

# The NEW Keiki Program Reduces BMI z-scores Among Overweight and Obese Children and BMI Among Their Adult Caregivers in Hawai'i

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## Abstract

The high prevalence of childhood obesity highlights the need for effective weight management interventions. This study evaluated a family-based weight management program (Nutrition+Exercise+Weight Management; NEW Keiki) in overweight and obese children and their adult caregivers. Data were collected on overweight (body mass index, BMI = 85th-94th percentile) and obese (BMI > 95th percentile) children (n = 75, 5-14 years) and their adult caregivers (n = 104). Seventy-one percent of the enrolled children identified as Native Hawaiian, Pacific Islander, and/or Filipino (NHPI+F). Families participated weekly in a multidisciplinary lifestyle program for 8-9 weeks (intervention phase); follow-up visits occurred at 6-months and 12-months post-intervention. Long-term data (14-50 months post intervention) were collected by chart review for the children. Change in children's BMI z-score and adult BMI were analyzed. The effects of ethnicity, acceptance of government assistance, and program attendance were evaluated. Participants identifying as NHPI+F and/or receiving government assistance had higher baseline BMI z-scores and BMIs. In children, BMI z-score decreased from baseline at all evaluation visits (-0.05 at 2 months [P < .001], -0.07 at 6-month follow-up [P < .001], -0.04 at 12-month follow-up [P = .05], -0.06 at long-term follow-up [P = .01]). At the 2 month visit BMI decreased from baseline for adults (-0.39 [P < .001]). Decreases in BMI z-score and BMI were independent of program attendance, ethnicity, and acceptance of government assistance. This study, unique in its inclusion of both adults and overweight children, supports the effectiveness of a community-developed program to address weight management in an ethnically diverse population.

## Keywords

Obese; Native Hawaiian; Pacific Islander; Filipino; Diverse; Lifestyle changes; Multidisciplinary

## Abbreviations

BMI = Body mass index  
KMCWC = Kapi'olani Medical Center for Women and Children  
NEW = Nutrition+Exercise+Weight Management  
NHPI+F = Native Hawaiian, Pacific Islander, and/or Filipino  
USPSTF = United States Preventive Services Task Force  
YMCA = Young Men's Christian Association

## Introduction

Although national family-based weight management programs address pediatric obesity and obesity-related co-morbidities,<sup>1</sup> obesity prevalence for youth 2-19 years old remains high at 18.5% in 2015-2016.<sup>2</sup> The 2017 United States Preventive Services Task Force (USPSTF) Recommendation Statement concluded that childhood ( $\geq 6$  years) weight management interventions

are beneficial. These interventions should be comprehensive, intensive behavioral interventions with multiple components, including parent and child involvement, goal-setting, self-monitoring, contingent rewards, problem-solving, supervised physical activities, and nutrition information.<sup>3</sup> Multidisciplinary programs targeting overweight and obese children are most effective when they involve the whole family.<sup>4-6</sup> Consensus and evidence are still forming on specifics and the best structured approach to take, and dependable funding is largely lacking.<sup>7,8</sup> Engaging families continues to be a challenge for participation in longer-term programs. Currently there is lack of information on the structure and efficacy of weight management programs in high-risk populations and sub-communities.

Pediatric weight maintenance data on long-term outcomes (> 2 years), critical for confirming treatment effect, are lacking,<sup>9</sup> especially for underrepresented ethnic minorities and lower socioeconomic populations, who are at higher-risk for chronic diseases like obesity.<sup>1,10-13</sup> Hawai'i has a diverse, multiethnic community with high rates of youth overweight and obesity. In 2005, 26.2% of sixth, seventh, and eighth graders were reported as overweight or obese.<sup>14</sup> In 2015, 28.3% of high school students were reported as overweight or obese.<sup>14</sup> Long-term community-based studies can contribute insight in these populations.<sup>11</sup>

In 2013, the Nutrition+Exercise+Weight Management (NEW) Keiki Program (*keiki* means "children" in the Hawaiian language) was initiated with Kapi'olani Medical Center for Women and Children (KMCWC) in Honolulu, Hawai'i and the Young Men's Christian Association (YMCA) of Honolulu to address the local pediatric overweight and obesity epidemic and lack of effective programs available to families in Hawai'i. NEW Keiki was premised on the USPSTF recommendations of family inter-dependence and shared obesogenic environment theories, hypothesizing associations between child and parent outcomes and success.<sup>15-17</sup>

A core team composed of a pediatrician, registered dietician, fitness trainer, and YMCA program director was assembled to develop an evidence-based program and remained intact throughout its 5-year lifespan. Funding for the program was provided by community partners and grants. Weight management programs validated in other populations were considered but not used due to cost and availability. The team created an original curriculum tailored to local needs and cultural norms.

This study evaluated NEW Keiki for change in children's body mass index (BMI) z-scores, not specific for ethnicity. BMI z-scores measure the number of standard deviations from the reference median BMI and allows comparisons across different age and gender groups. This study also examined adult caregivers' BMI and sustained treatment effect at follow-up.

## Methods

### NEW Keiki Design

NEW Keiki was a multidisciplinary, family-based program to treat childhood overweight and obesity and related comorbidities by changing family habits. Educational sessions were held weekly in evenings to maximize family participation by minimizing conflicts with work and school schedules. These sessions were held at strategic locations in community locations (YMCA Nu'uano and Waipahu branches, KMCWC, Pali Momi Medical Center, and Adventist Health Castle) to ease transportation burden. Families were grouped into cohorts that were run consecutively due to team capacity. The first cohort started on April 17, 2013.

The intervention phase consisted of 2-month curriculum on nutrition, home environment, fitness, screen time, medical comorbidities, mental health, and family support. Sessions were led by a multidisciplinary team: pediatrician, registered dietitian, fitness trainer, chef, and program facilitator. The facilitator organized referred families and program staff and oversaw the logistics of all individual sessions, follow-ups and extracurricular activities. The facilitator and program volunteers called and texted families between sessions and after the intervention phase to maintain contact and nurture family engagement.

Each session began with families exercising together. Core content was directed at caregivers while children continued exercising with the trainer. Families were reunited at the end of class to summarize objectives with an activity followed by goal-setting. The dietitian focused nutrition classes on elimination of artificial ingredients, portion control, mindful eating, and healthy eating environments. Screen time limitations and fitness were addressed in sessions taught by the program facilitator and fitness trainer. The pediatrician led discussions on obesity-related co-morbidities as well as behavioral health topics including body image, motivation and stages of change, communication and support within families, and connection of emotional and physical health. A chef conducted cooking classes to teach basic knife skills and food preparation and supervised families creating and eating meals together.

The maintenance phase consisted of follow-up sessions at 6- and 12-months post-intervention (at 8-9 and 14-15 months, respectively, from start date). At follow-up sessions, the pediatrician and registered dietitian met with families individually to review previously set goals, evaluate progress, answer

questions, address challenges, and provide encouragement. The fitness trainer conducted fitness testing on index children and the facilitator collected anthropometric data and lifestyle surveys. Optional monthly extracurricular activities available during the maintenance phase (ie, hikes and farmer's market tours) encouraged family engagement and troubleshooting of ongoing challenges.

In the long-term follow-up phase, data were collected (as available) for the referred child from their medical record. Data were collected up to 52 months from the child's start date in the program. Long-term data were collected through August 31, 2017 and follow-up time ranged from 14-50 months from the end of the intervention.

### Study Participants

Community pediatricians on O'ahu were asked to refer motivated pediatric patients (ages 7-12 years) and their families to NEW Keiki. For this research, families were included if the referred child (index subject) was overweight (BMI 85th-94th percentile) or obese (BMI  $\geq$ 95th percentile) and had at least 1 participating parent/adult caregiver. Child age was not an exclusion criteria. Families who could not provide informed consent in English were excluded.

The study was reviewed and approved by the Western Institutional Review Board (20140337). Parents/caregivers provided informed consent and children 6-17 years old provided assent. Family units were consented together, and included other siblings and non-nuclear family members who wanted to participate and who provided consent and assent as appropriate. Consent to participate in the research was not required for participation in NEW Keiki. Data reported are only from families that agreed to participate in the research.

### Data Collection

Data were collected at up to 5 time points (Figure 1): start of the intervention (Visit 1), immediate post-intervention (Visit 2), 6-months post-intervention (Visit 3), 12-months post-intervention (Visit 4), and 14-50 months post-intervention (Visit 5; by chart review only). Height, weight, BMI, blood pressure and heart rate were taken on-site with participants in bare feet and light clothing by program volunteers using calibrated equipment, scales, and stadiometers.

Families were asked to complete written questionnaires at each visit to collect demographics, attitudes, health habits, and socioeconomic status. Questions were based on previously validated instruments.<sup>18,19</sup> Some questions were altered to reflect local norms.

Trainers completed fitness evaluations on index children to assess cardiovascular health, flexibility, and balance. The refer-

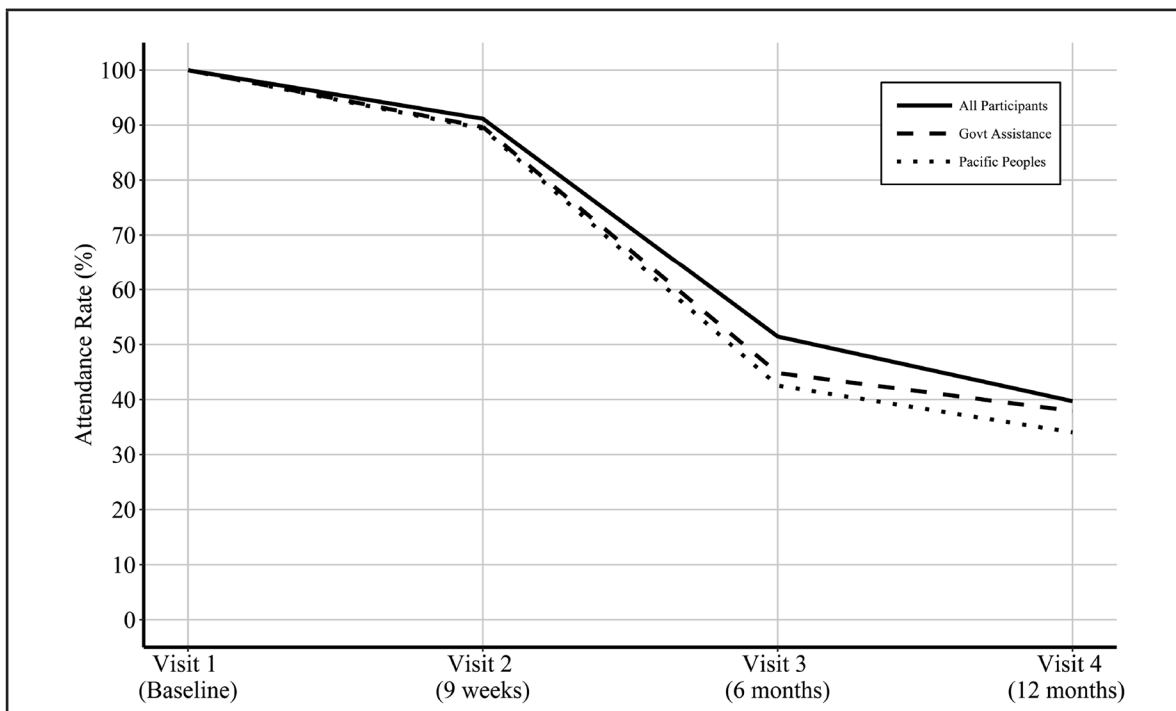
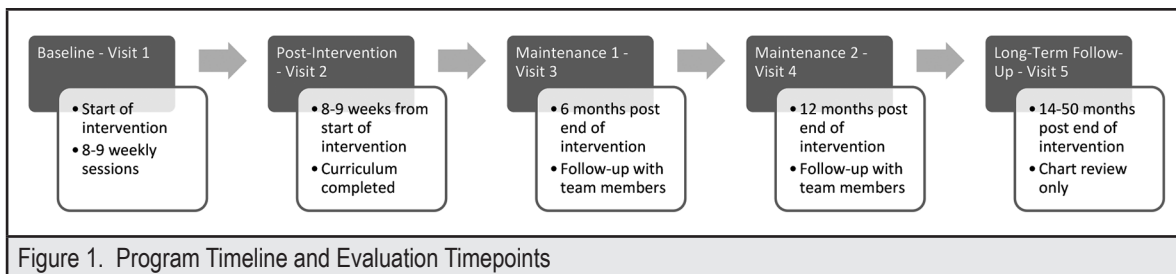


Figure 2. Program Attendance of Families, by Acceptance of Government Assistance and Ethnicity, at Formal Visits Immediately Post-intervention (Visit 2), 6 Months (Visit 3) and 12 Months (Visit 4) Post-intervention

ring pediatrician obtained fasting laboratory screenings for comorbidities such as hyperlipidemia, diabetes, and non-alcoholic liver disease within 1 year of enrollment in NEW Keiki.

Each family was asked about program satisfaction during an in-person, post-participation interview at Visit 4. Volunteers who did not administer the interventions interviewed participants to encourage honest and open responses. Families who did not attend Visit 4 had phone interviews and were considered lost to follow-up if not reached after 3 attempts.

After Visit 4 for the final cohort, follow-up anthropometric data were collated on index children from their medical record (Visit 5). Anthropometric and lab data were reported if documented from a well check or obesity-focused visit. If multiple visits were eligible, Visit 5 was the furthest from end of the child's intervention.

### Statistical Analysis

Exploratory analyses were conducted for participation, demographic, and clinical data using descriptive statistics. To examine changes in BMI z-scores (children) and BMI scores (adults), Singed rank test was utilized. Ethnicity or government assistance effects on BMI z-score or BMI score were examined using the Mann-Whitney test. Bivariate associations between attendance and ethnic group or family financial status were determined with Chi-squared or Fisher's exact test. Relationships between BMI z-score change (in children) and BMI change (in adults) were evaluated using Pearson correlation coefficient. A *P*-value of  $< .05$  was considered significant. R Version 3.4.3 (R Development Core Team: Vienna, Austria) was used for the analyses.

## Results

### Participants

A total of 77 families comprised of 267 participants (including 87 physician-referred children) enrolled in 12 cohorts (April 17, 2013-May 31, 2017). Cohorts of 4-8 families (averaging 6.4 families per cohort) attended weekly sessions during the intervention phase. As the curriculum evolved, the first 3 cohorts attended 8 sessions over 8 weeks, and the remaining 9 cohorts attended 9 sessions over 9 weeks. Assuming perfect attendance, total contact hours per enrolled family equaled 26.5 hours over the 14-month program (this includes activities during the maintenance phase).

Seventy-five children (86%) from 68 families consented to participate in the research study. One hundred thirty-five adults enrolled in NEW Keiki — most were parents, but the group also included grandparents, aunts, and uncles. Of these, 104 (77%) consented, including 61 (59%) who were mothers of index subject. Beyond the index child and adult caregivers, 34 family members (siblings and cousins < 18 years) were included in the program to encourage family participation but were not included in the results.

Table 1 shows the characteristics of the index children. Native Hawaiian, Pacific Islander, and/or Filipino (NHPI+F) represented the majority of participants (71%). Half of the families reported accepting government assistance from various programs.

### Program Attendance and Retention

Of 68 families, 62 (91%) completed intervention phase, however, only 22 of 68 families (32%) attended both Visits 3 and 4 (Figure 2). Eighteen families (27%) attended either Visit 3 or 4, and 28 families (41%) attended neither, including 6 families (9%) who dropped out.

Forty-seven families (69%) identified as NHPI+F. Intervention completion was 42 of 47 (89%) for NHPI+F and 20 of 21 (95%) non-NHPI+F families. Attendance at Visits 3 and 4 were 23% for NHPI+F families and 52% for non-NHPI+F families ( $P=.03$ ).

Among families accepting government assistance, 26 of 30 (87%) completed the intervention phase as compared to 28 of 30 (93%) who did not accept government assistance ( $P=.44$ ). Attendance at Visits 3 and 4 were 31% for families accepting assistance and 42% for families who did not accept assistance ( $P=.38$ ).

Anthropometric data collected during Visit 5 was available for 49 of 75 (65%) children.

Table 1. Baseline (Visit 1) Characteristics of Index Children	
	median (min, max)
<b>Anthropometrics (n=74*)</b>	
BMI, kg/m <sup>2</sup>	29.02 (21.04, 51.82)
BMI z-score	2.37 (1.42, 3.01)
Weight, kg	63.75 (30.80, 154.90)
Height, cm	146 (121, 173)
<b>Demographics (n=75*)</b>	
Age, y	10 (5, 14)
<b>Gender</b>	
Male	38 (51%)
Female	37 (49%)
<b>School Type</b>	
Public	62 (85%)
Private	11 (15%)
No response	3 (4%)
<b>Ethnic Group</b>	
Native Hawaiian	26 (35%)
Native Hawaiian and/or Pacific Islander	39 (52%)
Native Hawaiian, Pacific Islander, and/or Filipino	53 (71%)
<b>Accepting Government Assistance (n=64*)</b>	
SNAP	15 (23%)
Free/reduced School Lunch	23 (36%)
WIC	11 (17%)
Medicaid	28 (44%)
"Yes" to at least one of the above choices	32 (50%)
<b>Laboratory Values (n=68*)</b>	
<b>Cholesterol, mg/dL</b>	
Total ≥ 170	23 (34%)
HDL < 40	23 (34%)
LDL ≥ 100	21 (31%)
HbA1c ≥ 5.7 (n=59*)	23 (39%)
ALT ≥ 30 (n=58*)	12 (21%)

Data are presented as median (range) unless otherwise indicated. HDL indicates high-density lipoprotein; LDL indicates low-density lipoprotein; HbA1c indicates Hemoglobin A1c; ALT indicates alanine aminotransferase. \*Variations in n were due to (1) baseline anthropometric data not captured in one child, (2) some participants choosing not to answer demographic questions, and (3) laboratory values not collected by pediatricians.

## BMI z-score and BMI

BMI z-scores for children progressively decreased from baseline (Visit 1) at all evaluation visits. This decrease in BMI z-score was statistically significant at Visits 2, 3, and 5 (Table 2). BMI for adults decreased progressively from baseline at Visits 2, 3, and 4, achieving statistical significance only at Visit 2.

The median baseline BMI z-score was 2.37. The median baseline BMI z-score was higher in NHPI+F children (2.40) than non-NHPI+F children (2.20;  $P=.02$ ) and in those accepting government assistance (2.49) versus those who did not (2.27;  $P=.01$ ). Median baseline BMI of adults was 31.77 and was higher in NHPI+F adults (34.26) than non-NHPI+F adults (27.1;  $P<.001$ ) and between those accepting assistance (33.17) and those who did not (30.86;  $P=.04$ ).

The correlation coefficient between a child's BMI z-score change and their adult caregiver's BMI change were small ( $\rho=.04$  from Visit 1 to Visit 2;  $\rho=.04$  from Visit 1 to Visit 3;  $\rho=.01$  from Visit 1 to Visit 4) and not significant.

## Post-Participation Findings

At Visit 4 families were asked to complete a questionnaire about their experience in NEW Keiki. The majority of families completed the survey ( $n=41$ , 60%). Most families reported continuing at least 50% of lifestyle changes made during the program (88%), 61% reported family participation in at least one extracurricular activity outside of the weekly intervention classes, and 80% followed-up with their pediatrician (Table 3). Moreover, families were satisfied with the program (95%) and felt that it met their expectations and needs (90%) in a culturally sensitive manner (88%).

Table 2. BMI and BMI z-score Changes Compared to Baseline Visit 1 of Study Focus Participants										
	Visit 1 BMI z-score	P	Change at Visit 2	P	Change at Visit 3	P	Change at Visit 4	P	Change at Visit 5	P
<b>All Children</b>	2.37 (1.42, 3.01)	—	-0.05 (-0.13, -0.01)	<.001	-0.07 (-0.20, -0.02)	<.001	-0.04 (-0.17, 0.02)	.05	-0.06 (-0.23, 0.05)	.01
NHPI+F children	2.40 (2.22, 2.70)	.02	-0.04 (-0.09, -0.01)	.17	-0.06 (-0.11, -0.01)	.05	-0.04 (-0.16, 0.02)	.91	-0.05 (-0.17, 0.05)	.42
Non-NHPI+F children	2.20 (1.96, 2.44)		-0.09 (-0.16, -0.02)		-0.11 (-0.23, -0.06)		-0.04 (-0.20, 0.02)		-0.11 (-0.31, 0.04)	
Children in families accepting government assistance	2.49 (2.17, 2.76)	.01	-0.06 (-0.13, -0.01)	.92	-0.07 (-0.18, -0.02)	.99	-0.05 (-0.20, -0.01)	.33	-0.06 (-0.16, 0.05)	.52
Children in families not accepting government assistance	2.27 (1.94, 2.40)		-0.04 (-0.11, -0.01)		-0.07 (-0.18, -0.02)		-0.04 (-0.08, 0.06)		-0.09 (-0.28, 0.05)	
	<b>Visit 1 BMI</b>									
<b>All Adults</b>	31.77 (20.34, 73.62)	—	-0.39 (-0.93, -0.04)	<.001	-0.18 (-0.59, 0.45)	.42	-0.02 (-1.51, 0.48)	.45		
Adults with NHPI+F Children	34.26 (30.29, 41.03)	<.001	-0.39 (-0.93, -0.04)	.72	-0.05 (-0.50, 0.51)	.30	-0.02 (-2.11, 0.54)	.74		
Adults with Non-NHPI+F Children	27.1 (24.91, 31.36)		-0.38 (-0.94, -0.05)		-0.28 (-0.62, 0.15)		-0.02 (-1.06, 0.43)			
Adults in families accepting government assistance	33.17 (30.20, 41.11)	.04	-0.37 (-0.66, -0.04)	.24	-0.19 (-0.40, 0.19)	.81	-0.36 (-1.17, 0.46)	.76		
Adults in families not accepting government assistance	30.86 (26.06, 35.45)		-0.5 (-1.06, -0.16)		-0.18 (-0.68, 0.50)		-0.02 (-1.96, 0.43)			

Data are presented as median (IQR) unless otherwise indicated. NHPI+F indicates Native Hawaiian, Pacific Islander and/or Filipino. P-values for All Children and All Adults compare BMI z-score and BMI between visits. All other P-values compare between groups (NHPI+F vs non-NHPI+F and government assistance vs non-government assistance).

Table 3. Program Satisfaction Post-Participation Survey Results Conducted at Visit 4 n=41 (Response rate 60%)	
<b>Has your family been able to maintain any lifestyle changes made during the program over the last 12 months?</b>	
Yes, about 100% of lifestyle changes	1 (2%)
Yes, about 75% of lifestyle changes	13 (32%)
Yes, about 50% of lifestyle changes	22 (54%)
Yes, about 25% of lifestyle changes	3 (7%)
No, we did not maintain any lifestyle changes	2 (5%)
<b>Did the program meet your family's expectations and/or needs?</b>	
Strongly Agree	25 (61%)
Agree	12 (29%)
Neutral	3 (7%)
Disagree	1 (2%)
Completely Disagree	0 (0%)
<b>Were the class visits:</b>	
Just the right frequency	35 (85%)
Too frequent	1 (2%)
Not frequent enough	3 (7%)
No response	2 (5%)
<b>Did your family bond or make a personal connection with at least one program team member?</b>	
Yes	32 (78%)
No	8 (20%)
No response	1 (2%)
<b>How did the following items make it harder to attend classes, follow-ups and complete the program?</b>	
Participation Fees/Program Cost	41 (100%)
Program Schedule	12 (29%)
Program Location Site(s)	3 (7%)
Transportation	1 (2%)
Childcare or Eldercare	3 (7%)
Concerns about missed school or work	9 (22%)
Family readiness to make changes	7 (17%)
<b>How satisfied was your family with the program?</b>	
Completely satisfied	27 (66%)
Very satisfied	6 (15%)
Satisfied	6 (15%)
Slightly satisfied	2 (5%)
Not at all satisfied	0 (0)
<b>Did your family feel classes and teachings on lifestyle habits were culturally sensitive?</b>	
Strongly Agree	22 (54%)
Agree	14 (34%)
Neutral	2 (5%)
Disagree	1 (2%)
Completely Disagree	2 (5%)

<b>How many extracurricular activities (optional hikes, tours, other activities) did your family participate in since starting the program?</b>	
More than 5 activities	3 (7%)
3-5 activities	7 (17%)
1-3 activities	15 (37%)
None	16 (39%)
<b>Did your family have follow-up in the past 12 months from the primary care doctors who referred you to the program specifically related to lifestyle changes, weight management?</b>	
Yes	33 (80%)
No	7 (17%)
No Response	1 (2%)

## Discussion

The results of this study support the effectiveness of a multi-disciplinary, intensive intervention for pediatric overweight and obesity management. This community-based program, developed according to USPSTF recommendations, met community needs and provided additional evidence that these types of programs can be effective at sustained reduction in BMI z-scores in high-risk, ethnically-diverse populations.<sup>13,20</sup> Ethnic minorities and economically-disadvantaged families are historically underrepresented in pediatric overweight and obesity studies.<sup>3,4,9</sup> Furthermore, the high attendance rate, particularly during the intervention portion of the program, demonstrated the ability of this type of program to engage community members.

The primary outcome of this study was change in child BMI z-score. Previous studies suggested that decreases in BMI z-scores of at least 0.125 were needed to change cardiometabolic risk factors, however, a specific value had not been established.<sup>21</sup> Although the children in this study showed modest BMI z-score reductions (-0.05 at Visit 2,  $P < .001$ ), these reductions were sustained up to 4 years post-participation in the program (-0.06 at Visit 5,  $P = .01$ ). BMI z-score is one way to quantify the benefit of a weight management program, however, participants may benefit in other ways from participation in a program like NEW Keiki.

Sustained lifestyle change is necessary to improve long term health outcomes. NEW Keiki promoted maintaining lifestyle changes by (1) linking contingent rewards to personal and program milestone achievements, (2) hosting group extracurricular events, and (3) encouraging peer and team support of lifestyle goals through calls and texts. Family-based interventions tend to have short term effects,<sup>22</sup> however, children in this study were able to maintain BMI z-score reductions. Interestingly, this reduction was independent of family participation in follow-up visits. There were no differences in BMI z-score reductions between families that attended all follow-up visits and those who did not, supporting the findings of Savoye et al that “leaving the families to their own devices” fosters a sus-

tained treatment effect.<sup>13</sup> Selection bias may have contributed to the ability of families to sustain weight reduction without continued intervention because enrolled families may have been more self-reliant and motivated than families who were referred to the program, but did not enroll.

It is widely accepted that parental obesity is a strong risk factor for childhood obesity, including persistence into adulthood.<sup>2,3</sup> The lack of correlation within families between reduction in adult BMI and child BMI z-scores suggests complex interactions exist between weight management and lifestyle programs. For example, family members may be at different stages of readiness and motivation for change. With a larger sample size, correlations may have been identified.

Retention is also important for ensuring that participants learn skills for long-term change. The retention rate for NEW Keiki during the initial intervention (91%) was significantly higher than other reported programs.<sup>23-25</sup> As a community-developed program, NEW Keiki had the flexibility to adjust to meet participant needs. For example, Cohort 1 included a cooking class and farmer's market tour; all subsequent cohorts replaced the tour with a second cooking class. A third nutrition class was added beginning with Cohort 4 to allow for expansion on topics most interesting to families. Initially, a psychiatrist facilitated the behavioral health discussions, however, the NEW Keiki pediatrician assumed this responsibility by Cohort 4 because families felt more comfortable with familiar team members. A program enrollment fee was instituted starting with Cohort 5 to improve retention and engage families. This fee was refunded incrementally as an incentive. While parents' attitudes about weight management program incentives differ,<sup>26</sup> the goal was to improve retention through USPSTF-endorsed contingent rewards.<sup>3</sup> The enrollment fee decreased in later cohorts based on the feedback received from participants. Additionally, the fee was waived or reduced if families felt the fee was a barrier to enrollment. Although all surveyed families felt that program cost was a barrier to participation (Table 3), they were amenable to a small participation fee. Families recognized the program's value, and willingness to pay a small fee could support financial sustainability for future pediatric weight management programs.

Although participation rates were high during the weekly intervention portion of the program, nearly half of families did not attend any formal follow-ups (Visits 3 and 4). Because maintaining lifestyle change is lifelong, future family programs must have resources to continue follow-up indefinitely.<sup>19</sup> The existing relationship with medical systems allowed for collection of long-term follow-up data on index children by chart review. This is a benefit of integrating a community-based program within the health care system.

The lack of control group and small sample size limited the interpretation of treatment effect. Additional variability was introduced through program changes and use of on-site measurement tools. The relatively small sample size may have been insufficient to fully elucidate the influence of ethnicity and financial status on crucial components of program success. In the current analysis, ethnicity and acceptance of government assistance negatively impacted program retention but not BMI z-score or BMI outcomes. Factors that can influence retention and follow-up rates in high-risk populations include program schedule, work and school disruptions, readiness, and socioeconomic supports necessary for change.<sup>25,29</sup> Other environmental, socioeconomic, and cultural aspects were not analyzed and may also contribute to outcomes.<sup>27,28</sup> In a 2011 Cochrane obesity review, treatment effect can be skewed if families have positive experiences or are confident in their success and thus likely to follow-up; whereas, those more challenged or less confident do not follow-up.<sup>30</sup>

NEW Keiki was unique with its inclusion of adult parents and caregivers and overweight children. To the authors' knowledge, this is the first pediatric weight management program that reported measured (not self-reported) adult BMI outcome.<sup>31</sup> It was encouraging that although NEW Keiki was pediatrics-based, adults also benefitted with decreased BMI. Adult caregiver engagement is crucial to children's success as they depend on family units, particularly parents, to maintain lifestyle changes.<sup>3,4,24</sup> There are limited data and no USPSTF recommendations regarding management of overweight children. NEW Keiki showed that overweight and obese children equally benefit from weight management and healthy living programs. This study suggests that a community-based weight management curriculum is effective in multiethnic communities and those accepting government assistance. NEW Keiki participants achieved long-term weight management success and can serve as a model for future community-based programs.

### **Conflict of Interest**

The authors declare that there is no conflict of interest.

### **Disclosure Statement**

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