The evaluation of a nutrition education programme on the nutrition knowledge of children aged six and seven years

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OPSOMMING

Die doel van hierdie studie was om te toets of leer plaasgevind het deur die implementering van ‚n voeding voorligting program, wat spesiaal ontwikkelde voeding voorligting hulpmiddels vir voorskoolse kinders, ouderdom ses tot sewe jaar, ingesluit het in die Vaal area.

'n Gevalideerde vraelys is met die hulp van opgeleide veldwerkers voltooi deur 88 doelbewuste geselekteerde kleuterskoolkinders in twee ewekansige geselekteerde skole.

'n Voeding voorligting program met verskillende hulpmiddels, naamlik 'n aktiwiteitsboek, speelkaarte, bordspeletjie en legkaart is as intervensie gebruik.

Data is geanaliseer vir beskrywende data en gepaarde steekproef toetse is gedoen op die "Statistical Package for Social Sciences (SPSS)" vir "Windows" uitgawe 15,0 om die verandering in kennis te toets.

Die resultate dui daarop dat die voedingskennis van die respondente swak was, maar die kennis het statisties betekenisvol ($p \leq 0,05$) verbeter met 67% van die vrae wat voedingskennis getoets het na die implementering van die intervensie. Die kennis van voedselgroepe het verbeter van 13,4% voor tot 64,8% na die intervensie. Die funksies van die verskillende voedselgroepe met korrekte antwoorde het verbeter van 13,5-27,4% voor tot 60,2-77,9% na die intervensie.

Gevolgtrekkings en implikasies van die studie is dat die resultate toon dat 'n voeding voorligting program suksesvol aangebied kan word om voedingskennis van voorskoolse kinders te verbeter. Verdere navorsing is egter nodig om die doeltreffendheid van elk van die hulpmiddels op voedingskennis en dieet innames te toets.

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INTRODUCTION

The Medical Research Council in South Africa has reported on the presence of both over-nutrition and under-nutrition in addition to the HIV/AIDS pandemic in South Africa (SA) (Steyn *et al,* 2006:34). Despite a number of national nutrition and primary healthcare programmes implemented in South Africa during the past ten years, child health has deteriorated (Bourne *et al*, 2007). The National Food Consumption Survey (NFCS) conducted in 2005 found that in children from one to nine years of age in SA, the prevalence of stunting was 20%, underweight 10%, overweight 10% and obesity 4%. Furthermore, 66,7% of these children had poor vitamin A status and 33,3% were anaemic, based on serum haemoglobin concentration (Labadarios *et al,* 2008). This could be the result of the consumption of a mainly carbohydrate-based diet by the majority of children and also a poor dietary intake which includes only a limited number of foods with high micronutrient density (Bourne *et al*, 2007). A healthy food choice is the key to wellbeing and to the prevention of many of the above-mentioned nutrition-related problems.

Dietary recommendations, based on scientific evidence, provide guidance to consumers and healthcare professionals in choosing and planning a healthy diet. However, the growing incidence of malnutrition clearly indicates that there is a disparity between the dietary recommendations and dietary intake behaviour. Targeted interventions are thus needed to reduce this disparity (Kris-Etherton, 2004:18) and health and nutrition education can play an important role in this respect. Dietary improvement by means of nutrition education is regarded as a long-term solution to the problem, as opposed to the short-term solution of supplementation (Hallberg *et al*, 1992:169). Blom-Hoffman and colleagues (2004) have highlighted the importance of nutrition education programmes that include aspects of change in both knowledge and behaviour. According to Houts *et al* (2006), both research and clinical experience suggest that the incorporation of problem-solving techniques in nutrition education will increase long-term change in nutrition behaviours. Therefore, nutrition education tools should provide interactive and problem-solving activities such as food plate puzzles where children can replace food items in the same food group to construct a balanced meal. Furthermore, word searches, cross word puzzles and matching food items to food groups can also be included as was done in this study.

Although nutrition promotion, education and advocacy

are a set of one of the strategies of the existing national Integrated Nutrition Programme implemented by the South African Department of Health (Bourne *et al*, 2007), limited data on the impact of nutrition education are available. Walsh and colleagues reported on the impact of a community nutrition education programme on the anthropometric nutritional status of mixed-race children in the Free State (2002). From 2002 to 2004, various baseline surveys were conducted in the urban areas of the Vaal region. This is an industrial area situated ± 70 kilometres south of Johannesburg characterized by a population size of about 795 000 of which 47,9% were unemployed; 46,1% of households in this area lived in poverty (Mcilrath & Slabbert, 2003:13,21). The results of the studies undertaken in the Vaal region showed that poverty, household food insecurity, poor health and malnutrition (stunting in children, iron and zinc deficiency) were the major problems observed in this community. The high level of illiteracy and poor nutrition knowledge resulted in uninformed food-purchasing behaviour (Oldewage-Theron *et al*, 2006; Oldewage-Theron *et al*, 2008).

The main aim of this study was to evaluate the effect of a nutrition education programme on the nutrition knowledge of pre-primary school children, aged six and seven years old, in the Vaal region. The specific objective was to test if learning took place through the implementation of a nutrition education programme, using specific developed nutrition education tools.

METHODS

Ethics

The Medical Ethics Committee for research on human beings of the University of the Witwatersrand approved the study (M030566, M080365). Before the nutrition education programme was implemented, the researchers visited the selected schools to explain the objectives of the project and to acquire consent for the project from both the school management and the parents of the children attending the selected schools.

Sampling and respondents

The following power calculation (Gibson, 2006:6) was used to determine the sample size for a representative sample:

$$n = \frac{2 \times (u+v)^2 \times s^2}{E^2}$$

Where u = 0,67m corresponding to a ß for the test of 75% power;

v = 1,96 corresponding to a significance level of 5% for a two-tailed hypothesis;

E = the expected mean change in knowledge, set at 25% for this study;

s = the standard deviation of the change in the nutrition knowledge, assumed to be 2,5 for this study (range of 0,9-1,1 in study undertaken by Matvienko [2007]).

A total of 86 respondents was needed to obtain statistically representative data for this study. The children thus included a convenience sample of all 88 urban pre-school pupils, aged six and seven years, from two randomly selected public schools in an informalsettlement and a town in the Vaal region respectively. The sample of children comprised both genders, namely 54,5% girls (n=48) and 45,5% boys (n=40).

Intervention

An adapted version of the Food and Agricultural Organization (FAO) framework for the development of a nutrition education programme was used for the development of these tools (FAO, 1997). This framework includes four phases: 1) the preparation phase, where the nutritional problems and their causes are identified; 2) the formulation phase, where the objectives, messages and media used should be developed; 3) the implementation phase, where the materials are produced, the change agents are trained and the programme is implemented; and 4) the evaluation phase.

In this study, the nutritional problems in Phase one were identified by the literature and previous baseline studies conducted by the researchers (Oldewage-Theron *et al*, 2006).

Phase two included a previous study conducted by the researchers with 29 school teachers in the Vaal region, which indicated that nutrition was included in the pre-primary school syllabus by 93,1% (n=27) of the teachers as part of the life skills programme, but that only 30-60 minutes per week were allocated for this by 58,6% (n=17) of the teachers. However, no nutrition education resources or tools were available for any of the teachers, the majority of whom recommended the use of activity books (n=22, 75,9%), card and board games (n=20, 68,9%) and puzzles (n=19, 65,5%) as appropriate educational tools. Therefore, a text and activity book with theoretical and supporting visual information on food groups, hygiene and physical activity was designed and developed by the researchers, and included various activities like colouring in, connecting dots and matching pairs to reinforce the messages. The text and activity book was supplemented by 26 cards (Refer Figure 1) and a board game, also reinforcing the messages in the activity book, as well as six “little books” (Refer Figure 1). Five of the books illustrated the five food groups (protein, starch/carbohydrates, dairy, vegetables and fruit, and fat), while the sixth one dealt with hygiene practices. A food plate puzzle was also developed to teach the children about what a balanced meal looks like in terms of food groups and portion sizes (Refer Figure 2). The food items used for the puzzle pieces were based on the Top 20 most frequently consumed food items as was found in previous studies undertaken in the Vaal region (Oldewage-Theron *et al*, 2006; Oldewage-Theron *et al*, 2008).

All the supplementary tools used mainly visual images with very few theoretical explanations; these images were developed and tested for visual representational latitude in a group of pre-primary and primary school children by the researchers and Prof R Gaede from the Department of Visual Arts and Design at the Vaal University of Technology (Gaede & Oldewage-Theron, 2007:5-6).

The three pre-primary teachers in the two randomly selected schools chosen for this study were trained by the researchers in the use of the books and nutrition education tools as part of Phase three (FAO, 1997. The text and activity book covered all the theoretical subject material needed for the nutrition education programme. No other tools or sources of nutrition information were used during the intervention period, apart from the material provided. The teachers worked through the various lessons in the activity books for one hour per week and the children were divided into groups of four each day to participate in each of the three different supplementary learning activities (card game, board game or food puzzle) for another hour. Thus, a total of four hours per week, thus a total of 128 hours (32 hours theory and 96 hours activities such as cards games, puzzles and board games) was thus devoted to the nutrition education programme during the period of eight months. The lessons included the following topics: 1) introduction to the five food groups and the food items forming part of each group; 2) serving sizes and balanced meals; 3) other important facts about healthy eating, concentrating specifically on water, salt and sugar intake; 4) basic hygiene; and 5) the importance of physical activity. The board and card games as well as the puzzle was used to re-inforce the theoretical materials.

Data Collection and Analysis

The measuring instrument was a nutrition knowledge questionnaire that was developed by the researchers

FIGURE 1: EXAMPLES OF CARDS AN "LITTLE BOOKS"

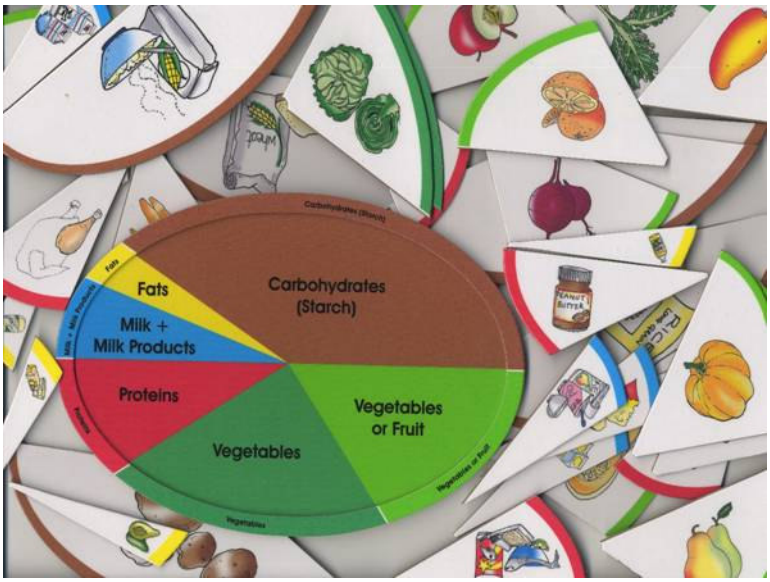

FIGURE 2: THE FOOD PLATE AND PUZZLE PIECES

for the purpose of this study. The questionnaire included multiple-choice questions, accompanied by colour illustrations, on the most important meal of the day, the number of food groups, the main functions of the various food groups, and the number of glasses of water that should be consumed per day. It also included six questions with pictures where the food item not belonging to a specific food group had to be crossed out. The last set of questions consisted of ten "true or false" statements on general nutrition, activity, hygiene and the functions of the food groups. The information included in the questionnaire was similar to the information in the activity books and the supplementary nutrition education tools.

The equivalence reliability of the questionnaire was tested in a school not participating in the nutrition education programme. Each week for a period of four weeks the same group of ten six-year-old pre-primary children, randomly selected from the total group, completed the questionnaire. The answers were compared by means of Cronnbach-Alpha analyses. Based on the results the questionnaire was accepted as reliable as a mean α=0,73 was found. In addition, factor analyses were carried out to unmask possible outliers in the reliability test.

The questionnaire was completed through one-on-one interviews with the participating children. These were conducted by two fieldworkers who spoke the various indigenous languages in the Vaal region and had been recruited from among postgraduate students at the Vaal University of Technology (VUT). They were trained to collect the data from the participants at the schools one week before the intervention and within one week after the intervention was completed (Phase four of the FAO framework).

Baseline and post-intervention data were captured from the knowledge questionnaires on an Excel spreadsheet. The Statistical Package for Social Sciences (SPSS) for Windows version 15,0 program was used to analyze the data. Descriptive statistics were used to determine the percentage of children who answered the questions correctly for each of the knowledge questions on the questionnaire and paired t-tests were carried out to measure the statistically significant difference ($p \leq 0,05$) before and after the intervention.

RESULTS

The results of the study summarized in Table 1 showed that in the multiple choice questions the minority of the children (45,8%) considered breakfast as the most important meal of the day before the intervention, in comparison with a statistically significant improvement of 79,8% after the intervention. Very few children (13,4%) were aware of the five food groups before the intervention and this is reflected in the poor responses to the functions of each of the food groups. However, following the intervention, 64,8% of the children knew the five food groups and most of the responses regarding the functions of each of the food groups improved significantly, except in the case of the role of the micronutrients in vegetables in protecting against infections, where the knowledge decreased from 23,4% before the nutrition education

TABLE 1: IMPACT OF NUTRITION EDUCATION PROGRAMME ON THE KNOWLEDGE OF PRE-SCHOOL CHILDREN (N=88)

Question	Correct answer at beginning (%)	Correct answer at end (%)	Effect on knowledge	Statistical significance (p≤0,05)
Multiple choice				
Breakfast is the most important meal of the day	45,8	79,8	á	0,000
Five food groups	13,4	64,8	á	0,000
The main function of protein foods is to build muscles	33,3	60,2	á	0,000
The main function of starch/ carbohydrates is to provide energy	26,6	32,4	á	0,594
The main function of dairy products is to build strong teeth and bones	27,4	77,9	á	0,000
One of the main functions of vegetables is protecting against infections	23,4	11,0	â	0,820
Six glasses of water should be drunk daily	3,1	63,6	á	0,765
Oranges help to heal sores (Vitamin C)	13,5	14,5	á	1,000
Identifying the correct foods in a group				
Vegetables and fruit	42,3	81,6	á	0,000
Dairy	32,0	71,3	á	0,000
Starch/carbohydrates	23,7	77,9	á	0,000
Foods that should be avoided	38,1	76,7	á	0,000
Protein	20,6	52,5	á	0,000
True and false				
Include a variety of foods in the diet	76,1	79,5	á	0,708
5-a-day	50,0	76,8	á	0,007
Be active	47,8	57,7	á	0,770
Wash fruit before eating	61,4	79,1	á	0,277
Wash hands before eating	47,7	84,9	á	0,000
The main function of protein foods is to build muscles	51,7	73,2	á	0,039
Different foods have different functions in the body	56,8	67,9	á	0,027
Fruit more beneficial than foods with high sugar content	48,3	71,3	á	0,001
Dairy products needed for healthy teeth	67,8	78,8	á	0,196
At least six glasses of water needed per day	44,0	82,6	á	0,000

intervention to 11,0% after the intervention. However, this was not statistically significant. Before the intervention, a minority of 3,1% of the children indicated that at least six glasses of water should be consumed daily and this improved to 63,6% after the intervention. However, in the "true and false" section the knowledge on water consumption improved significantly from 44,0% to 82,6%.

Regarding the identification of food items for each food group, before the intervention only 42,3% of the children identified the correct food items for the vegetables and fruit group, 32,0% correctly identified items for the dairy group, 23,7% for the starch/carbohydrate group and 20,6% for the protein group. Initially, only 38,1% of the children identified sweets, biscuits and cold drinks as foods to be avoided in a healthy diet, compared with 76,7% after the intervention. After the intervention, all the responses improved significantly as the majority of the children correctly identified the foods belonging to the vegetables and fruit group (81,6%) as well as the starch/carbohydrate (77,9%), dairy (71,3%) and protein (52,5%) groups.

The "true or false" question was included to measure general nutrition knowledge and showed that the majority of children knew that a variety of foods should be included in the diet (76,1%), which was confirmed by the 56,8% who realized that different foods perform different functions in the body. Before the intervention, the majority also indicated that dairy products are needed for strong teeth (67,8%) and protein foods are needed to build muscles (51,7%). The five-a-day concept was known to 50,0% of the children before the intervention. Although 61,4% indicated that they should wash fruit before eating, only 47,7% thought it necessary to wash their hands before eating. After the intervention, the majority of the children answered all of these questions correctly, the percentage of correct answers ranging from 57,7% to 84,9%. The question on physical activity was the most poorly answered as only 47,8% before and 57,7% after the intervention thought that physical activity was important, although the difference between the pre- and post-intervention results was not statistically significant. The question on including a variety of food items in the diet did not show a statistically significant improvement after the intervention, being rated first in pre-intervention results and third after intervention (76,1% and 79,5% respectively). The same trend was true for the question on the function of dairy products in the diet.

To summarise, the mean±SD for all the correctly answered questions was 0,38±0,64 before the intervention and this improved significantly to 0,56±0,44 after the intervention. This means an overall significant improvement of 18,2% correctly answered questions by all the respondents. The standard deviation decreased by 0.20 units meaning more accurate measurements towards the mean after the intervention. In the power calculation exercise the authors hypothesised a 25% change with a 2,5 SD in knowledge, but the results indicated an increase of 18,2% with a lower SD than anticipated. The SD of 0,44-0,64 in this study was consistent with the findings of Matvienko (2007).

DISCUSSION

Very little research has been done on the impact of nutrition education programmes in lower socio-economic populations globally (Swindle *et al*, 2007) and this is the first study, of which the authors are aware, where nutrition education tools were developed and implemented as part of a nutrition education programme for children of six and seven years of age from low-income households in South Africa. The purpose of this pilot study was to test the nutrition education tools for impact on nutritional knowledge before implementing them in a large-scale case-controlled nutrition education intervention programme.

In general, the programme was well received by both the children and the teachers. In this study, the children's initial knowledge of general nutrition was poor and included very little information about the food groups and the specific functions of the different foods in the body. Furthermore, poor knowledge of the importance of daily water intake and being physically active was prevalent before the intervention. The nutrition education programme proved to be successful in teaching the children about the various food items forming part of each of the food groups, as most of the responses improved significantly after the nutrition education programme intervention. However, it was evident that the nutrition education tools did not provide clarity on the functions of the vegetable and dairy food groups, as the responses did not improve significantly after the intervention.

Although it is believed that younger children do not make their own food choices, the nutrition education programme implemented in this study made a significant contribution to the nutrition knowledge of the children when it was measured directly after completing the eight-month nutrition education programme. Matvienko (2007) confirmed that six- and seven-year-old children can be empowered to make more healthful food choices after being educated on nutrition and food. Although not measured, observations by the teachers confirmed that the children inspected the lunch boxes of their peers for healthful food items. It thus appears that nutrition education could be successfully included in the curriculum for learners of six and seven years of age. However, the demanding development process of producing innovative nutrition education programmes with tools appropriate for nutrition education should be continuous (Vijayapushpam *et al*, 2008) and the results of this study will be used to adjust the nutrition education programme and tools, specifically in the areas where the knowledge of the children did not improve significantly, such as in the questions on activity and the various functions of vegetables and fruit in the diet.

Poor knowledge of nutrition is a key factor involved in the development of malnutrition and should be addressed (Walsh *et al*, 2003). It is known that dietary habits in childhood have an impact on growth, development and the prevalence of disease throughout the life cycle and that healthy eating habits should be

established during childhood, as children's eating habits are still being developed during the early school years (Anderson *et al*, 2004; Vijayapushpam *et al*, 2008). Healthful eating behaviours should be formed early in life and continue throughout life (Sharma *et al*, 2008). There is therefore an urgent need for the promotion of effective health nutrition education interventions to implement dietary and lifestyle changes in consumer behaviour (Brug, 2004:43) for both children and their caregivers who are responsible for procurement and preparation of food in the household . Since most children spend most of their time in school, school-based nutrition education can be employed to engage children in healthy eating and physical activity programmes to reinforce these messages (Gross & Cinelli, 2004; Wechsler *et al*, 2000).

LIMITATIONS OF THIS STUDY

Ideally, a study such as this should include a control group so that the results of the intervention and control groups can be compared. However, the sample size was calculated to deliver statistically significant results. A further limitation of this study was that all the nutrition education tools were used together in the nutrition education programme and the effect of each individual tool was not tested.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Further research is needed and a large-scale case-controlled study should be undertaken where the effectiveness and impact of each of the nutrition education tools individually, as well as of all the nutrition education tools in combination, is evaluated, not only for impact on nutritional knowledge of children in pre-primary school, but also on change in dietary intake behaviour (Swindle *et al*, 2007). Memory retention over a longer period should also be measured as this study focused only on the improvement in knowledge after one week of completing the nutrition education programme. It is further recommended that a nutrition education programme be developed for the mothers and caregivers of children, as they play a significant role in creating a healthy home environment and supporting healthful food choices by the children (Boutelle *et al*, 2007). Research is also needed to test the ease of use of the nutrition education tools by the teachers who will act as the change agents.

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