



Meal-Specific Dietary Changes From *Squires Quest! II*: A Serious Video Game Intervention

Karen W. Cullen, DrPH, RD; Yan Liu, MS; Debbe I. Thompson, PhD

ABSTRACT

Objective: *Squire's Quest! II: Saving the Kingdom of Fivealot*, an online video game, promotes fruit and vegetable (FV) consumption. An evaluation study varied the type of implementation intentions used during the goal-setting process (none, action, coping, or both action and coping plans). Participants who created action plans reported higher FV consumption 6 months after baseline. This study assessed changes by specific meal in that study.

Methods: A total of 400 fourth- and fifth-grade children completed 3 24-hour recalls at baseline and 6 months later. These were averaged to obtain FV intake. Analyses used repeated-measures ANCOVA.

Results: There was a significant group by time effect for vegetables at 6 months ($P = .01$); Action ($P = .01$) and coping ($P = .04$) group participants reported higher vegetable intake at dinner. There were significant increases in fruit intake at breakfast ($P = .009$), lunch ($P = .01$), and snack ($P < .001$).

Conclusions and Implications: Setting meal-specific goals and action or coping plans may enable children to overcome barriers and consume FV.

Key Words: video game, fruit, vegetables, children, implementation intentions (*J Nutr Educ Behav.* 2016;48:326-330.)

Accepted February 10, 2016.

INTRODUCTION

Few children in the US consume the daily recommended amounts of fruits (F) and vegetables (V) (FV)¹: at least 1.5 cups of F and 2.0–2.5 cups of V.² Fruits and vegetables are low in energy density and high in fiber, and may reduce the risk for developing chronic diseases such as cardiovascular disease and certain cancers.^{3,4} Interventions to establish behaviors in childhood are important so that they may track into adulthood.^{5,6-8} However, not all interventions to improve FV intake among children have been successful.⁹⁻¹¹

Serious video games are designed to both entertain and promote behavior change.¹²⁻¹⁴ One serious video game intervention, *Squire's Quest!*

(SQ!), successfully improved total FV intake among children,¹⁵ with significant improvements for F and 100% F juice consumption at snacks and for regular V at lunch.¹⁶ The SQ! intervention sessions included setting meal-specific goals for eating FV, and suggested that goal setting was an important component. However, there was only a weak association among goal setting, goal attainment, and FV consumption.¹⁷

Implementation intentions are detailed plans connected to achieving a specific goal.^{18,19} Action plans identify the specifics of how (ie, what, when, where) the goal will be attained. To create coping plans, children identify common barriers that could interfere with meeting a goal and then identify ways to overcome them.^{18,19}

In *Squire's Quest! II, Saving the Kingdom of Fivealot* (SQ!II), an updated and enhanced version of the original SQ! intervention, implementation intentions were added to the goal-setting procedure.¹⁸ It was hypothesized that creating either action or coping plans would improve children's ability to achieve their goals, and that creating both plans would add assistance to children to attain their goals and maintain them over a longer period.

In each game episode, the children set goals.^{20,21} In 5 episodes, children set specific F or V goals for a specific meal: 1 breakfast, 1 lunch, 1 dinner, and 2 snacks. Children could select the meal for 1 F and 1 V goal in 2 episodes. In the last 3 episodes, the children were to set a personal FV schema for eating 5 FV servings daily, such as 1 F for breakfast, 1 F and 1 V for lunch, 1 F for snack, and 1 V for dinner.

A recent randomized control trial that evaluated SQ!II with fourth- and fifth-grade children and assessed intake at baseline and about 3 and 6 months afterward documented success.²¹ Fruit and vegetable intake was significantly higher at 3 months for the action and coping groups compared with baseline.²¹ Only the action group children maintained

US Department of Agriculture/Agricultural Research Center, Children's Nutrition Research Center, Baylor College of Medicine, Houston, TX

Conflict of Interest Disclosure: The authors' conflict of interest disclosures can be found online with this article on www.jneb.org.

Address for correspondence: Karen W. Cullen, DrPH, RD, USDA/ARS Children's Nutrition Research Center, Baylor College of Medicine, 1100 Bates St, Houston, TX 77030; Phone: (713) 798-6764; Fax: (713) 798-9068; E-mail: kcullen@bcm.edu

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<http://dx.doi.org/10.1016/j.jneb.2016.02.004>

the increase at 6 months. Regardless of the group, there were significantly higher F intakes at both 3 and 6 months compared with baseline.

Because the children completed 24-hour dietary recalls, meal-specific changes could be identified. The objective of this report was to assess whether there were significant meal-specific changes 6 months after baseline for children participating in this intervention.

METHODS

Study Design

The primary study methods and outcomes have been described elsewhere but are briefly summarized here.^{20,21} The outcome evaluation study was a randomized design with 4 groups; the groups were based on the type of implementation intentions used within the goal-setting component in each episode (none, action, coping, and action plus coping). All groups played the same 10-episode online video game and set a goal to eat an FV in each episode. Data were collected at baseline and at about 3 and 6 months after baseline; only data from baseline and 6 months were analyzed in this study. Children were to attain the FV goal before playing the next episode and record goal attainment in the game.

Parents were e-mailed a newsletter for each episode and a link to a parent Web site. The content included information on their child's weekly goals, suggestions for supporting achievement of FV goals, and ways to overcome common barriers to helping their family make healthy food choices.

Sample

Participants were 400 children in the fourth or fifth grade (approximately 9- to 11-year-olds) who spoke English and had a computer and high-speed Internet access. Standard recruitment methods were used, such as flyers distributed to schools and community groups and postings on volunteer Web pages.¹⁸ The study was powered to detect a small effect size (Cohen's $d = 0.17$) of at least at least 0.51 servings^{20,21} in a child's FV intake. This study was approved by the Institutional Review Board at Baylor

College of Medicine, Houston, TX. The researchers obtained written parental consent and child assent.

Measurement

At each data collection period, the children completed 3 unannounced 24-hour dietary recalls (2 weekday and 1 weekend day) conducted via phone by trained staff using Nutrition Data System for Research–2009 (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN).²² As in the primary study, servings of F, but not 100% F juice, and regular V, not high-fat V, were calculated using Nutrient Data System for Research output. Fruit and V intake from each 3-day period were averaged to improve dietary intake estimates. Breakfast, lunch, snack, and dinner intakes were calculated.

Statistical Analysis

Baseline demographic characteristics and FV intake were examined to identify group differences using chi-square analysis and ANOVA for categorical and continuous variables, respectively. Numerical (skewness, kurtosis, and Kolmogorov–Smirnov D) and graphical methods were used for data normality testing. Because the dietary data were skewed (some children consumed no food for some food groups), all selected outcomes variables were log-transformed for analyses. The adjusted means presented in the tables were back-transformed to the original scale. Intervention group, time, and group by time interactions were included in the models.

To evaluate meal-specific changes from baseline to 6 months, a repeated-measures mixed-effects model²³ with a 4-level between-subject factor (group: control, action, coping, and action plus coping) and a 2-level within-subject factor (time: baseline and 6 months) was used. Subjects were treated as random effects, and group, measurement time (baseline and 6 months), and group by time interactions as fixed effects. Restricted maximum likelihood and weighted least-squares estimated variance components and fixed effects, respectively. All mixed-effects models were adjusted for child gender, race/ethnicity, total energy intake, parent

age, and household education. *Post hoc* analyses were conducted for each meal occasion. All statistical analyses were conducted with Statistical Analysis Software (version 9.3, SAS Institute Inc., Cary, NC, 2012). Significance was set at $P < .05$.

RESULTS

Baseline Characteristics

Participating children were diverse (white, 36.8%; Hispanic, 27.4%; African American, 26.4%); 52.7% were female. Most parents were female (96.3%), married (77.5%), and aged 40–59 years (55.3%), with an average household income of $> \$61,000$ (57.6%). A total of 387 children had complete data. There were no group differences in baseline demographic characteristics or FV intake.

Fruit and Vegetable Intake

At baseline, children consumed a daily average of 0.63 servings of F and 1.13 servings of V regardless of group.²¹ There was a significant intervention group by time interaction effect for V ($P = .01$); the relationship for V intake between the 2 time points differed based on group. Action ($P = .01$) and coping ($P = .05$) group participants reported higher V intake at dinner at 6 months than at baseline (Table). In the overall models, there were significant increases over time for F intake at breakfast ($P = .009$), lunch ($P = .014$), and snack ($P < .001$) at 6 months.

DISCUSSION

This study examined longitudinal changes in FV intake by specific meal after children played a 10-episode serious video game that systematically varied implementation intentions during goal setting. In the primary study, the only significant intervention interaction effect at 6 months was a 0.68-serving increase in total FV intake for the action group.²¹ However, there were overall significant time effects for F intake alone.²¹ In this current analysis of meal-specific changes, there were significant increases of 32% (1.5 tablespoons) and 18% (1.2 tablespoons) in dinner V intake for the action and coping

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