Pak. j. life soc. Sci. (2013), 11(2): 126-132 E-ISSN: 2221-7630;P-ISSN: 1727-4915

**Pakistan Journal of Life and Social Sciences**
www.pjlss.edu.pk

**RESEARCH ARTICLE**

# Implementation and Evaluation of a Computer-Based Nutrition Education Intervention in the Primary Schools of Lahore, Pakistan

Aisha Siddique
Institute of Rural Home Economics, University of Agriculture, Faisalabad, Pakistan

***ARTICLE INFO***
Received: May 14, 2013
Accepted: Jul 08, 2013
Online: July 11, 2013

***Keywords***
Computer based tool
Nutrition education
Nutrition knowledge
Work sheets

***Corresponding Author:**
aisha_riz@yahoo.com

**ABSTRACT**

The main objective of this study was to implement and evaluate a computer-based nutrition education intervention in the primary schools of Pakistan and to explore the acceptability of such a program in the Pakistani context. The study design was multi-factorial with repeated measures of nutrition knowledge, taken at three points in time (baseline, post-intervention and follow-up) from intervention and comparison groups. Qualitative methods (focus group and observations of lessons) were also employed. Three hundred and forty four children (8-10 years old) of eleven primary schools of Lahore participated in the study. In a two week school-based nutrition education intervention, comparison group received nutrition education through work-sheets, card and board games. Intervention group used computer-based tool along with work-sheets card and board games. Control group was not provided nutrition education. Nutrition knowledge was measured in each child at baseline, at the end of two-week intervention, and at three - months' follow-up with a validated nutrition knowledge questionnaire. The nutrition knowledge increased significantly in both intervention and comparison groups ($P<0.001$). No tangible difference was observed at post-intervention and follow-up between the two groups. The intervention effect was significantly maintained at three months' follow-up, indicating the retention of the nutrition knowledge. Long term knowledge gain and retention of knowledge is significantly higher among girls as compared to boys. Younger children (8-9 years) significantly ($p=0.037$) retained more nutrition knowledge at three months follow-up. Computer-based tools were found helpful in disseminating nutrition education. However, they were not the panacea. An amalgam of computer-based tools and other creative methods brings more fruitful results than using these methods in isolation. The low level of nutrition knowledge of Pakistani children urgently demands incorporation of the nutrition education in the school curriculum.

## INTRODUCTION

In Pakistan, 38% of under-five years of age and 30% of school-age children are either moderately or severely mal-nourished (Jafar et al., 2008). Despite food availability and accessibility, lack of nutrition knowledge (Grosso et al., 2012), awareness (Dur Afsar et al., 2005; Neetu and Kochar, 2009) and faulty concepts towards certain food items remain important impediment in the achievement of a healthy diet (Cayce et al., 2010). As more healthy eating habits are associated with individuals with more nutrition knowledge (Oldewage and Egal, 2010). Eating habits developed in early life continue to become persistent in later life (Bishnu et al., 2009). Therefore, in order to ensure life-long good health, children must be made aware of nutritional concepts and healthy eating habits early in life (Perez-Rodrigo and Aranceta, 2001).

Parents, being the foremost socializing agent, are responsible for promoting and sustaining healthy eating habits in children. The studies show that parents' eating habits and behaviours are strong determinants of children's eating habits and behaviours (Dos Santos et al, 2012). A strong coherence between the education levels of parents, especially mothers, and eating habits of children is amply documented in the relevant literature (Jones et al., 2010). But miserably, the low adult literacy rate (53%) is depriving Pakistani children from this provision with the result that their dietary habits are not healthy (Dur Afsar et al., 2005).

Besides parents, schools are also considered to be equally conducive towards disseminating nutrition knowledge (Pérez-Rodrigo and Aranceta, 2003). A review of the primary schools' curricula in Pakistan reveals that these do not impart sufficient knowledge regarding nutrition. This further limits children's opportunities to learn about a healthy diet thus making them nutritionally vulnerable.

School-based nutrition education intervention provides an opportunity to develop healthy eating habits in children (Lakshman et al., 2010). However, children find nutrition concepts difficult to comprehend. Therefore, nutrition education programmes that are age-appropriate and creative are known to be fruitful (Lytle and Achterberg, 1997). Computer-based programs constitute of multiple interactive elements including audio, text, simulation and graphics. Therefore, they are becoming an integral part in health promotion and nutrition education programs. Computer-Based Tools (CBT) have also been found effective in disseminating nutrition information (Elena and Jennifer, 2004; Valdez, 2010; Turnin et al., 2001). Unfortunately, this medium lacks application in Pakistani schools.

The scenario mentioned above i.e., high rate of mal-nutrition, low parental literacy rate and lack of nutrition education in school curricula justifies the need to provide nutrition education to children. In the present study, for the first time ever, a computer-based nutrition education-intervention was implemented and evaluated in the Pakistani primary school setting. The acceptability of computer-based nutrition education was also explored.

## MATERIALS AND METHODS

The power analysis program (G. Power) was used to calculate the sample size (Edgar et al., 1996). A total of 278 children were needed to test the hypothesis that nutrition knowledge (mean number of correct answers) increases 20% in all children from a mean of 10 correct answers at baseline to 12 correct answers at post-intervention subject to 80% power (1-ß) with standard deviation of 3 and an estimated medium effect size of d=0.3 at the 0.05 level of significance, irrespective of the teaching tool. In the a priori sample size calculations the expected difference in knowledge gain between intervention and comparison groups was not considered. Post-hoc analysis was used to determine the effect size of the actual difference in knowledge gain at post-intervention between intervention and comparison groups.

In order to reduce teaching bias, the nutrition education intervention was carried out during the practical experience of student teachers (STs). Out of the 7 localities of Lahore, 2 localities [1 from low socio-economic status (SES) and 1 from high SES] were randomly selected (which is subject to another publication). Twenty-five schools from each locality were contacted, out of which 22 schools were in accordance with the selection criterion.

From these 22 schools, children in 11 schools mostly belonged to low SES and those in the remaining 11 schools mostly belonged to higher SES. From these 11 low SES and 11 high SES schools, two schools (one from each SES) were randomly chosen and grouped together as control schools. At the next step, from the rest of the 10 low SES schools, five were chosen randomly and grouped as comparison schools and the remaining five as intervention schools. Similarly, from the 10 high SES schools, half were chosen randomly and grouped as comparison schools and the rest as intervention schools.

The intervention material for intervention group consisted of the computer-based nutrition education tool, i.e., "Cool Food Planet Kidz". It is an interactive website developed by "The European Food Information Council", which was used with due permission. For the comparison group, the intervention material was consisted of 11 worksheets, 2 board games and 1 card game. The worksheets mainly covered the topics including, healthy breakfast, healthy snacks, good food choices and nutrients in food.

A total of 11 schools (n=522), including four intervention (n=213), five comparison (n=249) and two control (n=60) schools participated in the study. Finally, 344 children from 11 primary schools, including 4 intervention schools (n=147), 5 comparison schools (n=156), and 2 control schools (n=41) successfully completed the study. Only those children successfully completed the study who were able to complete all three questionnaires (baseline, post-intervention and follow-up) and whose parental consent form was received. Flow of schools and children through the study is depicted in Figure 1.

Before implementation of the program, two workshops were organised. A one-day workshop was held for the class teachers. They were oriented to the core philosophy of the study. A two-day training workshop was held for the STs (n=17). The purpose of the training workshop was to brief them about the purpose of intervention and to discuss and gather ideas on how to incorporate nutrition lessons in the classroom. In addition, STs for the intervention group received training on the specifics of using the interactive CD-ROM.

Nutrition knowledge was the primary outcome measure, assessed in each child at baseline, at the end of two-week intervention, and at three - months' follow-up using a validated Nutrition Knowledge Questionnaire (Katrin, 2004). Children's demographic

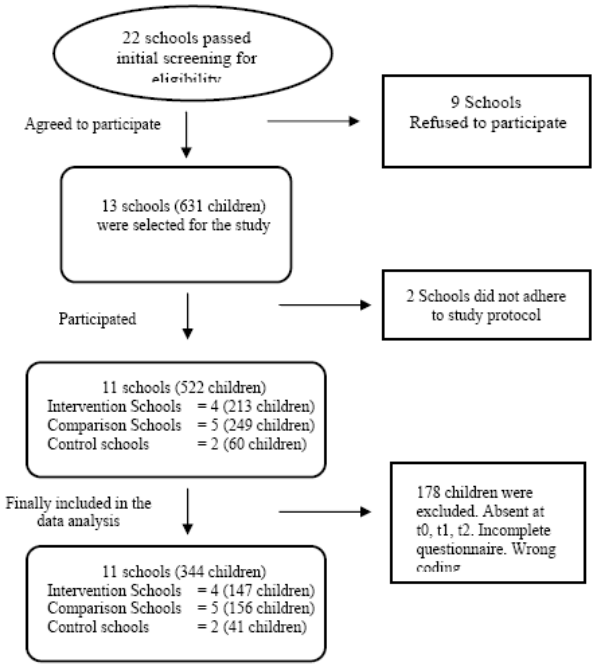


**Fig. 1: Flow of schools and children through the study**

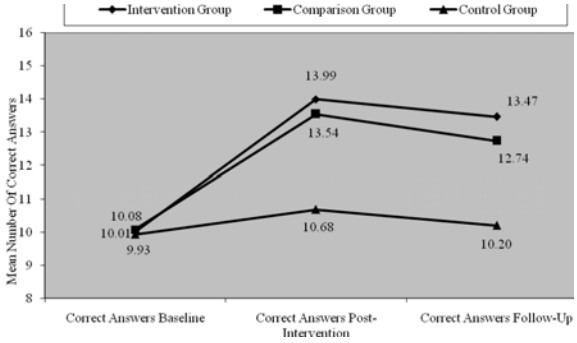


**Fig. 2: Mean number of correct answers of intervention, comparison and control groups at baseline, post-intervention and 3 months' follow-up**

information including age and gender was also obtained. In order to assess the acceptability of the intervention, evaluation questionnaires were distributed among the STs and children. For collection of qualitative information, focus groups were arranged with STs and children. Furthermore, additional information was obtained through observation of nutrition lessons.

Parametric test General Linear Model (GLM), with repeated measures and Non-parametric tests (Chi-square, Kruskal-Wallis and Mann-Whitney-U test) were computed to determine the differences across variables at baseline, post-intervention and follow-up, as required. Independent variable; group, age and gender were used as the between-subject-variables (two levels) and dependant variable; nutrition knowledge (three levels) as the within-subject variable. The data was analysed using the SPSS Version 15.0, SPSS Inc., 2006.

## RESULTS

A total of, 344 children, out of 522 participating children, completed all three questionnaires i.e., at baseline, post-intervention and follow-up. A high response rate of 83% was received. However, only 55% of children successfully completed the study i.e., adhered to the study protocol. The demographic characteristics of the children excluded from the data analysis and children included in to the data analysis were found to be similar. Chi-square test was used to determine the homogeneity of baseline variables including age (p=0.56), gender (p=0.56) and class level (P=0.085), however, no significant difference was found. The characteristics of study participants are summarized in Table 1.

The pair-wise comparison, as computed in GLM, indicated that baseline nutrition knowledge was comparable between the two groups (P= 0.82), age groups (P=0.45), genders (P=0.31) and class levels (P=0.81) (Table 2).

GLM, with repeated measure, indicates that nutrition education-intervention was helpful in increasing the nutrition knowledge. The effect of time in GLM is statistically significant (P<0.001).The result of pair-wise comparison (p-values adjusted with Bonferroni) reveals that combined nutrition knowledge (intervention and comparison groups together) increased significantly after intervention 13.76 (Standard Error [SE] 0.199; P<0.001) as compared to baseline (10.05). The post-three months' mean nutrition knowledge score of 13.09 was significantly higher (SE 0.181; P<0.001) than the mean nutrition knowledge score at baseline (Table 3). Furthermore, the difference between the mean of post-intervention nutrition knowledge i.e., 13.76 and the mean of follow-up nutrition knowledge i.e., 13.09, was significant (SE 0.181; P<0 .05).

The result of the test of between-subjects-effect shows that main effect of the variable "group" is not statistically significant (SE=0.181; P=0.157), indicating that the intervention was effectual in increasing nutrition knowledge regardless of the teaching method.

The mean number of correct answers were comparable between intervention, comparison and control groups at baseline (Kruskal-Wallis, P=0.93). However, they differ significantly at post-intervention and follow-up (Kruskal-Wallis, P=0.00 and P=0.00, respectively), as shown in Figure 2.

The effect size of the difference in nutrition knowledge at post-intervention between intervention and comparison

**Table 1: Baseline characteristics of intervention and comparison groups**

| Variables | Intervention | | | Comparison | | | Total |
|---|---|---|---|---|---|---|---|
| | n | % within Variable | % within Group | n | % within variable | % within Group | |
| 8-9years | 70 | 50.40 | 47.60 | 69 | 49.60 | 44.20 | 139 |
| 10-11 years | 77 | 47.00 | 52.40 | 87 | 53.00 | 55.80 | 164 |
| Total | 147 | | | 156 | | | 303 |
| Girl | 69 | 50.40 | 46.90 | 68 | 49.60 | 43.60 | 137 |
| Boy | 78 | 47.00 | 53.10 | 88 | 53.00 | 56.40 | 166 |
| Total | 147 | | | 156 | | | 303 |
| Fourth Class | 78 | 53.80 | 53.10 | 67 | 46.20 | 42.90 | 145 |
| Fifth Class | 69 | 43.70 | 46.90 | 89 | 56.30 | 57.10 | 158 |
| Total | 147 | | | 156 | | | 303 |

**Table 2: Nutrition knowledge at baseline in intervention and comparison groups**

| Variables | Intervention | | | Comparison | | |
|---|---|---|---|---|---|---|
| | n | Mean * | SD+ | n | Mean | SD |
| 8-9years | 70 | 10.16 | 2.92 | 69 | 10.30 | 2.95 |
| 10-11 years | 77 | 9.87 | 3.10 | 87 | 9.98 | 3.04 |
| Girls | 69 | 10.06 | 3.03 | 68 | 9.65 | 2.90 |
| Boys | 78 | 9.87 | 3.10 | 88 | 10.49 | 3.03 |
| Fourth Class | 78 | 9.92 | 3.04 | 67 | 10.37 | 2.97 |
| Fifth Class | 69 | 10.10 | 3.00 | 89 | 9.93 | 3.01 |
| Total Children | 147 | 10.01 | 3.01 | 156 | 10.12 | 2.99 |

*Mean number of correct answers from a total of 22 questions; + Standard Deviation

**Table 3: Nutrition knowledge at baseline, post-intervention and 3-months' follow-up in intervention and comparison groups**

| | Groups | n | Mean* | SD+ |
|---|---|---|---|---|
| | Intervention | 147 | 10.01 | 3.01 |
| Correct answers baseline | | | | |
| | Comparison | 156 | 10.08 | 3.01 |
| Combined Total | | 303 | 10.05 | 3.00 |
| | Intervention | 147 | 13.99 | 3.48 |
| Correct answers post-intervention | | | | |
| | Comparison | 156 | 13.54 | 3.42 |
| Combined Total | | 303 | 13.76 | 3.46 |
| | Intervention | 147 | 13.47 | 3.22 |
| Correct answers at Follow-up | | | | |
| | Comparison | 156 | 12.74 | 3.19 |
| Combined Total | | 303 | 13.09 | 3.22 |

*Mean number of correct answers from a total of 22 questions; + Standard Deviation

groups was d=0.130. The result of the test of between-subjects effect shows that main effect of the variable "age in two categories" is statistically significant (P=0.037). Younger children (8-9 years) significantly retained more nutrition knowledge at three months' follow-up, as shown in Table 3. Short term knowledge gain was comparable between girls and boys. Long term knowledge gain and retention of knowledge was significantly higher among girls as compared to boys (Mann-Whitney-U test P=0.025, P=0.024 respectively).

**Table 4: Nutrition knowledge of 8-9 years and 10-11 years old children at baseline, post-intervention and 3-months' follow-up**

| | Groups | n | Mean* | SD+ |
|---|---|---|---|---|
| | 8-9 years old | 139 | 10.19 | 2.94 |
| Correct answers baseline | | | | |
| | 10-11 years old | 164 | 9.93 | 3.06 |
| | 8-9 years old | 139 | 14.05 | 3.26 |
| Correct answers post-intervention | | | | |
| | 10-11 years old | 164 | 13.52 | 3.61 |
| | 8-9 years old | 139 | 13.55 | 3.23 |
| Correct answers at follow-up | | | | |
| | 10-11 years old | 164 | 12.71 | 3.18 |

**Acceptability of the intervention**

According to the evaluation questionnaires received from the intervention children, sixty-one percent of the children ranked the computer-based tool as *very good*, 23 % as *good* and only 2.3% as *not good at all*. Thirty-three percent of the children judged their computer skills as *good* and only 5.6% as *very good*. On the other hand, 40.7 % of the children judged as *not so good* and 20.3 % as *not good at all*.

The overall response of the children (comparison and intervention) and STs about the drill was very good. Three focus group (n=70) with intervention children revealed that the use of computer as a medium of learning was new to them. Therefore, initially, they faced difficulties in operating them. Despite difficulties, the children regarded learning through computers as interesting and amusing.

The evaluation questionnaire for STs of intervention group was filled out by all STs (n=8). The focus group discussion (n=3) with STs revealed that they were amazed by the immense interest and involvement of the children in computers. Some STs hinted that children regarded the computer as a thrilling and entertainment device instead of an educational tool. Some of them mentioned that, in the first few lessons, they had not felt comfortable and confident in using the computer as a teaching tool as they were not used to working with computers. Many STs showed eagerness to work in a computer-based system in future. However, they highlighted the prospective problems faced by

computer-based education in Pakistan including frequent power breakdowns, lack of support from school administrations, computer equipment and related skills. All of them agreed that nutrition education should be included in school curricula. To conclude, the present study highlights many important factors that need to be taken into account in order to integrate computer-assisted education in Pakistani primary schools successfully.

## DISCUSSION

The present study was distinctive in two aspects. For the first time, nutrition education intervention was applied and evaluated in the primary school scenario of Pakistan. Secondly, the acceptability of the computer-based nutrition education program in a Pakistan context was explored. In case of the first aspect, the study successfully demonstrated that the children could learn nutrition concepts and healthy eating habits in a lively and interesting environment. As regards the second aspect, the study found that the children and teachers were both positive and receptive to the computer-based nutrition education intervention. However, significant barriers were identified that negatively affect the acceptability of computer-based education, thus eventually, affecting its applicability in the Pakistani primary schools.

The highly significant increase found in the mean number of correct answers from baseline to post-intervention and at follow-up in both study groups supports the hypothesis of the present study and confirms that nutrition education intervention was successful in increasing the nutrition knowledge of children. The increase in nutrition knowledge found in the present study is in accordance with other school-based nutrition education interventions (Zalilah et al., 2008; Neetu and Kochar, 2009; Elena and Jennifer, 2004).

In the current study, nutrition knowledge of children of both (intervention and comparison) groups significantly increased. However, at the same time, no noticeable difference was found between the two study groups. It could be inferred that CBT did not result in additional learning in the children. Furthermore, the result of this study is consistent with the result of studies that indicated no difference between CBT and worksheets (traditional methods) as well (Katrin, 2004; Susan and Jenniffer, 2000; Munguba et al., 2008).

An analysis of research literature, which explored the effects of CBT on nutrition knowledge of children, displayed mixed results. This may be ascribed to the variations in the study designs. The studies, which reported significant increase in nutrition knowledge of the computer-based group, either evaluated it vis-à-vis teacher-led strategy or the group which did not receive nutrition education (Elena and Jennifer, 2004; Valadez, 2010; Turnin et al., 2001). On the contrary, the studies that compared the computer-based group with the one that received nutrition education through specifically developed worksheets, cards, boards and video games, reported no significant differences between the two groups, denoting that other creative mediums also confer equal positive influence on learning (Katrin, 2004; Susan and Jenniffer, 2000; Munguba et al., 2008) denoting that other creative mediums also confer equal positive influence on nutrition learning. However, interestingly, a study similar in study design to the present study, reported that control group (traditional method) attained more scores as compared to the experimental group who used CD-ROM (Fančovičová et al., 2010). While on the contrary, intervention children in the present study worked both with CD-ROM and traditional methods and attained more scores as compared to the comparison group. This indicates that CBT should be used to enhance the effectiveness of traditional methods rather than replacing them.

Apart from the research design, other factors such as animation, colour, sound effects and time allocated to explore the CBT are also accounted for the variations. Research literature is ambivalent in establishing the comparative effectiveness of CBT alone over traditional methods (Vernadakis et al., 2008) implying that more in-depth research is required to explain the prevailing discrepancies in the literature.

Although the study found substantial increase in nutrition knowledge in both groups, the difference in increase in nutrition knowledge of intervention group over the comparison group is small (effect size d= 0.130). The effect size below 0.2 is reported as small (Jacob, 1988), denoting that both CBT and worksheets and card games were equally effective in increasing nutrition knowledge.

The significant difference in mean number of correct answers between girls and boys at three months' follow-up could be attributed to the fact that, in Pakistani society, male and female domains and their respective roles are markedly distinct (women's role is confined mainly to the household). Accordingly, girls found nutrition knowledge more relevant to their future prospective role and, therefore, showed higher rate of retention as compared to the boys who considered nutrition knowledge as irrelevant.

The post-three-month follow-up finding, that younger children (8-9 years) significantly retain more nutrition knowledge, suggests that the intervention material was more suitable for the younger group. Furthermore, it indicates that the nutrition intervention is more advantageous when started at an early age (Perez-Rodrigo and Aranceta, 2001).

Like many other school-based nutrition education interventions, the present study had some limitations as

well. Initially, in order to reduce likely contamination effects, one classroom from each school was selected. However, some schools later refused to participate in the study. This situation resulted in the selection of two classes from the same school which might have possibly affected the tenacity of the findings. Frequent power breakdowns interrupted the time schedule and consequently reduced the time children had allocated for exploring the CD-ROM. This might have negatively affected children's learning through computers. The level of computer skills is directly related to the effective use of computers. The lack of computer skills, as reported by children, might have proved a strong barrier in attaining the maximum benefit from CBT.

**Conclusion**

The study successfully demonstrated that the children could learn nutrition concepts and healthy eating habits in a lively and interesting environment. An amalgam of computer-based tools and other creative methods brings more fruitful results than using these methods in isolation. This study provides evidence that the rate of nutrition knowledge in Pakistani children is low. However, it can be successfully targeted and change can be achieved with relatively few additional resources. It justifies the urgent inclusion of nutrition education in the primary school curricula. Additionally, it highlights the inadequacy of teachers in nutrition information and computers skills. Therefore, both nutrition and computer education needs to be incorporated in the STs curricula. Future studies should investigate the impact of computer-based nutrition education on attitude and practice. Furthermore, they should include other age-groups (adolescent) and children in other settings (public schools).

**Acknowledgements**

The author is especially thankful to the school principals, school children and student teachers whose participation made this research project possible.

**REFERENCES**

Bishnu S, H Michael, H Debra, and R Karin, 2009. Living independently and the impact on young adult eating behaviour in Germany. British Food Journal, 111: 436-451.

Cayce CH, AG Rachel, MF Daniel, and CW Robert, 2010. Barriers to obesity prevention in Head Start. Health Affairs, 29: 454-462.

Dos Santos BG, R Sichieri and R Salles-Costa, 2012. Relationship of socio-economic factors and parental eating habits with children's food intake in a population-based study in a metropolitan area of Brazil. Public Health Nutrition, 16: 1-6.

Dur Afsar A, M Sajid, and A Sameer, 2005. Is poverty or lack of nutrition awareness the main cause of malnutrition in children? Pakistan Pediatric Journal, 29: 63-67.

Edgar E, F Franz and B Axel, 1996. GPOWER: A general power analysis program. Behavior Research Methods, 28: 1-11.

Elena LS and EA Jennifer, 2004. The evaluation of food pyramid games, a bilingual computer nutrition education program for Latino youth. Journal of Family Consumer Science Education, 22: 1-16.

Fančovičová J, P Prokop and M Uşak, 2010. Web-site as an educational tool in biology education: a case of nutrition issue. Educational Sciences: Theory and Practice, 10: 907-921.

Grosso G, A Mistretta, G Turconi, H Cena, C Roggi, and F Galvano, 2012. Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy. Public Health Nutrition, 1: 1-10.

Jacob C, 1988. Statistical power analysis for the behavirol sciences. 2nd edition. Lawrence Erlbaum Associates, New Jersey, USA.

Jafar TH, Z Qadri, M Islam, J Hatcher, ZA Bhutta, and N Chaturvedi, 2008. Rise in childhood obesity with persistently high rates of under nutrition among urban school-aged Indo-Asian children. Archives of Disease in Childhood, 93: 373-378.

Jones LR, CD Steer, IS Rogers and PM Emmett, 2010. Influences on child fruit and vegetable intake: sociodemographic, parental and child factors in a longitudinal cohort study. Public Health Nutrition, 13: 1122-1130.

Katrin K, 2004. Evaluation of a computer-based nutrition education tool. Public Health Nutrition, 7: 271-277.

Lakshman RR, SJ Sharp, KK Ong, and NG Forouhi, 2010. A novel school-based intervention to improve nutrition knowledge in children: cluster randomised controlled trial. BMC Public Health, 10: 123.

Lytle L and C Achterberg, 1995. Changing the diet of American's children: what works and why? Journal of Nutrition Education, 27: 250-260.

Munguba MC, MTM Valdes, and CAB da Silva, 2008. The application of an occupational therapy nutrition education programme for children who are obese. Occupational Therapy International, 15: 56-70.

Neetu G and GK Kochar, 2009. Role of nutrition education in improving the nutritional awareness among adolescent girls. The Internet Journal of Nutrition and Wellness, 7: 1.

Oldewage-Theron WH and AA Egal, 2010. Nutrition knowledge and nutritional status of primary school children in QwaQwa. South African Journal of Clinical Nutrition, 23: 149-154.

Perez-Rodrigo C and J Aranceta, 2001. School-based nutrition education: Lessons learned and new perspectives. Public Health Nutrition, 4: 131-139.

Pérez-Rodrigo C and Aranceta, 2003. Nutrition education in schools: experiences and challenges. European Journal of Clinical Nutrition, 57: 82-85.

Susan MG and A Jenniffer, 2000. Using interactive multimedia nutrition education to reach low income persons: An effectiveness evaluation. Journal of Nutrition Education, 32: 204-213.

Turnin MC, MT Tauber, O Couvaras, B Jouret, C Bolzonella, O Bourgeois, JC Buisson, D Fabre, A Cance-Rouzaud, JP Tauber, and H Hanaire - Broutin, 2001. Evaluation of microcomputer nutritional teaching games in 1,876 children at school. Diabetes and Metabolism, 27: 459-464.

Valadez A, 2004. An interactive multimedia nutrition education resource for elementary school students. In The 132nd Annual Meeting the American Public Health Association.

Vernadakis N, E Zetou, E Tsitskari, M Giannousi and E Kioumourtzoglou E, 2008. Student attitude and learning outcomes of multimedia computer-assisted versus traditional instruction in basketball. Education and Information Technologies, 13: 167-183

Zalilah MS, SB Siti, O Norlijah, H Normah, I Maznah, J Zubaidah, MK Sham, P Laily, AS Bahaman and AMH Zabidi, 2008. Nutrition education intervention, nutrition knowledge, attitude and practices of primary school children: A pilot study. International Electronic Journal of Health Education, 1: 119-132.