37)	1.67 (1.16–2.42)*	1.48 (1.00–2.17)*	—
		Negative	124	(50)	141	(63)	1	1	
Society	Acquiring accurate health and dietary information from the media	Positive	154	(62)	126	(56)	1.27 (0.88–1.84)	1.30 (0.88–1.90)	—
		Negative	95	(38)	99	(44)	1	1	

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]Missing values were excluded for each item.
[b]Binominal logistic regression analysis was performed. In the univariate analysis, the eight perceptions of food environment items were introduced one by one (Model 1). The multivariate analysis performed 2 patterns (Models 2 or 3); these analyses were adjusted by sex, age, years since injury, lesion type, living status, current employment status and current use of welfare services and support. We used the simultaneous method in Models 1 and 2 and the stepwise method in Model 3.
*$P<0.05$.

Table 4 Association between dietary satisfaction and perceptions of food environment

Variables		Group	Dietary satisfaction[a]				Model 1[b]	Model 2[b]	Model 3[b]
			High		Low		OR (95% CI)	OR (95% CI)	OR (95% CI)
			n	(%)	n	(%)			
Access to food									
Household	Balanced meals in household	Positive	309	(79)	39	(36)	6.68 (4.22–10.59)*	6.68 (4.05–11.03)*	6.50 (3.95–10.70)*
		Negative	83	(21)	70	(64)	1	1	1
Community	Balanced meals being available in the neighborhood	Positive	133	(35)	23	(21)	1.97 (1.19–3.28)*	2.11 (1.23–3.61)*	—
		Negative	246	(65)	84	(79)	1	1	
	Nutritionally balanced foods at an appropriate price	Positive	205	(53)	37	(34)	2.15 (1.38–3.35)*	2.17 (1.35–3.49)*	—
		Negative	183	(47)	71	(66)	1	1	
	Existence of a store to get safe and reliable food	Positive	217	(57)	36	(34)	2.53 (1.61–3.96)*	2.36 (1.48–3.79)*	—
		Negative	167	(43)	70	(66)	1	1	
Access to information									
Household	Food and health information available from family	Positive	236	(61)	36	(33)	3.06 (1.96–4.80)*	3.28 (2.02–5.33)*	2.70 (1.65–4.43)*
		Negative	154	(39)	72	(67)	1	1	1
Community	Acquiring dietary information in their community	Positive	106	(27)	16	(15)	2.15 (1.21–3.82)*	2.18 (1.19–4.02)*	—
		Negative	281	(73)	91	(85)	1	1	
	Nutrition labels at nearby restaurants and grocery stores	Positive	172	(45)	42	(39)	1.28 (0.83–1.98)	1.22 (0.77–1.94)	—
		Negative	211	(55)	66	(61)	1	1	
Society	Acquiring accurate health and dietary information from the media	Positive	245	(63)	47	(44)	2.26 (1.46–3.48)*	2.33 (1.47–3.70)*	1.75 (1.08–2.83)*
		Negative	141	(37)	61	(56)	1	1	1

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]Missing values were excluded for each item.
[b]Binominal logistic regression analysis was performed. In the univariate analysis, the eight perceptions of food environment items were introduced one by one (Model 1). The multivariate analysis performed 2 patterns (Models 2 or 3); these analyses were adjusted by sex, age, years since injury, lesion type, living status, current employment status and current use of welfare services and support. We used the simultaneous method in Models 1 and 2 and the stepwise method in Model 3.
*$P<0.05$.

study to clarify the association between HRQOL, dietary satisfaction and perceived food environment in community-dwelling individuals with SCI. Our results could encourage the implementation of food environment improvement and health promotion programs for community-dwelling individuals with SCI.

Improvement in access to food or information is important to the health promotion of the community. Basic goals for the implementation of health promotion were established in Japan's health policy, Health Japan 21, which included goals related to food environment improvement.[10] Acquired dietary information was related to physical and mental summary scores of HRQOL in the household, community and society.

In this study, we asked whether people perceived dietary information, regardless of whether dietary information actually was provided by the community. It is important to examine key components, including whether people are provided information, such as the product, promotion, location and timing in the community and how these relate to health promotion. The communication between the sender and the receiver of information in the community is important.

Interestingly, the mental summary score was related to economic factors, such as price and access to food, rather than to safety and reliability. Cassady *et al.*[22] reported that appropriately priced food was related to positive dietary habits, such as an increase in fruit and vegetable consumption. However, it is difficult to control the gap between 'appropriate prices' and 'real prices', as an appropriate price is difficult to judge. Concerning Model 3, further studies are necessary to determine why appropriate price was related to mental summary score.

Dietary satisfaction was positively related to both access to food and access to information. A previous study within a sample of community residents revealed that people who perceive their access to food and information as positive, at the family and neighborhood level, have better dietary behavior when compared with individuals at the community level.[17] In the dietary habits framework,[10] the PRECEDE–PROCEED model[23] posits that if dietary behavior is positive, diet-related QOL is enhanced. In this study, perceived food environment in the household was positively related to dietary satisfaction. Access to food in the household was also related to the mental summary score. A home-cooked meal seems to be more related to the mental dimension, rather than the physical dimension, and this relationship is worth examining further in future studies.

The current study had several limitations. First, this study used a cross-sectional design; therefore, it is not possible to make causal inferences. Second, the perceived food environment questionnaire's reliability and validity have not been verified. It is possible that other variables exist that our questions did not address. Third, we did not directly investigate an objective food environment in this study, but asked about perceived food environment. It is necessary to examine this association in the future. Fourth, the response rate was low (i.e., 29%), even though a reminder postcard was sent and the amount of questionnaire items was reduced. Fifth, the SCI participants were recruited members of the SIJ organization; therefore, our findings may not be representative of the overall population of individuals with SCI in Japan. Last, we did not obtain data regarding completeness of injury as defined by the America Spinal Injury Association classifications A or B (motor/complete SCI).

Despite these limitations, this was the first report that showed an association between HRQOL/dietary satisfaction and perceived food environment in community-dwelling individuals with SCI. Encouraging the health promotion of individuals with a disability is long overdue in Japan. Our findings are critical to the field of health promotion for community-dwelling individuals with SCI. This research has identified the need to address two important issues. First, it is necessary to examine social marketing techniques used to reach community-dwelling individuals with SCI, to improve the perceived food environment, and second, it is necessary to examine whether this action promotes HRQOL improvements in individuals with SCI.

CONCLUSION

HRQOL was positively related to dietary information in the communities of participants. Additionally, dietary satisfaction was positively related to perceived food environment in the household. To improve the food environment of community-dwelling individuals with SCI, HRQOL should be improved through providing dietary information, and dietary satisfaction should be improved in the household.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

We thank all of the individuals with SCI who participated in this study. This work was supported by JSPSKAKENHI Grant Number 23500962.

1 Katoh S, Enishi T, Sato N, Sairyo K. High incidence of acute traumatic spinal cord injury in a rural population in Japan in 2011 and 2012: an epidemiological study. *Spinal Cord* 2014; **52**: 264–267.
2 Sumida M, Sugihara K, Tokuhiro A, Magara A, Uchida R, Genda E. Spinal cord injury in elderly individuals in Japan. *Jpn J Occup Med Traumatol* 2004; **52**: 17–23.
3 Tsurumi K, Isaji T, Ohnaka K. Multifaceted analysis of factors affecting home discharge of patients with cervical spinal cord injury. *Jpn J Rehabil Med* 2012; **49**: 726–733.
4 National Spinal Cord Injury Statistical Center. Annual Report for the spinal cord injury model systems, 2013—Public resources for National Spinal Cord Injury Statistical Center. Available at: https://www.nscisc.uab.edu/ (last accessed date 7 July 2016).
5 Garshick E, Kelley A, Cohen SA, Garrison A, Tun CG, Gagnon D *et al*. A prospective assessment of mortality in chronic spinal cord injury. *Spinal Cord* 2005; **43**: 408–416.
6 deGroot S, Post MW, Snoek GJ, Schuitemaker M, van der Woude LH. Longitudinal association between lifestyle and coronary heart disease risk factors among individuals with spinal cord injury. *Spinal Cord* 2013; **51**: 314–318.
7 Caspi CE, Sorensen G, Subramanian SV, Kawachi I. The local food environment and diet: a systematic review. *Health Place* 2012; **18**: 1172–1187.
8 Ministry of Health, Labour and Welfare. *Study meeting report about the food environment improvement for health promotion*. Available at: http://www.mhlw.go.jp/shingi/2004/12/dl/s1202-4a.pdf (in Japanese) (Accessed on 7 July 2016).
9 McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Behav* 1988; **15**: 351–377.
10 Ministry of Health, Labour and Welfare. *A basic direction for comprehensive implementation of national health promotion*. Available at: http://www.mhlw.go.jp/file/06-Seisakujouhou-10900000-Kenkoukyoku/0000047330.pdf (last accessed 7 July 2016).
11 Kushida O, Murayama N. Effects of environmental intervention in workplace cafeterias on vegetable consumption by male workers. *J Nutr Educ Behav* 2014; **46**: 350–358.
12 Misawa A, Yoshita K, Fukumura T, Tanaka T, Tamaki J, Takebayashi T *et al*. Effects of a long-term intervention in a work cafeteria on employee vegetable intake. *Sangyo Eiseigaku Zasshi* 2015; **57**: 97–107.
13 Sawada K, Takemi Y, Murayama N, Sasaki S, Ishida H. Development and evaluation of a worksite-based nutrition education program integrated with food environmental intervention applying the Transtheoretical Model. *Jpn J Health Edu Promotion* 2009; **17**: 54–70.
14 Lee NR, Kotler P. *Social Marketing: Influencing Behaviors for Good*, 4th edn. Sage Publications: Thousand Oaks, CA, USA, 2011, pp 1–26.
15 Williams LK, Thornton L, Ball K, Crawford D. Is the objective food environment associated with perceptions of the food environment? *Public Health Nutr* 2011; **15**: 291–298.
16 Contento IR. Nutrition education: Linking research, theory, and practice. *Asia Pac J Clin Nutr* 2008; **17**: 176–179.
17 Takemi Y. Study on evaluation of the food environment. In: Shimomitsu K (ed.). *Study on the Environment and the Evaluation Method of the Environmental Conditions to Support Health Promotion. Comprehensive Research on Prevention of Cardiovascular Diseases and Other Lifestyle Related Diseases*. Research report of Health Labour Sciences Research Grant: Tokyo, Japan, 2008, pp 43–50.
18 Fukuhara S, Suzukamo Y. *Manual of the SF-8 Japanese Version*. Institute for Health Outcomes and Process Evaluation Research: Kyoto, 2004.
19 Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992; **30**: 473–483.
20 Hata K, Inayama T, Matsushita M, Shinoda S. The combined associations of social participation and support with self-rated health and dietary satisfaction in men with spinal cord injury. *Spinal Cord* 2016; **54**: 406–410.
21 Takemi Y. Study on the development and goal setting of the food environment. In: Shimomitsu K (ed.). *Study on the Effective Environmental Implement of Health Promotion Supported Environment and Setting of the Policy Objective. Comprehensive Research on Prevention of Cardiovascular Diseases and Other Lifestyle Related Diseases*. Research Report of Health Labour Sciences Research Grant: Tokyo, Japan, 2011, pp 37–49.
22 Cassady D, Jetter KM, Culp J. Is price a barrier to eating more fruits and vegetables for low-income families? *J Am Diet Assoc* 2007; **107**: 1909–1915.
23 Green LW, Kreuter MW. *Health Program Planning: An Educational and Ecological Approach*, 4th edn. Mc Graw-Hill: Boston, MA, USA, 2005, pp 7–17.