Fight for Your Right to Fruit: Development of a Manga Comic Promoting Fruit Consumption in Youth

May May Leung[1*], Melanie C Green[2], Jianwen Cai[3], Ann Gaba[1], Deborah Tate[4] and Alice Ammerman[5]

[1]*Nutrition Program, City University of New York School of Public Health, Hunter College, New York, NY, United States America; 10035*

[2]*Psychology Department, University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, NC, United States America; 27599*

[3]*Biostatistics Department, University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, NC, United States America; 27599*

[4]*Nutrition and Health Behavior Departments, University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, NC, United States America; 27599*

[5]*Nutrition Department, University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, NC, United States America; 27599*

Abstract: Innovative interventions addressing childhood obesity are needed to capture the attention of youth living in a multi-media environment. The purpose of this paper is to describe the qualitative study that was conducted to inform the development of an appealing manga comic (Japanese comic art) to promote fruit consumption in youth and the process of creating the comic. Seven focus groups and two interviews (N=28) were conducted with middle-school students to better understand such topics as enjoyable components of manga comics and important health concepts. Two researchers independently analyzed each transcript using ATLAS.ti. Inductive and deductive processes were used to identify codes (ideas emerging from text); similar codes were grouped into themes. Most frequently mentioned themes related to enjoyable components of manga comics were detailed graphics and artistic style of text used to convey sound effects. The majority said eating fruits and vegetables was the most important nutrition behavior for proper health. When asked about story ideas for a manga comic to encourage youth to be healthy, many responded with ideas involving comic characters who would consume fruit, then gain beneficial attributes. Others suggested highlighting more practical benefits, such as increased focus and energy. These findings informed the development of a 30-page manga comic promoting fruit consumption, with the aim of developing an appealing storyline and relatable characters for youth. Manga comics may be able to create an entertaining learning environment that has potential to promote positive dietary behaviors in youth.

Keywords: Narrative, health communication, childhood obesity, manga comic.

INTRODUCTION

Childhood obesity continues to be a major public health issue in the United States (U.S.) as approximately 17% of its youth between the ages of two and 19 are obese; the rates nearly double to 31.8% when combined with those who are overweight [1]. It is a complex epidemic with multiple contributing factors, including poor dietary habits, such as inadequate intake of nutrient-dense fruits and vegetables and increased consumption of energy-dense and low-fiber foods and beverages [2-6]. As food preferences established in childhood are often maintained into adulthood [7] and improving these dietary behaviors among youth has been shown to reduce the risk of developing chronic diseases in adulthood, [8-10] it is critical to develop effective and engaging interventions to promote sustainable healthy dietary behaviors during childhood.

Interventions that incorporate narratives, such as entertainment-education or storytelling, may engage today's younger population living in a media-saturated environment. Narratives, which have been used to change beliefs and inspire action, are now emerging as promising tools to support health-behavior change [11-14].

Japanese comic art, commonly known as *manga*, may be a novel narrative platform to promote positive health behaviors in youth. Unlike Western-style comic books,

*Address correspondence to this author at the Nutrition Program, City University of New York School of Public Health, Hunter College, New York, NY, United States America; 10035; Tel: (212)-396 -7775; E-mail: mm.leung@hunter.cuny.edu

manga are a unique form of multimodal narrative media that stimulate a reader's attention by combining detailed visual images and text to create more of a subjective or personal viewpoint of a story [15]. Another distinct feature of manga comics is their wider range of genres. Manga have been used as a form of entertainment-education for topics such as history, culture, religion and career advice [16-18]. Because of this, manga are an increasingly popular form of entertainment in many countries, including the U.S., irrespective of gender, nationality or age [19-22]. However, to date, manga comics have only begun to be used for health behavior change interventions [23].

Theoretical Framework

Narrative transportation theory (NTT) explains how narrative communications, such as manga, could contribute to changes in health-related beliefs and behaviors [11, 24]. NTT posits that narrative persuasion occurs because an individual is 'transported' or immersed into the narrative world [24, 25]. Transportation is defined as "an integrative melding of attention, imagery and feelings focused on story events" [26]. NTT applies specifically to narratives, particularly ones that evoke vivid imagery, as opposed to "didactic rhetoric" [24, 25].

Transportation into a narrative world is believed to lead to acceptance of persuasive messages within a story through multiple mechanisms [24-26]. The first mechanism is the relationship with characters. If a reader likes or identifies with a specific character, the events experienced or statements made by the character may have a greater effect in shifting the reader's beliefs [11].

Transportation may also elicit belief changes by reducing counterarguing and thus, lowering resistance to messages in the narrative [12, 24]. Resistance, defined as a reaction against change or a motivation to oppose persuasive appeals, is a key barrier to changing attitudes and behaviors [27]. Narratives may be particularly effective at overcoming resistance as narrative evidence has been shown to be more effective than fact-based evidence, particularly when messages are not similar to one's own beliefs. For example, Slater and Rouner [28] found that alcohol-education messages based on anecdotal evidence were considered more persuasive and believable than those based on statistical evidence among college students whose values differed from the educational messages.

A third potential mechanism of transportation is making narrative experiences seem more like direct experiences [24]. In health communication, this is often accomplished by imagery. NTT suggests that images are most impactful when embedded in a story, rather than provided in isolation [25], as it could enhance the narrative influence. Therefore, visual images relevant to the story's messages, such as those incorporated in manga comics, may further impact attitudes and beliefs.

Social cognitive theory (SCT) highlights another mechanism through which narratives, that include characters to whom readers can relate, could influence health-behavior change. By observing a role model (observational learning), individuals could learn a behavior and may be more likely to perform it, if they see the model rewarded in ways they value [29]. The development of entertainment-education narratives draws greatly on SCT by using role models to perform new behaviors, which aim to improve outcome expectancies, outcome expectations, behavioral capability and self-efficacy. Given their potential as innovative education tools, a manga comic with its storytelling through detailed imagery and text may influence the critical SCT constructs associated with behavior change, through observational learning and transportation. Furthermore, utilizing behavior change theories, such as SCT and NTT, provide a conceptual underpinning and a framework to guide the development of a health-promoting narrative like a manga comic promoting fruit consumption.

An appealing storyline, identifiable characters and evidence-based behaviors are mechanisms through which entertainment-education in the form of a manga comic could promote positive behavior change. However, formative research is needed prior to the development of a comic to ensure that the concept, approach and storyline are appealing to the intended audience. This paper describes the qualitative formative research that was conducted to inform the development of a manga comic promoting fruit consumption for middle school youth and also the developmental process of creating the comic.

MATERIALS AND METHODOLOGY

Sample

In Fall 2008, seven focus group discussions and two in-depth interviews (total of 28 participants) were conducted with youth in Grades 6th to 8th in central North Carolina. The in-depth interviews were conducted as a result of only one student attending a scheduled group discussion in two instances. Recruitment occurred at a public middle school during after-school programming. All students were eligible to participate as there were no specific exclusionary criteria. During recruitment, the research staff attended the programs and classes to explain the purpose of the study. Students who expressed interest received information about the study, along with parental consent forms.

Signed parental consent and student assent were obtained. Participants received small gifts (e.g., stationery, water bottles, school supplies) that were valued at $5. The study was approved by the school district and the Public Health-Nursing IRB at the University of North Carolina at Chapel Hill.

Data Collection

Instrument

The discussion guide consisted of 30 open-ended questions, probes and follow-up questions, covering topics such as: manga stories youth prefer to read and enjoyable aspects of manga comics. Questions asked of both manga and non-manga readers related to health concepts youth want to read about and values and ideals of the youth. The manga-related questions (eight questions) were only asked of the youth who reported reading manga comics. Prior to completing the focus groups and interviews, the discussion

guide was pilot-tested with the intended population by a trained moderator and minor modifications were made based upon feedback.

Procedures

Prior to the start of the discussion, participants completed a brief socio-demographic questionnaire. The principal investigator and trained research assistants conducted the discussions and interviews, which lasted approximately 40 to 60 minutes, in a classroom setting during after school.

When possible (five out of the seven), focus groups were segmented by gender and grade as prior research indicate students are more comfortable in sharing thoughts and opinions related to nutrition and physical activity in similar groups [30, 31]. Such a format could also minimize responses associated with social desirability. Groups were also separated according to manga and non-manga readers. As mentioned previously, seven focus groups and two in-depth interviews were conducted; an interview was conducted on the rare case when only one participant arrived to a scheduled focus group discussion. Therefore, the interviews offered the opportunity to ask the same questions as in the focus groups with the ability to probe for additional detail. Data collection was conducted until data saturation was obtained.

Data Analysis

Focus groups and interviews were audio taped and transcribed verbatim. All transcripts were reviewed to check for accuracy and completeness against the audiotapes.

Transcript texts were loaded into ATLAS.ti, a software program designed to analyze text-based data (Scientific Software, Berlin; version 5.2). Inductive and deductive processes were used to identify codes (ideas emerging from the text), themes (groups of similar codes) and categories (general domains of information covered).

A preliminary codebook was developed by one researcher upon initial review of the data. The codebook was then reviewed by two researchers to ensure standardized definitions of the codes. Each transcript was independently reviewed to identify additional codes and discrete units of text (phrases, sentences, paragraphs) that corresponded to specific codes. The two researchers compared their coding and resolved any discrepancies through discussion and consensus. Upon completion of coding, data reduction occurred wherein codes with similar meanings were merged. This process also assisted with the identification of themes. The coding reports were then summarized by key themes, while identifying related text evidence.

RESULTS

Participants

A total of 28 middle school students participated in the study; about half of the participants were male (57%) and the majority had read at least one manga comic (61%). Nearly all participants were sixth graders (93%) with a mean age of 12.4 years and a range of 11.6 to 14.6 years. Table **1** lists the demographic information of the focus group and interview participants.

Table 1.   Characteristics of focus group and interview participants.

	Focus Groups	**Interviews**	**Total N**
Gender			
Male	14 (50.0)	2 (7.1)	16
Female	12 (42.9)	-	12
Grade			
6	25 (89.2)	1 (3.6)	26
7	1 (3.6)	-	1
8	-	1 (3.6)	1
Ethnicity			
African-American/Black	9 (32.1)	-	9
White	7 (25.0)	1 (3.6)	8
Latino/Hispanic	5 (17.9)	1 (3.6)	6
Mixed Race	5 (17.9)	-	5
Manga Reader			
Yes	15 (53.6)	2 (7.1)	17
No	11 (39.3)	-	11

Note: Results presented as N (%), unless otherwise noted.

Discussions and Interviews

Data from the focus groups and in-depth interviews were collapsed into three categories: a) Components of manga comics that may increase transportation (immersion into media), b) Storyline that may engage youth, and c) Main characters with whom youth would likely identify. While the in-depth interviews provided an opportunity to enquire about further details, the findings were relatively similar between the interviews and group discussions. Table **2** summarizes the key themes for each of the categories.

Components of Manga Comics that May Increase Transportation

To understand what components of manga comics may increase transportation, manga-reading participants were asked, "What do you like about reading manga comics?" One of the most frequently mentioned topics was the visual images of manga comics. Both male and female participants agreed that the drawings of manga comics are unique relative to other comics because of the detail. They mentioned that this style of detailing is often used when conveying speed and intensity of action scenes and emotions of characters through exaggerated facial expressions.

The drawings are cool, and…I like the expressions they use, like when they get mad…and it shows... OOOoooh!! I want to scream myself! (focus group participant, female)

Another common topic that was mentioned was the incorporation of onomatopoeia (use of words to denote sounds) in manga comics. Readers explained that the artistic style and sizes of the text, which are used to express different types and levels of sound effects, were enjoyable to read.

[I like] the sound effects…they always catch my eyes. Cuz it's not just written there. It's a special way of 'BOOM'. If it says boom it's gonna be the letters are all big and if it's something quiet then they can make it small. So, the different sizes actually convey the noise and the way they write it. (focus group participant, male)

When prompted as to the reasons why the visual images and onomatopoeia resulted in enjoyment of the stories, many of the participants reported feeling that they became a part of the story as they read.

Table 2. **Summary of key themes presented by categories and how they were addressed in the developed comic.**

Category	Key themes	Components of developed comic

Components of manga comics that may increase transportation	Detailed visual images
	   o Conveys intensity of action scenes and emotions of characters
	Artistic style of onomatopoeia
	   o Conveys different types and levels of sound effects through text
		Detailed artwork, including facial expressions of characters and background of scenes, was incorporated into the comic
		
		Implied sound effects of various scenes, such as crunch sounds of consuming fruits and fight sounds of martial arts scenes, were conveyed through onomatopoeia

Storyline that may engage youth	Preferred genres identified by youth
	   o Adventure, Action, Suspense, Comedy, Fantasy, Romance
	Important nutrition topics
	   o Consume fruits and vegetables
	   o Avoid sugary drinks
	Ideas for a comic to promote healthy dietary behaviors
	   o Character consumes fruit, then gains a unique ability or displays strength and energy
	Balance between education and entertainment
		Preferred genres were incorporated into the story - the main character discovers he has a destiny to battle an evil empire that has prevented its people access to fresh fruits and vegetables. Additional characters were incorporated to play a role in addressing the multiple genres as well.
		Key health message of comic is the importance of consuming fruit. Secondary message of limiting sugary drink consumption is included.
		The main character must consume whole fruits to raise his *nano-nutrient level* so he has the energy and focus to battle the evil empire.
		Aim was to first engage youth to encourage reading of the entire comic. Health messages were then embedded into various scenes. Didactic information, reinforcing the comic's health messages and highlighting additional health benefits of fruit, were presented at the end of comic.

Main characters with whom youth would likely identify	Preferred character traits and values identified by youth
	   o Humor
	   o Strength
	   o Integrity
	   o Vulnerability
	Preferred special powers identified by youth
	   o Magical (e.g., time travel, be invisible)
	   o Physical (e.g., martial arts skills)
		The main character is an average high school student, who often encounters the school bully. He eventually realizes he has an important destiny to save the world from an evil empire.
		The main character discovers he has martial arts skills, which is only realized when his *nano-nutrient levels* are high.

When you're reading [manga comics], you just don't think about anything. You just...read. You just feel like part of the book, and you don't really think about...like how a good person you are, you just feel like...part of the book....I feel like I'm in the story. (focus group participant, female)

Storyline that May Engage Youth

To develop a storyline that would appeal to the intended population, manga readers were asked "Of the manga stories you have read, which one is your most favorite?" Naruto™[1] was overwhelmingly the favorite manga comic for both males and females. When prompted to explain why, the youth reported that the storyline has action, adventure, fantasy and humor. Others mentioned, in addition to action, Naruto™ has a well-developed storyline and provides moral lessons.

[I like] Naruto because it's action, but...it has a concept. Like "Don't fight because war doesn't solve everything. And it's a fun story." (focus group participant, male)

While not a main genre of the comic, romance is incorporated into Naruto™ as well. Only two readers mentioned this when asked why they enjoyed the story. We followed up by asking the other readers of this comic if they thought romance was incorporated. All the readers, regardless of gender, acknowledged that romance existed in the story, to some degree. Two males and one female commented that they found those scenes to be humorous.

It was also important to develop a storyline that would appeal to youth who do not read manga comics. Thus, we asked non-manga readers, "If you could pick up any book to read, what would it be?" The majority of non-manga readers expressed the desire for books with fantasy, action and suspense. Some expressed interest in comic books, however, not specifically manga comics. A couple of the females wanted to read books that included romance.

Next, we asked both manga and non-manga readers "What food and nutrition topics do you think are most important to your health?" This question aimed to identify an appealing health topic that could be incorporated into a health-related comic storyline. Most participants said that eating fruits and vegetables is important for proper health. A few others reported that junk food should be avoided. Diet was the main focus, however, a couple of participants mentioned the importance of physical activity. The explanations given for the importance of eating fruits and vegetables were that they provide energy, prevent weight gain and increase strength.

We followed up by asking the participants to suggest ideas for a comic that would encourage other people their age to be healthy. Most of the participants suggested ideas involving characters who eat fruit, then gain a beneficial attribute such as a special power. However, there were still a substantial number of ideas related to highlighting the practical benefits of eating fruit, such as increased focus and energy and a decreased risk of becoming overweight.

I would have regular people [as comic characters]. But when they eat fruit... they get magical powers. (focus group participant, male)

Several participants highlighted the importance of ensuring that the comic is entertaining – they expressed a strong preference for comics that did not blatantly try to educate the reader.

My friends are exactly like me. They hate books that are educational... [The comic] needs to be so that you don't know you're learning, but you're learning. (in-depth interviewee)

Main Characters with Whom Youth Would Likely Identify

To inform the development of characters with whom youth could identify or relate, manga readers were asked "Which [manga comic] characters are your most favorite?" Several characters were mentioned, but again Naruto was cited as the favorite. When prompted as to why they chose a specific character, several personality traits were repeated. Those traits included, 1) Humor, whether it was behaviorally such as being clumsy or through exaggerated emotive facial expressions, 2) Strength, either physical or emotional, 3) Integrity, such as fighting for a just cause, and 4) Vulnerability, such as feeling isolated at school. The participants reported that they related to the main characters as they exhibited traits the youth either respected or perceived to be similar to themselves.

My favorite character is the anger-management dude from Fruits Basket™ because he has anger management issues, and it's really funny. Plus, I have anger issues, too. (focus group participant, female)

To further inform development of a relatable comic character, participants were also asked "If you were to create a story, who would be the main character?" The most common topics discussed were age and personality. The participants tended to describe a character in their mid- to upper teens (slightly older than themselves). They also preferred a main character who is unpopular or misunderstood, however, s/he would have strong positive values.

He'd be a trouble maker, but would have a heart of gold. (in-depth interviewee)

[The main character would] not be popular. But when something happens, she's outgoing and gets braver. (focus group participant, female)

Main characters of manga comics often possess a special power. Thus, to further aid our knowledge in character development for a manga comic, we asked the participants "If you could have one power, which power would that be - magical (e.g., ability to create storms), physical (e.g., martial arts skill) or brain power (e.g., telepathy, telekinesis)?". Magical and physical powers were the most popular. The magical powers most often mentioned included, 1) being able to fly so one could travel the world, 2) being invisible so one could hear conversations and secrets of other people, and 3) being able to time travel, either back into the past or forward into the future.

Some common themes of physical powers included having martial arts skills or being able to run fast. The main reason for desiring such powers was to ultimately defend oneself from others, in particular, school bullies.

I would be Bruce Lee. 'Cause...if someone try to mess with me, all I gotta do is...[showing martial arts moves with his arms]...and he'd be down. (focus group participant, male)

I would love to be able to run fast. That'd be one very useful power! Some people pick on me...so all these people chase me a lot of the time...I don't want to get tackled by this kid going 20 miles an hour. (in-depth interviewee, male)

To better understand character traits that youth value, we asked the participants "If you could have one wish for yourself, what would it be?" The most common responses involved either doing something to benefit the current state of the world (environmentally, economically, or through humanitarian means) or to become rich. When prompted for the reasons behind their desire for wealth, a couple of participants mentioned they wanted to be able to purchase material goods. However, the majority stated they would use the money to help people in need.

I'd use my wish so there wouldn't be anything else. No more global warming... I'd use my wish on the world so... there wouldn't be no more chaos and stuff like that. (focus group participant, male)

Money! Well, I mean... I'm sorry, but money 'cause then I'd...build a house for homeless people, put them in there... Take care of them, feed them good. (focus group participant, female)

Comic Development

Based upon the above findings and guided by a theoretical framework, a manga comic focused on fruit consumption was developed. Table **2** not only summarizes the themes that emerged from the formative research, but also highlights components of the comic that were informed by these data.

An interdisciplinary team was formed, including an artist who was engaged to create the characters and draw the comic. Feedback and guidance were provided by academic researchers in the fields of health behavior and health education, journalism and mass communication, psychology, and nutrition. The characters and storyline were piloted with the intended population and was further refined based upon feedback from the youth and research team. By tailoring the manga comic to meet the specific preferences of the intended population, while also addressing an obesity-related behavior, we aimed to increase engagement of youth and appeal towards the targeted health behavior, thereby positively influencing relevant attitudes and beliefs. Specifically, the comic was designed to increase transportation and improve SCT constructs of self-efficacy, outcome expectations and behavioral capability related to fruit consumption through the comic's storyline, characters, graphics and text. A conceptual model of the comic is presented in Fig. (**1**).

The final product was *Zen Aku: Fight for Your Right to Fruit!* - a 30 page, 99 picture panel comic. The cover was printed in color and other pages printed in black and white, which is the traditional format in which manga comic books are printed. The main character of the comic is Kenzo, a seemingly average 15-year old male, who attends a local high school and enjoys playing soccer. He eventually discovers he has a destiny to save the world by battling an evil empire that starves its people of fresh fruits. Kenzo is only able to fight the enemy if his *nano-nutrient level* is high enough as it provides him the necessary energy and focus. The needed *nano-nutrient level* can only be achieved by consuming whole fruits and avoiding sugary drinks.

In addition to health messages embedded in the narrative comic, didactic information related to the practical benefits of fruit was included at the end of the comic to provide additional information and reinforce the comic's messages as "A Note from Kenzo". Fig. (**2**) displays the front cover of the comic.
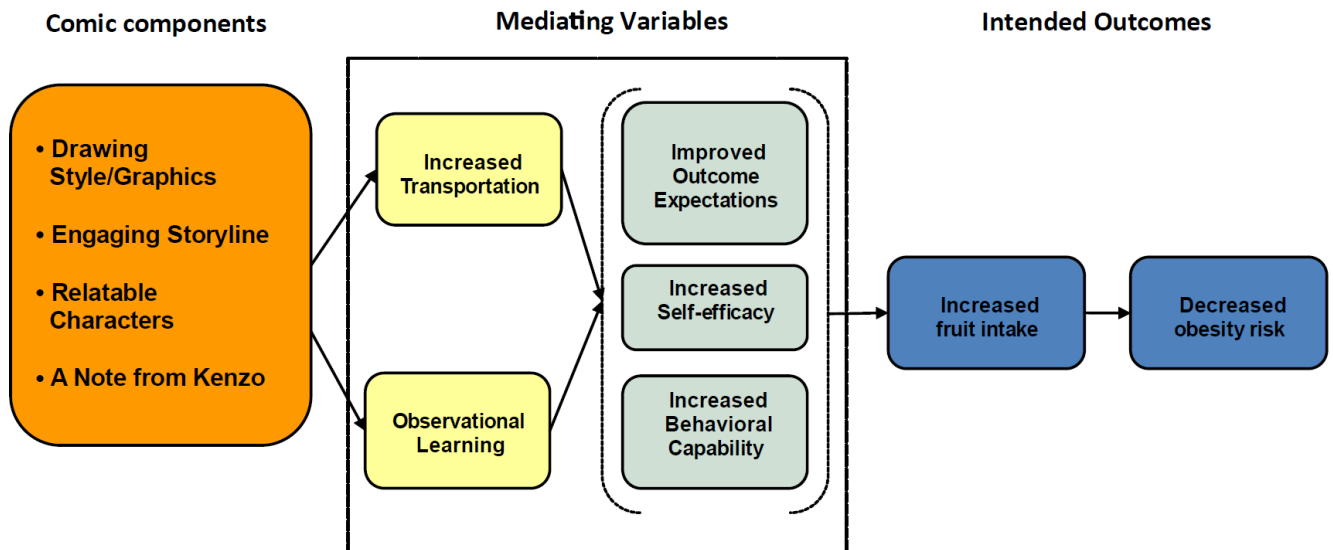

Fig. (1). Conceptual model of manga comic promoting fruit consumption in youth.

DISCUSSION

Findings from this study were used to guide the development of a manga comic to promote fruit consumption in youth, with the aim to enhancing the comic's potential for effectiveness and appeal to middle school youth. As transportation could be an effective mechanism for promoting health behavior knowledge and change, particularly with narratives such as comics, components of manga comics that may enhance it should be incorporated [12, 24, 32]. According to the data collected, these components may include the details of the graphics that could increase audience engagement and the artistic style of text used to convey sound effects, which may help to increase sensory perceptions of the scenes. The unique drawing style and technique of manga comics may promote greater reader participation, which could lead to increased attention and mental imagery focused on the story's events. Based on (NTT), it is possible that readers of the developed manga comic may become 'transported' or immersed into a story and thus, be more persuaded by the messages within, which could lead to attitude, belief and behavior changes.

Ensuring a proper balance between the entertainment, education and theory of the comic further increases potential for transportation [11, 24]. The study participants clearly stated that although a comic may be about health promotion, they did not want it to blatantly educate the reader. Similar to other forms of persuasive communication, entertainment-education must find a proper balance between the two - the

Fig. (2). Front cover of the developed manga comic - *Zen'Aku: Fight for Your Right to Fruit!*[©]

degree of exposure to health information should be such that the message is effectively conveyed, however, not to the extent that a reader may become disengaged from the narrative [11, 24]. Thus, the comic was designed to first engage the youth around the story and characters through developing empathy with the main character. The first two scenes focused on introducing the main character as stories often engage readers through empathy with the protagonist, so readers may understand and relate to him [33]. Health messages were then carefully embedded into following scenes. While the comic is mainly narrative, entertainment education research suggests a combination of narrative and non-narrative information may be the most effective in improving health beliefs and behaviors [34]. Therefore, didactic information was included at the end of the comic to reinforce the story's health messages and highlight additional health benefits of fruit consumption.

When determining which obesity-related nutrition behavior should be incorporated into a story, it is important to identify a topic that the intended population would value as this could further ensure appeal and engagement of the comic. Several nutrition and health topics were mentioned by the participants, however, the majority believed that eating fruits and vegetables was the most important behavior to address. While the participants identified this behavior as important to their health, research has consistently shown that U.S. youth consume well under the recommended amounts of fruits and vegetables [6, 35]. Recent research highlights that up to 89% of U.S. children between the ages of six and 18 years do not meet the recommended fruit and vegetable consumption levels on a given day [36]. Encouraging fruit and vegetable consumption is also a target behavior strategy identified by the Expert Committee to prevent and treat childhood obesity, further confirming that fruit and vegetable consumption would be a meaningful behavior to address in a health-related manga comic [37].

Characters within a narrative can be effective role models to promote the targeted behavior when they are perceived to be similar or represent personality traits readers value [38, 39]. Interestingly, study participants expressed preference for a main character who is unpopular or misunderstood. This preference could reflect common experiences of the transitional and often disruptive stage of adolescence, when youth are in search of their own identity and independence, yet also seeking acceptance into peer groups [40].

While it is important to develop an appealing main character, creating multiple characters with different appearances and personalities increases opportunities for readers to become engaged with the story. Additional appealing characters also provide multiple opportunities for observational learning, thus further enhancing the narrative's potential impact on attitudes and beliefs. The developed comic includes five additional characters, of various ages and of both genders, to convey the health messages from different perspectives thereby increasing the potential of the reader to respond positively to the story's health messages.

The current study also enquired about youth preferences of storylines and their own story ideas, which informed how the comic addressed SCT constructs of outcome expectations, self-efficacy and behavioral capability. Many

study participants responded with ideas involving characters who would consume a fruit and then gain a unique power or ability, such as having martial arts skills to defend oneself from school bullies. Others suggested highlighting practical benefits of eating fruit, such as increased focus and energy. Additionally, youth expressed a desire to be able to contribute to positive change within their own society.

With this in mind, the developed manga comic aimed to emphasize important values by featuring morally upstanding characters contributing towards improving the society. The resulting premise of the current comic included the main character discovering his responsibility to save his friends and loved ones from an enemy that is promoting ill health. Kenzo is able to do this through developing keen martial arts skills when he consumes enough fruits. These fighting skills are used to battle the *evil empire* that prevents their people access to fresh fruits. The storyline also covers practical benefits of fruit consumption aimed to further influence outcome expectations and behavioral capability. Furthermore, observational learning through the role model displaying positive fruit consumption behaviors addresses self-efficacy.

Conducting formative research is a critical component of the intervention development phase as it increases the potential for creating an entertaining and appealing product for the target population. Furthermore, utilizing behavior change theory provides a conceptual underpinning and a framework to apply the formative research in a systematic manner. Our team recently published research highlighting the potential impact of this developed manga comic as Leung *et al.* [23] found that New York City Black and Hispanic youth, who read *Zen Aku: Fight for Your Right to Fruit* comic, were significantly more likely (odds ratio 3.6, p=0.04) to choose fruit as a snack compared to a control group.

There are several limitations to the current study that should be noted. When engaging with youth, particularly in a group environment, social desirability could bias study findings. Because of the social norms and peer group dynamics of youth, we segmented the groups according to age and gender with the goal of promoting honest and open discussions, which in turn could lead to more meaningful results. This resulted in smaller discussion groups than traditional focus groups of eight to ten [41]. However, structuring the groups in this manner may have minimized responses associated with social desirability. The findings from the in-depth interviews were similar to those of the group discussions, which may suggest such biases may have been mitigated. Another limitation is the limited generalizability of the results to all youth as the study sample was predominately sixth graders. In addition, this study was conducted in central North Carolina, and thus may not reflect opinions outside the geographic region. Furthermore, the sample was not large enough to identify clear differences between race/ethnicity, age and gender. However, strengths of the study include the diverse ethnicities represented by the study participants and the inclusion of non-manga readers to broaden the comic's potential reach. In addition, the information collected has enabled the development of a potentially appealing obesity prevention tool using an innovative format based on youth's preferences.

CONCLUSION

As a complex public health problem, childhood obesity should be addressed at multiple levels and through various mediums. Health-promoting manga comics could be one component of a comprehensive program aimed at combating this multifaceted health issue. As a popular reading trend for U.S. youth, manga comics hold promise as a potentially engaging and entertaining behavior change vehicle for youth living in a multi-media environment. Furthermore, the comics' visual graphics and minimal text make it a promising format to educate younger populations and those with lower literacy skills.

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FOOTNOTE

Japanese manga series written and illustrated by Masashi Kishimoto. It is about Naruto Uzumaki, an adolescent ninja who searches for recognition and aspires to become a Hokage (a ninja that is acknowledged as a village leader).

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