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Full Length Research Paper

Developing knowledge level scale of functional foods: Validity and reliability study

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The aim of the study was to develop a scale to determine the knowledge levels of University students on functional foods and to investigate the validity and reliability of the scale. The research was conducted on 417 (209 girls and 208 boys) undergraduate students in Selcuk University regarding functional foods. The participants were selected from different departments of Selcuk University using proportional cluster sampling method and the scale was repeated twice. Split-half test, Kuder-Richardson (KR 20) internal consistence coefficient and test- retest reliability methods were used to determine the validity of application during reliability test when examining the validity of content, view and structure of application. Seventy-seven questions that did not contribute to the result in the first application were removed from the achievement scale, and thus achievement scale was reduced to 45 items which were reorganized. Eleven more items that had little or no contribution were eliminated from 45 items of achievement test so that the scale was further reduced to 34 items. According to the data obtained from the scale applied, a significant difference was found between information levels of undergraduate student regarding functional foods ($p<0.05$). In calculating reliability, correlation between the first and the second application results was determined by using test-retest method and it was established that relationship between two applications was significant at 0.05 level. Reliability coefficient of the tool was found as 0.82 by split half test in the first application, while it was determined as 0.80 by Kuder-Richardson (KR-20) test. On the other hand, reliability coefficient of the tool was calculated as 0.91 in the second application.

Key words: Functional food, scale, validity, reliability, University students.

INTRODUCTION

There is little doubt that nutrition and health are intimately linked. For generations, people have believed that foods could do more than merely provide energy. Beliefs in the medicinal properties of foods were highlighted in a number of the early writings of mankind (Milner, 2002). Hippocrates (460 - 770 BCE) already recommended a balanced diet, sufficient physical activity and a moderate lifestyle in order to grow old in good health (Oltersdorf, 2003). In the 1980s, as the ageing society began to manifest itself in many countries of the world, prompt increase in the so-called life-style related diseases became a matter of public concern. Growing awareness was then observed for the need of eating to beat the odds. The purpose was to prevent life-style related diseases such as diabetes, arteriosclerosis, osteoporosis, cancer, and even some kinds of infectious diseases, through this also improved dietary practices in daily life (Arai, 2002).

The food products that have special beneficial effects on the human organism were usually referred to as ‘‘nutraceuticals”, ‘‘pharma foods”, ‘‘nutritional foods”, ‘‘medical foods”, ‘‘designer foods”, ‘‘super foods” and also as ‘‘functional foods” (Childs and Poryzees, 1997). The term ‘physiologically functional food’ first appeared in 1993 with the headline ‘Japan explores the boundary between food and medicine’ (Swinbanks and O’Brien, 1993). Functional foods can be defined as those providing health benefits beyond basic nutrition and include whole, fortified, enriched or enhanced foods, which have a potentially beneficial effect on health when

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consumed as part of a varied diet on a regular basis at effective levels (Hasler, 2000). The basic idea behind functional foods is summarized in the following Hippocrates' saying: "Let your food be your medicine, and your medicine be your food" (Jonas and Beckmann, 1998). Nowadays, an internationally acknowledged definition of functional foods is still lacking. According to Margaret (2002), a food can be regarded as functional if it is satisfactorily demonstrated to beneficially affect one or more target functions in the body beyond adequate nutritional effects in a way that is relevant to either an improved state of health and well-being and/or to a reduction of risk of disease. Rapid advances in science and technology, increasing healthcare costs, changes in food laws affecting label and product claims, an aging population and rising interest in attaining wellness through diet are among the factors fuelling U.S. and other countries' interest in functional foods. Attitudes and lifestyle factors, in addition to demographic factors such as gender, age, occupational status or education, strongly affect the acceptability or intention to use functional foods (Verbeke, 2006; Niva, 2006; Urala and Lahteenmaki, 2007).

Functional foods are relatively new to Turkish consumers, hence there are very few researches done on this field of subject. Most especially, the scales aiming to determine the consumer knowledge for functional foods are quite limited both in Turkey and around the world. Choosing a research tool or instrument is one of the most important steps in planning a research study. Research instruments must be selected or developed carefully to fit the research design and the plan for data analysis so that the data collected will be useful for answering the research questions. Good research instruments produce valid and reliable results. Validity and reliability often are caned psychometric properties of the research instrument, which means they represent how well instruments measure the variables of interest to the researcher (Gaberson, 1997). The aim of the study was to develop a scale to determine the knowledge levels of University students on functional foods and to investigate the validity and reliability of the scale.

MATERIALS AND METHODS

Sample of study

The universe of the study composed of senior students at Selçuk University, Konya. Fourth and fifth-year students who were chosen among students with "random sampling method" were included in the study. Using proportional cluster sampling method, a certain amount of students (60%) were chosen from each Faculty. Success test was administrated to a total of 417 (50.1% female, 49.9% male) undergraduate student from various faculties.

Developing the scale

The topics and objectives in the conceptual construct were transformed into an indication table of specifications. The main framework to form questions on the scale was also prepared. Under the light of the table of specifications, 72 questions at knowledge and conceptualization level that can determine students' functional food knowledge level were prepared. While expert views were taken to determine content and face validity of the scale, pilot applications were made on the students for constructing validity and reliability, while the questions which did not work or which did not explain the researched behaviour were omitted and the scale was given its final form. The success test prepared to determine students' functional food knowledge levels composed of 2 sub-sections and 40 questions. In the first section, there were some questions regarding personal features, while the second section was composed of 34 questions measuring students' level of knowledge. At first, knowledge questions which were 72 in all were reduced down to 34 after 27 questions which were determined as not appropriate were omitted as a result of the first application, and 11 questions were further omitted after the second application and its final version was given.

Data collection

The students in each department were allowed to take part in the study for an hour without hindering their education by contacting the head of the related departments. The scales were first applied to 417 students by the researchers in their classes. One week after the first application, the scale was applied for the second time in convenient hours in line with the same plan. Before the application, the participants were given brief information about the study and they were told that their choosing the closest answer is significant for the reliability of the study. They were told not to look at the answers of others and also not to talk with each other so as not to be influenced while answering the questions. The application of data collection device took almost 30 to 35 min.

Data analysis

In the analysis of data, Statistical Packet for Social Sciences (SPSS) 15.0 package program was used. Content validity, face validity, construct validity, split test reliability and KR 20 inner consistency calculations were made for both applications. Data from two different applications on students were coded as 1 (correct) and 0 (wrong), and then transferred on the computer. Besides, in line with the data obtained from the administrations of the scale and based on the remaining items (after some items were omitted), whether there was a significant difference between the scores of the students from 12 different departments was examined with one-way variance analysis.

RESULTS

When validation results based on data from the first application in Table 1 were examined, it was observed that according to factor analysis results carried out to determine construct validity, the total variance explanation rate of the scale to determine one factor was 35.81. Factor loads of items varied between 20 and 56. The items written bold in Table 1 are the ones which were not omitted after the first application, while all these items in bold were omitted after the second II. For reliability test, spilt half test and Kuder-Richardson (KR 20) inner consistency formula were applied. According to split

Table 1. Factor and item analysis results of the first application.

Item	New item number	Factor loading	$\bar{x}$	SD	P	r	Total item corelation
1	**1**	0.30	0.95	**0.22**	**0.92**	**0.08**	0.24
4	2	0.30	0.94	0.23	0.88	0.12	0.25
8	3	0.32	0.70	0.46	0.71	0.29	0.29
9	4	0.29	0.86	0.35	0.81	0.19	0.25
10	**5**	0.33	0.79	0.41	**0.80**	**0.20**	0.31
11	6	0.43	0.92	0.27	0.66	0.34	0.39
13	7	0.29	0.33	0.47	0.32	0.68	0.27
14	8	0.25	0.28	0.45	0.52	0.48	0.21
15	9	0.43	0.73	0.45	0.70	0.30	0.42
16	10	0.44	0.75	0.43	0.74	0.26	0.43
17	**11**	0.51	0.90	**0.30**	0.62	**0.38**	0.49
18	12	0.29	0.29	0.46	0.61	0.39	0.27
20	13	0.27	0.87	0.56	0.70	0.30	0.35
21	14	0.40	0.43	0.50	0.58	0.42	0.41
22	15	0.48	0.77	0.42	0.62	0.38	0.47
23	16	0.34	0.47	0.50	0.44	0.56	0.33
25	17	0.34	0.42	0.49	0.38	0.62	0.33
26	18	0.28	0.36	0.48	0.54	0.46	0.24
27	19	0.39	0.63	0.48	0.58	0.42	0.40
28	20	0.31	0.70	0.46	0.62	0.38	0.28
30	21	0.33	0.61	0.49	0.66	0.34	0.30
32	22	0.35	0.87	0.33	0.81	0.19	0.41
35	23	0.56	0.85	0.36	0.77	0.23	0.51
36	24	0.52	0.90	0.30	0.46	0.54	0.47
38	25	0.26	0.49	0.50	0.57	0.43	0.21
39	26	0.33	0.61	0.49	0.69	0.31	0.33
40	27	0.53	0.71	0.45	0.47	0.53	0.52
41	28	0.30	0.50	0.50	0.48	0.52	0.27
43	29	0.29	0.46	0.50	0.38	0.62	**0.27**
44	30	0.26	0.41	0.49	0.37	0.63	0.23
46	**31**	0.25	**0.32**	0.47	0.48	0.52	**0.21**
48	**32**	0.43	**0.51**	**0.50**	**0.42**	0.**58**	**0.44**
49	33	0.29	**0.39**	**0.49**	0.65	0.35	**0.29**
50	**34**	0.41	**0.64**	**0.48**	**0.57**	**0.43**	**0.39**
51	35	0.41	0.58	0.49	0.51	0.49	0.42
52	**36**	0.43	**0.50**	**0.50**	**0.58**	**0.42**	**0.32**
53	37	0.38	0.60	0.49	0.67	0.33	0.38
54	38	0.32	0.74	0.63	0.54	0.46	0.30
58	39	0.27	0.56	0.50	0.39	0.61	0.21
60	40	0.25	0.38	0.48	0.77	0.23	0.19
62	41	0.49	0.83	0.37	0.64	0.36	0.46
63	42	0.37	0.72	0.45	0.55	0.45	0.35
66	43	0.36	0.62	0.49	0.61	0.39	0.32
70	**44**	0.30	0.59	0.49	0.34	0.66	**0.34**
71	**45**	0.20	0.35	0.48	0.46	0.54	**0.26**
Total variance					35.81		

half test method, the reliability coefficient of the instrument was found to be 0.82 and the reliability coefficient calculated with Kuder-Richardson (KR 20) was found to be .80. The measurement instrument which was first developed to have 72 items was reduced to 45 items as a result of validation study which includes

Table 2. Independent t test results of the comparison of the mean scores upper and lower groups derived from the scale in the first application.

Group	n	$\bar{x}$	ss	t	P
Upper	113	36.96	2.69	34.095	.001
Lower	113	17.88	5.30		

content validity, face validity, construct validity, spilt half reliability and KR 20 inner consistency calculations.

In Table 2, t-test results of the comparison of the difference in knowledge level of successful and unsuccessful students are given. As indicated in Table 2 according to data from the application of scale, there was a significant difference between successful and unsuccessful students' level of knowledge about functional food ($t = 34.095$; $p<0.05$). Moreover, the mean of functional food knowledge level of the students in the upper group was $\bar{x} = 36.96$, while that of the students in the lower group was $\bar{x} = 17.88$.

Findings with regard to the second application

The measurement instrument, which was reduced to 45 items as a result of the first application, was re-administrated to the same students. In the second application, while content, face and construct validity were examined for validity, spilt-half test, Kuder-Richardson (KR 20) inner consistency coefficient and test-retest methods were applied to determine reliability. As a result of these, 11 items which did not work or worked less were omitted and the scale was reduced to have 34 items. In Table 3, the factor loads and total variance explanation rates of the items left after the second application are given. Kuder-Richardson (KR 20) formula was applied as one of the basic criteria for the reliability test. In order to determine the inner consistency of the measurement instrument, the existence of difference between students with high and low scores on the scale was re-investigated. Thereafter, the items that did not work in the second application were omitted, the most successful 27% (upper group) and the least successful 27% (low group) groups were determined, while t-test was finally carried out to determine whether there was a significant difference between their scores. As indicated in Table 4, for the t-test results of the data obtained from the scale which was reduced to 34 items after the second application are examined, it was observed that there is a significant difference between successful and unsuccessful students in terms of level of knowledge about functional food ($t=32.681$; $p<0.05$). While the knowledge level mean of the students in the upper group is $\bar{x} = 28,48$, that of the students in the lower group is $\bar{x} = 14.07$. In addition, as another indicator of the inner consistency of the measurement instrument, the consistency or decisiveness levels of the results of the first and second applications were determined using the test retest in reliability calculation. Table 5 shows the Pearson moments multiplication correlation results with regard to the relation between the results of the applications I and II.

DISCUSSION

In this study, for data obtained from application I, there was a significant difference between successful and unsuccessful students in terms of their level of knowledge about functional food ($t = 34.095$; $p<0.05$). This is an indication that measurement instrument can discriminate successful and unsuccessful students in terms of their knowledge level about functional food. The data obtained as a result of the second application was used in the analysis related to reliability tests and to determine the time required for the test. Kuder-Richardson (KR 20) formula which is one of the essential criteria for reliability was applied. The reliability coefficient of the instrument was determined to be 0.91. When the t-test results of the instrument which was reduced to 34 items as a result of data from the second application was examined, a significant difference was observed between successful students and unsuccessful students in terms of their level of knowledge about functional food ($t = 32.681$; $p<0.05$). As another indicator of the inner consistency of the measurement instrument to determine reliability, the level of consistency the first and second application was examined. This method called the test-retest was used in calculating the reliability, the correlation between the first and the second application was determined. It shows that the relation between the two applications was significant at 0.05 level.

In a study in Finland to investigate the produced new knowledge on how consumers in Finland perceive functional foods and what dimensions underlie the interest in using functional food products, which lasted for 27 months (during 2001 to 2004), a tool was suggested for explaining consumers' willingness to use functional food products. The process for developing a tool for measuring functional food attitudes was however, reported to be challenging. Also, in another study, the functional food statements were found to provide more functional food questionnaire than a fixed attitude scale; as such, the questionnaire proved to be a practicable tool for both academic research and industry to measure

Table 3. Factor and item analysis results of the second application.

Items	New item number	Factor loading	$\bar{x}$	SD	Item difficulty (P)	Item discriminating Power (r)	Total item corelation
2	1	0.60	0.80	0.32	0.88	0.39	0.31
3	2	0.50	0.71	0.46	0.71	0.37	0.42
4	3	0.54	0.81	0.40	0.81	0.37	0.53
6	4	0.72	0.65	0.48	0.65	0.48	0.47
7	5	0.47	0.78	0.41	0.78	0.38	0.46
8	6	0.32	0.70	0.46	0.70	0.39	0.46
9	7	0.47	0.81	0.40	0.81	0.34	0.52
10	8	0.40	0.37	0.48	0.37	0.32	0.34
12	9	0.47	0.66	0.47	0.66	0.50	0.54
13	10	0.46	0.69	0.46	0.69	0.52	0.57
14	11	0.49	0.77	0.42	0.77	0.40	0.54
15	12	0.60	0.47	0.50	0.47	0.37	0.39
16	13	0.48	0.73	0.45	0.73	0.46	0.60
17	14	0.50	0.44	0.50	0.44	0.42	0.43
18	15	0.46	0.64	0.48	0.64	0.50	0.50
19	16	0.53	0.46	0.50	0.46	0.43	0.45
20	17	0.35	0.35	0.48	0.35	0.37	0.39
21	18	0.42	0.37	0.48	0.37	0.38	0.37
22	19	0.30	0.55	0.50	0.55	0.48	0.47
23	20	0.35	0.65	0.48	0.65	0.36	0.38
24	21	0.40	0.49	0.50	0.49	0.50	0.48
25	22	0.42	0.71	0.46	0.71	0.42	0.47
26	23	0.31	0.73	0.44	0.73	0.44	0.54
27	24	0.57	0.80	0.40	0.80	0.35	0.52
29	25	0.47	0.58	0.49	0.58	0.51	0.53
30	26	0.44	0.69	0.79	0.69	0.61	0.32
35	27	0.38	0.57	0.50	0.57	0.34	0.36
37	28	0.39	0.58	0.49	0.58	0.31	0.32
38	29	0.32	0.59	0.49	0.59	0.41	0.37
39	30	0.25	0.45	0.50	0.45	0.43	0.44
40	31	0.48	0.60	0.49	0.60	0.33	0.36
41	32	0.29	0.65	0.48	0.65	0.48	0.50
42	33	0.32	0.72	0.45	0.72	0.42	0.44
43	34	0.33	0.64	0.48	0.64	0.43	0.46
Total variance					43.29		

Table 4. Independent T-test results of the comparison of the mean scores upper and lower groups derived from the scale in the second application.

Group	n	$\bar{x}$	SD	t	p
Upper	113	28.48	2.81	32.681	**0.001***
Lower	113	14.07	3.75		

* P< 0.05.

attitudes of consumers. The functional food-related attitude measurements were found to be a good tool for explaining respondents. Consumers were reported to have willingness to use functional food products. There is however, a lack of comprehensive knowledge on the dimensions underlying the acceptance of functional foods and tools for measuring them (Urala, 2005). De Jong et al. (2004) carried out a study on Dutch dieticians to

Table 5. Test-retest reliability results.

Parameter	Item	$\bar{x}$	SD	r	P
Test I	68	66.76	31.26	54.30	**0.001**
Test II	68	70.71	28.47		

determine their knowledge levels, consumption habits and preferences of functional foods, and observed that dieticians recommended function foods to their patients. However, 50% of dieticians were found to have inadequate knowledge on functional foods. Pelletier et al. (2002) applied a questionnaire including 142-item nutrition training to investigate the effects of training program on functional food consumption, and questionnaire forms were sent to dieticians by mail. Accordingly, the majority of 530 participants stated to increase their functional food consumption at the end of the training program. In addition, a study performed in Finland in 2002 to determine the effects of high consumption of functional foods on health, reported that gums with xylitol addition, prebiotic foods, oat products, omega-3 fatty acids, foods including sitostanol esters, fibrous foods, vegetal oils and fermented yogurt are among the products most demanded by consumers (Milner 2002).

Conclusion

Measurement tool developed in this study could be used to ascertain the knowledge levels of students on functional foods. Correlation between the results of the first and second applications of the measurement tool was found significant and the reliability coefficient was also high. We therefore suggest that further research be conducted to obtain more information about Turkish consumers' perception, knowledge and attitudes regarding functional foods.

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