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# Educational software and improvement of first grade school students' knowledge about prevention of overweight and obesity

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### **Educational software and improvement of first grade school students' knowledge about prevention of overweight and obesity**

**Objective.** To evaluate the effects of educational software to improve first grade school students' knowledge about prevention of overweight and obesity. **Methods.** This non-controlled trial with a before-and-after evaluation was carried out in a school located in the municipality of Divinópolis (Brazil) among 71 students aged 6 to 10 years. The educational software about prevention of overweight and obesity was designed and then validated. The educational intervention comprised the use of the software. Before and after of the intervention we applied a questionnaire based on the *Ten Steps to Healthy Eating for Children*, proposed by the Brazilian Ministry of Health. **Results.** Comparing the times before and after application of the educational software, we observed statistically significant differences in proportion of questions answered correctly by first grade school students, mainly concerning daily eating of healthy and unhealthy food, adequate preparation of food and importance of exercise. **Conclusion.** This study highlights the importance of educational actions using software to build knowledge of first grade school students about prevention of overweight and obesity.

**Key words:** child; health education; overweight; obesity; schools; software.

### **Software educativo y mejoramiento del conocimiento de los escolares sobre la prevención del sobrepeso y la obesidad**

**Objetivo.** Evaluar los efectos de la utilización de un software educativo en el mejoramiento del conocimiento de los escolares sobre la prevención del sobrepeso y la obesidad. **Métodos.** Ensayo no controlado con evaluaciones antes y después, realizado en una escuela municipal de Divinópolis (Brasil). Participaron 71 escolares con edades entre 6 y 10 años. El software educativo sobre prevención del sobrepeso y la obesidad se construyó y validó. La intervención educativa estuvo constituida por la utilización del software. Antes y después de la intervención se aplicó un cuestionario basado en los *Diez pasos de la alimentación saludable de los niños*, propuesta por el Ministerio da Salud.

**Resultados.** Comparando los momentos antes y después de la utilización del software educativo, se observaron diferencias estadísticamente significativas en la proporción de preguntas contestadas correctamente por los escolares, en especial, en lo que se refiere a ingesta diaria de alimentos saludables y no saludables, preparación adecuada de alimentos y la importancia de la actividad física. **Conclusión.** El presente estudio resalta la importancia de las acciones educativas mediante la utilización de un software en la construcción de conocimiento en los escolares acerca de la prevención del sobrepeso y de la obesidad.

**Palabras clave:** niño; educación en salud; sobrepeso; obesidad; instituciones académicas; programas informáticos.

### **Software educativo e melhoria do conhecimento de escolares sobre prevenção de sobrepeso e obesidade**

**Objetivo.** Avaliar os efeitos da utilização de um software educativo na melhoria de conhecimento dos escolares sobre prevenção de sobrepeso e obesidade. **Métodos.** Ensaio não controlado com avaliação antes e depois, realizada em uma escola municipal de Divinópolis (Brasil). Participaram 71 escolares com idade entre 6 e 10 anos. O software educativo sobre prevenção de sobrepeso e obesidade foi construído e validado. A intervenção educativa foi constituída pela utilização deste software. Antes e depois da intervenção foi aplicado um questionário baseado nos Dez Passos da Alimentação Saudável da Criança, proposta pelo Ministério da Saúde. **Resultados.** Comparando os momentos antes e depois da utilização do software educativo se observaram diferenças estatisticamente significativas na proporção de perguntas respondidas corretamente pelos escolares, especialmente no que se refere à ingesta diária de alimentos saudáveis e não saudáveis, preparação adequada de alimentos e importância da atividade física. **Conclusão.** O presente estudo resalta a importância das ações educativas por meio de um software na construção de conhecimento dos escolares acerca da prevenção de sobrepeso e obesidade.

**Palavras chave:** criança; educação em saúde; sobrepeso; obesidade; instituições acadêmicas; software.

## Introduction

Obesity and overweight are critical concerns, and the main sign is accumulation of adipose tissue in the body. These conditions can lead to a variety of chronic disease, including diabetes, cardiovascular diseases and cancer.<sup>1</sup> In addition; they are simultaneously correlated with blood hypertension, dyslipidemia, type 2 diabetes mellitus and other risk factors for heart diseases.<sup>2</sup> These diseases are often seen in children and adolescents around the world. Data show that in 2013 more than 42 million children were overweight or obese.<sup>1</sup> In Brazil, overweight and obesity are seen in both rural and urban environments, especially among children and adolescents with a low level of physical activity.<sup>3</sup> A study carried out in Rio Grande do Sul showed that first grade school students in a rural area were more obese (22.7%) than students in an urban area (13.6%).<sup>4</sup> Another investigation in first grade school students from the south region Brazil found no significant difference in prevalence of overweight and obesity between rural and urban areas.<sup>5</sup> Researchers agree that overweight in first grade school students may be due to access to industrialized food, sedentary behavior and nutritional transition.<sup>4,5</sup>

The relationship between socioeconomic factors and overweight is still not clearly defined. Some authors have argued that higher family income and better-educated mothers are not enough to protect children from becoming overweight. This situation might be due to greater access to processed food and the fact that better-educated mothers are typically involved with work activities that consume much of their time.<sup>3</sup> Another factor is the long periods children spend watching TV; this behavior directly influences eating habits and promotes sedentarism.<sup>6</sup>

According to the World Health Organization (WHO), strategies to prevent and control these diseases must include environment elements that affect weight status of the community, individual and groups at risk, and protocols for the obese population. Such strategies must be easy and

accessible and contain attractive methods for each age range; they should produce a higher impact on efficient long-term control of obesity.<sup>7</sup> Current strategies for health education with state-of-the-art tools, particularly the use of interactive methods, have been indicated as helpful for improving skills and knowledge acquisition in childhood and adolescence. Indeed, supervised use of videogames, for example, has shown to be an efficient method to enhance cognitive and perceptive skills, primarily the educational games that are highlighted as beneficial to users.<sup>8</sup> Another study using a digital educational game among students in the first year of middle school reported that this pedagogical strategy was a great learning stimulus builder in the Portuguese language and in other disciplines.<sup>9</sup> A study with first grade school students to prevent intestinal parasites also reported that videogames caused a significant increase in students' knowledge about health habits to prevent helminthiasis.<sup>10</sup>

Interactive methods are crucial in knowledge building because they draw higher interest and participation of children and adolescents. They become able to activate their background knowledge about the subject, elaborate on this knowledge, and give the information a new meaning, thereby changing their behavior. For this reason, active methods are relevant to prevent health problems and promote better health.<sup>11</sup> We believe in the potential of interactive methods as a tool for health education. This study sought to evaluate the effect of an educational software among first grade school students' knowledge on prevention of overweight and obesity.

## Methods

This quantitative, non-controlled study with before-and-after evaluations was carried out at an elementary education school in the municipality of Divinópolis. The study occurred in two stages. First, at baseline, the educational software was designed and validated using the Reeves method. This method is based on 14 pedagogical

criteria, including epistemologic aspects, role of the instruction, and valorization of error. The study was also based on 10 criteria for user interface, such as facilitation of use, navigation, and screen design. The pedagogical subjacent model to design the software considered Freud's pedagogical constructive philosophy.<sup>12,13</sup> Graphic interface was implemented through lineages of HTML 5 marking language<sup>14</sup> and CSS 3;<sup>15</sup> for programming we used the Java 7<sup>16</sup> language and the MySQL 5.1 database.<sup>17,18</sup> The software comprised 3 modules. The first module includes the web interface for user access, registration, maintenance and data analysis. The second module includes the interactive game, in which the user needs to collect food and answer questions concerning healthy eating habits to gain scores. The third module is a web service that connects the interactive game and web software interface. The software is accessible free of charge at <http://www.sistemasaladamista.com.br>.

The educational software's content consists of questions to be answered by first grade school students about healthy eating by age range based on Ten Steps to Healthy Eating for Children, proposed by the Brazilian Ministry of Health.<sup>19</sup> Validation was carried out by 15 teachers with pedagogical specialization using the criteria proposed by the Reeves method.<sup>12</sup> We applied a structured questionnaire with language appropriate for the age of the participants, including nine direct questions in relation to prevention of overweight and obesity; these were also based on the Ten Steps proposed by the Brazilian Ministry of Health.<sup>19</sup> Subsequently, the educational software was made available for first grade school students of the study: 71 children aged 6 to 10 years. In the second stage, after students had used the software for 1 month, first grade school students we again applied the questionnaire.

The chosen age range, 6 to 10 years, was based on elective pedagogical principles for software design, mainly in relation to previously acquired knowledge by participants in this group (i.e., the ability to read and interpret). The project

was presented for parents or legal guardians for the students, and participation of the children was requested. After authorization, children were approached in classrooms and the project was explained to them. After the invitation to participate, children answered the questionnaire using the software in the computer laboratory of the school. Statistical Package for Social Sciences software, version 15.0, was used for data tabulation and analyses. Descriptive analyses compared variables at two different times (before and after interventions), and the McNemar and Bowker tests were applied; the significance level adopted was 5%.

This study followed all ethical proposals stated in the resolution 466/2012 and was approved by Ethical and Research involving Human Subjects Committee of the Universidade Federal de São João del-Rei, CAAE 32787614.9.0000.5545.

## Results

Our study included 71 participants who were students of elementary school. Most of them (50.7%) were girls and were 8 years old (38.0%). Results of our study showed improvement in students' knowledge about prevention of overweight and obesity and about eating habits after use of the educational software. In the second stage of the study, we observed a higher percentage of students recognizing as a healthy habit eating 3 meals a day (50.7%) (Table 1). In addition, more students recognized that daily consumption of soft drinks (94.4%), filled biscuits (99.0%), candy (90.1%), chocolate (94.4%), cookies (78.9%), and snacks (94.4%) is not a healthy eating habit (Table 1). We also identified an increase in the number of students recognizing that boiling the food is healthier than other methods of food preparation (80.3%) (Table 2).

In the second stage of the study, there was a significant increase in the number of first grade school students first grade school students identifying playing videogames (81.7%), watching TV (84.5%) and playing on the computer (80.3%)

as practices that do not involve healthy physical activity. Another significant finding was that individuals recognized that riding a bike (90.1%) and playing soccer (80.3%) are healthy activities (Table 3).

Some information provided by students was correct in the first stage, for example, the daily consumption of rice, corn, bread and water. This knowledge remained correct after the intervention. Therefore, we did not consider this information to be significant in the statistical analysis.

**Table 1.** Knowledge of first grade school students on daily consumption of food, before and after the intervention, Divinópolis, MG, 2014. n=71

Variable	Before	After	p-value
Meals per day			
1	21 (19.6)	2 (2.8)	0.006*
2	13 (18.3)	14 (19.7)	
3	25 (35.2)	36 (50.7)	
4 or more	12 (16.9)	19 (26.8)	
Snacks per day			
Once a day	29 (40.8)	14 (19.7)	0.092†
Twice a day	29 (40.8)	37 (52.1)	
Three times a day	8 (11.3)	14 (19.7)	
Four or more times a day	5 (7.0)	6 (8.5)	
Daily consumption of soft drink			
Yes	21 (29.6)	4 (5.6)	<0.001
No	50 (70.4)	67 (94.4)	
Daily consumption of filled biscuit			
Yes	16 (22.5)	5 (7.0)	0.0031
No	55 (77.5)	66 (93.0)	
Daily consumption of candy			
Yes	14 (19.7)	7 (9.9)	0.0421
No	57 (80.3)	64 (90.1)	
Daily consumption of chocolate			
Yes	24 (33.8)	4 (5.6)	<0.001
No	47 (66.2)	67 (94.4)	
Daily consumptions of pasta			
Yes	33 (46.5)	46 (64.8)	0.0091
No	38 (53.5)	25 (35.2)	
Daily consumption of snacks			
Yes	21 (29.6)	4 (5.6)	<0.001
No	50 (70.4)	67 (94.4)	
Daily consumption of leaf vegetables			
Yes	62 (87.3)	69 (97.2)	0.0181
No	9 (12.7)	2 (2.8)	
Daily consumption of vegetables			
Yes	60 (84.5)	67 (94.4)	0.0351
No	11 (15.5)	4 (5.6)	
Daily consumption of fruits			
Yes	70 (98.6)	68 (95.8)	0.2501
No	1 (1.4)	3 (4.2)	
Daily intake of water			
Yes	62 (87.3)	67 (94.4)	0.0701
No	9 (12.7)	4 (5.6)	

(\*) Mc Nemar; (†) Mc Nemar-Bowker

**Table 2.** Knowledge of first grade school students about preparing food, before and after the intervention, Divinópolis, MG, 2014. n=71

Best way for preparing food	Before	After	p-value
Frying			
Yes	8 (11.3)	6 (8.5)	0.1931
No	63 (88.7)	65 (91.5)	
Boiling			
Yes	42 (59.2)	57 (80.3)	0.0021*
No	29 (40.8)	14 (19.7)	
Roasting			
Yes	21 (29.6)	8 (11.3)	0.0041†
No	50 (70.4)	63 (88.7)	
Saltier			
Yes	6 (8.5)	3 (4.2)	0.1561
No	64 (90.1)	68 (95.8)	
Less salty			
Yes	65 (91.5)	68 (95.8)	0.1561
No	6 (8.5)	3 (4.2)	

(†)Mc Nemar Bowker

**Table 3.** Knowledge of first grade school students on exercise, before and after the intervention, Divinópolis, MG, 2014. n=71

Activity considered healthy	Before	After	p-value
Play videogame			
Yes	28 (39.4)	13 (18.3)	0.002*
No	43 (60.6)	58 (81.7)	
Ride a bike			
Yes	54 (76.1)	64 (90.1)	0.012*
No	17 (23.9)	7 (9.9)	
Play soccer			
Yes	40 (56.3)	57 (80.3)	<0.001*
No	31 (43.7)	14 (19.7)	
Watch TV			
Yes	29 (40.8)	11 (15.5)	0.001*
No	42 (59.2)	60 (84.5)	
Play on the computer			
Yes	40 (56.3)	14 (19.7)	<0.001*
No	31 (43.7)	57 (80.3)	

(\*) Mc Nemar

## Discussion

This study showed that educational software was helpful in building and re-elaborating students' knowledge of first grade school students healthy eating habits. Our study corroborates recent research showing that educational software

contributes to learning through visual resources that promote better assimilation of the content.<sup>20</sup> In fact, this type of approach has been highlighted as providing access to first grade school students to information about healthy eating and favors acquisition of knowledge about the subject.<sup>21</sup> Direct use and supervised use of videogames



have been noted as efficient methods to improve cognitive and perceptive skills; in addition, educational games are a beneficial experience to users.<sup>22</sup> Another study used a digital educational game with students in the first year of middle school and showed that this pedagogical strategy generated a great stimulus for learning in the Portuguese language and other disciplines.<sup>8</sup>

In the first stage of the study, most participants considered as healthy the daily consumption of soft drinks, filled biscuits, candy, chocolate, cookies, and snacks. A similar study carried out with adolescents based on the Ten Steps to Healthy Eating for Children showed that participants did not adhere to recommendations to avoid consumption of soft drinks, processed juice and candy.<sup>23</sup> These findings show that strategies that lead to reflection about unhealthy food are important to promote adequate eating behavior. Another study using the same Ten Steps, which was a randomized clinical trial, showed changes in eating habits and in the health status of children.<sup>24</sup> In this sense, a different study pointed out the relevance of educational actions among children to promote acquisition of adequate eating habits, and, therefore, to reduce costs of disease and hospital admissions and improve quality of life among children.<sup>25</sup> It is important to discuss this subject not only with children but also with those responsible for preparing food for them. Another study evaluated the impact of training cafeteria owners about healthy eating and observed an improvement in the type of snacks and meals offered to children after the educational intervention.<sup>26</sup>

Our study is also relevant because it improved knowledge about the importance of exercise. A systematic literature review identified a reduction of body mass index after participation in physical activity by first grade school students.<sup>27</sup> Similarly, the knowledge about how to prepare food improved after educational intervention proposed in the study, mainly because in the second stage of the investigation children believed boiling is the healthier way to prepare food. This is a relevant result because food preparation involves issues

related to culture, which is difficult to manage, as highlighted in a study about nutritional problems.<sup>28</sup> It is important to reinforce the benefits of interactive methods for health promotion and disease prevention. Such methods overcome teaching traditional methods and seek to widen children's previous knowledge and produce new meanings.<sup>29</sup> Another study reported that healthy eating habit projects must have multiple approaches and should be continuous; they also require interactive methods for knowledge building.<sup>30</sup>

We conclude that the use of educational software improved the knowledge of first grade school students on prevention of overweight and obesity. In addition, we highlight the importance of educational actions including the knowledge of first grade school students focused on healthy food aiming to prevent overweight and obesity. The software enabled reinforcement of the building of previous knowledge about adequate healthy eating and rebuilding of this knowledge from the scientific information provided. Therefore, the continued use of software applications to maintain knowledge is essential for the healthy behavior of first grade school students.

A limitation of this study is the short-term application of the educational software in the school. Effective change in behavior requires the intervention to be continuous, an approach that was not possible in our investigation. Further studies are required to evaluate the improvement of children's knowledge about healthy food and their related behavior. Our study results support the importance of educational interactive activities in childhood and indicate that educational software is a relevant tool for nursing practice regarding nutritional education of first grade school students.

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