Mal J Nutr 28(1): 107-117, 2022

Validation of questionnaire for assessing perceived benefits and barriers of vegetable consumption in Japanese adults

Yaeko Kawaguchi[1], Junichiro Somei[1], Chikana Kawaguchi[2], Akiko Suganuma[1] & Naoki Sakane[1*]

[1]*Division of Preventive Medicine, Clinical Research Institute, National Hospital Organization Kyoto Medical Center, Kyoto, Japan*; [2]*Tohoku University, School of Medicine, Sendai, Miyagi, Japan*

ABSTRACT

Introduction: This study aimed to develop and validate a diet consultation tool that assesses the perceived benefits and barriers of vegetable consumption attached to the stage of change in Japanese adults. **Methods:** A web-based survey was conducted among university and vocational school students, medical staffs, and local residents in the Aichi, Osaka, and Kyoto prefectures of Japan between September 2017 and January 2018. Participants comprised of 379 adults aged 20–70 years (mean age: 30.5±12.6 years; men: 21.4%). The scale for decisional balance of vegetable consumption contained 15 benefit items and 15 barrier items. The internal consistency of the scale was examined using Cronbach's alpha and construct validity was examined using an exploratory factor analysis with Promax rotation. **Results:** The developed questionnaire had 12 items across two domains for benefits and 12 items across three domains for barriers that were structured with high internal consistencies (Cronbach's alpha: 0.82, 0.79, 0.82, 0.76 and 0.76, respectively). The intraclass correlation coefficient in the test-retest reliability study was substantial (0.77). We found a very clear association between decreasing barrier score with increasing vegetable consumption and progress in the stage of change. The decisional balance score (benefits score minus barriers score) was positively correlated with the number of vegetable servings as an external parameter (Spearman's correlation: 0.461*; p*<0.001). **Conclusion:** The developed questionnaire was a valid, reliable, and useful tool for diet consultants to assess the perceived benefits and barriers of vegetable consumption in Japanese adults.

Keywords: balance, benefits and barriers, diet consultation, questionnaire, vegetable

INTRODUCTION

Eating vegetables has widely accepted health benefits, including the prevention of type 2 diabetes, hypertension, cancer, stroke, metabolic syndrome, cardiovascular disease, and a reduction in all-cause mortality (Aune *et al.*, 2017; Nanri *et al.*, 2017; Wang *et al.*, 2014). According to Meader *et al.* (2017), eating vegetables is a commonly recommended non-pharmacological intervention and is endorsed by most countries; however, many individuals do not consume enough vegetables to reap the benefits.

*Corresponding author: Dr Naoki Sakane
Division of Preventive Medicine, Clinical Research Institute, National Hospital Organization Kyoto Medical Center, Kyoto, Japan
Tel: (81)75-641-9161; Fax: (81)75-645-2781; E-mail: nsakane@gf6.so-net.ne.jp
doi: https://doi.org/10.31246/mjn-2021-0051

Appleton *et al.* (2018) reported that the knowledge of the 5-a-day message in the UK encourages people to eat more fruits and vegetables.

The Japanese recommendation by the Ministry of Agriculture, Forestry and Fisheries (2010) of 350 g of vegetables per day for adults is equivalent to five servings (SVs) because a standard serving of vegetables is 70 g in Japan. However, as shown by the National Institute of Health and Nutrition (2018), only 30% of Japanese people (men: 30.7%, women: 27.0%) over 20 years of age consume five or more SVs of vegetables per day. It should be pointed out that unlike the proposals of the World Health Organization (WHO) and some countries, the 5-a-day campaign in Japan does not include fruits in five SVs because of the different roles of fruits and vegetables in the promotion of health, and the high sugar content in Japanese fruits. Wilunda *et al.* (2021) reported that vegetable consumption was inversely associated with weight changes in Japanese adults, while fruit consumption was positively associated with weight changes. Therefore, an effective assessment tool to promote vegetable consumption is required.

The transtheoretical model (TTM) is a unique scientific theoretical behavioural model, as well as a practice model, that involves distinct components such as changes in behaviour, self-efficacy, decisional balance, and change of process for effective intervention. Di & Prochaska (2010) reported that the decisional balance tool is a promotional tool that weighs the perceived benefits and barriers of a specific behaviour. Miller & Rose (2015) pointed out that in ambivalent people, interventions affecting decisional balance tend to hinder commitment to change. Several studies have been conducted on decisional balance tools for vegetable consumption, such as Shtaynberger & Krebs (2016), Wang *et al.* (2016), and Chuan & Horwath (2001). However, their results were not useful for diet consultation because vegetable consumption was determined on a daily gram amount basis, not on each meal serving basis, and the relationship between vegetable consumption and barriers to intake (barrier score) was not clear, even though the removal of barriers is regarded as one of the most effective ways to increase vegetable consumption.

Therefore, the aim of this study was to develop and validate a decisional balance tool, based on the stages of change, to help diet consultants identify ways to increase vegetable consumption in Japanese adults.

MATERIALS AND METHODS

Study design and participants

A web-based, self-administered questionnaire survey was conducted. The participants were recruited between September 2017 and January 2018 among university and vocational school students majoring in nutrition, medical staffs, and local area residents in the Aichi, Osaka, and Kyoto prefectures of Japan. Participants were provided with a study protocol paper with a QR code that introduced them to the website. The inclusion criteria were people of age 20 years or more and who could respond to the questionnaire using their own device. A total of 398 individuals responded to the web-based survey. Nineteen respondents were excluded because they did not meet the lower age limit of at least 20 years. The final number of adults enrolled in this study was 379.

Development of questionnaire

With reference to a previous study, the questionnaire developed for the web-based survey consisted of demographic parameters (age, marital status,

employment status, household income, residential situation), body mass index (BMI), vegetable consumption per meal (breakfast, lunch, dinner, snack), stage of change (pre-contemplation, contemplation, preparation, action/ maintenance), decisional balance (perceived benefits and barriers), the importance of vegetable consumption, and confidence (self-efficacy) in eating five SVs of vegetables per day.

The following question was asked to assess vegetable consumption: "About how many SVs of vegetables do you consume for breakfast, lunch, and dinner, and as a snack?", similar to the studies by Barad *et al.* (2019), and McGuirt, Jilcott & Gustafson (2018). Pictures and descriptions of vegetables, including root vegetables and vegetable juices, were provided. According to Health Japan 21 (published by the Ministry of Health, Labor and Welfare, 2012) and the Dietary Guidelines for Japanese (Ministry of Agriculture, Forestry and Fisheries, 2010), vegetables did not include potatoes, mushrooms, seaweed, or soybeans. A visual call-out box providing examples of SV sizes was included in the questionnaire; 0.5, 1, and 2 SVs consisted of 35, 70, and 140 g of raw vegetables, respectively. The red oval in Figure 1 indicates SV size of 0.5. The options for SV size per meal in the questionnaire were none, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, and 5 or more.

The stages in the TTM model can be applied to dietary behaviours, such as the consumption of vegetables and fruits in adults, as reported by Laforge, Greene & Prochaska (1994). The following question was asked to assess the stage of change for vegetable consumption: "Are you currently eating the target amount (350 g or more per day) of vegetables?". The answer options were as follows: "No intention of starting in the next six months" (pre-contemplation), "Intention of starting in the next six months" (contemplation), "Intention of starting in the next 30 days" (preparation), "Engagement in activity for less than six months" (action), and "Engagement in activity for more than six months"

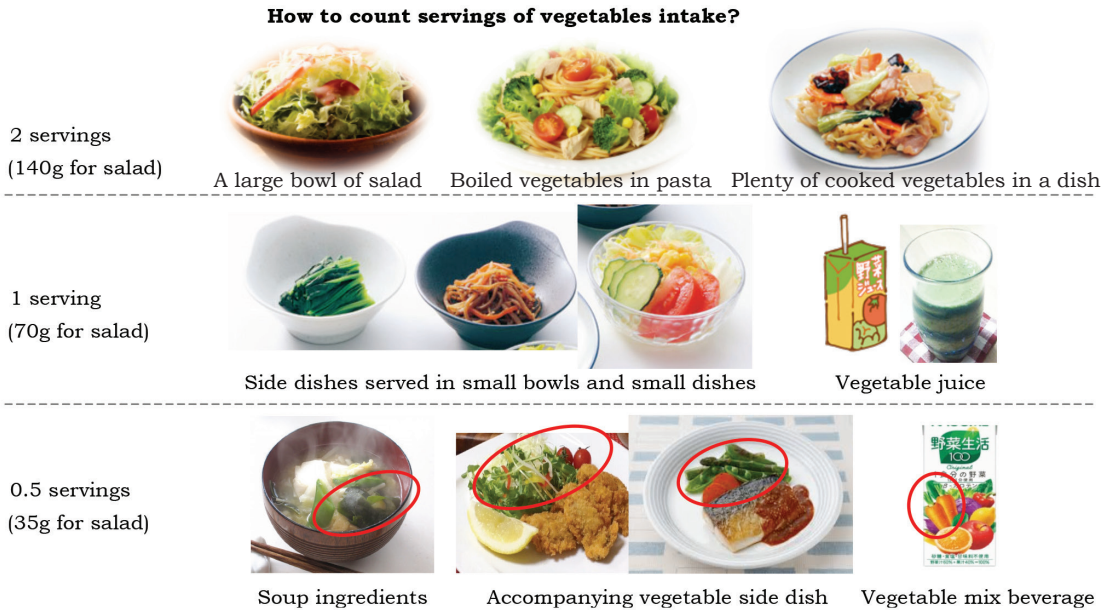

Figure 1. Number of servings as a guide for vegetable consumption

(maintenance). These answers were scored from 1 to 4, respectively, with the action and maintenance stages combined.

The questionnaire initially included 15 items related to perceived benefits and 15 items related to perceived barriers. Each item was scored on a 5-point Likert scale ranging from "strongly disagree" (1 point) to "strongly agree" (5 points).

Evaluation

The questionnaire was modified through evaluation by five dietitians and three researchers, who were engaged in diet consultation for outpatients with non-communicable diseases and their prevention.

Scaling

Exploratory factor analysis was performed using the Promax rotation to determine the factor structure of the benefits and the barriers, and to create scales of benefits and barriers.

The factor analysis involved the Promax rotation of the retained items. Promax rotation maximises the sum of the variance of the squared loadings, where loading is defined as the correlation between the item and the factor. It highlights a small number of key items, which simplifies the interpretation of the results. The interpretation of the rotated value involved the identification of the items loaded on each retained factor, the determination of the conceptual meaning of the items loaded on the same factor, and the conceptual differences between the items loaded on different factors. The relationship between each item and the underlying factor was expressed by the rotated factor loading value. Pattern loadings with an absolute value of approximately 0.35 or more were used to interpret the results, according to Hatcher (1994).

Validity

The items assessing perceived benefits and perceived barriers were tested for construct validity using the Kaiser–Meyer–Olkin (KMO) test. A KMO value of approximately 1 is good, and a value of 0.6 is acceptable. Items with KMO values <0.5, which indicates low communality, can usually be excluded from the analysis based on a previous report by Cerny & Kaiser (1977).

Reliability

The reliability of the questionnaire was evaluated using Cronbach's alpha coefficient, which scores internal consistency as follows: <0.5: unacceptable; 0.5 to <0.6: poor; 0.6 to <0.7: questionable; 0.7 to <0.8: acceptable; 0.8 to <0.9: good; and ≥0.9: excellent, as reported by Heo, Kim & Faith (2015).

The reliability of participants' responses to the questions was assessed by comparing two time points using intraclass correlation coefficients (ICCs) with 95% confidence intervals (CIs). The interval between the test and retest was at least one week, but less than four weeks. The ICCs were calculated using a 2-way mixed model based on absolute agreement. The strength of the agreement was rated as suggested by Landis & Koch (1977) as follows: <0.00: poor; 0.00–0.20: slight; 0.21–0.40: fair; 0.41–0.60: moderate; 0.61–0.80: substantial; and 0.81–1.00: almost perfect.

Statistical analysis

The association of decisional balance with vegetable consumption was analysed using logistical regression analysis. Trend analysis and *T*-scores were used to examine the relationship between decisional balance and the stage of change. Statistical significance

was set at $p<0.05$. Hedges' g was used to categorise effect sizes as small, medium, or large (g = 0.20, 0.50, and 0.80, respectively). The correlation between the decisional balance score and vegetable consumption was provided by Spearman's rank correlation coefficients. All statistical analyses were performed using the IBM SPSS Statistics version 20.0 (IBM Corp, Armonk, New York, USA).

Ethical approval

Informed consent was obtained from all participants prior to the start of the survey. The study design was approved by the ethics committee of Kyoto Medical Centre (18-095).

RESULTS

Characteristics of the participants

Our study comprised of 379 adults aged 20–70 years (mean age: 30.5±12.6 years; men: 21.4%) with a mean body mass index (BMI) of 21.0±2.8 kg/m^2. More than two-thirds were single (71.2%), although most lived with their families or others (67.3%). The annual household income was low (<2 million yen) in 4.0%, middle (>2 to <6 million yen) in 24.5%, high (>6 million yen) in 31.7%, and unknown in 39.8%. The number of vegetable SVs per day was 2.59±1.46; per meal was 0.36±0.48 (breakfast), 0.84±0.58 (lunch), 1.35±0.79 (dinner), and 0.05±0.19 (snack). Overall, 237 participants (62.5%) were aware of the current recommendation for vegetable consumption.

Scaling

Using exploratory factor analysis, six items (three for perceived benefits and three for perceived barriers) were excluded from the questionnaire owing to the factor loading value of <0.35. For perceived benefits, the excluded items were "I feel guilty if I don't eat vegetables", "Eating vegetables pleases my family", and "I drink vegetable juice as a part of meal every day" (questions 4, 10, and 15 on the questionnaire, respectively). For perceived barriers, they were "I don't know what vegetables I should buy", "Eating vegetables takes time", and "I don't have utensils for cooking vegetables" (questions 1, 5, and 10, respectively). The final 24 items had a two-domain structure ("pleasure" and "healthy") for perceived benefits and a three-domain structure ("not attractive", "low priority", and "hard to get") for perceived barriers.

Validity

The KMO values for the 12 items in the perceived benefits category and 12 items in the perceived barriers category were good (0.887 and 0.876, respectively).

Reliability

The two domains for perceived benefits (Cronbach's alpha: 0.82 and 0.79, respectively) and the three domains for perceived barriers (Cronbach's alpha: 0.82, 0.76, and 0.76, respectively) demonstrated acceptable or good internal consistency (Table 1). The Cronbach's alpha coefficients ranged between 0.76–0.87, which were within the range previously reported by Ma *et al.*, (2002) and Fontes *et al.*, (2005) for pro and con items, and the process of change measurements in adults had high internal consistency (Table 1). The test-retest reliability study showed that the agreement ICCs was 0.77 (95% CI 0.59-0.88), demonstrating 'substantial'.

Association of vegetable consumption with stage of change and decisional balance

Regarding the stage of change for vegetable consumption, 10.6% of the participants were in the pre-contemplation stage, 63.6% were in

Table 1. Factors and factor loading values for vegetable consumption

	Items	*Factor loading*
Perceived benefits (Cronbach's α = 0.87)		
Pleasure (Cronbach's α = 0.82)		
9	Eating fresh vegetables makes me feel better.	0.79
3	Vegetables are delicious.	0.77
8	Eating seasonal vegetables puts me in touch with the season.	0.71
14	A variety of vegetables makes eating enjoyable.	0.69
2	Eating vegetables refreshes my mouth.	0.51
5	I feel full after eating vegetables.	0.47
Healthy (Cronbach's α = 0.79)		
7	Eating vegetables improves my appearance (especially my skin condition).	0.75
12	Eating vegetables helps me stay healthy.	0.75
13	Vegetables are healthy because of low energy density.	0.60
6	Eating vegetables aids bowel movements.	0.48
1	Eating vegetables maintains a good physical condition.	0.40
11	Dishes with vegetables look appealing and colorful.	0.40
Perceived barriers (Cronbach's α = 0.87)		
Not attractive (Cronbach's α = 0.82)		
8	Vegetables are boring because of limited cooking methods.	0.73
3	Vegetables do not last long and cannot be used up well.	0.66
9	Cooking and preparing vegetables is time-consuming.	0.65
6	It is difficult to buy the right amount of vegetables.	0.59
11	The vegetables I cook myself are not tasty.	0.47
13	Buying vegetables is not economical.	0.40
7	I do not feel satisfied after eating vegetables.	0.39
Low priority (Cronbach's α = 0.76)		
14	I do not eat vegetables when I have a late dinner.	0.82
15	I do not eat vegetables when I am tired.	0.73
12	I do not eat vegetables if there are other choices more to my liking.	0.50
Hard to get (Cronbach's α = 0.76)		
4	It is difficult to go to stores to buy vegetables.	0.79
2	I do not have time to buy or obtain vegetables.	0.70

contemplation, 8.7% in preparation, and 17.1% in action/maintenance stages. The characteristics of the participants at each stage of change are shown in Table 2. Since more than 60% of the participants belonged to the contemplation stage, concern arose about the statistical analysis being affected by unbalanced stage settings. It was assumed that the effect of unbalanced settings was small because the trend analysis demonstrated 'reasonable'. The number of SVs for the stages were 2.04, 2.23, 2.67, and 4.22, respectively (p for trend <0.001). For each meal except snacks, vegetable consumption increased across the stages (p for trend <0.001).

The decisional balance score (the benefit score minus the barrier score) was 0.72 for pre-contemplation, 1.28 for contemplation, 1.73 for preparation, and 2.30 for action/maintenance (p for trend <0.001). It increased in both benefit domains and decreased in all

Table 2. Characteristics of the participants by stages of change

Variables	*Stage of change*					*p* *PC vs A/M*
	All (n=379)	*PC (n=40)*	*C (n=241)*	*P (n=33)*	*A/M (n=65)*	
Age (years)	30.5±12.6	26.7±9.7	29.3±12.0	31.5±13.7	36.5±13.9	<0.001
Sex (female, %)	78.2	72.5	80.5	81.8	73.8	1.000
Body mass index (kg/m^2)	21.0±2.8	20.6±2.8	21.0±2.6	21.2±3.4	21.1±3.0	0.413
Marital status (single, %)	71.2	85.0	74.3	66.7	53.8	0.001
Household income (high, %)	52.6	27.3	53.6	47.4	63.3	0.009
Residential situation (alone, %)	32.7	35.0	34.4	42.4	20.0	0.109

Values are presented as mean±standard deviation
t-test and Fisher's exact test were used.
Household income: A total of 151 participants with missing data were excluded (PC, pre-contemplation = 18, C, contemplation = 103, P, preparation = 14, A/M, action/maintenance = 16)

three barrier domains across the stages (p for trend <0.001) (Table 3). At each stage, there was a significant difference between the *T*-scores for the benefit and the barrier items (Figure 2).

Higher vegetable consumption was associated with lower perceived barrier scores (odds ratio (OR): 0.42; 95% CI: 0.26, 0.68) and higher perceived benefit scores (OR: 2.75; 95% CI: 1.40, 5.40). Awareness of the importance of, and confidence (self-efficacy) in, eating five SVs of vegetables per day at each stage of change is shown in Table 3. Both parameters differed significantly across the stage of the change spectrum in the trend analysis (p<0.05).

Correlation between vegetable consumption and decisional balance

The number of vegetable SVs was directly proportional to the perceived benefits score and inversely proportional to the perceived barriers score (Spearman's correlation: 0.324 and -0.435, respectively). The decisional balance score was positively correlated with vegetable consumption (Spearman's correlation: 0.461; p<0.001). For each increase in the number of vegetable SVs, the benefits score increased by 0.76 (standard error: 0.12), whereas the barriers score decreased by 0.77 (standard error: 0.09). Interestingly, the effect sizes for the pro and con items were similar (Hedges' g: 1.18 and 1.29, respectively).

DISCUSSION

We developed and validated a diet consultation tool to assess the perceived benefits and barriers of vegetable consumption in adults. In contrast to a prior study by Wang *et al.* (2016), our results showed a very clear relationship between vegetable consumption and decisional balance, as well as decisional balance and stage of change. Thus, the developed questionnaire stands useful for promoting vegetable consumption.

The clear association between increasing vegetable consumption and decreasing barrier score in accordance with the progress in the stage of change is a useful message for diet consultants

Table 3. Vegetable consumption and decisional balance scores by stages of change

Stages of change	*All (n=379)*	*PC (n=40)*	*C (n=241)*	*P (n=33)*	*A/M (n=65)*	*p*
Vegetable consumption, SVs						
Breakfast	0.36±0.48	0.19±0.29	0.26±0.38	0.41±0.46	0.78±0.63	<0.001
Lunch	0.84±0.58	0.81±0.55	0.73±0.53	0.89±0.46	1.24±0.64	<0.001
Dinner	1.35±0.79	1.04±0.58	1.20±0.68	1.33±0.55	2.11±0.95	<0.001
Snack	0.05±0.19	0.00±0.00	0.04±0.18	0.03±0.12	0.10±0.28	0.013
Decisional balance score†	1.43±1.12	0.72±0.79	1.28±1.07	1.73±0.86	2.30±1.10	<0.001
Benefits†						
Total score	4.00±0.60	3.66±0.62	3.95±0.59	4.16±0.42	4.32±0.52	<0.001
"Pleasure"	3.92±0.71	3.55±0.74	3.85±0.71	4.12±0.48	4.31±0.58	<0.001
"Healthy"	4.08±0.61	3.77±0.64	4.04±0.62	4.21±0.48	4.33±0.52	<0.001
Barriers†						
Total score	2.57±0.76	2.94±0.61	2.67±0.72	2.43±0.71	2.02±0.77	<0.001
"Not attractive"	2.81±0.82	3.16±0.64	2.92±0.77	2.69±0.82	2.27±0.88	<0.001
"Low priority"	2.16±0.96	2.56±0.93	2.26±0.97	2.10±0.88	1.58±0.76	<0.001
"Hard to get"	2.30±1.09	2.75±1.19	2.40±1.09	2.02±0.91	1.79±0.94	<0.001
Importance/ Confidence‡						
Importance	4.47±0.62	4.08±0.66	4.43±0.62	4.64±0.49	4.78±0.52	0.001
Confidence	2.17±1.18	1.65±0.77	1.90±0.98	2.09±0.91	3.52±1.21	<0.001

Values are presented as mean±standard deviation.
p for trend analysis was used to examine the relationship between the values and the stage of change.
PC (pre-contemplation, *n*=40), C (contemplation, *n*=241), P (preparation, *n*=33), A/M (action/ maintenance, *n*=65)
†The decisional balance score consisted of 12 benefits and 12 barriers items scored from 1 to 5 Likert scales anchored from 1 = not important (confident) up to 5 = completely important (confident)
‡The question is "How important (confident) are you on a scale of 1 to 5 that you eat 5 SVs of vegetables, with 1 being not at all important (confident) and 5 being very important (confident)?"

who promote vegetable consumption. This is because the removal of a barrier factor is more important than adding a benefit factor for people in the early stage due to lack of confidence (self-efficacy).

In our study, the decisional balance score varied across the stages of change, which is consistent with the findings of previous studies by Greene *et al.* (2004), Mainvil *et al.* (2010), and Chuan & Horwath (2001).

Implication for practice

From the perspective of cost effectiveness, it is important to adopt a stage-matched intervention using a population strategy. Further study is needed to develop an effective diet consultation intervention programme that promotes vegetable consumption using the developed questionnaire.

In addition, it is desirable to monitor the population strategy for health promotion in local communities, occupational health, schools, hospitals, etc., through a regular web-based survey using the developed questionnaire.

Limitation

This study has some limitations. Firstly, it included only Japanese adults. Further investigation is required to determine

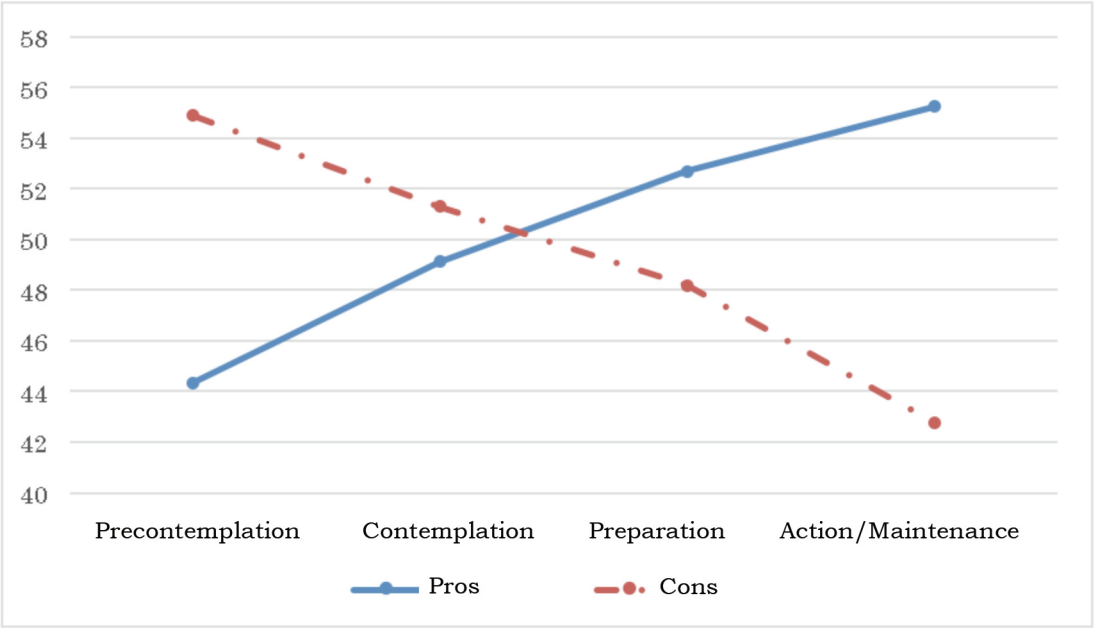

Figure 2. Benefit and barrier *T*-scores by stage of change. The scores are presented as standardised *T*-scores (mean=50, standard deviation=10)

Supplemental Table S2. Likert scale values: stages of change and importance/confidence of vegetable consumption

Item	*Stages of change*					*p*
	All (n=379)	*PC (n=40)*	*C (n=241)*	*P (n=33)*	*A/M (n=65)*	
Importance	4.47±0.62	4.08±0.66	4.43±0.62	4.64±0.49	4.78±0.52	0.001
Confidence	2.17±1.18	1.65±0.77	1.90±0.98	2.09±0.91	3.52±1.21	<0.001

Values are presented as mean±standard deviation.
PC (pre-contemplation), C (contemplation), P (preparation), A/M (action/maintenance)
Likert scales anchored from 1 = not important (confident) up to 5 = completely important (confident). The question is, "How important (confident) are you on a scale of 1 to 5 that you eat 5 SVs of vegetables, with 1 being not at all important (confident) and 5 being very important (confident)?"
p for trend analysis was used to examine the relationship between the values and the stage of change.

whether our results can be extended to other ethnic groups and children. Moreover, it is important to examine the willingness to eat vegetables at an earlier age. Secondly, we did not consider the stage of change or decisional balance variations for different vegetable categories such as tuber, leafy and non-leafy vegetables. Finally, the data were self-reported and were therefore subjected to recall bias.

CONCLUSION

The developed questionnaire is a valid, reliable, and useful tool for diet consultants to assess the perceived benefits and barriers of vegetable consumption in Japanese adults.

Acknowledgement

This work was partly supported by JSPS KAKENHI (Grant Number 16K08900, 19K02668).

Authors' contributions

YK, principal investigator, conceptualised and designed the study, prepared the draft of the manuscript and reviewed the manuscript; JS, led the data collection, advised on data analysis and interpretation, and reviewed the manuscript; NS, conducted the study, conceived the ideas, reviewed the manuscript; CK, conducted data analysis and interpretation, and reviewed the manuscript; AS, collected and analysed the data.

Conflict of interest

The authors declare no conflict of interest.

References

Appleton KM, Krumplevska K, Smith E, Rooney C, McKinley MC & Woodside JV (2018). Low fruit and vegetable consumption is associated with low knowledge of the details of the 5-a-day fruit and vegetable message in the UK: findings from two cross-sectional questionnaire studies. *J Hum Nutr Diet* 31:121-130.

Aune D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, Greenwood DC, Riboli E, Vatten LJ & Tonstad S (2017). Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality-a systematic review and dose-response meta-analysis of prospective studies. *Int J Epidemiol* 46:1029–1056.

Barad A, Cartledge A, Gemmill K, Misner NM, Santiago CE, Yavelow M & Langkamp-Henken B (2019). Associations between intuitive eating behaviors and fruit and vegetable intake among college students. *J Nutr Educ Behav* 51:758-762.

Cerny BA & Kaiser HF (1977). A study of a measure of sampling adequacy for factor-analytic correlation matrices. *Multivariate Behav Res* 12:43-47.

Chuan Ling AM & Horwath C (2001). Perceived benefits and barriers of increased fruit and vegetable consumption: Validation of a Decisional Balance Scale. *J Nutr Educ* 33:257-65.

Di Noia J & Prochaska JO (2010). Dietary stages of change and decisional balance: a meta-analytic review. *Am J Health Behav* 34:618-632.

Fontes de Oliveira MDC, Anderson J, Auld G & Kendall P (2005). Validation of a tool to measure processes of change for fruit and vegetable consumption among male college students. *J Nutr Educ Behav* 37:2-11.

Greene GW, Fey-Yensan N, Padula C, Rossi S, Rossi JS & Clark PG (2004). Differences in psychosocial variables by stage of change for fruits and vegetables in older adults. *J Am Diet Assoc* 104:1236-1243.

Hatcher L (1994). *A step by step approach to using the SAS system for factor analysis and structural equation modeling. Cary, NC:* SAS Institute

Heo M, Kim N & Faith MS (2015). Statistical power as a function of Cronbach alpha of instrument questionnaire items. *BMC Med Res Methodol* 25:86.

Laforge RG, Greene GW & Prochaska JO (1994). Psychosocial factors influencing low fruit and vegetable consumption. *J Behav Med* 17:361-74.

Landis JR & Koch GG (1977). The management of observer agreement for categorical data. *Biometrics* 33: 159-174

Mainvil LA, Lawson R, Horwath CC, McKenzie JE & Hart I (2010). Validated scales to assess adult decisional balance to eat more fruits and vegetables. *Appetite* 55:454-465.

Ma J, Betts NM, Horacek T, Georgiou C, White A & Nitzke S (2002). The importance of decisional balance and self-efficacy in relation to stages of change for fruit and vegetable intakes by young adults. *Am J Health Promot* 16:157-166.

McGuirt JT, Jilcott Pitts SB & Gustafson A (2018). Association between spatial access to food outlets, frequency of grocery shopping, and objectively-assessed and self-reported fruit and vegetable consumption. *Nutrients* 10:1974.

Meader N, King K, Wright K, Graham HM, Petticrew M, Power C, White M & Sowden AJ (2017). Multiple risk behavior interventions: Meta-analyses of RCTs. *Am J Prev Med* 53:e19-e30.

Miller WR & Rose GS (2015). Motivational interviewing and decisional balance: contrasting responses to client ambivalence. *Behav Cogn Psychother* 43:129-141.

Ministry of Agriculture, Forestry and Fisheries (2010). *Food-Based Dietary Guidelines*. From http://www.fao.org/nutrition/education/food-based-dietary-guidelines/regions/countries/japan/en/ [Retrieved May 1 2020].

Ministry of Health, Labor and Welfare (2012). *Health Japan 21*. From https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/kenkou_iryou/kenkou/kenkounippon21.html [Retrieved May 1 2020].

Nanri A, Mizoue T, Shimazu T, Ishihara J, Takachi R, Mitsuhiko N, Iso H, Sasazuki S, Sawada N, Tsugane S & Japan Public Health Center-Based Prospective Study Group (2017). Dietary patterns and all-cause, cancer, and cardiovascular disease mortality in Japanese men and women: The Japan public health center-based prospective study. *PLoS One* 12(4):e0174848.

National Institute of Health and Nutrition (2018). *Outline of the National Health and Nutrition Survey Japan* 2018. From https://www.mhlw.go.jp/content/000615342.pdf [Retrieved May 1 2020].

Shtaynberger J & Krebs P (2016). Associations between decisional balance and health behaviors among adult cancer survivors. *J Cancer Educ* 31:749-754.

Wang DH, Kogashiwa M, Mori N, Yamashita S, Fujii W, Ueda N, Homma H, Suzuki H & Masuoka N (2016). Psychosocial determinants of fruit and vegetable consumption in a Japanese population. *Int J Environ Res Public Health* 13:786.

Wang X, Ouyang Y, Liu J, Zhu M, Zhao G, Bao W & Hu FB (2014). Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: systematic review and dose-response meta-analysis of prospective cohort studies [published correction appears in *BMJ* 2014, 349:5472]. *BMJ* 349:g4490.

Wilunda C, Sawada N, Goto A, Yamaji T, Takachi R, Ishihara J, Mori N, Kotemori A, Iwasaki M, Tsugane S (2021). Associations between changes in fruit and vegetable consumption and weight change in Japanese adults. *Eur J Nutr* 60:217-227.