The Effects of Nutrition Education on 6th graders Knowledge of Nutrition in Nine-year Primary Schools in Slovenia

Stojan Kostanjevec, Janez Jerman and Verena Koch
University of Ljubljana, Ljubljana, SLOVENIA

Incorporating nutrition topics in the primary school curricula should support the acquisition of nutrition knowledge in different ways and indirectly the development of healthy eating habits in children and teenagers. In Slovenia, nutrition education is part of all primary school education levels and may take the form of compulsory and/or elective school subjects. The main goal of the study was to find out the effectiveness of nutrition education of 6th graders where home economics is taught as a compulsory subject in nine-grade primary schools. The sample involved 630 pupils from 28 Slovenian primary schools. The nutrition knowledge was assessed by a knowledge test at the beginning and the end of the school year. The results show that the nutrition knowledge of students significantly improved. The students who scored lower on the test at the beginning of the school year made most improvement, and the students who scored best on the same test did not improve significantly. The results show that students' knowledge and understanding of the facts about energy and nutritive values of the foods is poor. Understanding a particular nutrient's role in human nutrition, or the energy value of the foods, requires certain abstract thinking ability, which the students, due to their cognitive developmental level, find difficult. Therefore, nutrition education should be adapted to the cognitive level of students and later, in the third triad of primary school, reinforced with interdisciplinary and constructivist approach.

Keywords: Nutrition Education; Nutrition Knowledge; Primary School; Pupils; Slovenia.

INTRODUCTION

The resolution of the National programme of nutrition policy in Slovenia sets out measures and activities for improving nutritional habits of Slovenian citizens. One of the strategic goals of healthy nutrition of children and young persons is to develop healthy nutrition habits. To improve healthy life styles of people, one of the activities for promoting healthy nutrition is also reshaping educational contents in school curricula (Maučec Zakotnik et al., 2007).

Correspondence to: Stojan Kostanjevec, Ph.D of Educational Science University of Ljubljana, Faculty of Education Kardeljeva ploščad 16, 1000 Ljubljana, SLOVENIA
E-mail: stojan.kostanjevec@pef.uni-lj.si

In view of the risk factors, which are due to improper diets of children and teenagers, the researchers agree in that nutrition recommendations and school syllabi should be adapted to cultural characteristics of a particular group. Nutrition strategies aiming at children and young persons should therefore become a priority at the national level (Rodrigues et al., 2004; Schneiderm, 2000).

Numerous studies have shown that well planned nutrition education can significantly influence the quality of nutrition knowledge of children (Manios and Kafatos, 1999; McAleese and Rankin, 2007; Wagner, Meusel and Kirch, 2005; Powers, Struempler, Guarino and Parmer, 2005). Nutrition education, which may take various forms of formal and informal education, can also significantly change nutrition behaviour and dietary habits of children (Lytle et al., 1996; Reynolds, Winton,

State of the literature

- Nutrition education is an important factor in promoting lifelong healthy eating habits and should start at an early stage of life. It should form part of the compulsory subjects of school-based programme;
- Well-planned nutrition education and the adaptation of topic to the stage of cognitive development can significantly influence on the nutrition knowledge of children and the change of their dietary habits;
- The type of education and professional experience of nutrition educators are important for successful work.

Contribution of this paper to the literature

- Formal nutrition education significantly improves the nutrition knowledge of 11-year-old students;
- 11-year-old students acquired general knowledge about nutrition but they have had a problem to solve complex questions related to healthy diets;
- We certain that adequate qualifications and professional knowledge of teachers would improve the quality of teaching nutrition topics and nutrition knowledge of students. Schools should employ professionals with suitable qualifications.

Shewchuk and Hickey, 1999; Worsley, 2002). Understanding different factors which influence nutrition behaviour of children is the first step to forming efficient measures which may change nutrition behaviour (Cullen, Rittenberry, Olivera and Baranowski, 2000). Education, as well as nutrition knowledge, do not always have direct impact on nutrition behaviour of individuals, however they may significantly influence the attitudes, and other psychosocial factors which directly influence nutrition behaviour (Conner and Armitage, 2002; McCullough, Yoo and Ainsworth, 2004). Worsley (2002) believes that nutrition education is necessary, however it is not the only factor which can change nutrition behaviour of persons. Harnack, Block and Lane (1997) stress that nutrition education is a key element to promoting lifelong healthy eating and should start at early stages of life. Nutrition education is an accessible effective tool in the promotion of health nutrition in education programmes with focus on healthy eating (Kelder, Perry, Lytle and Klepp, 1995; Torkar, Pintarič and Koch, 2010).

"School nutrition education should focus not only on the provision of nutrition information, but also on the development of skills and behaviours related to areas such as food preparation, food preservation and storage; social and cultural aspects of food and eating; enhanced self-esteem and positive body image and other

consumer aspects" (Perez Rodrigo and Aranceta, 2003). The authors Perez Rodrigo and Aranceta (2003) describe some basic characteristics of a successful school-based nutrition education programme which should include the following: behavioural focus, theory-driven strategies, adequate time and intensity, family involvement, multi-component strategies, development appropriateness, considerations to the needs of student, teachers and school, self-assessment elements (older children), self-efficacy (strengthened skills, influence attitudes, behavioural capability), adequate teaching methods, modifying school environment (access to healthy food, school food policies, school meals), teacher training opportunities, cultural relevance and evaluation.

In the curriculum of nine-year primary schools in Slovenia various topics on nutrition are included, mainly offered through science subjects. The nutrition education in primary school is most intense in the 6th grade and is offered within the Home Economics course. The course is compulsory and provides numerous teaching topics for acquiring knowledge and skills in nutrition (Koch and Kostanjevec, 2005).

The module Food and Nutrition within the home economics subject has the following aims: understanding recommendations for healthy nutrition, classifying food according to nutrients, interpreting various nutrition habits, learning various ways of nutrition and analyzing human needs for energy values of food (Lap Drozg, Simčič, Koch, Orešič and Fijavž, 2003).

Other aims in the module Food and Nutrition are: food labelling, food hygiene, mechanical and thermal processing of food and acquiring cooking skills and serving food.

Later on, students can upgrade nutrition knowledge through elective courses offered at higher grades: Modern ways of food preparation and Nutrition, which are taught in the third triad of the nine-year primary schools. In addition to that, an important source of knowledge and support to nutrition knowledge are topics taught within subjects, e.g. Science, Biology, Chemistry and Physics.

Evaluation of the effectiveness of formal nutrition education is basic for reconsideration and modernisation of the curriculum and syllabi. Therefore, we need to analyse the nutrition knowledge of the participants and identify the factors which influence the acquisition of knowledge and changes of nutrition behaviour. An important factor is definitely the teacher managing the programme. Hoover, Martin and Litchfield (2009) note that factors influencing behaviour change include participant and educator race and educator experience.

METHOD

Purpose of the research and research questions

The research conducted so far on the impacts of formal education on nutrition knowledge and nutrition behaviour of children and teenagers indicates to a certain extent whether educational programmes are suitable and efficient in terms of achieving teaching goals and how they influence the knowledge and human behaviour. The purpose of our research was to analyse the effectiveness of compulsory nutrition education of children attending the 6th grade of nine-grade primary schools in Slovenia and to analyse their nutrition knowledge. By the analysis of variables, measured before and after the school year we could determine the level of changes of individual variables as a result of the educational process the children went through, and to critically assess the quality of the teaching contents in view of the curricular goals.

The research questions of this study are as follows:

I. Does formal nutrition education improve nutrition knowledge of students in primary school?

II. What are the difficulties to understand of nutrition topic for 6th grade students?

Participants

The study encompassed 630 students from 27 elementary schools from ten different statistical regions. Our research sample represents 10.6% of the total population of 6th graders of nine-grade elementary schools who attended home economics classes with the programme in nutrition.

Teachers

Teaching was conducted by 27 home economics teachers. As far as the professional qualification of teachers is concerned, there were 70.0% of teachers with suitable formal education, i.e. a completed undergraduate study programme at the Faculty of Education, University of Ljubljana. There were three teachers with completed primary level teachers' programme and two teachers who had completed a combined, two-subject programme in biology and chemistry. One teacher was a qualified art teacher, one was a professional in agronomy, and one primary-level teacher without a university degree.

The analysis of teachers' work experience showed that approximately a fifth of them (18.5%) had ten or less than ten years of work experience, 37.0% had been teaching between 11 and 19 years and 44.5% of teachers had above 20 years of work experience. Thus, the majority of teachers in our sample were well-experienced home economics professionals and hence well-acquainted with nutrition topics.

Data collection

By the end of the school year we invited thirty primary school to join the research in the coming school year. The schools were selected randomly. Home economics teachers were invited to participate in the study, assuming that the same teachers would be teaching the programme in the following school year. 27 schools agreed to participate in the study.

Every school participating in the research gave courses of home economics, which also included nutritional topics. Nutrition education was taught according to the home economics curriculum, which sets the goals, topics and knowledge standards (Lap Drozg, Simčič, Koch, Orešič and Fijavž, 2003). On the average students had 50.7 hours of home economics lessons, and about 38.6 hours were devoted to nutrition. As for the form of teaching, group work was the most frequent form. Students were organised in pairs or small groups, less frequently teaching was done individually, or by frontal explanation. Other teaching methods mentioned were also: practical work, problem-based approach, and - less frequently - project work and excursions.

The idea was to test the nutrition knowledge of students at the beginning of the school year and at the end. The survey was anonymised by coding all tests, as well as teachers' names. The knowledge tests were designed by the authors of this article working at the Faculty of Education. Test items were formulated in view of the knowledge standards of the home economics curriculum (Lap Drozg, Simčič, Koch, Orešič and Fijavž, 2003). Questions included topics related to healthy nutrition. Measured characteristics of the knowledge test were verified by a pilot research. The reliability of the knowledge test was tested by determining internal consistency of the test. We applied the Cronbach alpha test. The reliability of test instruments was above 0.60 which proves that the reliability level of the test instruments was appropriate.

Structure of the knowledge test

Student nutrition knowledge was analysed by the knowledge test which comprised of 27 multiple-choice questions (Table 2). The questions covered all main topics taught during the course while considering the standards set out by the curriculum.

We used different types of questions to test the knowledge and comprehension as well as students' skills to apply the knowledge in practice. In test items No. 7 to 24, students had to decide whether the statement was correct or incorrect, while other questions offered multiple choice answers in which students had to select one correct answer.

Each answer in the knowledge test was assigned with a number of points. Maximum number of points one could achieve in the test was 27. After calculating all the points collected we classified the results into three categories of knowledge:

Category 1: 0 - 13 points (poor knowledge),
Category 2: 14 - 18 points (fair knowledge),
Category 3: 19 - 27 points (good knowledge).

Data analysis

For the empirical part of research we analysed the data using SPSS statistical software and used the following methods: Cronbach reliability coefficient, statistical series – frequency distribution: absolute and relative frequency, arithmetic mean, standard deviation, Pearson correlation coefficient. We used independent sample T-test, One-Way ANOVA test and LSD test (Least Significance Difference).The results are presented in the tables below. For statistical assessment we used the risk factor 0.05.

RESULTS

The results of the first and the second knowledge testing were analysed by calculating the total number of points achieved in both tests (Table 1). A comparison of the mean values of total points achieved between the first and the second testing shows that the students performed better during the second testing and there is a statistically significant difference between the two tests. The average number of points achieved during the first testing was 14.60, and 15.91 points during the second test. This indicates that students' knowledge improved after going through the educational process, however, the level of acquired knowledge was not very high.

Table 1. Comparison of mean values of points achieved after the first and the second knowledge testing

	N	M^a	SD	t	P
First knowledge testing	524	14.60	3.428	-8.174	0.000
Second knowledge testing	524	15.91	4.008		

[a] *Maximum points: 27*

Table 2. First and second test results

	Number and percent of students with correct answ			
	1st test		2nd test	
	f	f%	f	f%
1. Which nutrients provide energy?	100	15.9	152	24.8
2. Select the food with the highest content of proteins.	69	11.0	138	22.5
3. Which food, if consumed in excess, will increase your body mass?	81	12.9	84	13.7
4. Select the food which belongs to the group of fats.	25	4.0	68	11.1
5. Select the food with the highest content of vitamins.	241	38.3	287	46.7
6. How are the groups of food classified in the food pyramid?	449	71.3	517	85.5
7. Nutrients provide energy to our body.	520	83.7	475	77.9
8. Human body does not burn energy during sleep.	422	68.0	428	70.0
9. More energy is spent during running than sitting.	576	92.9	543	89.2
10. Fats are the most important source of energy for human body.	463	74.7	358	58.6
11. Proteins are needed for the development of muscles.	446	71.9	460	75.4
12. Calcium is essential for the growth of bones.	550	89.3	540	88.7
13. Carbohydrates contain more energy than fats.	179	29.0	278	45.6
14. A kilogram of bread gives more energy than a kilogram of butter.	244	39.5	304	49.6
15. Oil is rich with carbohydrates.	379	61.5	393	64.3
16. Vegetables contain a lot of dietary fibres.	321	52.3	358	58.8
17. Wholemeal flour contains less dietary fibres than meat.	211	34.3	225	37.3
18. Leguminous plants (soya beans, peas) are important sources of proteins.	309	50.2	390	63.9
19. Yoghurt contains more fats than cheese.	395	64.3	397	65.2
20. At least two meals should be taken every day.	276	44.8	302	49.7
21. Every meal should consist of food which contains all nutrients.	166	27.0	136	22.3
22. It is recommended to eat diverse food, i.e. of animal and plant origin.	520	84.4	514	84.3
23. Eating more fruit will improve our immune system.	465	75.5	455	74.3
24. Improper nutrition can lead to coronary diseases.	465	75.5	497	81.3
25. Look at the menus and select the healthiest one.	445	72.2	607	80.6
26. From the options given select the sandwich containing little fat and lots of vitamins and dietary fibres.	345	55.6	413	67.7
27. What does the information "550 kcal" on food tell you?	268	42.7	339	55.7

More in-depth analysis of student answers for individual questions is given separately for the first and second testing in Tables 2 and 3 below. In questions from 1 to 6, 8, 11, 13 to 20, 22, and from 24 to 27 the number of correct answers was higher compared to the first knowledge testing (Table 2).

From the results presented above we can infer that students' knowledge on energy values of food is rather poor, (question 1). After completing the course only less than a quarter of students answered correctly which nutrients provide energy to our bodies. However, we can observe an overall statistically significant change in that more correct answers were given in the second testing, which shows a positive impact of education. We also observed that less than half of students knew that carbohydrates give less energy compared to fats, and that fats are not the essential source of energy for human body. In both tests students were able to find a correlation between the intake of fats and the increase of body mass. In both tests, a great deal of students (> 95.0%) answered correctly that vitamins, minerals and water do not influence our body mass, and 95.0% of students also correctly answered that the intake of fats increases body mass (Tables 2 and 3). Also, a large percentage of students (> 70.0%) answered correctly that carbohydrates and proteins are not the nutrients which have impacts on the increase of body mass. In both tests students were able to make a correct correlation between physical exercise and the use of energy, however, they did not know that body needs energy also during sleep.

In the second knowledge testing more than a half of students (55.7%) correctly explained that the symbol »kcal« on food labels refers to energy value of food and is given in kilocalories or kilojoules (question 27). If students understand this information on nutrients and energy values of food they can decide which food is good and healthy for them?

Students seem to know well which typical foods of animal origin are a good source of proteins (eggs, meat, fish), however proteins of plant origin present a problem, e.g. soya (question 2). This may be understood because soya is not a typical field crop in our environment, and is therefore less frequently mentioned in our education. The results show that students know that margarine, oil and butter belong to the group of foods containing fats (question 4). From the answers to the question on vitamins in food we can infer that students can better correlate fruits as a source of vitamins than vegetables (question 5). In naming the fruits rich in vitamins the results of the first testing were the following: apples (91.6% correct answers), lemons 80.6% and pears 78.6%. Among vegetables, students opted for cauliflower (62.5% correct answers), and broccoli (59.8% answers).

Students' understanding of the food pyramid and food categorisation was good at the beginning of the school year, and even improved after completing the course (question 6). However, the analysis of the results of the knowledge test showed that while on the one hand students knew how food pyramid is structured, the answers to other questions indicate poor theoretical background since they were unable to use the pyramid in planning their own diets. They named groups of food (e.g. fruits, vegetables, milk and dairy products, meat and meat products, sweets) in the food pyramid using general expressions which they had already learned before, and they also knew some common types of food belonging to a particular category.

Given a choice of three menus, our students demonstrated the ability to select a healthy menu (question 25). In second testing most of the students (80.6%) chose the menu which contained a rich variety of food, including fruits and vegetables, and only a small percentage of students opted for a menu with fried food and a desert. Approximately one third of students (29.8%) justified their selection of the menu on the grounds that a healthy menu should contain little fats and no fried food. With this explanation students demonstrated their awareness that eating fried food is a bad dietary habit. However, students had more problems in selecting a healthy sandwich containing less fat and more vitamins and dietary fibres (question 26). The share of students who selected a healthy sandwich was relatively low during the first testing (55.6%), however, the results improved during the second testing (67.7% correct answers). This result can be understood because students, without knowing the composition of particular ingredients in the sandwich, could not make a correct choice since they did not know which food contains more dietary fibres.

The results also showed that students are well aware that proteins are important for building muscles (question 11). Compared with the first testing where 71.9% correct answers were given to this question, the number of correct answers increased in the second testing (75.4%) However, there is no statistical difference in the average number of collected points for this question. The importance of calcium for the growth of bones is known to most of the students (question 12): a correct answer to this statement during the first testing was given by 89.3% of students, and 88.7% during the second testing. Three quarters of students (75.5%) during the first testing and 74.3% of students during the second testing gave a correct answer to the statement that our immune system will improve if we eat more fruit (question 23). A relatively high percentage of students (75.5%) also correctly answered that improper nutrition leads to coronary diseases (question 24). This result even improved to 81.3% of correct answers during the second testing.

On the other hand, students' knowledge about nutrient values of foods is rather poor. During the first testing the share of students who gave a correct answer to the statement that bread gives more energy than butter (question 14) was 39.5%, and increased to 49.6% during the second testing. Questions 16 and 17 asked about the content of dietary fibres in foodstuffs. During the first testing approximately a half of students (52.3%) correctly answered that vegetables are rich in dietary fibres. The share of correct answers to other statements was even smaller: there were only 34.3% correct answers to the statement that wholemeal flour contains little fibres during the first testing and during the second testing 37.3%, and statement 19 (cheese contains more fats than yoghurt) resulted in 64.3% correct answers during the first testing and 65.2% during the second testing.

To find out statistically significant differences between the points collected during the first and the second testing we analysed the average number of points collected in individual questions. Statistically significant differences were found out in questions 1, 3, 5 to 7, 9 and 10, 13 and 14, 16, 18, 21, and 24 to 27 (Table 3).

Analysis of students' nutrition knowledge by categories of knowledge

Students' results were also compared within the categories of knowledge after the first and the second testing. By comparing the average points achieved during the first and the second testing we found out that students who demonstrated poor knowledge (category 1), or fair knowledge (category 2) at the beginning,

Table 3. Comparison of the average points achieved in individual questions with time of testing

| Questions | Average number of points (difficulty index) | | | | | |
| | 1st test | | 2nd test | | | |
	M[a]	SD	M[a]	SD	t	2P
1. Which nutrients provide energy?	0.16	0.37	0.25	0.43	-4.860	0.000
2. Select the food with the highest content of proteins.	0.11	0.31	0.22	0.42	-6.438	0.000
3. Which food, if consumed in excess, will increase your body mass?	0.13	0.34	0.14	0.34	-0.507	0.612
4. Select the food which belongs to the group of fats.	0.04	0.20	0.11	0.31	-4.929	0.000
5. Select the food with the highest content of vitamins.	0.38	0.49	0.47	0.50	-3.618	0.000
6. How are the groups of food classified in the food pyramid?	0.71	0.45	0.85	0.35	-6.266	0.000
7. Nutrients provide energy to our body.	0.84	0.37	0.78	0.41	2.958	0.003
8. Human body does not burn energy during sleep.	0.68	0.46	0.70	0.46	-0.509	0.611
9. More energy is spent during running than sitting.	0.93	0.26	0.89	0.31	2.207	0.028
10. Fats are the most important source of energy for human body.	0.75	0.44	0.59	0.49	6.608	0.000
11. Proteins are needed for the development of muscles.	0.72	0.45	0.75	0.43	-1.498	0.135
12. Calcium is essential for the growth of bones.	0.89	0.31	0.89	0.31	0.301	0.763
13. Carbohydrates contain more energy than fats.	0.29	0.45	0.46	0.50	-6.884	0.000
14. A kilogram of bread gives more energy than a kilogram of butter.	0.40	0.49	0.50	0.50	-3.801	0.000
15. Oil is rich with carbohydrates.	0.62	0.49	0.64	0.48	-1.550	0.122
16. Vegetables contain a lot of dietary fibres.	0.52	0.50	0.59	0.49	-2.786	0.006
17. Wholemeal flour contains less dietary fibres than meat.	0.34	0.48	0.37	0.48	-1.205	0.229
18. Leguminous plants (soya beans, peas) are important sources of proteins.	0.50	0.50	0.64	0.48	-5.058	0.000
19. Yogurt contains more fats than cheese.	0.64	0.48	0.65	0.48	-0.668	0.504
20. At least two meals should be taken every day.	0.45	0.50	0.50	0.50	-1.767	0.078
21. Every meal should consist of food which contains all nutrients.	0.27	0.44	0.22	0.42	1.999	0.046
22. It is recommended to eat diverse food, i.e. of animal and plant origin.	0.84	0.36	0.84	0.36	-0.186	0.853
23. Eating more fruit will improve our immune system.	0.75	0.43	0.74	0.43	0.145	0.885
24. Improper nutrition can lead to coronary diseases.	0.75	0.43	0.81	0.39	-2.863	0.004
25. Look at the menus and select the healthiest one.	0.72	0.44	0.81	0.39	-3.628	0.000
26. From the options given select the sandwich containing little fat and lots of vitamins and dietary fibres.	0.56	0.50	0.68	0.47	-4.668	0.000
27. What does the information "550 kcal" on food tell you?	0.43	0.50	0.56	0.50	-4.907	0.000

[a] *Maximum possible number was 1 point.*

improved their performance in the second testing and collected more points, which can be considered as statistically significant (Table 4). We observed that students from knowledge categories 1 and 2 made more progress. Those students who performed poorly during first testing (category 1) made more progress compared with the students of other knowledge categories. On the other hand, those students who performed well in first testing and were classified as category 3, did not make much progress in the second testing (Table 4).

In addition to calculating the average number of points we also used Pearson's correlation coefficient to determine the level of linear correlation between the results achieved during both tests. We found out medium correlation (r = 0.519), which is statistically significant (2P < 0.01).

DISCUSSION

With the research carried out with 6th graders of elementary schools in Slovenia we wanted to study the impact of formal education on nutrition knowledge of children. Home economics courses, which cover topics on nutrition, aim at building process knowledge which should motivate children to create positive attitudes towards healthy nutrition. To be able to evaluate their own nutrition behaviour students need to acquire basic theoretical knowledge about food and nutrition. By testing their nutrition knowledge at the beginning and at the end of the school year we could analyse the level of knowledge and observe their progress.

It needs to be noted that formal nutrition education is given to students within the home economics subject, compulsory to all 6th graders of nine-year elementary schools in Slovenia, regardless of their general or specific interests for learning about healthy nutrition. Thus students' motivation varied greatly. Considering that motivation is crucial for learning outcomes, the motivational level will influence the formation and changing of attitudes and behaviour of individuals to permanently maintain these new attitudes. For this reason Gracey, Stanley, Burke, Corti and Beilin (1996) emphasize the necessity to introduce such teaching activities and methods into compulsory nutrition education which would motivate and consolidate student self-efficiency.

Our second research question was aimed at analysing the most common troubles that students have in understanding the nutritional topics. We found out that students had problems with defining foods according to their energy and nutritional value, which may be due to the fact that they do not know well the nutrients and their energy values. We found out that 6th graders found it very difficult to apply the criteria for classifying food into categories by the content of a particular nutrient because children at that age had not acquired basic knowledge about nutrients. This shows that it would be necessary to revise the curricular goals for home economics subject for 6th graders and suitably adapt the goals to the cognitive development level of children. At this age students develop logical thinking for solving problems, but they are still unable to solve abstract and hypothetical problems and hence understand abstract concepts such as nutrients and energy. Presumably, at higher levels of cognitive development, i.e. at higher levels of elementary schooling, when systematic explanations of the concepts taught within other subjects (e.g. chemistry, biology, physics) are given, students should be able to comprehend the concepts of nutrients and energy. Reports of other studies (Baranowski and Stables, 2000; Nicklas and O'Neil, 2000) show that if nutrition topics are incorporated into other subjects and presented to students by cross-curricular approach, learning can become more efficient.

In view of the results from our research we can conclude that formal nutrition education had positive effects on students' knowledge on the nutritional value of foodstuffs. The fact that students understood well some types of food with higher content of nutrients may also be due to the previously acquired knowledge and the influence of other information acquired through informal education. Children, by watching various advertisements on healthy nutrition, get the message that fats have negative impacts on our body mass, or that eating fruits and vegetables is healthy. Children usually relate positive effects of food to vitamins. Also, children learn about healthy food from other subjects at previous levels of elementary education and even during pre-school education (Koch and Kostanjevec, 2002; Koch and Kostanjevec, 2005).

Food pyramid is the most recognisable teaching model, frequently used in presenting nutrition topics. It

Table 4. Average values of collected points by category of knowledge and time of testing

Knowledge category	Time of testing	N	Points M [a]	SD	t	P
1	1st test	196	11.09	3.643	-10.862	0.000
	2nd test	196	13.91			
2	1st test	260	15.87	3.499	-2.765	0.006
	2nd test	260	16.47			
3	1st test	68	19.84	2.923	0.871	0.387
	2nd test	68	19.53			

[a] *Maximum points: 27*

is used in the kindergarten, continuing over the first and the second triad of nine-grade elementary school. Thus children know the groups of food which compose the pyramid but as the results of our research show, 6th graders do not understand the theoretical foundations on which the food pyramid has been structured. This is in agreement with the findings of Beltran et al. (2008), who observed that students at the age from 8 to 13, are capable of classifying food by its origin but cannot classify it into groups according to the nutritional value of food. Therefore, the use of food pyramid as a didactic tool should be revaluated to be used efficiently in achieving the teaching goals.

An important factor influencing human nutrition behaviour and human health is the ability to correlate the knowledge on the properties of foodstuffs with the impacts of food on human health (Wansink, Westgren and Cheney, 2005). In our study we found out that students understand the general principles of healthy nutrition: they understand how important it is to eat various types of food and that diets should include food of plant and animal origin. As found out in our research, students are aware that food can influence human health and this has been learned at lower levels of education. They are aware that there is a correlation between unhealthy diets and human diseases. Being exposed to advertisements they know that proteins are important for the development of human muscles, and that calcium is good for the bones.

The overall analysis of the nutrition knowledge of 6th graders of nine-grade elementary schools in Slovenia shows improvement of nutrition knowledge after completing the course. We can therefore answer positively to the research question that formal nutrition education improves the nutrition knowledge of children. Students who made most progress were those who started at poor or medium knowledge level. On the other hand, students with good knowledge at the beginning made little progress. This observation indicates that the students with good knowledge had already acquired basic nutrition knowledge before entering the 6th grade, while the course of home economics was only an opportunity for refreshing and upgrading their knowledge. This is something that home economics teachers should bear in mind, namely that 6th graders have differing levels of knowledge, differing abilities and interests. Therefore they should adapt their teaching practice correspondingly to lead students towards higher levels of learning. Contento, Randell and Basch (2002) also stress the importance of adapting the educational process to the target group of learners.

Adequate pedagogical qualifications and good nutrition knowledge on the part of teachers are also important. Therefore, suitable teacher training is necessary. According to Kealey, Peterson, Gaul and Dinh (2000), teacher training should be conceptualized

as a behaviour change process, and including explicit teacher motivation components can promote effective implementation of behaviour change in public school classrooms. Therefore, motivating teachers to permanent education and forming healthy life styles will have positive effects on the success of teaching.

CONCLUSION

We focused our research on the effects of formal education on the nutrition knowledge of our elementary school children. The overall conclusion is that the nutrition knowledge has improved.

By determining the level of changes of individual variables we could critically assess the curricular goals for elementary school programmes in Slovenia. In terms of acquiring new knowledge, formal nutrition education of 6th graders proved to be successful. The analysis of knowledge tests showed that the students acquired general knowledge about nutrition, however they are still unable to explain complex problems related to healthy diets. Therefore, teaching should aim at leading children towards analytical and logical thinking for solving problems. Only good and consolidated nutrition knowledge can further lead to forming positive attitudes towards healthy eating which would later, in the years of adolescence, influence the formation of positive dietary habits and make children less susceptible to negative eating habits or the negative influence of their peers.

According to the operative goals set out by the home economics curriculum students should be able to analyse human needs for nutrients and energy, and should know the nutritional value of foodstuffs to be able to categorise food into groups. Considering the cognitive level of children development it cannot be expected from children to be able to solve complex problems before entering higher levels of elementary education. For this reason nutrition topics should be presented later, in the third (last) triad. The existing syllabi for the courses in which nutrition topics appear need to be redefined and adapted to the cognitive level of children development, taking into consideration recent developments in nutrition science. Also, the concepts which need to be presented in nutrition education should be clearly defined. In addition to that, carefully planned continuous teacher education needs to be provided and combined with interdisciplinary and constructivist approach which would lead to the formation of process knowledge, necessary for critical evaluation of personal nutrition behaviour.

The educational structure of the teachers included in our study was quite diverse (see the Sample description). A little less than a third of teachers had inadequate qualifications for teaching home economics. Authors DeCicco and Bergman (1997) found out that teachers' knowledge of nutrition and their attitudes to nutrition

are in correlation with the number of hours devoted to nutrition education which the teachers received during their own course of studies as well as with teachers' practical experience. In our case we believe that inadequate qualifications were one of the factors which influenced the quality of teaching nutrition topics. Teachers, conveying the knowledge on nutrition need to have adequate professional knowledge, as well as didactic skills. For this reason schools should make sure to employ only professionals with suitable qualifications.

To improve the quality of nutrition education in Slovenia we propose that schools introduce supplementary education in nutrition science and provide didactic training for the teachers teaching nutrition topics as part of compulsory or elective subjects. We need to stress that teachers serve as an example to their students and they themselves need to make changes in their attitudes towards healthy nutrition and nutrition behaviour. This could be made possible by offering continuous teacher training programmes through which teachers would gain the knowledge and skills for transferring the latest developments in nutrition science into teaching.

Some of the recommendations which derive from our study are the following: more hours should be devoted to nutrition education and the programmes should run throughout the course of elementary school education. This would lead to better and permanent knowledge and hence the formation of healthy nutrition habits of children. A carefully planned and continuous nutrition education needs to be implemented into the systems of secondary and tertiary school education since it is vital that nutrition knowledge is constantly upgraded and interdisciplinary connected (Perez-Rodrigo and Aranceta, 2003). Nutrition education should become a national concern aiming at improving nutritional habits of people and raising the quality of life styles of Slovenian people. Equipped with good nutrition knowledge, children will be able to develop suitable lifestyles, which would consequently lead to taking their own responsibility for personal development and development of the society as a whole.

The research treats the influence of formal education on nutrition knowledge of children. Further research is needed to determine with more precision the effect of nutrition knowledge of teachers and the methods used in teaching nutrition topics. Besides, it would be necessary to analyse other factors which directly or indirectly influence the nutrition knowledge of children

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