Validity of Observed Differences in Dietary Surveys by Two Self-Administered Questionnaires Over a 5-year Period: Concordance with Self-Reported Change

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Abstract

Differences observed by comparing the responses to two surveys taken 5 years apart were compared with self-reported changes in dietary habits in the second survey to examine the construct validity of dietary change. That is, when an observed difference about a certain food was consistent with a self-reported change, these two methods seemed to show a high validity regarding dietary change. Both surveys used the same self-administered food intake frequency questionnaire, and subjective changes in food intake were evaluated at the second survey (self-reported change). Eight hundred fifty-five males and one thousand females aged 30-69 years were analyzed.

Since results by both methods showed a higher frequency of increased intake of green-yellow vegetables in general, pale-colored vegetables in general, carrots, and squash, these results were thought to be of high validity. However, cabbage, lettuce, and seaweeds showed inconsistent results regarding higher frequencies of intake. Changes among quintiles of lower frequency seemed to show lower validity because the results obtained by the two methods were often inconsistent for dairy foods and some other foods. Thus, self-reported changes may reflect respondents' attitudes toward foods, not their actual behavior.

Key words: Dietary habits, Validity, Food frequency questionnaire, Change, Health

Introduction

Evaluating the causal relationship between dietary habits and various lifestyle-related diseases is important in a cohort study. However, individual dietary habits may continuously change during the study period, so repeated surveys are necessary to precisely evaluate individual long-term dietary habits. There are sometimes somewhat different responses to the same questions on lifestyle surveys, so it is desirable to determine whether the difference reflects a true change.

The validity of a dietary survey is usually evaluated by concurrent validity¹⁾ based on an individual comparison of changes measured by different two methods over a certain period²⁻⁷⁾. However, we evaluated the construct validity¹⁾ of this study by comparing observed differences between two dietary surveys

taken 5 years apart with self-reported changes at the second survey. This was thought to indicate the construct validity because objective measurements of the two surveys were compared with subjective recognition at the second survey.

As for the advantages of our methodology, it was sufficient to include additional questions in the second survey. However, an evaluation method other than a questionnaire is necessary in the usual validity study²⁻⁷⁾. Regarding disadvantages, our method showed less direct indicators of validity than the usual method, and could not evaluate validity unless there were observed differences and self-reported changes.

We used group analysis without individual matching between the two surveys in this study. The first reason for this was that individual matching would make it rather complicated to evaluate the concordance of the two methods in our material since one method involved a food frequency questionnaire and the other concerned self-reported changes that did not specify either quality or quantity. The second reason was that we were investigating whether our method could be applied in cases for which individual matching was impossible.

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Materials and Methods

In 1989, a baseline survey of dietary habits for a cohort study of cancer was performed in a town using a self-adminis-

tered food-frequency questionnaire. A second survey was conducted in 1994 using the same questionnaire with additional questions about dietary changes during the 5 years. Nine hundred eighty-three males and 1197 females responded to both the first and the second survey (Table 1). Analysis was performed for

Table 1 Sex and age distribution of respondents for the 1st and the 2nd dietary surveys

	Sex Age	Male 30-49	50-69	70+	Total	Female 30-49	50-69	70+	Total
Respondents to the 1st survey, 1989		641	663	265	1569	735	700	367	1802
Respondents to the 2nd survey, 1994, among those from the 1st survey		391	464	128	983	491	509	197	1197

Table 2 Comparison of self-reported changes (S) with observed changes between the two surveys over a 5-year period (O)

Food items	Sex Age	Male 30-49 S O Quintiles *1 changed	50-69 S O Quintiles changed	Female 30-49 S O Quintiles changed	50-69 S O Quintiles changed
<i>Meat</i>					
Beef		-*2	-	-	-
Pork		-	-	-	-
Ham, sausage		-	-	-	-
Chicken		-	-- 2-3	-	-
Liver		- + 1-2	-	- + 1-2, 3-4	-
Eggs					
<i>Milk, dairy foods, and oily foods</i>					
Milk				++	+
Yogurt		- + 1-2	- +	+ 1-2	+ 1-2, 3-4
Cheese		- + 1-2	- + 1-2	- + 1-2, 3-4	- + 1-2
Butter		- + 1-2, 3-4	- + 1-2	--	
Margarine		-	-	-	-
Fried foods, Tempura		-	-	-	-
Sautéed vegetable				-	
<i>Fish</i>					
Fresh fish		+	+	+	++ 1-2
Kamaboko (boiled fish paste)		-	-	-	-
Dried or salted fish					
<i>Vegetables</i>					
Green-yellow vegetables in general		++	++ 1-2	++ 2-3, 3-4	++
Leafy green vegetables		+	+	+	+
Carrots, squash		+	+	++ 3-4, 4-5	++ 3-4
Tomatos				-	-
Pale-colored vegetables in general		+ + 1-2, 2-3	+	+ + 2-3, 3-4	++
Cabbage, lettuce		+	+ - 3-4	+	+ - 4-5
Chinese cabbage		+	+	+	+
Edible wild plants		+ 1-2, 2-3	+ 1-2, 2-3	- + 1-2, 2-3	- + 1-2, 2-3
Mushrooms		-	- 1-2	+ -	+ -
Potatoes					+
Seaweeds		+ - 4-5	+ - 4-5	+ - 4-5	+ - 4-5
<i>Others</i>					
Japanese pickles					-
Foods boiled in soy sauce		- + 1-2	-	-	- + 1-2
Cooked beans		- + 1-2	-	- + 1-2	+ 2-3
Tofu (bean curd)		+	+	+	+
Orange				- 3-4, 4-5	+
Fruits other than oranges		- 4-5		+ - 4-5	- 1-2, 4-5
Cakes		+ 2-3, 3-4	- + 2-3, 3-4	+ 2-3, 3-4, 4-5	- + 3-4, 4-5

Abbreviations:

*1 S: self-reported change, O: observed change

Quintiles; 1=none, 2=once or twice a month, 3=once or twice a week, 4=three or four times a week, 5=almost every day

*2 "+/-" indicates increased/decreased food intake at the level of 5% by chi-square test in S and Wilcoxon rank sum test in O. Absence of symbols indicates no significant difference. "1-2" indicates the difference between the 1st and the 2nd quintiles if significantly increased/decreased food intake was observed in O.

855 males and 1,000 females aged 30-69 years.

Foods surveyed are listed in Table 2, and food intake frequency was chosen from quintiles; 1=none, 2=once or twice a month, 3=once or twice a week, 4=three or four times a week, 5=almost every day. "Observed difference" in food intake frequency in sex and age specific groups was measured as a difference in food intake frequency between the two surveys. The difference was examined using the Wilcoxon rank sum test, and when there was a significant difference ($p < 0.05$), differences of two adjacent quintiles (1-2, 2-3, 3-4, 4-5) were examined by the 2x2 chi-square test. From the perspective of expression of quintiles, the fourth quintile (three or four times a week) might be really recognized as "more than once or twice a week but not almost every day." This recognition can be permitted because these data were analyzed as order variables.

"Self-reported change" was measured by asking about food intake changes during the 5 years recognized by the respondent him/herself at the second survey, and the answer was chosen from three possibilities; 1=decreased, 2=not changed, 3=increased. Distribution of answers in sex- and age-specific groups was examined by the one-sample chi-square test to analyze whether the proportion of people who answered "decreased" equaled that of "increased."

Results

Table 2 shows self-reported changes in column *S*, the observed difference in frequency in column *O*, and the quintiles that changed if the observed difference was significant. The columns in the table are shown in reverse of the order of comparison so that the results of quintiles that changed could be written adjacent to column *O*. The symbol "+" indicates significantly increased frequency of food intake at a level of 5%, the symbol "-" indicates the same for decreased intake, while the absence of symbols indicates that there was no significant change.

Foods with both increased self-reported change and increased observed change (*S*+, *O*+) were green-yellow vegetables in general and pale-colored vegetables in general in almost all sex- and age-specific groups, carrots and squash in 30-69-year-old females, and milk in 30-49-year-old females. Changes were observed among higher quintiles than the third (once or twice a week) in females and among relatively lower quintiles in males. There were almost no foods with both decreased self-reported changes and decreased observed changes (*S*-, *O*-) except for chicken and butter in a sex- and age-specific group.

Foods with significantly increased self-reported changes but no change in observed frequency (*S*+, *O*) were fresh fish, tofu, and leafy green vegetables. Those with significantly decreased

self-reported changes and no difference in frequency (*S*-, *O*) were beef, pork, ham and sausage, margarine, fried foods and tempura, and "kamaboko" fish sausage, in almost all sex- and age-specific groups, and liver, tomatoes, and foods boiled in soy sauce in some sex- and age-specific groups.

Foods with increased self-reported intake despite decreased frequency (*S*+, *O*-) were cabbage and lettuce, seaweeds, and fruits other than oranges in some sex- and age-specific groups. In these foods, differences among high quintiles were observed and many respondents chose higher quintiles at the first survey than at the second survey. However, foods with decreased self-reported intake despite increased frequency (*S*-, *O*+) were cakes in almost all sex- and age-specific groups, and liver, yogurt, cheese, butter, edible wild plants, and foods boiled in soy sauce in some sex- and age-specific groups. Significant differences among low quintiles (=none, once or twice a month) were observed for most of these foods. That is, more than half of the respondents chose the lowest quintile (=none) at the first survey and most of them chose a more frequent quintile at the second survey.

Foods without self-reported changes and with increased or decreased frequencies (*S*, *O*+/-) were yogurt among females, edible wild plants and mushrooms among males, and some other foods in a sex- and age-specific group.

Discussion

This study evaluated the construct validity of a dietary survey by comparing the differences between two objective measurements with a subjective report of change. Regarding limitations of this study, first, this construct validity was a less direct indicator of validity than the concurrent validity, which was a comparison of changes measured by two different methods over a certain period. Thus, the concurrent validity of intake changes could not be evaluated for foods in which self-reported changes and observed differences did not coincide in this study.

Second, this study did not evaluate the changes quantitatively, but it was tested statistically whether food intake frequency increased/decreased or remained unchanged. The statistical power was dependent on the distribution of respondents over the quintiles. Furthermore, questions about self-reported changes did not indicate either frequency or quantity although each "observed change" was compared by frequency between the two surveys.

A summary of rational interpretations of the results is shown in Table 3. Results of the two evaluation methods were consistent in categories 1 (*S*+, *O*+) and 2 (*S*-, *O*-), so the change was considered to show high validity. Results in categories 3 (*S*+, *O*) and 4 (*S*-, *O*) suggested a quantity change and/or frequen-

Table 3 Proposed interpretation of the results of *S* and *O* and their validity

Category	<i>S</i>	<i>O</i>	Meaning (if rational)	Validity of intake change
1	+	+	Increased intake	High
2	-	-	Decreased intake	High
3	+		Increased intake within the same quintile	Intermediate
4	-		Decreased intake within the same quintile	Intermediate
5	+	-	Increased quantity despite decreased frequency	Possibly low
6	-	+	Decreased quantity despite increased frequency	Possibly low
7		+/-	Balance of decreased frequency and increased quantity (or the reverse combination)	Possibly low
			Not changed	Not determined

S, *O*; symbols are the same as those used in Table 2.

cy change within the same quintile, so the rationality seemed to be limited to certain situations and the validity was also limited. Results of the two methods for categories 5 ($S+$, $O-$), 6 ($S-$, $O+$), and 7 (S , $O+/-$) were inconsistent. However, such discrepancy may be permitted in limited situations, for example, in category 6, when the extent of decrease was smaller than the extent of increase, when the food intake decreased in quantity and increased in frequency. Thus, the results in categories 5-7 suggested low validity, but were not definitive.

In addition, the questionnaire in each survey did not contain questions that would detect inconsistent answers or psychological wavering. For example, health education for a desirable lifestyle may bias responses towards the expected ones, especially in indicating self-reported changes. That is, self-reported changes may reflect respondents' attitudes toward foods rather than actual behavior. This bias may lower the validity. Thus, high validity of food intake changes in a food-frequency questionnaire is suggested by this methodology when food intake changed and the changes showed the same direction with both methods.

Green-yellow vegetables in general, carrots and squash, and pale-colored vegetables in general were thought to be of high validity, especially among quintiles of higher frequency, because their intake increased both objectively and subjectively (category 1). These changes might be due to efforts based on health education to prevent chronic diseases. However, there were few foods in category 2 (decreased intake of high validity).

Many foods in categories 3 ($S+$, O) and 4 ($S-$, O) are discussed in health education, for example, increased intakes of fresh fish, tofu, and leafy green vegetables are recommended, while decreased intakes of ham and sausage, *kamaboko*, and foods boiled in soy sauce are recommended to avoid excessive salt intake. This suggests that intakes of these foods changed in amount but not frequency, or that respondents' attitudes towards foods was influenced by health education, which might be reflect-

ed as self-reported changes without actual behavior changes. Other foods such as beef, pork, ham and sausage, margarine, fried foods and tempura, seemed to be decreased in amount due to aging during these 5 years.

Foods in categories 5 ($S+$, $O-$) and 6 ($S-$, $O+$) showed divergent directions between observed changes and self-reported changes. Reasons for these differences were discussed in the previous section, but there may also be other reasons. One possibility was the phenomenon of regression to the mean on repeated surveys. However, other possibilities should be considered because the observed changes were linked to the subjective changes. Many foods in category 5 showed decreased intake on observed change among higher quintiles, and many foods in category 6 showed increased intake on observed change among lower quintiles. Of course respondents were not expected to remember their answers to the first survey. Thus, respondents in the second survey seemed to avoid choosing the extreme quintiles (both highest and lowest) for the direction of their recognition of changes. This phenomenon may be due to psychological wavering, probably associated with changes in their attitudes toward foods due to health education. Therefore, the observed changes far from the extreme quintile may have low validity, especially among lower quintiles, because this phenomenon was tangible among them.

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