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Home-Based and Technology-Centered Childhood Obesity Prevention for Chinese Mothers With Preschool-Aged Children

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Abstract

Introduction: Nearly a quarter of preschool-aged Chinese American children are overweight or obese. Children of overweight mothers are at higher risk for obesity. Efforts to prevent obesity among low-income minority children with overweight mothers should start in early childhood. **Methodology:** This randomized pilot study consisted of 8 weekly sessions, examined feasibility of a tablet computer–based intervention among 32 mother–child dyads. The study estimated effect size of the intervention at baseline, 3 and 6 months on maternal outcomes including self-efficacy, eating behaviors, physical activity, child-feeding practices, and change in body mass index. **Results:** The tablet computer–based intervention is feasible among low-income Chinese mothers with low acculturation. A large-effect size was observed in reducing maternal body mass index, waist circumference, and improving maternal eating style and self-efficacy for promoting healthy eating. **Discussion:** Multimedia tablet-based education tailored for Chinese immigrant mothers was successful in short-term maternal behaviors changes related to diet and exercise.

Keywords

Asian Americans, child health, cultural competence, diet, family health, health behaviors, obesity, overweight

Introduction

Childhood obesity, one of the most prevalent public health problems, inordinately affects minority immigrants such as Chinese Americans (Humes, Jones, & Ramirez, 2011). Twenty-four percent of 4-year-old Chinese American children had a body mass index (BMI) above the 85th percentile (Jain et al., 2012). Although Chinese Americans are considered to be at low risk for obesity, they have a higher percentage of body fat and a higher risk of developing cardiovascular disease at the same BMI as non-Hispanic Whites (Stevens, Truesdale, Katz, & Cai, 2008). Chinese parents also tend to underestimate their children's overweight status (G. H. Wang, Tan, & Cheah, 2017). For these reasons, Chinese American children and their families need obesity prevention programs.

Children in an "obesogenic" home environment are more likely to be obese or overweight than those who are not (Adair, Gordon-Larsen, Du, Zhang, & Popkin, 2014; Bond, Wyatt, Lloyd, & Taylor, 2011). Higher maternal BMI has been associated with increased child obesity as well as with decreased chance for resolution of child obesity (Kerr et al., 2017). The home environment and parental health behaviors are key influences on the development of children's food preferences, eating styles, and activity patterns (Bruss, Morris, & Dannison, 2003; Kral & Rauh, 2010). Maternal knowledge, attitudes, role modeling, and self-efficacy for healthy behaviors have all been associated with a child's eating and physical activity habits (Bergmeier et al., 2017; Bolton, Kremer, Hesketh, Laws, & Campbell, 2016; Dattilo, 2017; Lindsay, Greaney, Wallington, Mesa, & Salas, 2017; Northrup & Smaldone, 2017). The transition to motherhood, accompanied by additional family responsibilities, can place women at risk for unhealthy lifestyles which in turn can influence the health of their children. Maternal stress level has been associated with lower child physical activity level and a more sedentary lifestyle (O'Connor et al., 2017). Effective childhood obesity prevention programs for young children improve the healthfulness of the home environment by targeting both maternal and child behaviors (Humes et al., 2011).

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Mobile technology, such as tablet computers (tablets), can increase the accessibility of health information resources in a convenient and nonintrusive way. Tablet computer ownership and Internet access are widespread. Fifty percent of Asian Americans own a tablet computer, the highest percentage among all racial groups in the United States (Rainie & Smith, 2013). Seventy-five percent of convenience-sampled low-income Chinese Americans in San Francisco indicated having Internet access and 62% owned computers (Sun, Cheng, Chan, & Chow, 2011).

This pilot study was a randomized, controlled study to assess the feasibility and impact of a family-centered, technology-based intervention to improve the health behaviors of low-income, overweight, or obese Chinese mothers and their children. The study was guided by the Information Motivation Behavioral Skills Model. We hypothesized that improving maternal health knowledge and motivation will result in the increase of skills needed to affect behavioral change which lead to improved healthy behavior and outcomes.

Theoretical Framework

The intervention is based on the Information–Motivation–Behavior (IMB) model which postulates that a health behavior is performed if one has the requisite knowledge, motivation, and behavioral skills needed to accomplish the behavior. It predicts that people who are well-informed, motivated to act, and in possession of the skills and confidence to take action (self-efficacy) are more likely to initiate and maintain a health behavior. Our intervention delivers critical information tailored to the lifestyles of Chinese mothers of preschool-aged children attending Head Start Programs. The program provides information aimed to increase the motivation and self-efficacy needed for behavior change. The IMB model has been validated in multiple health promotion and behavior change studies in sexual risk reduction (Anderson et al., 2006; Fisher, Fisher, Amico, & Harman, 2006; Reid & Aiken, 2011), tobacco use prevention (Shell, Newman, Perry, & Folsom, 2011), cancer screening (Kim, Jo, & Lee, 2012), and chronic disease self-management (Amico, 2011; Osborn, Amico, Fisher, Egede, & Fisher, 2010).

Method

Design and Sample

This randomized, controlled study recruited 32 mother–child pairs through four Northern California Head Start Programs in the San Francisco Bay Area. *Inclusion criteria: Children*: ages 3 to 5 years; have a mother who identifies herself as Chinese; and attend preschool at the Head Start Program during the study period. *Mothers*: identify themselves as Chinese; are the primary caregiver of the child; speak Cantonese and read Chinese; have a BMI ≥ 23 or waist circumference >31.5 inches; have basic computer and Internet skills; and have Internet access during the study period. *Exclusion criteria*: participants of the intervention development focus group; mothers and/or children who have an acute or life-threatening disease or are unable to engage in daily activities; mothers who are pregnant during the study period. A lower BMI cutoff was chosen because a BMI of 23 has been shown to increase the risk of metabolic disorder in Chinese (Weng et al., 2006).

Development of the Intervention Educational Modules. The family-centered modules were developed as a tablet-based educational tool adapted from the National Heart, Lung, and Blood Institute's (2014) "We Can!" (Ways to Enhance Children's Activity & Nutrition) program, the Consortium to Lower Obesity in Chicago Children's (n.d.) "5-4-3-2-1-Go!" program, and the Barbara Bush Children's Hospital at Maine Medical Center (n.d.) "5-2-1-0 Let's Go!" campaign. These programs contain recommendations (5 servings fruits and vegetables, 4 cups water, 3 servings dairy, 2 hours screen time, 1 hour physical activity, 0 sugary drinks) for children and families to achieve a healthy lifestyle.

Culturally and linguistically tailored interventions improve health literacy and behaviors (Nam, Janson, Stotts, Chesla, & Kroon, 2012; Nguyen, Stewart, Nguyen, Bui-Tong, & McPhee, 2015; Song et al., 2010; Sun, Kessell, Tsoh, Chan, & Chang, 2013; Sun, Tsoh, Saw, Chan, & Cheng, 2012). We used images, food items, and sample menus familiar to the Chinese culture, and provided examples of easy family physical activities specific to inner cities where our participants resided.

The intervention consisted of 8 weekly 30-minute, interactive, Cantonese, educational modules accessed online via tablet computers. The topics were as follows: (a) Introduction to the 5-4-3-2-1-0 program, (b) Energy balance—maintain a healthy weight, (c) What to feed my family—energy IN, (d) Grocery shopping, (e) Find fun in physical activity—energy OUT, (f) Less sit, more fit—decrease screen time, (g) Smart parenting, and (h) Maintain a healthy weight for life.

Animations, short videos, and songs improve health information learning in individuals with low health literacy and income levels (Higgs et al., 2014; D. S. Wang et al., 2015). Six of eight lessons (#2, 3, 4, 5, 6, 8) were in the format of a 10 to 15-minute animated short video in Cantonese, and two lessons (#1, 7) were in a talk show format hosted by a bicultural registered dietitian/health educator with Cantonese-speaking mothers of young children. Registered dietitians and health educators wrote lesson scripts in English which were then translated into Chinese by an experienced translator on the research team. A back-translation was conducted to assure the accuracy of the translation. A design team working closely with the researchers produced the animations and live videos.

To improve retention of the 5-4-3-2-1-0 message, an English-language song to the tune of the classic children's

song "Twinkle, Twinkle, Little Star" was produced with Chinese-subtitled lyrics relaying the key messages (Green, 2005; McClelland, Jayaratne, & Bird, 2015; Shore & Strasser, 2006; Sun, Zhang, Tsoh, Wong-Kim, & Chow, 2007). Mothers were encouraged to practice this song with their children.

Focus Group Testing. Eight Chinese mothers with preschool-aged children from the target population formed a focus group aimed to test the intervention modules and the usability of using tablets to deliver the modules. The focus group, conducted in Cantonese by a bicultural and bilingual research team member, provided feedback on the format, content, ease of use, usefulness, literacy level, communication style, cultural appropriateness, acceptability, and overall quality of the intervention modules. Changes were made based on this feedback.

Study Procedure. This study was approved by the Committee on Human Research at the University of California, San Francisco. Participants were screened for eligibility in person at participating Head Start Program locations by trained, bilingual research assistants.

All eligible study participants were invited to take part in the study. All focus group and study participants were informed of the study details, and of their right to refuse participation or withdraw from the study at any time. Written informed consent was obtained from mothers and verbal assent was obtained from their child.

Mother–child dyads were randomized to either the intervention or control groups after baseline data collection. The investigators and research assistants who collected data were blinded to the group assignment. Because of the nature of the intervention, study participants were not similarly blinded.

Data were collected just before the intervention (T_0), and at 3 months (T_1) and 6 months (T_2) after T_0. All mothers completed mail-in questionnaires about family demographics, maternal acculturation, family health behaviors, and child-feeding practices at T_0. They were also given pedometers (Yamax Digi-Walker SW-701) to assess physical activity over 1 week. All these assessments, except for demographic and acculturation measures, were repeated at T_1 and T_2. Research assistants obtained participating mothers' weight, height, BMI, and waist circumferences and their child's weight and height at T_0 and T_2. On completion of each assessment, mothers each received an incentive of one $10 gift card at T_0 and one $20 gift card at T_1 and at T_2.

Intervention group participants received a 7-inch tablet computer (DELL Venue 7) and instructions on how to access the intervention modules. Participants were allotted 1 week to complete each of the eight modules. They were able to review past modules but could only advance to the next module after the end of 1 week. Research team members contacted participants via telephone periodically to resolve any tablet-related problems.

Control group members received weekly mailings of printed health information relevant to preschool-aged children over the 8 weeks. The topics included an introduction to the study, food safety, choking hazards, oral health, immunizations, appropriate antibiotic use, injury prevention, and disaster preparation. The materials were adapted from Centers for Disease Control and Prevention, KidsHealth, and the American Academy of Pediatrics. Articles were first written in English and then translated into Chinese.

Measures

All subjects' weights and heights were measured while wearing light-weight clothes and no shoes. Stature was measured using a 214 Road Rod portable stadiometer, which has graduations of 1/8 inch (0.1 cm). Body weight was measured by using the 840 Bella Digital Scale (Vogel & Halke GmbH & Co), which has graduations of 0.2 lb (100 g). Scales were calibrated according to the manufacturer instructions before measuring each subject. BMI was calculated as weight in kilograms divided by height in meters squared.

Waist circumference was measured midway between the lowest rib and the superior border of the iliac crest. The circumference was given as the mean of the two measurements to the nearest 0.1 cm.

The sociodemographic questionnaire assessed participants' ages, parental education and occupation, household members, availability of television and computers at home, feeding situation during infancy, and knowledge of obesity.

Acculturation was assessed with the 21-item Asian Self-Identity acculturation scale (Chen & Kennedy, 2005; Suinn, Khoo, & Ahuna, 1995). Measures include language skills, racial identification, ethnic origin; association, preferences; perceptions and beliefs, birth place, and generation status in United States. The Cronbach alpha for the Asian Self-Identity acculturation scale was 0.79 to 0.91 for Chinese Americans (Suinn, 1998; Suinn et al., 1995). This questionnaire is available in Chinese and English at a fifth-grade reading level.

The following instruments have been translated and back translated and reviewed by content experts to ensure the content and face validity.

The Family Eating and Activity Habits Questionnaire (FEAHQ) is a 29-item questionnaire used to assess the environmental factors and family eating behaviors for both mother and child (Golan & Weizman, 1998). It has four subscales: activity level, stimulus exposure, eating related to hunger, and eating styles. The FEAHQ has an established validity and internal consistency (Golan & Weizman, 1998). In this current study, the Cronbach alpha ranged from .71 to .78.

Mothers self-reported child-feeding behaviors using the 28-item Child Feeding Questionnaire (Birch et al., 2001; Burrows, Warren, & Collins, 2010). The domains include feeding and perceived responsibility, parent and child's weight status, weight concerns, child's food preferences, pressure to

eat, and restrictions and monitoring of child's eating. The Cronbach alpha ranged from .76 to .81 in this study.

The Maternal Self-Efficacy scale, a 12-item scale, measures the mother's self-efficacy for promoting healthy eating, physical activity, and in limiting noncore foods. Participants rated their self-efficacy for each item as: *not at all confident, slightly confident, moderately confident, very confident*, and *extremely confident*. In this study, the Cronbach alpha ranged from .72 to .79.

Mothers reported their overall satisfaction with the intervention and gave feedback on its format, content, delivery, usability, usefulness, literacy level, communication style, and cultural appropriateness via phone interviews conducted in Cantonese at the end of the study.

Analytic Strategy

Descriptive statistics were calculated for demographic characteristics and all major study variables. *t* Tests were used to examine differences in quantitative variables between the intervention and control groups at baseline when they were normally distributed and nonparametric bootstrapped bias-corrected confidence intervals were used for mean differences of nonnormally distributed variables. Multilevel linear regression models were estimated to test the linear change over three time points (T_0, T_1, T_2). These models were used for analysis of the outcomes over time and to test for differences between the groups in their linear change trajectories. Estimation for the multilevel regression was carried out with the bootstrap using 5,000 draws to accommodate the small sample size and nonnormality of the outcome. Paired *t* tests were used to calculate the change in BMI in children at baseline and at 6-month follow-up.

Because of the small sample size, a Cohen's *d* was used to estimate for the differences between the intervention and comparison group at 6 months (Cohen, 1988). The effect sizes were calculated by dividing the difference of the mean change in the intervention groups and control groups by the standard deviation of the pretreatment scores. The formula for calculating effect size is d = (Mean1 − Mean2)/(pooled *SD*) where *d* as the difference between the means at 6-month follow-up, divided by pooled standard deviation. Effect size: small (0.2), medium (0.5), and large (0.8) is used when interpreting the effect of an intervention (Cohen, 1988).

The statistical significance of all tests was evaluated at a p value <.1. Stata Statistical Software, Release 13 (from StataCorp LP, College Station, Texas, USA) was used for data analysis.

Power Analysis. With the sample of 15 children in each group (30 total), we will be able to detect an effect size of 1.1 (Cohen, 1988), assuming an alpha of .05, power of .80, and an intraclass correlation of .5 (Liu, Spybrook, Congdon, Martinez, & Raudenbush, 2006; Raudenbush & Liu, 2000).

Results

Sample Characteristics

Thirty-two mother–child dyads were randomized; half to the intervention and half to the control group. The mean age of the children was 4.31 (*SD* = 0.69) years. Fifteen of the children were girls (46.9%), and 12 children (37.5%) were overweight or obese with BMI greater than the 85th percentile based on Centers for Disease Control and Prevention growth chart. The mean maternal age was 36 (*SD* = 4.9) years, and the mean number of years of education was 13 (*SD* = 3.5) years. Their mean acculturation score was 1.92 (*SD* = 0.31) suggesting low acculturation. The mean BMI for mothers was 25.0 (*SD* = 2.71) and average waist circumference was 33.7 inches (*SD* = 2.45). Baseline variables did not differ significantly between intervention and control groups (see Tables 1 and 2).

Effect of the Intervention

Twenty-nine mother–child dyads (90.6%) completed the baseline and follow-up measures. No significant differences were found in baseline variables between children who provided follow-up data and those lost to follow-up.

There was no difference in child's BMI between baseline and 6 months postbaseline assessment (t = 1.21, p = .24). Significantly more of the mothers in the intervention group decreased their BMI (z = −14.18, p = .001) and increased their confidence for promoting healthful eating at home compared with those in the control group (z = −2.51, p = .01). Medium effect sizes were found for maternal BMI (d = .53), maternal waist circumference (d = .52), and maternal self-efficacy for promoting healthy eating (d = .73). Small effect sizes were found for parental perceived weight (d = .43), child-feeding practice related to restriction (d = .27), maternal physical activity (d = .20), FEAHQ home stimulus (d = .37), FEAHQ maternal eating related to hunger (d = .32), and maternal self-efficacy for limiting TV viewing (d = .29; see Table 3 for effect size).

Postintervention Satisfaction Survey

Seven participants were randomly selected to complete postintervention satisfaction phone surveys. Six of 7 participants rated that they were "extremely satisfied" with the program, and one of the participants rated "satisfactory" because she or he had difficulties using the tablet. Several themes were identified as contributors to the success of the intervention: (a) the convenience and ease of use of the tablets, (b) the engaging appeal of the multimedia educational modules, (c) the use of Chinese language, (d) the use of culturally appropriate food menus and health tips, (e) the endorsement by health professionals, (f) motivation from the pedometer, and (g) the theme song as an effective memory aid.

Table 1. Means and Standard Deviations for Child's BMI, Maternal BMI, and Waist Circumference and CFQ Scores Over Three Time Points by Treatment (N = 16) and Control (N = 16) Groups.

	Intervention			Control		
Variable	T_0	T_1	T_2	T_0	T_1	T_2
Child BMI	16.86 (1.57)		16.58 (1.43)	16.24 (1.28)		16.25 (1.34)
Mother BMI	24.67 (2.89)	22.77 (2.71)	24.49 (2.46)	25.30 (2.57)	25.59 (2.56)	25.60 (2.65)
Mother's waist circumference, inches	33.99 (2.42)	35.50 (7.76)	32.07 (2.63)	33.48 (2.54)	33.71 (2.93)	32.96 (3.01)
CFQ perceived (mean score)						
Responsibility	3.63 (0.76)	3.58 (0.41)	3.49 (0.60)	3.79 (0.56)	3.56 (0.67)	3.60 (0.47)
Parent weight	3.09 (0.50)	3.20 (0.22)	3.03 (0.37)	3.09 (0.41)	3.27 (0.36)	3.25 (0.34)
Child weight	3.08 (0.52)	3.02 (0.39)	3.00 (0.36)	3.02 (0.37)	3.00 (0.49)	2.98 (0.63)
CFQ concern about child weight mean score	3.54 (0.83)	3.27 (0.82)	3.22 (0.94)	3.46 (0.88)	3.46 (0.74)	3.42 (0.85)
CFQ restriction mean score	3.96 (0.66)	3.87 (0.60)	3.75 (0.65)	3.76 (0.68)	3.63 (0.83)	3.55 (0.73)
CFQ pressure to eat mean score	3.56 (0.85)	3.48 (0.73)	3.37 (0.64)	3.32 (0.99)	3.37 (0.94)	3.39 (0.77)
CFQ monitoring mean score	3.58 (0.88)	3.51 (1.17)	3.62 (1.02)	3.31 (1.09)	3.62 (0.72)	3.60 (1.16)

Note. T_0 = baseline; T_1 = 3 months after the baseline; T_2 = 6 months after the baseline; BMI = body mass index; CFQ = Child Feeding Questionnaire; FEAHQ = Family Eating and Activity Habits Questionnaire.

Table 2. Means and Standard Deviations for FEAHQ Scores, Maternal Self-Efficacy Scores, and Pedometer Steps Over Three Time Points by Treatment (N = 16) and Control (N = 16) Groups.

	Intervention			Control		
Variable	T_0	T_1	T_2	T_0	T_1	T_2
FEAHQ (total score)						
Mother activity level	3.50 (1.02)	3.17 (1.21)	3.47 (1.04)	3.38 (0.99)	3.77 (0.63)	3.64 (0.93)
Children activity level	−9.10 (11.92)	−10.17 (12.66)	−6.93 (18.09)	−9.97 (17.29)	−10.15 (16.62)	−8.19 (15.14)
Stimulus	8.70 (2.57)	8.46 (2.78)	9.22 (3.48)	7.18 (3.40)	7.88 (2.42)	8.33 (2.55)
Eating related to hunger—Child	5.78 (1.82)	6.07 (1.91)	5.73 (2.25)	5.38 (2.13)	5.38 (2.43)	5.50 (2.35)
Eating related to hunger—Mother	1.06 (0.44)	1.13 (1.52)	0.93 (0.46)	0.81 (0.40)	0.77 (0.44)	0.86 (0.36)
FEAHQ eating style—Mother	12.19 (5.19)	9.73 (5.71)	9.63 (5.66)	11.51 (5.11)	10.69 (4.11)	12.12 (4.66)
FEAHQ eating style—Children	19.48 (7.33)	16.74 (6.22)	18.22 (7.29)	18.67 (4.33)	16.00 (5.69)	18.02 (6.42)
Maternal self-efficacy for						
Promoting health eating	3.96 (0.59)	3.82 (0.49)	4.04 (0.54)	3.93 (0.54)	3.87 (0.61)	3.59 (0.50)
Limiting noncore foods	2.69 (0.92)	2.92 (1.20)	3.04 (1.01)	3.14 (0.92)	3.28 (1.11)	2.98 (1.04)
Promoting physical activity to replace viewing TV/DVD	3.81 (0.83)	3.73 (0.88)	3.67 (1.11)	3.60 (0.99)	4.15 (0.80)	3.64 (1.08)
Limiting viewing	3.50 (1.02)	3.17 (1.21)	3.38 (1.08)	3.38 (0.99)	3.77 (0.63)	3.64 (0.93)
Pedometer steps (physical activity)	7942.53 (4654.29)	8057.80 (5952.21)	8953.63 (4978.65)	9366.00 (5316.39)	9841.00 (4829.47)	9741.04 (2693.12)

Note. T_0 = baseline; T_1 = 3 months after the baseline; T_2 = 6 months after the baseline; BMI = body mass index; CFQ = Child Feeding Questionnaire; FEAHQ = Family Eating and Activity Habits Questionnaire.

Discussion

This pilot study suggests that a tablet-based intervention for low-income, low-acculturation Chinese mothers is feasible and favorably received. The intervention significantly decreased maternal BMI and waist circumferences which are risk factors for cardiovascular disease, diabetes, and some cancers (Schrempft, van Jaarsveld, Fisher, Fildes, & Wardle, 2016; Schrempft, van Jaarsveld, Fisher, & Wardle, 2015). It increased maternal confidence in encouraging healthful habits at home. The improvement of maternal self-efficacy in promoting healthy eating, limiting television viewing, and reducing unhealthy home stimuli are critical in eliminating obesogenic factors in the home (Adair et al., 2014; Bond et al., 2011).

Mothers in the intervention group also improved their physical activity, eating habits, and feeding practices comparedto mothers in the control group. As parental feeding practices and health behaviors affect children's risk for obesity (Anzman, Rollins, & Birch, 2010; Baranowski et al., 2010; Thompson, 2010), the establishment of healthful eating habits and physical activity early

Table 3. Effect Size for Outcome Variables.

Variable	Effect size
Child BMI	0.09
Mother BMI	0.53
Mother's waist circumference, inches	0.52
CFQ perceived responsibility mean score	0.08
CFQ perceived parent weight mean score	0.43
CFQ perceived child weight mean score	0.17
CFQ concern about child weight mean score	0.13
CFQ restriction mean score	0.27
CFQ pressure to eat mean score	0.06
CFQ monitoring mean score	0.07
FAEHQ mother activity level total score	0.20
FEAHQ children activity level total score	0.03
FEAHQ stimulus total score	0.37
FEAHQ eating related to hunger—Child total score	0.04
FEAHQ eating related to hunger—Mother total score	0.32
FEAHQ eating style—Mother	0.03
FEAHQ eating style—Children	0.04
Maternal self-efficacy for promoting health eating	0.73
Maternal self-efficacy for limiting noncore foods	0.03
Maternal self-efficacy for promoting physical activity to replace viewing TV/DVD	0.14
Maternal self-efficacy for limiting viewing	0.29
Pedometer steps	0.13

Note. BMI = body mass index; CFQ = Child Feeding Questionnaire; FEAHQ = Family Eating and Activity Habits Questionnaire. Effect size: small (0.2-0.49), medium (0.5-0.79), and large (>0.8).

on is important for obesity prevention in preschool-aged children.

Although children's BMI did not change significantly during the course of this study, the 6-month time frame may have been insufficient to assess this change. A small effect was found in child-feeding practice and home stimulus change suggesting the potential for positive effects on children as well as on mothers.

A medium effect size was also detected in reducing maternal BMI and waist circumference, and maternal self-efficacy for promoting healthy eating. Contributors to the success of the intervention in maternal health behaviors may have included the delivery of culturally tailored health information, motivational materials, practical guidance, and easy-to-adapt food menus through convenient and accessible tablets. The results of our study are supported by previous studies suggesting that multimedia-based education programs demonstrated significant improvement in health literacy and greater patient engagement (Lu, Winkelman, & Wong, 2016; Myint-U et al., 2008; Sun et al., 2007). In addition, the findings from the focus group on the intervention material development and postintervention satisfaction phone surveys revealed that the tablet-based modules were appealing and participants favored accessing intervention materials through tablet computers.

Our culturally tailored program may have contributed to the effect of the intervention. When delivering culturally congruent care, health professionals should be aware that "one size" does not fit all when caring for patients from various cultural backgrounds. Therefore, it is essential to tailor interventions for the target population that we are trying to reach. Extensive research has demonstrated that the use of culturally and linguistically tailored interventions was associated with positive changes in participants' health literacy and behaviors (Nguyen et al., 2015; Sun et al., 2012; Sun et al., 2013). Culturally adapted food items and menus have been shown to improve nutrition, specific knowledge, and guideline compliance (Song et al., 2010; Sun et al., 2012). When tailoring our intervention materials for the intended population, we used images representing the Asian culture and incorporated food items from the Chinese culture such as steamed buns and stir-fry items using common Chinese vegetables. Our intervention program provided examples of easy exercise and family activities specific to residents of an urban inner city. The intervention materials also included practical tips from health professionals on achieving a healthier BMI, food label reading instructions, shopping tips, and simple sample menus for Chinese and American foods. The endorsement from health care professionals on the intervention education modules may have contributed to the success of the intervention as Asian cultural motivation effect of deference to authority was also suggested by literature (Gelfand, Erez, & Aycan, 2007; Hawks, Madanat, Merrill, Goudy, & Miyagawa, 2003).

The use of songs has been shown to facilitate learning in adults (McClelland et al., 2015; Sun et al., 2007) and especially in children (Green, 2005; Shore & Strasser, 2006). Development of a song with the 5-4-3-2-1-0 message in this study may have helped in information retention and motivation. Use of animations, short videos, and songs can enhance the learning of health information in individuals with low health literacy and income levels and thus promote health behavior changes (Higgs et al., 2014; D. S. Wang et al., 2015).

This intervention can be used in community and clinical settings. For example, health educators and clinicians can access and use the modules and handouts as teaching tools when teaching their clients or patients about childhood obesity prevention, particularly those with limited English proficiency. Additionally, patients can review the materials, presented by their providers, either through their mobile devices or computers at their own convenience.

The study limitations included the small sample size and short length of follow-up. Future studies should examine the long-term impact of family-based childhood obesity prevention intervention on maternal outcomes. Additionally, further studies should expand the study population to include grandparents and test the intervention modules through other mobile devices, in different languages and assess changes over a longer period of time.

In conclusion, using a multimedia education module tailored for the Chinese immigrant mothers, delivered via tablet computers, was successful in producing short-term maternal behavior changes related to diet and exercise. This study describes a novel approach to health education and promotion. Additionally, this study may fill gaps in knowledge regarding childhood obesity for low-income Chinese American families.

Declaration of Conflicting Interests

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