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Technology-based intervention for healthy lifestyle promotion in Italian adolescents

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Abstract

Introduction. Healthy lifestyle promotion programs are essential to prevent metabolic diseases such as obesity and diabetes. Adolescents could represent the ideal target population especially using serious web games.

Objective. To test the improvement of knowledge about healthy nutrition in adolescents and to analyze participants' enjoyment in playing the web game "Gustavo in Gnam's Planet" in comparison with a leisure web game.

Subjects and Methods. Sixty-five adolescents were engaged in three supervised group sessions. Measures about healthy food knowledge and games' enjoyment were collected during the three stages of assessment.

Results. After playing Gustavo in Gnam's Planet, participants significantly improved their knowledge on a healthy diet, compared to the recreational web games; whereas the level of fun experienced while playing the recreational and the educational games was not significantly different.

Conclusions. Gustavo in Gnam's Planet is an important promising tool, with entertainment property, to promote a healthy lifestyle in Italian adolescents.

Key words

- healthy lifestyle promotion
- serious game
- nutrition-related knowledge
- preventable diseases

INTRODUCTION

Healthy lifestyles include a series of potential modifiable behaviors that can prevent a wide range of diseases [1]. The promotion of a healthy lifestyle is an issue of social, health and economic relevance. However, motivational issues, as well as the lack of time to participate in health promotion programs and the interventions' low reach into the target group, often represent obstacles to the adoption and maintenance of a healthy lifestyle [2, 3].

On the one hand, traditional forms of electronic media, such as TV and radio, have been shown to encourage awareness behaviors related to health issues [4]. On the other hand, other types of media, such as computer or videogames, may be more effective in producing improvement and awareness of healthy lifestyle importance in that they encourage active engagement, processing of information and learning by fun. Moreover, computer and videogame interventions have been successfully designed to overcome impediments to the adoption and maintenance of a healthy lifestyle.

A survey conducted in 2012 [5], on a sample of 1319 Italian online population (16-64 years old), demonstrated that 41% of the respondents had played a game in the past 12 months (52% male). Online represented the favorite kind (82%), and computer (laptops and PCs) represented the most-used device to play games (from about 34% of sample).

Some 23% of the online population considered interesting to play a game, of which the 31% perceived gaming as a fun activity, 22% as an entertainment and 21% as an evasion tool.

Given their widespread use and interactive capabilities, computer and videogames are becoming a popular component of a broader integrative approach to promote health interventions and to manage chronic medical diseases (*e.g.* obesity and diabetes) in adolescents. Results from the American 2009-2010 NHANES indicate that almost 17% of children and adolescents are obese and therefore at greater risk of developing diabetes [6].

It implies higher health care costs, and the necessity

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to explore health strategies to prevent and reduce these conditions.

Since video gaming is a common pastime among adolescents, serious video games offer promise of innovative channels for effective healthy lifestyle promotion programs [1], and youth are the ideal target population for the prevention of metabolic diseases. However, little research has been done on the efficacy of technology-based intervention, especially on their effect on health or safety behavior [4]. In a recent systematic review [7], the main result was that computer-based interventions were effective to increase fruit and vegetable consumption among children.

Most health-related video games have some positive outcome. Previous international studies showed that a behaviorally targeted videogame can produce significant improvements in nutritional knowledge and dietary habits [8-11].

Gustavo in Gnam's Planet is a web game designed to prevent obesity and type 2 diabetes among Italian adolescents. It was developed by a multidisciplinary team based on an integrative approach of effective constructs of behavioral change theories (*e.g.,* transtheoretical model of change, social cognitive theory, self-determination theory and elaboration likelihood model). A detailed description of the web game appears in our previous study [11]. Results of the pilot study showed that, by playing Gustavo in Gnam's Planet, the participants have acquired specific nutritional notions of the Mediterranean diet [11]. Since the effects of the web game were not compared with a non-educational game, it could be that the change obtained in knowledge content was a result of the assessment measure focused on the fact that participants believe 22 kinds of food should be recommended in a healthy diet. Moreover, educational research also needs to address the question of whether the chosen features are perceived as fun [3]. As shown in a recent meta-analysis on serious games for health promotion, game enjoyment matters because it is significantly related to game effectiveness [12].

The aims of the current research were to: 1) test the improvement of knowledge about healthy nutrition in adolescents aged 17-21 years playing the web game Gustavo in Gnam's Planet in comparison with a recreational free web game; 2) analyze the participants' enjoyment in playing Gustavo in Gnam's Planet compared to a pure recreational game. Our hypotheses were that: the exposure to Gustavo in Gnam's Planet could increase the knowledge of adolescents about a healthy diet, while the leisure web game could not; the participants' enjoyment in playing Gustavo in Gnam's Planet did not differ from that experienced in playing the recreational game.

MATERIALS AND METHODS

Participants and procedures

During a meeting with an expert in nutrition and metabolic diseases, eighty-nine adolescents, attending high school in Chieti, Italy, were asked to join the research. After the informed consent was orally obtained from students and their parents, 78 enrolled the study. Overall 65 participants (95.4% females) ranged from 17 to 21 years (mean age 17.8 ± 0.7 years) finished the study and their data were used for analyses. The sample involved more girls than boys due to gender distribution in school. Participants were provided with personal credentials to access the reserved web area, where they could find all the contents of the research.

The questionnaires for T0, T1 and T2 evaluations were delivered through LimeSurvey, an open source tool for online surveys. The reserved Web area displayed the instructions of the research, the links to LimeSurvey's pages for the three stages of the assessment, and the links to the web pages of the two web games Angry Birds Halloween and Gustavo in Gnam's Planet.

Each adolescent participated in 3 group sessions at school to perform all the activities under the supervision of two research members. During session one (T0), the participants first filled out the baseline measures and then played with Angry Birds Halloween for the remaining time. One week later, session 2 (T1) was performed. During this session the participants filled out for the second time all the measures filled in the first session. After that, they played with Gustavo in Gnam's Planet. One week later, the last session (T2) was performed, in which participants accomplished only the measurement task.

Measures

Basic demographic data (age and gender) were collected.

The healthy food knowledge questionnaire was developed and used for a previous study [11] to evaluate the participants' knowledge about healthy foods. For 22 kinds of food the participants were asked to indicate, on a 5-point Likert-type scale ranging from "disagree" (0) to "agree" (4), the level they believe each food should be recommended in a healthy diet. The scale provides a total score, ranging from 0 to 88, with a higher score indicating greater knowledge about healthy foods. The measure demonstrated a good reliability (alpha =.83).

Fun question. The question "I enjoyed playing this game"' was used to evaluate the level of fun experienced by the participants while playing the leisure game (Angry Birds Halloween) and the educational game (Gustavo in Gnam's Planet). The respondents answered on a 5-point Likert-type scale ranging from disagree (0) to agree (4).

Statistical analysis

Data were collected for pretest and posttest in 2014. Data of participants completed all the stages (from T0 to T2) of the study were used for analyses (n = 65). The study used a repeated measure design.

The results are shown as mean ± standard deviation unless otherwise stated. The primary efficacy variable was absolute change in knowledge on healthy diet score. A one-way (3 x 1) repeated measure ANOVA was conducted to test differences at T0, T1, T2 for knowledge on healthy diet. Post-hoc comparisons were made to determine the significance of pairwise contrasts, using the Bonferroni correction. Second, to test whether Gustavo in Gnam's Planet almost looks fun as a recreational web game (*i.e.* Angry Birds Halloween) the Wilcoxon signed-rank test was used to compare level of fun

declared by participants at T1 and T2. A P-value < 0.05 was the criterion for statistical significance. Statistical analysis was carried out with SPSS statistical package version 19.0 (SPSS, Inc., Chicago, IL).

RESULTS

Information about the effectiveness of the web-game Gustavo in Gnam's Planet to improve knowledge on a healthy diet was tested. Knowledge improvement was tested through an analysis of variance (ANOVA) for repeated measures. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2) = 7.37$, $p < 0.05$, therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.90$).

The repeated measures ANOVA with the Greenhouse-Geisser correction determined that mean knowledge on healthy diet differed statistically significantly between time points [$F(1.80, 115.26) = 10.08$, $p < 0.001$]. Post hoc tests using the Bonferroni correction revealed that Angry Birds Halloween elicited a slight reduction in knowledge on healthy diet from T0 to T1, which was not statistically significant ($p = 0.46$). However, playing with Gustavo in Gnams Planet (T2) resulted in higher level of knowledge on healthy diet, which was statistically significantly different to T0 ($p < 0.05$) and T1 ($p < 0.01$). Therefore, we can conclude that level of knowledge on healthy food was affected by the type of game played. After having played Gustavo in Gnam's Planet, the participants significantly improved their knowledge on a healthy diet, instead Angry Birds Halloween failed to improve it (*Table 1*).

Since fun is an important factor affecting the efficacy of health games, the Wilcoxon signed-rank test was used to test whether Gustavo in Gnam's Planet looks fun as a recreational web game (*i.e.* Angry Birds Halloween). As expected, the level of fun experienced and reported by the participants in the two times of assessment (T1 and T2) after playing the recreational and the educational games (*Table 1*) does not significantly differ, $z = -0.11$, $p = 0.91$. This means that the participants declared the same level of fun in playing both Gustavo in Gnam's Planet and Angry Birds Halloween. This is an important result since Gustavo in Gnam's Planet was developed for educational purposes, taking into account studies suggesting the importance of fun experience to improve the effectiveness of non-commercial health videogames [12].

DISCUSSION

Over the last decades, the increase in the consumption of foods that are energy-dense yet low in nutritional value, as well as the strong reduction of regular exercise, has contributed to the global spread of overweight and obesity. Weight excess is a risk for multiple chronic diseases (Non Communicable Diseases, NCDs), like diabetes, hypertension, cardiovascular disease that affect the patient's quality of life and life expectancy. It is well accepted that many cases of NCDs are preventable thanks to healthy lifestyle choices. For this reason, healthy lifestyles intervention programs are important issues for public and government services.

Some recent studies, reviews of literature and meta-analyses suggest how school may be the ideal environment for effective preventive actions [13-15]. These studies have shown that computer based interventions result in fruit and vegetables consumption increase [7]. It is also known that several and essential components are required to undertake preventive, efficient and effective actions. At first, the intervention plan should promote behavioral changes through educational programs on the improvement of knowledge. These interventions should increase knowledge and knowhow, which can be only reached through the active involvement of people.

We have designed and developed Gustavo in Gnam's Planet because we firmly believe that, in accordance with data from the recent literature, educational web games can effectively contribute to change the behavior also and above all of that part of population for which prevention is a priority and communication is more difficult.

Adolescents are the ideal target population for prevention of unhealthy habits and promotion of a healthy lifestyle. In order to identify useful tools for prevention purposes, technology-based intervention gained increasing support. Given the fact that video gaming already captures adolescents' attention, why not develop and test games targeted at increasing adolescents' knowledge about healthy lifestyles? In this way, the time adolescents already spend playing video games can be simultaneously used for health behavior education.

Our long-term goal is to validate, by using our web game, an innovative educational methodology able to overcome difficulties and pitfalls of an ineffective communication (verbal or nonverbal) about healthy lifestyles and nutrition.

In our knowledge, Gustavo in Gnam's Planet is the first web game developed in Italy to promote a healthy lifestyle among adolescents through improving nutritional knowledge. This study was designed to answer two research questions regarding technology-based intervention for prevention purposes. The first question

Table 1
Results of the stages of assessment on healthy food knowledge and fun

	T0[a]		T1[a]		T2[a]	
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**
Healthy food knowledge	72.38	6.77	71.41	6.61	74.24	6.57
Fun	–	–	2.00[b]	–	2.00[b]	–

[a]T0 is the baseline session; T1 is the stage of assessment after Angry Birds Halloween playing; T2 is the stage of assessment after Gustavo in Gnam's Planet playing.
[b]This value is the median.
Data were collected in March 2014, in Chieti, Italy

focused on Gustavo in Gnam's Planet's efficacy to improve the participants' nutritional knowledge: will players learn more nutrition content when playing Gustavo rather than Angry Birds Halloween? The answer confirmed our expectancies, since the participants' scores to the healthy knowledge questionnaire significantly increased only after playing Gustavo in Gnam's Planet. This important result confirms the findings of our first evaluation study [11] and provides solidity to its efficacy by controlling that the effect observed was not a consequence of the evaluation process that could activate a reflective process about the nutritional properties of healthy and unhealthy foods.

For the second question regarding the entertainment property of our web game, this data suggest that the participants' level of fun was the same as that experienced while playing a sheer recreational video game. This finding, together with the result about improvement of learning, showed how, compared to an entertainment web game, Gustavo in Gnam's Planet is a fun way to promote a healthy lifestyle among adolescents by teaching nutrition notions.

The main limitation of this study is the prevalence of the female participants involved in the sample. Since recent studies conducted with students of different school grades suggest that females had higher mean nutrition knowledge scores than boys [16-18], this gender bias of the study could potentially limit the generalizability of the results to other types of populations, especially males. However, the results of our previous study demonstrated the efficacy of "Gustavo in Gnam's Planet" to improve the knowledge on healthy diet in a sample of participants with a greater number of males than females.

CONCLUSION

Important issues for health policies and strategies are prevention of chronic and metabolic diseases through effective interventions and their sustainability. The findings of this research suggest how "Gustavo in Gnam's Planet" could be an important useful means and an auspicious tool for prevention programs targeted to Italian adolescents within a multidimensional educational program.

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Conflict of interest statement

None to declare.

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