

Short Communication

Associations of self-efficacy, social support, and knowledge with fruit and vegetable consumption in Japanese workers

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Background and Objectives: Previous studies have suggested that self-efficacy, social support, and knowledge are primary psychosocial predictors of dietary behavior in adults. The present study aimed to investigate the associations of self-efficacy, social support, and knowledge with fruit and vegetable consumption in Japanese workers. **Methods and Study Design:** From September to November 2014, a self-administered questionnaire was completed by Japanese workers at 8 workplaces in Niigata, Japan. Self-efficacy and social support for fruit and vegetable consumption were measured using a 3-item Likert scale across particular situations. Knowledge was measured using a single item about the recommended guidelines for fruit and vegetable consumption in Japan. Fruit and vegetable consumption was assessed using a validated, brief-type self-administered diet history questionnaire. **Results:** Of the 457 respondents, 395 participants' data were analyzed. Scores in self-efficacy and social support showed a significant and positive association with fruit ($p < 0.001$, $p = 0.002$) and vegetable consumption ($p = 0.001$, $p = 0.015$). Knowledge was significantly and positively associated with vegetable consumption ($p = 0.015$) but did not statistically differ in fruit consumption ($p = 0.645$). **Conclusions:** The findings of this study suggest that self-efficacy and social support are positively associated with fruit and vegetable consumption in Japanese workers.

Key Words: fruit, vegetables, self-efficacy, social support, knowledge

INTRODUCTION

Current epidemiological studies have correlated a reduced risk of coronary heart disease with fruit and vegetable (FV) consumption.¹ Some cohort studies in Japan have also found that a moderate level of fruit consumption reduced the risk of lung cancer² and that high vegetable consumption reduced the risk of distal gastric cancer.³ However, the National Health and Nutrition Survey in 2013⁴ showed that FV consumption was below the recommended amount for Japanese adults, especially in those aged 20-59 years. Because the majority of the population aged 15 years and over are employed,⁵ opportunities are present in the workplace to influence employee behavior.

Understanding psychosocial predictors in FV consumption is needed to design effective intervention programs.⁶ According to a previous systematic review,⁶ three psychosocial constructs, self-efficacy, social support, and knowledge, are stronger predictors of adult FV consumption than other constructs. Previous studies have also shown the following: self-efficacy is the factor that is most consistently associated with FV consumption;⁷ as an indicator of self-efficacy, social support indirectly predicts FV consumption;⁸ and a higher level of knowledge

about FV recommendations is associated with high FV consumption.⁹ In the Asian region, very little research has been conducted on these topics. Thus, the present study investigated the associations of self-efficacy, social support, and knowledge with FV consumption in Japanese workers, and assessed the usefulness of these associations for future interventions.

METHODS

Study design and participant recruitment

This cross-sectional study used baseline data from a randomized controlled trial in the field of behavioral science to improve the food environment in workplace cafeterias. A survey consisting of self-administered questionnaires was conducted in September to November 2014.

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Because the basis of this survey was an intervention, we estimated the necessary sample size to be 600 participants, and we recruited 20 workplaces with approximately over 150 cafeteria users in Niigata prefecture. Ultimately, this study included 8 workplaces. The industrial classifications of each workplace included 4 manufacturing sites, 3 wholesale and retail trade sites, and 1 compound service site.

The participants were Japanese workers aged 20–69 years. The respondents were selected by the staff that managed each cafeteria in the department of general affairs. The management staff arranged the distribution and collection of the questionnaires, and they answered the participant's questions. Because the return envelopes for the questionnaires included a signature space, missing or illogical answers were obtained or corrected with a re-survey. The protocol was approved by the Ethical Committee of the Niigata University of Health and Welfare (Approval number: 17483–140512). The participants received a written explanation of the study and provided informed consent.

Psychosocial measures

Self-efficacy was measured using 3 items on a 5-point Likert scale, with 1 representing “very unsure” and 5 representing “very sure”. These self-efficacy items were similar to items from an existing scale¹⁰ that stated “I can eat more than 1 serving of fruit/ 5 servings of vegetables per day”, “I can make time to eat fruit/ vegetables”, and “When I am eating out, I can eat fruit/ more vegetables.” Social support was also measured using 3 items on a 5-point Likert scale similar to items from an existing scale¹¹ that inquired whether “family members”, “colleagues”, and “workplace cafeterias” encourage the consumption of fruit/vegetables. For both constructs, higher scores reflected better self-efficacy and social support.

Knowledge was measured using a single-item that was similar to an existing scale¹² and questioned participants about the recommended guidelines for fruit/vegetable consumption.^{13,14} The participants were asked to circle their beliefs about the amount of fruits/vegetables needed per day (do not know, 50, 100, 150, and 200 g fruit; do not know, 150, 250, 350, and 500 g or more vegetables). Those who reported 200 g of fruit and ≥ 350 g of vegetables were considered to have provided the correct answer.

To assess the validity and reliability of the three constructs, we examined the content validity, face validity, construct validity, and internal consistency. Initially, content and face validity were established by the registered dietitian and staff of the Niigata city government. For the evaluation of concurrent validity, we examined differences between the participants' scores and stages of change¹⁵ in consuming fruits¹⁶ and vegetables¹⁷ using a staging algorithm. The scores for self-efficacy, social support, and knowledge increased with increasing stage, and statistically significant differences in all variables examined, except fruit knowledge, were detected by analysis of variance (all $p < 0.05$). The internal consistency values were estimated using the Cronbach's Alpha, as follows: (1) self-efficacy: 0.84 for fruit/0.77 for vegetables; and (2) social support: 0.60 for fruit/0.51 for vegetables.

Fruit and vegetable consumption

FV consumption was assessed using a validated, brief-type self-administered diet history questionnaire.¹⁸ Items of fruit consisted of “citrus fruit including oranges”, “persimmons, strawberries, and kiwi fruit”, and “other fruits”, and vegetables consisted of “pickled dark-green leafy vegetables and others (excluding pickled ume)”, “raw (salad) lettuces and julienne cabbages, etc.”, “tomatoes/ tomato ketchup/ boiled tomato/ stewed tomato”, “cooked green leafy vegetable (including broccoli), cabbage/ Chinese cabbage, carrots/ pumpkins, Japanese radishes/ turnips, and all other root crops (onions/ burdock/ lotus root, etc.). For the questionnaire, because the correlation values of energy with the 16-day semi-weighed dietary record were 0.23 for men and 0.30 for women,¹⁹ density methods were used to compute the amount of FV consumed daily per 4184 kJ (1000 kcal) of daily energy intake.

Personal characteristics

The questionnaire was used to ask participants about their sex, age, body height, body weight, household income, family structure, and smoking habit.

Data analysis

The participants were excluded from the analysis if they were missing outcome or demographic data, their calculated energy intake was less than half the energy requirement for the lowest physical activity category according to the recommended Dietary Reference Intakes for Japanese, 2010²⁰ or their energy intake was as much or more than 1.5 times the energy requirement of the highest physical activity category. Because the Kolmogorov–Smirnov test revealed that the recorded variable distributions were not normally distributed, binary logistic regression was used to examine the associations of the self-efficacy, social support, and knowledge scores with FV consumption while adjusting for sex, age, body mass index, household income, family structure, and smoking habit. Statistical significance was set at $p < 0.05$ for all analyses. All of the statistical analyses were performed using IBM SPSS Statistics Version 21 (IBM Japan, Ltd., Tokyo, Japan).

RESULTS

Participant flow and characteristics

Of the 457 respondents, we excluded individuals who were missing outcome data ($n=5$), who reported that they do not know or refused to report their household income ($n=37$), and who reported extremely low or high energy intakes ($n=20$). In total, the data of 395 participants were analyzed.

FV consumption was significantly higher in women ($p < 0.001$ and $p < 0.001$). The basic characteristics of the participants are shown in Table 1. Among men, fruit consumption was significantly higher in higher income groups, those living with family, and non-smokers. Among women, fruit consumption was significantly higher among those aged 50–69 years. Although vegetable consumption was not associated with any characteristics among women, vegetable consumption was significantly higher among men living with family.

Table 1. Demographic characteristics of participants (*n*=395)

| | Men (<i>n</i> =239) | | Fruit consumption [†] | | | Vegetable consumption [†] | | | Women (<i>n</i> =156) | | Fruit consumption [†] | | | Vegetable consumption [†] | | |
|--------------------------------------|-------------------------|------|-----------------------------------|-----|------------|---------------------------------------|------|------------|---------------------------|------|-----------------------------------|------|------------|---------------------------------------|------|------------|
| | <i>n</i> | % | Mean | SE | <i>p</i> * | Mean | SE | <i>p</i> * | <i>n</i> | % | Mean | SE | <i>p</i> * | Mean | SE | <i>p</i> * |
| Age (y) | | | | | | | | | | | | | | | | |
| 20-29 | 31 | 13.0 | 12.8 | 2.1 | 0.350 | 81.4 | 7.2 | 0.264 | 16 | 10.3 | 28.7 | 5.6 | 0.001 | 104 | 10.4 | 0.650 |
| 30-49 | 153 | 64.0 | 17.9 | 1.7 | | 93.9 | 3.9 | | 106 | 67.9 | 30.8 | 3.0 | | 115 | 6.3 | |
| 50-69 | 55 | 23.0 | 20.2 | 2.5 | | 98.5 | 6.9 | | 34 | 21.8 | 49.5 | 5.2 | | 116 | 7.3 | |
| Body mass index (kg/m ²) | | | | | | | | | | | | | | | | |
| <18.5 | 4 | 1.7 | 17.3 | 5.6 | 0.803 | 83.7 | 23.6 | 0.787 | 22 | 14.1 | 31.6 | 5.9 | 0.857 | 103 | 10.9 | 0.560 |
| ≥18.5, <25.0 | 161 | 67.4 | 17.4 | 1.5 | | 92.0 | 3.3 | | 106 | 67.9 | 34.1 | 2.8 | | 116 | 6.0 | |
| ≥25.0 | 74 | 31.0 | 18.7 | 2.6 | | 96.6 | 7.0 | | 28 | 17.9 | 39.1 | 7.1 | | 115 | 9.7 | |
| Household income (JPY) | | | | | | | | | | | | | | | | |
| <2 million | 6 | 2.5 | 5.8 | 2.7 | 0.016 | 66.1 | 12.7 | 0.102 | 3 | 1.9 | 17.1 | 13.5 | 0.320 | 68.9 | 19.3 | 0.337 |
| ≥2 million, <6 million | 120 | 50.2 | 16.1 | 1.8 | | 92.4 | 4.9 | | 89 | 57.1 | 33.6 | 3.3 | | 111 | 5.5 | |
| ≥6 million | 113 | 47.3 | 20.2 | 2.0 | | 95.7 | 4.0 | | 64 | 41.0 | 36.9 | 3.8 | | 120 | 8.3 | |
| Family structure | | | | | | | | | | | | | | | | |
| Alone | 74 | 31.0 | 14.0 | 2.3 | 0.011 | 79.5 | 5.5 | 0.001 | 27 | 17.3 | 31.1 | 5.7 | 0.522 | 100 | 9.1 | 0.256 |
| Other | 165 | 69.0 | 19.5 | 1.5 | | 99.5 | 3.7 | | 129 | 82.7 | 35.4 | 2.7 | | 117 | 5.3 | |
| Smoking habit [‡] | | | | | | | | | | | | | | | | |
| Have | 96 | 40.2 | 14.2 | 1.6 | 0.013 | 91.7 | 4.7 | 0.807 | 15 | 9.6 | 36.3 | 11.1 | 0.341 | 104 | 14.1 | 0.650 |
| No | 143 | 59.8 | 20.2 | 1.8 | | 94.4 | 4.2 | | 141 | 90.4 | 34.5 | 2.4 | | 115 | 4.9 | |

SE: standard error; JPY: Japanese Yen.

[†]Consumption was calculated as g/4184 kJ (1000 kcal).[‡]Have: "everyday" and "sometimes", No: "ever" and "do not".^{*}*p*-values were calculated using the Kruskal-wallis test between groups.

Degrees of self-efficacy and social support for FV consumption and knowledge of FV recommendations

The score distributions for the self-efficacy and social support for FV consumption and knowledge of FV recommendations of the participants are shown in Table 2. The mean self-efficacy score was 7.8 (SE=0.2) for fruit and 7.4 (SE=0.1) for vegetables. The mean score for social support was 7.6 (SE=0.1) for fruit and 8.8 (SE=0.1) for vegetables. For knowledge, the correct answers were 49 (12.4%) for fruit and 212 (53.7%) for vegetables.

Self-efficacy and the knowledge of vegetable consumption were significantly higher in women than in men. Regarding the score for each item, self-efficacy for "I can make time to eat fruit" and "When I am eating out, I can eat more vegetables", and perceived social support for "Colleagues encourage the consumption of FV" were significantly higher among women than men. Conversely, perceived social support for "Workplace cafeterias encourage the consumption of FV" was significantly higher among men than women.

Association of self-efficacy, social support, and knowledge with FV consumption

Table 3 shows the association of the factors with FV consumption.

Significant and positive associations were observed between FV consumption and self-efficacy ($p < 0.001$ and $p = 0.001$) and social support ($p = 0.002$ and $p = 0.015$). Knowledge was significantly and positively associated with vegetable consumption ($p = 0.015$) but did not statistically differ in fruit consumption ($p = 0.645$).

DISCUSSION

To the best of our knowledge, no previous study has assessed the associations of self-efficacy, social support, and knowledge with FV consumption in a Japanese population. In this cross-sectional study of a group of Japanese workers, differences in self-efficacy, social support, and knowledge were positively associated with FV consumption except for between knowledge and fruit consumption. The odds ratio for self-efficacy was higher than for any other factor, considering the range of each score. This finding is reasonable considering the strong association between self-efficacy and FV consumption in this population. The results showed higher FV consumption among men with families. From a different perspective, higher perceived social support from colleagues among women and higher perceived social support from workplace cafeterias among men. Although family members and col-

Table 2. The score in self-efficacy and social support for fruit and vegetable consumption, and distribution of knowledge of recommended guidelines for fruit and vegetables of participants (n=395)

| | Total (n=395) | | Men (n=239) | | Women (n=156) | | p* |
|--|------------------|------|----------------|------------|------------------|------|--------|
| | Mean | SE | Mean | SE | Mean | SE | |
| Self-Efficacy [†] | | | | | | | |
| Fruit | 7.8 | 0.2 | 7.6 | 0.2 | 8.1 | 0.2 | 0.094 |
| Vegetables | 7.4 | 0.1 | 7.2 | 0.2 | 7.7 | 0.2 | 0.040 |
| Social Support [†] | | | | | | | |
| Fruit | 7.6 | 0.1 | 7.7 | 0.2 | 7.6 | 0.2 | 0.740 |
| Vegetables | 8.8 | 0.1 | 8.7 | 0.2 | 9.0 | 0.2 | 0.342 |
| | | | | | | | |
| | | | Median IQR | Median IQR | Median IQR | | p* |
| Self-Efficacy [†] | | | | | | | |
| Fruit | | | | | | | |
| I can eat more than 1 serving of fruit per day | 2 | 2 | 2 | 2 | 3 | 2 | 0.116 |
| I can make time to eat fruit | 3 | 2 | 3 | 2 | 3 | 2 | 0.005 |
| When I am eating out, I can eat fruit | 2 | 2 | 2 | 2 | 2 | 1.75 | 0.754 |
| Vegetables | | | | | | | |
| I can eat more than 5 servings of vegetables per day | 2 | 2 | 2 | 2 | 2 | 2 | 0.757 |
| I can make time to eat vegetables | 3 | 2 | 3 | 2 | 3 | 2 | 0.063 |
| When I am eating out, I can eat more vegetables | 3 | 1 | 2 | 1 | 3 | 1 | 0.003 |
| Social Support [†] | | | | | | | |
| Fruit | | | | | | | |
| Family members encourage the consumption of fruit | 4 | 2 | 4 | 2 | 4 | 1 | 0.172 |
| Colleagues encourage the consumption of fruit | 2 | 2 | 2 | 2 | 2 | 2 | 0.036 |
| Workplace cafeterias encourage the consumption of fruit | 2 | 2 | 3 | 1 | 2 | 2 | <0.001 |
| Vegetables | | | | | | | |
| Family members encourage the consumption of vegetables | 4 | 1 | 4 | 1 | 4 | 1 | 0.378 |
| Colleagues encourage the consumption of vegetables | 2 | 2 | 2 | 2 | 3 | 2 | 0.001 |
| Workplace cafeterias encourage the consumption of vegetables | 3 | 1 | 3 | 1 | 3 | 2 | 0.020 |
| | | | | | | | |
| | | | n | % | n | % | p** |
| Knowledge [‡] | | | | | | | |
| Fruit (=200 g/day) | 49 | 12.4 | 33 | 13.8 | 16 | 10.3 | 0.373 |
| Vegetables (≥350 g/day) | 212 | 53.7 | 115 | 48.1 | 97 | 62.2 | 0.008 |

SE: standard error; IQR: interquartile range.

[†]Score per item: 1=disagree, 5=agree, Total score range: 3-15.

[‡]Respondents who answered correctly.

*p-values were calculated using the Mann-Whitney U test between sex.

**p-values were calculated using the chi-square test (Yate's continuity correction) between sex.

Table 3. Association of self-efficacy, social support, and knowledge with fruit and vegetable consumption[†] (n=395)

| | Total (n=395) | | |
|-----------------------------|---------------|------------|--------|
| | OR | 95% CI | p* |
| Self-Efficacy [‡] | | | |
| Fruit | 1.41 | 1.29-1.55 | <0.001 |
| Vegetables | 1.15 | 1.06-1.26 | 0.001 |
| Social Support [‡] | | | |
| Fruit | 1.17 | 1.06-1.29 | 0.002 |
| Vegetables | 1.13 | 1.02-1.24 | 0.015 |
| Knowledge [§] | | | |
| Fruit | 1.17 | 0.602-2.27 | 0.645 |
| Vegetables | 1.68 | 1.10-2.54 | 0.015 |

OR: odds ratio, CI: confidence interval.

[†]0=Lower fruit (≤ 15.5 g/4184 kJ (1000 kcal)) and vegetable (≤ 90.3 g/4184 kJ (1000 kcal)) consumption (n=198). 1=Higher fruit (> 15.5 g/4184 kJ (1000 kcal)) and vegetable (> 90.3 g/4184 kJ (1000 kcal)) consumption (n=197).

[‡]Score range: 3–15.

[§]Score range: 0 (incorrect)–1 (correct).

*p-values were calculated using binary logistic regression adjusted for sex, age (y), body mass index (kg/m²), household income (< 2 million JPY, 2–6 million JPY, and ≥ 6 million JPY), family structure (alone/other), smoking habit (have/no).

leagues are generally cited as sources of social support for workers,²¹ the present results suggest that increasing the perception of workplace cafeteria support also has beneficial effects, especially for men. The results showed gender differences in self-efficacy that has a tendency similar to that observed in Western populations.²²⁻²³ Furthermore, among men, fruit consumption was lower among smokers. This may have resulted in the co-occurrence of FV consumption and multiple health risk behaviors.²⁴⁻²⁶ Therefore, there might be a specific reason to promote the FV consumption among people with other health risk behaviors.

Although our findings were generally consistent with those of several previous studies,²⁷⁻²⁹ knowledge of fruit consumption was not statistically significantly associated with the frequency of fruit consumption. In our study, the association between knowledge of fruit recommendation and stages of change was not significant in terms of concurrent validity, so it is possible that there was no clear difference between knowledge and fruit consumption. Thus, it is necessary to further examine the associations with other validated fruit knowledge scales.

This study had several limitations. First, because the respondents were workers within a limited area, these results may not be extrapolated to the general population. Second, although we observed good concurrent validity and internal consistency of the scales of the self-efficacy and social support, the number of items was limited, including knowledge of FV. Thus, to evaluate the factors with more precision, our results may require further investigation. Furthermore, the density method used did not allow us to definitively determine the amount of crude FV consumption. Assuming that the participants' energy intake was equivalent to the energy requirement of the middle physical activity category according to the recommended Dietary Reference Intakes for Japanese, 2010,²⁰ the proportion of participants who met the recommended consumption amount was 2.8% for fruit and 15.7% for vegetables. Third, this is a cross-sectional study, and causality cannot be inferred. In addition to our results, previous prospective studies have reported that self-efficacy, social support, and knowledge were significant mediators

between FV consumption for Western populations.³⁰⁻³² Therefore, these factors are expected to show a similar pattern in this study population. Fourth, we estimated the necessary sample size for the planned underlying intervention study, but the final number of participants did not reach the recommended sample size. Consequently, there is the possibility that the statistical power of the results was weak.

The findings of this study suggest that self-efficacy and social support are positively associated with FV consumption in Japanese workers. Although the findings of this study may serve as a guide when designing psychosocial interventions for workers, further prospective evaluations are needed.

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AUTHOR DISCLOSURES

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