

# Acceptability and Applicability of an American Health Videogame with Story for Childhood Obesity Prevention Among Hong Kong Chinese Children

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## Abstract

**Objective:** Positive changes in diet have been observed in research carried out in the United States from the use of “Escape from Diab” (Diab), a health videogame designed to lower the risk of obesity and type 2 diabetes. Whether the American story and characters in Diab might be perceived by Hong Kong Chinese children as interesting has not been explored. This study assessed the acceptability and applicability of Diab among Hong Kong Chinese children, whether the Diab story was understood by them, and whether it had potential to influence them both during the game and afterward.

**Subjects and Methods:** Thirty-four students (21 males, 13 females) 9–12 years of age were included. Upon completion of all the Diab episodes, children completed an immersion scale with 18 items, as well as an individual interview with 10 open-ended questions.

**Results:** Children achieved average immersion after playing Diab with the mean score at 39.1 (standard deviation=9.0), higher than the median (36) of possible scores (range, 18–54). Four themes using framework analysis emerged from the interviews, including intuitive feelings about the interface, playing experience, perception of the effect of Diab on behavior change, and the applicability of Diab to Hong Kong children. The story and game developed for American children were found acceptable and applicable to Hong Kong Chinese children.

**Conclusions:** The combination of quantitative and qualitative methods confirmed the acceptability and applicability of Diab to Hong Kong Chinese children.

## Background

OBESITY IS A MAJOR HEALTH PROBLEM in developed and developing countries with many associated comorbidities.<sup>1</sup> Childhood obesity prevalence increased by 182 percent among 2–19-year-old children in the United States between 1971 and 2000.<sup>2</sup> In 2011–2012, 31.2 percent and 16.9 percent of U.S. children 2–19 years of age were overweight or obese, respectively.<sup>3,4</sup> In well-developed urban areas in China, the 2010 overweight rates for children were 32.6 percent for boys and 19.1 percent for girls.<sup>5</sup> Similarly in Hong Kong, childhood overweight increased from 11.2 percent in 1995 to 20.0 percent in 2014.<sup>6</sup>

Obesity is a metabolic disorder characterized by an increase of body fat resulting from energy imbalance with

energy intake exceeding expenditure.<sup>7</sup> Increased consumption of fruit, vegetables, and water had positive results in weight management research.<sup>8,9</sup> Children 5–17 years of age should accumulate at least 60 minutes per day of moderate-to-vigorous physical activity (PA).<sup>10</sup> However, Hong Kong youth consumed insufficient servings of fruit and vegetables,<sup>11,12</sup> and only 8.3 percent of children 7–12 years of age in Hong Kong engaged in the recommended PA levels, suggesting that Hong Kong children may be among the most inactive compared with their international peers.<sup>13</sup> It is therefore imperative to discover strategies that modify Hong Kong children’s dietary and PA behaviors.

Videogames can be effective at capturing a player’s imagination and generating positive emotions by immersing him or her in the game.<sup>14</sup> Videogames increase enjoyment or

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fun through interaction with characters and instant feedback. Serious videogames targeted at enhancing health, called “games for health” (G4Hs), are designed to persuade players to modify their health-related attitudes or behaviors through playing and entertainment.<sup>15</sup> G4Hs have been considered an innovative channel and a fantasy trigger to motivate health behaviors.<sup>16</sup> Growing interest in videogame-based interventions has resulted from some G4Hs increasing children’s PA<sup>17</sup> and healthier dietary behaviors.<sup>18</sup>

Videogames provide interactive channels and immersive qualities. Narrative is the basic feature and universally enjoyed aspect of playing for children.<sup>19</sup> A narrative is defined as “the framework for the sequence of events that make up the plot we see, and the story we imagine.”<sup>20</sup> Transportation is conceived as a convergent process, where all mental systems of players focused on the narrative or stories.<sup>21</sup> To avoid confusion, transportation during videogame playing is called immersion.<sup>22</sup> Story (or “narrative”) immersion refers to the experience of being absorbed in the story. Immersion is a phenomenological experience of people’s engagement with narratives, a process in which people travel into a story world and are changed by the journey.<sup>23</sup> Immersion is an attraction of games for players and has been hypothesized to be an important attribute that links videogame interactivity with enjoyment. Story immersion can influence a player’s cognition, affect, attitude and, potentially, health behavior.<sup>21</sup> Well-crafted narratives embedded within a G4H may be especially suitable for health behavior change, as players may experience psychological immersion while being fully engaged in games, thereby paying close attention to embedded messages and closely following behavior change procedures.

“Escape from Diab” (Diab) is a G4H with an embedded story designed to lower the risk of obesity and type 2 diabetes by changing children’s diet and PA behaviors. Positive changes in psychological and behavioral indicators (i.e., fruit and vegetable preference, fruit and vegetable self-efficacy, and PA self-efficacy) were detected using Diab in research in the United States.<sup>22</sup> However, there has been a lack of videogame-based obesity prevention research among Hong Kong primary school children. Given obvious cultural differences, it was unclear how Hong Kong Chinese children would perceive Diab. This study assessed the acceptability and applicability of Diab and whether it might influence Hong Kong Chinese children’s diet and PA behaviors both during and after playing it.

## Subjects and Methods

### G4H: “Diab”

The design of Diab was predicated on the integration of social cognitive,<sup>24</sup> self-determination,<sup>25</sup> and persuasion<sup>15</sup> theories. Diab combined (1) knowledge games about diet and PA (e.g., “What is a vegetable?”, “Which are aerobic activities?”, “How to balance calories of food consumption with energy expenditure?”), (2) goal setting activities (at the end of each episode, setting personalized goals on subsequent behavior changes tailored to their current status with multiple steps consisting of selecting value and reason statements, goals and days, summary display of goal and reasons, behavior inoculation, and anticipatory problem solving including solution selection), and (3) motivational statements

to inspire children’s behavior modification toward goal-related lifestyle change.

Diab is a G4H inside a three-dimensional setting. The game has nine episodes telling the story of DeeJay, an athletic, healthy, modern-day youth who accidentally falls through the floor of an abandoned building. He awakens in the dark land of Diab governed by evil King Etes. In this land, fruit, vegetables, and PA are forbidden, which make the population less fit and thereby more malleable. Upon his arrival, DeeJay is captured by the King’s guards but is rescued by new friends. Together they plot their escape from Diab. To enhance the personal fitness for the arduous task, DeeJay guides his new friends to eat more healthily (more fruit, vegetables, and water) and to engage in more PA. Players perform behavior change activities as part of the game’s storyline. There are alternative game endings (the player escaping or not), which are dependent on the player’s personal decisions related to behavior change choices throughout the game.

## Research design

Quantitative and qualitative methods (survey and individual interviews) were used to assess Chinese children’s perception of the storyline and the content delivered by Diab. Upon completion of the nine episodes, children were required to complete a 18-item immersion scale adapted from the narrative transportation scale,<sup>23</sup> which demonstrated good internal consistency ( $\alpha=0.89$ ). Participants rated their levels of agreement with statements (e.g., “I can easily imagine the things that happened in “Diab.” “At least one of the Diab characters reminds me of myself,” “I felt like I was part of the action in “Diab”) on a 3-point Likert scale (1 = do not agree; 2 = somewhat agree; 3 = agree a lot). The score was summed after reverse recoding selective items. Possible scores ranged from 18 to 54. To explore the levels of difficulty and preference children perceived from Diab, two single questions with a 10-point scale were used to assess how difficult they considered Diab (from 0 = very easy to 10 = very difficult) and how much they liked the game (from 0 = not like at all to 10 = very much liked).

Individual interviews were then conducted to assess participants’ attitudes about playing the game. Four independent dimensions (amount, content, form, and mechanism) should be considered when studying the effects of videogame playing.<sup>26</sup> Amount refers to the amount of time spent playing the game. Content focuses on the message, topic, and story of the videogame. Form is the type of activity performed in the game. Mechanism is the methods of interface with the game. Based on these dimensions, the research team developed an interview protocol using commonly accepted methods<sup>27</sup> comprising 10 open-ended questions with follow-up prompts and probes (Table 1). Individual semistructured interviews were conducted in person in Cantonese or Mandarin, either by the primary author or a trained research assistant (S.C. Kwan), upon completion of all Diab episodes in computer rooms of participating schools. Interviews were audiotaped and lasted approximately 10–15 minutes.

### Participants

Participants were recruited from four primary schools in two Hong Kong districts, which had varied student social

TABLE 1. INTERVIEW QUESTIONS

1. How long did you spend playing each episode? Was there anything about playing Diab that made you uncomfortable? If yes, what made you feel uncomfortable?
2. Did you have difficulty with the English language of the videogame?  
What percentage of English could you understand?
3. What did you think of the characters in the videogame?
4. Please tell me how much you liked the game. If the possible score was from 0 (did not like at all) to 10 (liked a lot), what score would you give this videogame?
  - Please tell me what you liked about the videogame.
  - Please tell me what you did not like about the videogame.
5. Please tell me how difficult you thought the game was. If the possible score was from 0 (very easy) to 10 (very difficult), what score would you give for difficulty level of the game?
  - Please tell me which episode was the easiest.
  - Please tell me which episode was the most difficult.
6. What diet and PA goals did you set while playing the game?
  - Did you meet the goals you set when playing?
  - Please tell me why you did or did not meet the goals?
7. Did you learn about fruit, vegetables, water, and PA? Did what you learned help you make healthier changes in your diet and PA behaviors?
8. What do you think about the dietary and PA behaviors in Hong Kong children?  
Were the environments in Diab similar to those in Hong Kong, including foods and exercise habits in the game?
9. Do you think Diab is suitable for Hong Kong children? Would you recommend the videogame to your friends?
10. Is there anything else you want to tell me about the game that we did not talk about?

Diab, "Escape from Diabetes"; PA, physical activity.

economic backgrounds. A total of 34 students (21 males, 13 females) in grades 4–6, from 9 to 12 years of age (9 years,  $n=4$ ; 10 years,  $n=8$ ; 11 years,  $n=21$ ; 12 years,  $n=1$ ), returned written informed consent and were included in the study. All participants received prior medical clearance to ensure there were no physical, psychological, sensory, or genetic limitations. Children's height and weight were measured before the study with a FISCO measuring tape (CMS Weighting Equipment Ltd., London, United Kingdom) and Tanita electronic digital scale (model HD305; Tanita Inc., Tokyo, Japan) complying with standard anthropometric methods.<sup>28</sup> Height was measured to the nearest 0.1 cm, and weight was measured to the nearest 0.1 kg. Body mass index was calculated as weight (in kg) divided by height squared ( $m^2$ ). The body mass index of the participating children ranged from 14.11 to 29.31  $kg/m^2$  with a mean value of 18.87  $kg/m^2$ . According to the international body mass index cutoff points for childhood overweight and obesity,<sup>29</sup> of the 34 participants, 24 were normal weight, 8 were overweight, and 2 were obese. The study was approved by the Hong

Kong Baptist University Committee on the Use of Human and Animal Subjects in Teaching and Research.

*Procedures*

Based on the schedules of the four schools, the gameplay sessions were arranged during morning sessions before classes or afternoon sessions after school, which lasted between 4 and 6 weeks. Two sessions were offered each week, and each session lasted 40–60 minutes. Prior to the study, Diab was installed in the multimedia classroom computers and tested. Each participant conducted the game sessions on an individual computer in the school's multimedia classroom. During each session, children were asked to play one episode. If the student had time remaining in the session, the player could return to the current or previous episode and replay the minigames. However, players could not move on to the following episode until the next game session. Translated subtitles were available to any children who had language difficulties during playing. One researcher was present to monitor children's progress and to solve minor hardware or software problems during the session. Upon completion of the nine episodes, the survey and individual interview were conducted to collect children's perception of Diab.

*Data analyses*

Cronbach's alpha of internal consistency was calculated on the 18-item immersion scale. Means and standard deviation (SD) were calculated to describe the distribution of immersion scores. All interviews were transcribed verbatim and checked carefully for accuracy with reference to the original audiotapes. A framework approach, a widely used and well-developed method for analyzing qualitative data,<sup>30</sup> was used to analyze individual interviews. Framework analysis<sup>31</sup> provides distinct, but highly interconnected, stages of systematic and transparent data analysis, enabling researchers to work through and understand qualitative data.<sup>32</sup> Framework analysis suits research with predesigned samples, specific topics, a limited time frame, and *a priori* issues. The five key stages of this technique are summarized in Table 2.

TABLE 2. THE FIVE STAGES OF FRAMEWORK ANALYSIS

1. Familiarization	Sorting audio and written data, sifting through the transcripts
2. Theme identification	Searching for patterns and similar words, identifying key issues
3. Indexing	Extracting specific comments and forming a thematic framework applicable to the data
4. Charting	Rearranging the data and lifting the data from the original context according to the extracted thematic reference
5. Mapping and interpretation	Synthesizing the content of each theme, reviewing research notes, comparing perceptions, accounts, and experiences for different patterns, and explaining the meaning

## Results

All 34 children completed the game, and 32 provided complete immersion questionnaire data ( $\alpha=0.91$ ). Immersion scores ranged widely, from 20 to 51, and were normally distributed ( $P=0.20$  for the Kolmogorov–Smirnov test). Mean score was 39.1 ( $SD=9.0$ ), which was higher than the median (36) of possible scores (range, 18–54). Skewness ( $-0.076$ ) and kurtosis ( $-0.576$ ) were lower than the absolute value of 1.0. Children achieved above a median amount of immersion in Diab.

Four themes emerged from interview data, including intuitive feelings about the interface, playing experience, perception of the effect of Diab on behavior change, and the applicability of Diab for Hong Kong children.

### *Intuitive feelings about the interface*

Children spent from 25 to 60 minutes on each episode. Although 30 children reported nothing made them uncomfortable during playing Diab, 3 children reported slightly uncomfortable feelings:

Actually, I felt a bit dizzy when I was playing the game. But this feeling did not exist in all the episodes, just one or two sessions. I think it may be related to the 3-D [three-dimensional] image. I may not be used to screen. (10-year-old boy)

Sometimes, my ears hurt after playing. It was due to the tight earphone. The sounds were a bit terrible if failed to complete the task. (11-year-old boy)

I was tired when I was playing the difficult episode, such as the second one. Um, I am a girl, and I needed to spend more time on these episodes. The long time staring at the screen made my eyes tired. (10-year-old girl)

Due to varying levels of English proficiency, participants could understand from 20 percent to 90 percent of the language. Twenty-two children (64.7 percent) reported they could understand 70 percent or more of the content, 8 children (23.5 percent) could understand 40–70 percent, and 4 children (11.8 percent) could understand only 20–40 percent. Two children asked for translated subtitles:

I am a 4th-grade student. I don't know some of the vocabulary about fruit and vegetables. Well, the pictures beside could give me some remind, and I may guess what they are. So even I only understood 50 percent of language, I don't think it is a barrier for me to play the game. (9-year-old girl)

I am so shy to say that I could not understand the English well even I am Grade 6 now. I had the bad performance in English

test. The translation and subtitle the teacher provided helped me a lot on the comprehension. (11-year-old boy)

The game's character design was generally considered vivid and fun. Participants considered it easy to distinguish good from bad characters. For example, the antagonists (the King and his minions) were crafty and evil, and due to their unhealthy lifestyles, both the king and guards were overweight and obese, which meant their actions were clumsy. DeeJay and his friends were resourceful, brave, and full of team spirit and had generally healthy body shapes:

These young people are very smart and healthy. They would like to try to solve the problems. The good and bad persons are similar to the real world. But ... I just think the girl in purple clothes (named "Mayza") had little hair and designer should give her more hair to make her beautiful. (10-year-old girl)

Um ... I don't like the appearance they look. They are ugly. But to be sure, I quite like their characters. (11-year-old girl)

### *Diab playing experiences*

Table 3 presents the distributions of children's scores by gender for how difficult they considered Diab (from 0 = very easy to 10 = very difficult) and how much they liked the game (from 0 = not like at all to 10 = very much liked). More than half the children (19 of 34) considered Diab to have moderate difficulty, with scores ranging from 4 to 6. Comments on difficulty indicated both playability and challenge. Ten children scored it 7 or higher for difficulty. Five children scored it 3 or lower. The first episode (involving picking up fruit and vegetables while crossing the road) was considered the easiest. The most difficult episodes were reported those involving escaping while being chased by the King and making balanced snacks, breakfasts, lunches, and dinners:

You know, I can accept the game well because it was neither too easy to lose my interest nor too difficult to dampen my initiative. I spent too much time on making balance on the dinner. If any diet component was too much or too little, the plan could not be passed. But this method helped me learn a lot on how to balance my own meal. (10-year-old boy)

The overwhelming majority of children (29 out of 34) stated they liked the game with a score equal to or greater than 7. The game was considered fun, challenging, and enjoyable. However, issues surrounding playing stations and game controllers made them wait too long to restart the game when there were issues with the game freezing:

TABLE 3. THE DISTRIBUTION OF SCORES THAT CHILDREN MARKED FOR "ESCAPE FROM DIABETES"

	Score									
	1	2	3	4	5	6	7	8	9	10
How difficult did you think the game was? (from 0 = very easy to 10 = very difficult)										
Male	3	1		1	8	2	4	1		1
Female			1	1	4	3	3	1		
Total	3	1	1	2	12	5	7	2		1
How much did you like the game? (from 0 = not like at all to 10 = very much liked)										
Male			1		1		5	8	4	2
Female					2	1	4	3	2	1
Total			1		3	1	9	11	6	3

I liked the game very much. But, I think, the background music was a bit boring. (11-year-old girl)

Um, the game controller did not work sometimes. (11-year-old girl)

#### *Participants' perception about the effect of Diab on behavior change*

Goal setting followed the end of each episode and was integrated into the game to help children change their own lifestyles. However, only 15 students set goals for each episode, and 6 students set partial goals. The remaining participants did not engage in the goal setting seriously as they wanted to complete the episode as quickly as possible. Due to the limited time arranged for playing after school, some children had no time to set goals:

I have set the goals for each episode. I think I meet the goals with the help of my parents. (11-year-old girl)

I did not conduct goal setting carefully since I want to pass the episode quickly. Also, I do not think it is necessary to set the goals each episode because my dietary and PA habits are healthy now. (11-year-old girl)

All children agreed that Diab was an appropriate, innovative, and helpful way to deliver knowledge about fruit, vegetables, and water intake, as well as PA engagement. The information they received could potentially motivate them to modify their health behaviors, although four participants expressed uncertainty as to the long-term effects of Diab on behavioral modification:

Definitely, I got much new knowledge from the game. If I am taught the knowledge through the lecture, I may forget them soon. But this time, I learn them through play and practice. All are impressive and helpful for my daily life. (9-year-old girl)

Um, to be sure, after playing the Diab I have learnt the knowledge which I didn't know before. During these days, I remembered to change my behaviors and try to intake more fruit and water. But I have no idea if the change could be lasted too long without the motivation from game. (11-year-old girl)

I just think the video has more effects on dietary than that on PA, because the real PA activities are better than PA education from the video. (12-year-old boy)

#### *Applicability of Diab to Hong Kong children*

Of the 34 participants, 20 indicated the game was similar to Hong Kong in terms of the availability of snacks, distribution of stores, and the physique of Hong Kong people. Several children expressed that there were environmental differences between the game and Hong Kong with regard to buildings and streets. Students pointed out the high-density situation in Hong Kong, as well as the lack of outdoor play space, which may limit children's activity. The majority of children agreed that Hong Kong people eat more high-calorie foods and often have meals in fast food restaurants due to a rapid pace of life. The children also agreed that vegetable intake was insufficient among Hong Kong people. Meanwhile, Hong Kong people are more likely to be inactive because of intense work and study pressure. Nearly all the children agreed that the game was suitable for Hong Kong children and would recommend Diab to their friends. Despite the fact that there were some difficulties in comprehension

due to varying English proficiency, language was not considered a barrier that would affect the dissemination of knowledge and health behavior modification:

There are many stores and restaurants in the game. This is quite similar with traditional areas in Hong Kong, such as Mong Kok, Causeway Bay, etc. (11-year-old boy)

I cannot see Hong Kong people do the PA in the street because the streets here are very crowded. (10-year-old boy)

Yeah, I believe the game help me a lot on how to choose foods and to engage in more PA. And I highly recommend the video to my classmates. I will continue to play the minigames offered in Diab at home. (9-year-old boy)

#### **Discussion**

Videogames are a popular form of entertainment and integrated into the fabric of children's lives, which creates a virtual environment and can make users feel fully immersed in the game and consequently experience a high degree of control, which impacts on their virtual environment.<sup>33</sup> G4Hs in Western countries have influenced psychological mediators or moderators of PA and dietary outcomes.<sup>34</sup> This study is the first to report the acceptability and applicability of a G4H with story immersion among Chinese children. Compared with console gaming, videogames in immersive virtual realities are considered effective because they provide a more realistic experience.<sup>35</sup> Videogames provide an important interaction with players through the characteristics that make the narrative personally relevant.<sup>36</sup> For characters to serve as models for audiences, their perceived similarity and competence are important.<sup>37</sup> Compared with adults, children are more receptive to the story in the game. Children as a group have a rich imagination that could be more influenced by media context if they perceive themselves to be similar to the characters.<sup>38</sup> In Diab, the characters were created to have diverse appearances with different genders, racial origins, body sizes and shapes, facial features, and personalities, which were acceptable to Hong Kong Chinese children.

Diab was perceived to be an immersive game by this sample of Hong Kong Chinese children. The average score they achieved (mean = 39.1; SD = 9.0) was similar to a prior study of Diab in U.S. children (mean = 40.8; SD = 8.2).<sup>22</sup> Four themes emerged from qualitative interviews: intuitive feelings about the interface, playing experience, perception of the effect of Diab on behavior change, and the applicability of Diab to Hong Kong children. With respect to the interface, the majority of 34 children reported that they were comfortable with the game. Character design was generally considered vivid and fun, and language was not reported to be a major barrier. Most reported they enjoyed playing Diab and also enjoyed the emphasis on healthy eating and PA. Diab was considered to be moderately difficult in both playability and challenge. The majority of children reported Diab motivated them to change some diet and PA behaviors. Their perception of the environmental background of the game compared with Hong Kong was that the two were similar, as were the lifestyles of the antagonists compared with Hong Kong children. Most participants agreed that Diab was suitable for Hong Kong Chinese children and would recommend the game to their friends. These findings suggest that Diab, an American G4H with story immersion, is acceptable and applicable among Hong Kong children.

According to Social Cognitive Theory, goals are set for behavior change and can stimulate and increase an individual's cognitive abilities as well as his or her reactions to outcomes.<sup>39</sup> Goal setting as a key component of self-regulatory processing focuses on the effort behind behavior change. The concept of goal setting has been used for reducing drug abuse<sup>40</sup> and tobacco use<sup>41</sup> among Hong Kong youth; however, it has not been applied to childhood obesity prevention. Within Diab, goal setting is integrated as a multistep process at the end of each episode (Episodes 1–4, diet goals; Episodes 5–8, PA goals).

Implementation intentions (i.e., specific foods, number of days to attempt goals) and coping intentions (i.e., the most likely barrier to achieving the goal and the most likely effective solution for overcoming the barrier) are two phases of the goal setting process.<sup>42</sup> Players are asked to develop an implementation plan (e.g., eat one more portion of fruit for your afterschool snack in the following 4 days) and a plan to overcome potential barriers (e.g., fruit or juice is not always available at home) to the achievement of their goals (e.g., ask your parent to have more available at home).

A prior study of Diab identified that the most important diet-related values and reasons in U.S. children were getting good grades and being healthy. PA-related important values and reasons were having energy to do homework and not missing school.<sup>43</sup> However, the potential of the approach of Gollwitzer<sup>42</sup> to bridge the intention–behavior gap was limited in this study by the fact that only half of the participants completed goal setting. The remaining children in the present study only partly completed it, or skipped the component entirely, as they were eager to pass the episodes as quickly as possible due to limited time. The diet- and PA-related values, goal selections, reasons, and barriers in Hong Kong children were not adequately explored.

This study evaluated and demonstrated the acceptability of Diab, a health videogame originally created in the United States, among 9–12-year-old children in Hong Kong. This study also provides support prior to disseminating a successful health game from one culture to another. As the childhood obesity crisis continues, interventions are needed that can effectively tackle the epidemic. Efforts aimed at obesity prevention may benefit from innovative technologies that provide an alternative method to encourage healthy behaviors. This study provides an important contribution to G4H interventions for childhood obesity. The findings indicate the applicability of Diab for childhood obesity prevention among Hong Kong Chinese children.

However, there are several points to be noted before implementing further intervention studies. First, to maximize the behavior change potential of Diab, Chinese researchers should pay more attention to completing the goal setting in future studies. Teacher briefing prior to play and monitoring the completion of goal setting in the intervention phase should be conducted. Second, although conversations within the game were not considered a major problem for the majority of participants, some students still had difficulty in understanding some PA and food vocabulary. Due to the limited playtime, children may not have enough time to follow the subtitles. Besides, it is hard to distract players from the game even when they encounter the language problems. Giving a brief explanation of the episodes at the beginning of the session to help non-English-speaking

children and offering PA and food vocabulary on the multimedia screen during the game session are recommended.

Even though this study did not use a large sample, the combination of quantitative and qualitative methods provides rich information, which has confirmed the acceptability and applicability of an American G4H with story immersion to Hong Kong Chinese children. Diab, a videogame with behavior change procedures and an integrated story, aims to motivate players to reduce unhealthy obesity-related behaviors. Although moderate story immersion was obtained, this research is not an outcome study. Therefore, further studies are warranted to explore and quantify the effects of the game on Hong Kong children's behaviors and adiposity.

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### Author Disclosure Statement

R.B. is the President of Archimage, Inc., the company that created Diab. No competing financial interests exist for J.J.W., P.W.C.L., T.B., and A.J.P.

All authors read and approved the final manuscript.

### References

1. Prentice AM. The emerging epidemic of obesity in developing countries. *Int J Epidemiol* 2006; 35:93–99.
2. Jolliffe D. Extent of overweight among US children and adolescents from 1971 to 2000. *Int J Obes* 2004; 28:4–9.
3. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA* 2014; 311:806–814.
4. Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999–2012. *JAMA Pediatr* 2014; 168:561–566.
5. Ji CY, Chen TJ, China WGOC. Empirical changes in the prevalence of overweight and obesity among Chinese students from 1985 to 2010 and corresponding preventive strategies. *Biomed Environ Sci* 2013; 26:1–12.
6. Department of Health, Hong Kong. Obesity Rate of Hong Kong Primary Students. 2013. [http://school.eatsmart.gov.hk/files/pdf/Childhood\\_obesity\\_bi.pdf](http://school.eatsmart.gov.hk/files/pdf/Childhood_obesity_bi.pdf) (accessed March 10, 2015).
7. Maziak W, Ward K, Stockton M. Childhood obesity: Are we missing the big picture? *Obes Rev* 2008; 9:35–42.
8. Rolls BJ, Eлло-Martin JA, Tohill BC. What can intervention studies tell us about the relationship between fruit and vegetable consumption and weight management? *Nutr Rev* 2004; 62:1–17.
9. Daniels MC, Popkin BM. Impact of water intake on energy intake and weight status: A systematic review. *Nutr Rev* 2010; 68:505–521.

10. World Health Organization. Global Recommendations on Physical Activity for Health. 2010. [www.who.int/dietphysicalactivity/publications/9789241599979/en/](http://www.who.int/dietphysicalactivity/publications/9789241599979/en/) (accessed February 22, 2015).
11. Yung TK, Lee A, Ho MM, et al. Maternal influences on fruit and vegetable consumption of schoolchildren: Case study in Hong Kong. *Matern Child Nutr* 2010; 6:190–198.
12. Lee A, Tsang C. Youth risk behaviour in a Chinese population: A territory-wide youth risk behavioural surveillance in Hong Kong. *Public Health* 2004; 118:88–95.
13. Leisure and Cultural Services Department. Health Exercise for All Campaign—Physical Fitness Test for Community: Final Summary Report. 2012. [www.lcsd.gov.hk/healthy/physical\\_fitness/download/SummaryReport\\_en.pdf](http://www.lcsd.gov.hk/healthy/physical_fitness/download/SummaryReport_en.pdf) (accessed February 23, 2015).
14. de Gortari ABO, Aronsson K, Griffiths M. Game transfer phenomena in video game playing: A qualitative interview study. *International Journal of Cyber Behavior, Psychology and Learning* 2011;1(3):15–33.
15. Thompson D, Baranowski T, Buday R, et al. Serious video games for health: How behavioral science guided the design of a game on diabetes and obesity. *Simul Gaming* 2010; 41:587–606.
16. Baranowski T, Buday R, Thompson DI, Baranowski J. Playing for real: Video games and stories for health-related behavior change. *Am J Prev Med* 2008; 34:74–82.
17. Biddiss E, Irwin J. Active video games to promote physical activity in children and youth: A systematic review. *Arch Pediatr Adolesc Med* 2010; 164:664–672.
18. Baranowski T, Baranowski J, Cullen KW, et al. Squire's Quest!: Dietary outcome evaluation of a multimedia game. *Am J Prev Med* 2003; 24:52–61.
19. Fisher WR. The narrative paradigm: In the beginning. *J Commun* 1985; 35:74–89.
20. Bizzocchi J. Games and narrative: An analytical framework. *Loading* 2007; 1:5–10.
21. Gerrig RJ. *Experiencing Narrative Worlds: On the Psychological Activities of Reading*. New Haven, CT: Yale University Press; 1993.
22. Lu AS, Thompson D, Baranowski J, et al. Story immersion in a health videogame for childhood obesity prevention. *Games Health J* 2012; 1:37–44.
23. Green MC, Brock TC. The role of transportation in the persuasiveness of public narratives. *J Pers Soc Psychol* 2000; 79:701–721.
24. Bandura A. *Social Foundations of Thought and Action: A Social-Cognitive View*. Englewood Cliffs, NJ: Prentice Hall; 1986.
25. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol* 2000; 55:68–78.
26. Gentile D, Stone W. Violent video game effects on children and adolescents. A review of the literature. *Minerva Pediatr* 2005; 57:337–358.
27. Locander W, Sudman S, Bradburn N. An investigation of interview method, threat and response distortion. *J Am Stat Assoc* 1976; 71:269–275.
28. Cameron N. The methods of axiological anthropometry. In: Falkner F, Tanner JM, eds. *Human Growth*. London: Plenum Press; 1978: pp. 1–42.
29. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: International survey. *BMJ* 2000; 320:1240–1243.
30. Pope C, Ziebland S, Mays N. Qualitative research in health care: Analysing qualitative data. *BMJ* 2000; 320:114–116.
31. Ritchie J, Spencer L, Bryman A, Burgess R. *Analysing Qualitative Data*. London: Routledge; 1994: p. 3.
32. Malterud K. Qualitative research: Standards, challenges, and guidelines. *Lancet* 2001; 358:483–488.
33. McMahan A. Immersion, engagement and presence: A method for analyzing 3-D video games. In: Wolf MJP, Perron B, eds. *The Video Game Theory Reader*. New York: Routledge; 2003: pp. 67–86.
34. Guy S, Ratzki-Leewing A, Gwadry-Sridhar F. Moving beyond the stigma: Systematic review of video games and their potential to combat obesity. *Int J Hypertens* 2011; 2011:e179124.
35. Dede C. The evolution of constructivist learning environments: Immersion in distributed, virtual worlds. *Educ Tech* 1995; 35:46–52.
36. Green MC. Transportation into narrative worlds: The role of prior knowledge and perceived realism. *Discourse Process* 2004; 38:247–266.
37. Schunk DH. Vicarious influences on self-efficacy for cognitive skill learning. *J Soc Clin Psychol* 1986; 4:316–327.
38. Burnstein E, Stotland E, Zander A. Similarity to a model and self-evaluation. *J Abnorm Soc Psychol* 1961; 62:257–264.
39. Bandura A. Social cognitive theory of self-regulation. *Organ Behav Hum Dev* 1991; 50:248–287.
40. Cheung CK, Ngai SSY. Reducing youth's drug abuse through training social workers for cognitive-behavioral integrated treatment. *Children Youth Serv Rev* 2013; 35: 302–311.
41. Ziedonis DM, Wang X, Li T, et al. Addressing tobacco through organizational change in a hospital-based mental health center in China: The intervention and lessons learned in a pilot implementation project. *J Dual Diagn* 2012; 8: 148–157.
42. Gollwitzer PM. Implementation intentions: Strong effects of simple plans. *Am Psychol* 1999; 54:493–503.
43. Simons M, Baranowski J, Thompson D, et al. Child goal setting of dietary and physical activity in a serious videogame. *Games Health J* 2013; 2:150–157.

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