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Prevention and treatment of pediatric obesity: a strategy involving children, adolescents and the family for improved body composition

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ABSTRACT

Purpose: Pediatric obesity is a serious health problem affecting 1 of 6 children in the U.S. A two- to threefold increased incidence is evident in the last two decades. This study analyzes the outcomes of the ProActive Kids Foundation three-tiered early intervention program to determine the improvement in body composition in overweight and obese youth by incorporating the family along with the pediatric participant.
Methods: We analyzed data from 884 overweight (BMI between 85% and 95th percentile) or obese (BMI > 95th percentile) youth (5 to 17 years) in a major metropolitan area in Illinois, to determine body composition improvement from an 8-week intervention between 2010 and 2017. Weight, percent body fat, fat free mass and BMI were analyzed using mixed model analysis, ANCOVA and paired *t*-test analysis.
Results: All measures of weight, percent body fat, fat free mass and BMI improved significantly in pediatric participants. Age, county of residence and time impacted weight, body fat, fat free mass and BMI. Gender did not impact the average change in weight or BMI.
Conclusions: The ProActive Kids early intervention program utilizes a targeted approach for the treatment of pediatric obesity during critical developmental ages. By educating parents along with children and adolescents about mental health coaching (lifestyle), nutrition and physical activity, we observed improvements in body composition that have potential to be sustainable.
Practice Implications: The ProActive Kids strategy provides a successful model for future treatment and prevention of pediatric obesity.

Introduction

Pediatric obesity is the most serious health problem of this century (World Health Organization, 2018). Approximately one in six children and adolescents, or 12.7 million youth between 2 and 19 years of age are currently overweight or obese (Centers for Disease Control and Prevention, 2018a, 2018b; Ogden, Carroll, Fryar, & Flegal, 2015). The incidence has increased two- threefold in the last two decades, (World Health Organization, 2018) in spite of prevention efforts, with an upward trend in certain age subgroups (Cockrell Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018). Complex metabolic complications such as, increased insulin resistance, prediabetes, and type 2 diabetes, previously atypical of childhood, manifest into adulthood years, (Bhupathiraju & Hu, 2016; Mareno, 2014) in addition to psychological effects of low self-esteem, low academic achievement, and depression (Towns & D'Auria, 2009). The costs of treatment and complications exceeds $254 billion (Mozaffarian et al., 2015) yet, the progression to its development is for the most part, preventable. The etiology of pediatric obesity involves the complex interplay between genetic, environmental, physiological, and psychosocial factors (Johnson III & Johnson, 2015), irrespective of age, race, ethnic group, region, educational background or socioeconomic strata (Mokdad et al., 2001; Towns & D'Auria, 2009). Those most disparaged are at greatest risk (Strauss & Pollack, 2001). A disproportionate incidence is observed in lower socioeconomic groups due to limited health care and barriers to access healthy foods (Bhupathiraju & Hu, 2016; Mokdad et al., 2001) rates of obesity have increased fastest in minority populations (Strauss & Pollack, 2001). Hispanic (21.9%) and non-Hispanic blacks (19.5%) report a greater incidence than non-Hispanic whites (14.7%) or non-Hispanic

Abbreviations: BMI, Body Mass Index; PAK, ProActive Kids; FFM, Free fat mass.

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Asian youth (8.6%) (Centers for Disease Control and Prevention, 2018a, 2018b). Children from racial and ethnic minority groups and marginalized communities bear an excess burden of obesity (Ogden, Flegal, Carroll, & Johnson, 2002).

Parental involvement is essential for behavioral change to occur, especially during the childhood years (Hudson, McGloin, & McConnon, 2012). In an interesting study by Eckstein et al. (2006), parental perception toward the weight of their child was found to be skewed. Parents not only lacked an accurate recognition of the weight status of their child, but appropriate concern for such. Others found parents considered their child's weight as "normal", when their children were overweight or obese upon medical examination (Newson, Povey, Casson, & Grogan, 2013; Young et al., 2010). These findings indicate the dire need for a more accurate understanding of appropriate weight status by parents, and the reversal of overweight in our society as "normal". Healthcare providers and nurses have a responsibility to provide parents with the association between their child's overweight status or rate of weight gain and established guidelines for body mass index (BMI), as well as the impact of weight on health during routine examinations. Barriers to successful obesity interventions emerging in the literature involve interpersonal influences, such as the lack of breastfeeding (Johnson III & Johnson, 2015), parental engagement, cooking skills, a limited family budget, or understanding the difference between diet and nutrition, in addition to environmental barriers such as an unsafe environment or inaccessible programs (Ling, Robbins, & Hines-Martin, 2016).

The rampant infiltration of technology affects incidence (Johnson III & Johnson, 2015) manifested by time spent watching television and the use of electronic media. Perhaps most concerning is the progressive decline in physical activity in children and adolescents. A mere 27.1% of high school students currently engage in the minimum requirements of 60 or more minutes physical activity each day (American College of Sports Medicine, 2018; CDC, 2016) and many children engage in no physical activity outside of the school environment, although physical activity habits developed during childhood have a lifelong impact (Chin & Ludwig, 2014). Physical activity not only improves body composition but is well established to improve overall health.

Substantial efforts to prevent pediatric obesity demonstrate modest outcomes, at best. Educating children and adolescents to live a healthy lifestyle during early developmental stages is pivotal in their ability to maintain these habits in adulthood. The early intervention program designed by the ProActive Kids Foundation utilizes a three-tiered approach of educating the parent or caregiver along with children and adolescents to implement lifestyle changes to prevent and treat pediatric obesity (ProActive Kids Foundation [PAK], 2018).

Methods

Data

We analyzed a dataset obtained from the PAK Foundation involving 884 children between 5 and 17 years of age who participated in the program between 2010 and 2017. The study involved a quasi-experimental pre-and post-test design. PAK is open to the public. Kids can join the program in a variety of ways such as, parents, caregivers or children learning about the program from a neighbor, teacher, sibling, or anyone who is familiar with it. Many physicians or social workers also make referrals to the program, and in a public setting like a park district, PAK may be included in the program listing. As a result, the sample was not randomly selected for this study.

The initial data obtained for the purpose of the PAK program was obtained with a different objective than the aim of this analysis. Results were analyzed to determine the significance of the change in body composition from baseline measures.

All children resided in the greater Chicagoland area. Proactive Kids was founded in 2008 by Tony Burke, as an early intervention, nonprofit organization with the mission of improving body composition, physical strength, body image and self-esteem in children. According to Burke (PAK, 2018), "kids alone can't turn their lives around" therefore parental support is essential for behavior change.

The ProActive Kids Foundation utilizes a three-tiered approach on the topics of mental health coaching (i.e., lifestyle), fitness, and nutrition and educates parents or caregivers along with the child or adolescent to impact variables affecting body composition. The child attends the sessions individually on Mondays and Wednesdays (90 min), and with a parent or a caregiver on Fridays (120 min, mandatory sessions). Children participate in two workouts per week for 45-minutes (Monday and Wednesday) and one workout per week for 40 min (Friday) to improve muscle mass and body composition. Parents participate in one workout per week (Friday) for 40-minutes with children. The family is involved in education about nutrition on topics of dietary options and habits, portion control, interpreting food labels, dining out, or grocery shopping. The final component of the program is lifestyle coaching [mental health coaching (45-minutes)] that occurs for children following the workout, on Monday and Wednesdays. The goals of the lifestyle coaching are increased confidence, communication, and provide the child with effective coping strategies. Burke (PAK, 2018) believes confidence and self-esteem in children may be improved by creating an open dialogue in the families regarding food, body image, bullying, family matters and personal struggles the child may have. Fridays are considered a, "Family Day" in which siblings are welcome to attend sessions. The workout is shorter (40 min), and followed by a lifestyle session and a nutrition session, each lasting 40 min. Private sessions are offered for parents or caregivers to meet with a PAK coach to discuss various concerns, challenges, and change. To alleviate program cost, PAK has established collaborative partnerships with hospitals or healthcare organizations, so the program is funded by hospital providers at no cost to the family, without requiring proof of insurance (PAK, 2018).

Measures

Age groups

Demographic data was obtained during the final visit via paper survey. For purposes of analysis, we stratified children into three groups according to age, subdivided by gender. Group 1 involved children <8.9 years of age, children in Group 2 were 9 to 12.9 years of age, and Group 3 children, 13 years of age and older. Children were required to be enrolled in the PAK program by a parent or a caregiver and to have their age and weight validated by a healthcare provider. To be eligible for participation in the PAK program, inclusion criteria for potential children participants were (a) body mass index (BMI) of ≥85th percentile for age-sex; (b) residence in either Cook County, DuPage County, Will County or Kane County in Illinois; (c) ages 5 to 17 years. All participants provided informed consent prior to participation. Participant data was de-identified upon entry into the program and therefore exempt from review by the IRB.

Body composition

Height (inches), weight (pounds), body fat (percent) and fat free mass (FFM) were obtained at week 1 and week 8. Height and weight were measured by PAK-trained personnel using a consistent scale for each measurement (PAK, 2018). BMI was measured to determine eligibility. In children and adolescents (2 to 19 years). BMI is as a surrogate measure of obesity and is measured by weight in kilograms divided by height in meters-squared (kg/m^2) (CDC, 2018a, 2018b). BMI is interpreted according to age and gender-specific growth charts. A normal BMI is between the 5th and 85th percentile; overweight, between the 85th and 95th percentile and; obesity, >95th percentile (CDC, 2018a, 2018b; Ogden & Flegal, 2010). BMI is recommended for screening rather than diagnostic purposes and does not indicate excess weight from fat; fatness requires additional measures of weight, percent body fat or FFM.

Statistical approach

Pre-established growth charts with separate weight categories were used to compare children according to age and gender. Demographic and baseline samples are presented as mean ± SD for continuous variables, and the categorical variables are presented as percentages. We employed Analysis of Covariance (ANCOVA) to identify body composition changes by county of residence. The mean change in weight, percent body fat, FFM, and BMI were obtained between the week 1 and week 8 amongst the four counties, with the county as a factor and week 1 as a covariate. Paired *t*-test analyses were employed for pre- and post- body composition comparisons from week 1 through week 8. All statistical tests were 2-tailed, with an adopted significance level of $p < 0.05$. Correcting for multiple comparisons was conducted using the Bonferroni method. All statistical analyses were performed using SAS® software version 9.4 (2013, SAS Institute Inc., Cary, NC, USA).

Linear mixed model analyses were used to predict variables of body composition according to demographic variables. The model included child as a subject, and a structured covariance matrix to determine whether weight, percent body fat, FFM, and BMI were able to be predicted by age, county of residence or gender. Most of the questionnaires were answered completely and only a few individual items had missing data. The percentage of missing values ranges from 1% to 6.2% (the percentage of missing values are 1%, 1%, 6.09% and 6.2% for weight, BMI, body fat and fat free mass, respectively). The missing values of the data were replaced by the imputed values via MCMC option using SAS PROC MI with random seed 54,321 used. Changes for the body composition measurements of weight, percent body fat, fat free mass, and BMI that were not clinically meaningful were removed from the analysis. For example, 3 subjects (487, 915 and 985) demonstrated a change in BMI >20% between week 1 and week 8 were not clinically meaningful and were removed from the dataset. These values were considered recording errors.

Results

Demographic data

Overall, we observed a minimal but significant decrease in weight, body fat and BMI, and increase in FFM as a result of the PAK intervention.

The dataset included more female (51.1%) than male children, and most between 9 and 12.9 years (Group 2, 55.3%). Children younger than 8.9 years (Group 1) comprised 29.1% of the sample, with only 15.6% older than 13 years of age (Group 3). Ethnicity comprised primarily white Caucasian (48.39%), followed by Hispanic (29.64%) and black children (21.97%). Children resided in DuPage County (51%), Cook County (46%), with few (3%) in Kane County or Will County (2% and 1%, respectively). PAK participants' average income ranged from $25,000 to $49,999; 58.37% of participants had health insurance (PAK, 2018).

Body composition

Weight, percent body fat, FFM and BMI were subdivided for each Group by gender (Table 1). Females in Group 3 had the highest percent body fat and BMI, while males in Group 3 demonstrated the greatest weights in the sample. Females and males in Group 3 had the highest weight changes. The improvement of body composition was in all measures and consistent, including weight, BMI and body fat decreased, and FFM increased.

Using paired t-test analyses, we found all measures of body composition; weight ($p < 0.002$), percent body fat ($p < 0.0001$) FFM ($p < 0.0001$), and BMI ($p < 0.0001$), improved significantly by week 8 for Group 1, Group 2, and the Combined Groups as shown in Table 2.

Table 1
Body composition change according to age and gender.

Age groups	Group 1 (5–8.9 years)		Group 2 (9–12.9 years)		Group 3 (13+ years)		Combined	
	(Mean ± SD) (percentage)		(Mean ± SD) (percentage)		(Mean ± SD) (percentage)		(Mean ± SD) (percentage)	
Gender	Female (n = 124)	Male (n = 134)	Female (n = 237)	Male (n = 253)	Female (n = 79)	Male (n = 59)	Female (n = 440)	Male (n = 446)
Weight	−0.48 ± 2.52	−1.00 ± 3.04	−0.72 ± 3.00	−1.38 ± 3.67	−4.22 ± 12.31	−2.11 ± 3.44	−1.31 ± 6.05	−1.36 ± 3.48
week 8–week 1	(−0.41)	(−0.77)	(−0.50)	(−0.89)	(−2.15)	(−1.05)	(−0.78)	(−0.88)
Body fat	−0.02 ± 0.02	−0.02 ± 0.04	−0.02 ± 0.02	−0.01 ± 0.04	−0.01 ± 0.02	−0.02 ± 0.03	−0.01 ± 0.02	−0.02 ± 0.04
week 8–week 1	(−1.82)	(2.02)	(−2.44)	(−1.01)	(−2.46)	(−5.99)	(−2.27)	(−4.90)
FFM	0.83 ± 2.70	1.839 ± 4.23	1.06 ± 3.56	2.27 ± 4.74	0.25 ± 6.00	1.04 ± 17.55	0.85 ± 3.95	2.00 ± 7.45
week 8–week 1	(1.19)	(2.51)	(1.52)	(2.71)	(0.39)	(0.45)	(1.22)	(2.38)
BMI	−0.47 ± 0.72	−0.87 ± 1.25	−0.47 ± 0.77	−0.53 ± 1.46	−0.58 ± 0.75	−0.50 ± 0.92	−0.49 ± 0.75	−0.62 ± 1.36
week 8–week 1	(−1.70)	(−3.01)	(−1.61)	(−1.68)	(−1.74)	(−1.51)	(−1.66)	(−2.04)

Table 2
Body composition change according to age[a] and combined groups using paired *t*-test analyses.

Baseline to post-program (week 1 to week 8)	Age group 1 (Mean ± SE, *p*-Value)	Age group 2 (Mean ± SE, *p*-Value)	Age group 3 (Mean ± SE, *p*-Value)	combined Groups (Mean ± SE, *p*-Value)
Weight	0.561 ± 0.176, 0.0017	0.9017 ± 0.153, <0.0001	2.934 ± 0.788, 0.0003	1.119 ± 0.159, <0.0001
Body Fat	0.014 ± 0.002, <0.0001	0.015 ± 0.002, <0.0001	0.015 ± 0.002, <0.0001	0.015 ± 0.001, <0.0001
FFM	−1.712 ± 0.254, <0.0001	−1.641 ± 0.205, <0.0001	−0.513 ± 0.952, 0.5914	−1.490 ± 0.201, <0.0001
BMI	0.628 ± 0.063, <0.0001	0.462 ± 0.052, <0.0001	0.526 ± 0.071, <0.0001	0.520 ± 0.036, <0.0001

[a] Groups by Age: Group 1, 0–8.9 years; Group 2, 9–12.9 years; Group 3, 13 years and older.

*W*eight, percent body fat and BMI significantly improved in Group 3, with no improvement in FFM ($p = 0.591$).

We analyzed the mean body composition change between week 1 and week 8 according to county using analysis of covariance (ANCOVA). County was the factor and week 1 the covariate. The pairwise comparison amongst the four counties revealed statistically different changes between Cook vs DuPage Counties for weight and percent body fat; only weight differed significantly across all four counties (Cook vs. DuPage, $p \leq 0.0001$; Kane vs Will, $p = 0.0018$; Global, $p \leq 0.0001$, Table 3). Percent body fat ($p < 0.0001$) improved significantly in Cook County vs. DuPage County and in the Combined Group (body fat, $p < 0.0001$) as indicated in Table 3. No significance difference was observed in percent body fat ($p = 0.2720$) in Kane County vs. Will County. FFM and BMI demonstrated insignificant differences in all counties (Combined, $p = 0.1560$ and $p = 0.1669$, respectively). For the insignificant combined test, pairwise comparisons were not performed.

Using a mixed model analyses, we predicted the main effect for the variables; age, county of residence, and time, on the measures; weight, percent body fat, FFM, and BMI (Table 4). *Time* refers to the difference between baseline and the end of the study (week 1 to week 8). For children and adolescent participants, improvements in body composition reflect potential effects from the PAK intervention. The fixed-effects estimates indicate the improvement of the four body composition measurements from baseline to the end of the study. The fixed-effects parameter estimates revealed weight and BMI were significantly impacted by age ($p < 0.0001$), and county of residence ($p < 0.0001$) but were not impacted by gender ($p = 0.9708$ and 0.8069, respectively). Gender, age and county of residence significantly impacted percent body fat (gender, $p = 0.0004$; age, $p = 0.0006$; county of residence, $p = 0.0009$; time, $p < 0.0001$) and FFM (gender, $p = 0.0003$; age, $p < 0.0001$; county of residence, $p < 0.0001$; time, $p < 0.0001$).

Discussion

If the prevalence of pediatric obesity continues to increase, today's youth may live shorter lives than their parents (Olshansky, Passaro, Hershow, et al., 2005), necessitating interventional strategies that effectively improve body composition, such as that employed by PAK. The PAK strategy is successful because it addresses factors that contribute to the etiology of pediatric obesity. Many interventions are useful, provide an education, but are not sustainable because they are not able to be effectively implemented on a long-term basis.

The strategy utilized by PAK to improve body composition in children demonstrated a successful improvement in body composition for several reasons: they utilized a three-tiered approach of addressing physical, emotional and social aspects of the child's life; the no-cost enhanced feasibility of the program; and the educational component providing an increased likelihood to incorporate content into lifestyle. This wholistic strategy improves the likelihood for future impact and sustainability of improved body composition in children. Parental participation is key to implement the strategies into lifestyle since the children depend on parents for resources and lifestyle choices.

The PAK program is in part, successful due to the high commitment on the part of the family. Three sessions per week is demanding for an average child today, not to mention working parents. According to

Table 3
body composition from baseline to post-study for the four counties (Cook, DuPage, Kane and Will) using ANCOVA models[a].

Difference (week 1 – week 8)	Global (P-Value)	Cook vs. DuPage (P-Value)	Kane vs. Will (P-Value)
Weight	<0.0001	<0.0001	0.0183
Body Fat	<0.0001	<0.0001	0.2720
FFM	0.1560	NA	NA
BMI	0.1669	NA	NA

[a] Considering the sample sizes from these four counties are highly unbalanced with most of subjects from Cook and DuPage, pairwise comparisons between Cook and DuPage and between Will and Kane were conducted.

Table 4
Mixed model analysis to determine tests of fixed effects involving age, county, and gender on obesity-related variables (weight, body fat, fat free mass and BMI).

Dependent variable	Effect estimate	Estimates	P-Value
Weight	Gender	Female 0.0751	0.9708
		Male reference	
	Age	2.8435	<0.0001
	County	Cook 9.6833	<0.0001
		DuPage −1.6833	
		Will 14.421	
		Kane reference	
	Time	Pre 1.1130	<0.0001
		Post reference	
Body fat	Gender	Female 0.0217	0.0004
		Male reference	
	Age	0.0400	0.0006
	County	Cook 0.0256	0.0009
		DuPage 0.0021	
		Will 0.0054	
		Kane reference	
	Time	Pre 0.0140	<0.0001
		Post reference	
FFM	Gender	Female −4.5949	0.0003
		Male reference	
	Age	1.8982	<0.0001
	County	Cook 1.8790	<0.0001
		DuPage −3.8998	
		Will −4.5413	
		Kane reference	
	Time	Pre −1.6410	<0.0001
		Post reference	
BMI	Gender	Female −0.0836	0.8069
		Male reference	
	Age	0.3642	<0.0001
	County	Cook 0.9913	<0.0001
		DuPage −0.6878	
		Will 0.2015	
		Kane reference	
	Time	Pre 0.5289	<0.0001
		Post reference	

PAK, this commitment is required for the observed beneficial outcomes. PAK considers a program duration of 12-weeks ideal for beneficial outcomes, although earlier attempts of this duration resulted in a high attrition rate (PAK, 2018). Compliance to the 8-week program was high based on completion of the Progression Survey for Parents, with a 99% completion rate, primarily by mothers (80.03%), followed by fathers (14.71%) and grandmothers (2.56%). Other caregivers identified amounted to a total of 2.68% of responses. Whether mothers or fathers attended the most sessions with the kids was not specifically tracked by PAK (2018).

A recent update by the Expert Exchange authors also suggests involving the family and community in the treatment of pediatric obesity by enhancing communication between the healthcare and community sectors (Siegel, Haemer, Kharofa, et al., 2018). The Expert Exchange is an interprofessional group of 40 childhood obesity specialists who convened in 2014 to improve treatment for children with obesity (Siegel et al., 2018).

The collaborative partnerships with hospitals or healthcare organizations illustrate such an initiative, moreover, PAK employs expert practitioners who develop a relationship with the child and family to improve communication and educate parents. The extent of the complexity of pediatric obesity results from the aforementioned cultural desensitization to weight status as suggested by the research of Eckstein et al. (2006). A premise of the PAK intervention strategy is need for children to receive support from either a parent or caregiver, since they alone are not equipped to make lifestyle changes. The enhanced communication provided to improve parental understanding by incorporating educational sessions regarding weight status is consistent with the recommendations of the American Academy of Pediatrics (AAP, 2018). The AAP recommends educating parents during routine examinations following BMI screenings and weight classification according to gender-specific growth charts. They (AAP) then suggest the incorporation of lifestyle interventions, consistent with the strategy utilized by PAK, in the management of pediatric obesity. According to PAK, 2018, communication is a skill that may be developed in children to improve their overall health. PAK includes communication lessons involving parents and children, to educate children to communicate more effectively for such strategies as coping with and to avoid bullying; children who are overweight often experience bullying. PAK implements the communication skills learned by the children during lessons, by utilizing techniques such as role play during the Friday sessions in which the parents participate.

According to (PAK (2018), the role of the parent is crucial for kids to make changes, so it is essential to educate parents. Three sessions are specifically focused on educating parents, with time allocated for parental concerns along with available PAK staff to tailor health-related or behavioral strategies in the home setting. According to Burke (PAK, 2018), motivation is a key to the success of the lifestyle coaching sessions. Lifestyle coaching improves confidence, thereby improving motivation to further improve self-care. If parents, as role models for children, are motivated to implement lifestyle changes for improved health, children are more likely be motivated. The children participants are primarily in developmental ages that are highly influential, yet are also able to understand the importance of the educational content and improving lifestyle behaviors. By including parents as participants, barriers preventing the incorporation of healthy lifestyle behaviors may be identified, and goals to support children for suggested lifestyle changes, embraced. For example, family time for many participants, often involves food, and adjusting this routine to include healthier, low-calorie snacks, is a common theme (PAK, 2018).

Children who participated in PAK were between 5 and 17 years of age, and primarily in the developmental stages of industry versus inferiority and identity versus role confusion (Erikson, 1993). The stage of *industry versus inferiority* encompasses children between 6 and 12 years during the elementary school years. School age children have a heightened social awareness and begin to compare themselves with peers in the development of self-esteem. The family has a key role during this age range, as children depend on parents for support and resources to participate in school activities, sports and to a great extent, social relationships. Successful competency of these tasks facilitates industry, whereas, if their efforts are stifled by parents or role models in the environment, feelings of inferiority may ensue. During the adolescence between 13 and 18 years of age (Erikson, 1993) the transitional into adulthood occurs, identified by the stage *identity versus role confusion*. The habits, values and beliefs established during this time are typically manifest in adulthood. Adolescents who perceive they are respected for their personal convictions develop a positive self-esteem, whereas, the lack of a meaningful family or social context erodes their sense of identity, contributing to role confusion.

The strategy of including children to participate in PAK sessions independently from parents is an extension of their development, as learning may be enhanced in children in these age groups, from peers, without perceived parental influence. Many variables affect the weight of children, often factors in the school setting, unrelated to the family. The opportunities provided by PAK encourage children to learn to identify how to make changes independently from parents. Conversely, parental involvement in the PAK sessions provides a connection to the child's lifestyle to impact future change in behavior. According to Tony Burke, lifestyle coaching is facilitated by creating an open dialogue in the family to not only educate, but improve coping and remedy current lifestyle concerns and challenges to improve general health as well as pediatric overweight and obesity, often manifest from other lifestyle complications (PAK, 2018).

The ProActive Kids methodology educates parents with the child or adolescent on topics of fitness and nutrition, resulting in an increased likelihood of sustainability. Children participate in a 45-minute workout individually, and attend educational sessions with the parent and/or family. The Cardinal Behaviors of Successful Long-Term Weight Management (Klem, Wing, McGuire, Seagle, & Hill, 1997; McGuire, Wing, Klem, Seagle, & Hill, 1998) employed a strategy to improve long-term weight management by implementing a combination of dietary interventions along with physical activity. Individuals consumed a low-calorie (1300–1400 kcal/day) diet, including breakfast and recorded daily food intake, assessed weight on a weekly basis, and engaged in regular physical activity equivalent to walking four miles on a daily basis.

Dr. Len Epstein did a series of studies showing that parent/family involvement in weight management programs for children is an effective approach (Epstein, Dearing, Temple, & Cavanaugh, 2008; (Epstein, Paluch, Beecher, & Roemmich, 2008; Epstein, Yokum, Feda, & Stice, 2014). He believed the importance of studying parent and child relationships included determining the influence of genetic or familial factors as demonstrated in the findings of one study (Epstein, Dearing, et al., 2008) in which the number of food reinforcers chosen by parents and children were significantly correlated ($r = 0.57$, $p < 0.001$). In another study (Epstein, Paluch, et al., 2008) evaluating the context of a family-based behavioral weight control program that provided for a reduction in energy intake, increased energy expenditure and changes in parenting behaviors, targeting an increased consumption of fruits, vegetables and low-fat dairy products, a significantly greater reduction in zBMI and percent overweight was observed in children and their parents than focusing on reducing high energy-dense foods. Perhaps most important was the fact that no weight regain was observed in the 6-month intensive treatment group who increased healthy food consumption at the 2-year follow-up (Epstein, Paluch, et al., 2008). In addition to this seminal work, Epstein et al. (2014) recently demonstrated that food reinforcement, in addition to parental obesity are independent predictors of future weight gain in adolescents, suggesting obesity prevention programs should target both high risk groups.

Lifestyle coaching, a final objective utilized by PAK, [topics of mental health coaching (45-minutes)] aims to increase confidence, communication, and coping in children. Lifestyle Coaching is a mental health

education program, described by PAK by the terminology, "mental health coaching", to avoid negative connotation. PAK believes confidence and self-esteem are improved in children by creating an open dialogue in families on topics of food, body image, bullying, and personal struggles the child may have. Tailored communication utilized in the approach is consistent with that recommended by the Expert Exchange authors. PAK emphasizes parental support in lifestyle coaching in addition to education since children may lack an accurate understanding of weight status or the motivation and maturity to self-monitor their weight. Educational sessions also instill values to impact future knowledge and behavior to maintain a healthy weight.

Demographic data and body composition

The demographics in the four counties were highly variable. A majority (97%) of participants lived in DuPage County or Cook County which vary greatly in demographic and socioeconomic status. Cook County is comprised of a highly diverse population compared to DuPage, Kane and Will Counties which are relatively homogeneous.

DuPage, Kane and Will Counties are relatively homogenous, each ranked in the top 10 of 102 Illinois' healthiest counties (DuPage, 1; Kane, 7th; Will, 9th, Cook 59th), as well as in the top 100 U.S. wealthiest counties according to mean income (Cook County, 2017; DuPage County, 2018; Kane County, 2017; Will County, 2016). All participants demonstrated improvements in body composition from the intervention, irrespective of age, gender, or county of residence. Age, gender, and county of residence significantly influenced percent body fat and FFM. Weight and BMI were significantly influenced by age and county of residence, though not by gender, a finding which requires more exploration. County of residence significantly affected all obesity-related variables; weight, percent body fat, FFM, and BMI. Geographic residence was a factor in change body composition, as demonstrated by the significant decrease in percent body fat in DuPage County residents.

Weight, percent body fat and fat free mass

The most important outcome from our analysis was the consistent improvement in all measures of body composition; weight, percent body fat, FFM, and BMI. Weight improved in each of the three Groups, although varied according to age, gender and growth patterns. Weight and percent body fat improved in children in DuPage or Cook Counties where most resided (97%). In Group 2, males lost more weight than females, whereas females in Group 3 lost more weight than males and represented the greatest improvement of any subgroup. As expected, Group 3 males weighed the most at baseline. For either gender in Group 3 the hormone levels are higher than Group 1 or Group 2, affecting percent body fat and FFM. Females in Group 3 had the highest percent body fat at week 1, although the improvements in percent body fat and FFM were negligible.

BMI

A BMI ≥ of the 85th percentile for age-sex was required for participation in the PAK Program. BMI is a surrogate measure of obesity and correlates with skinfold measurements, underwater weighing (densitometry) and dual energy x-ray absorptiometry (Barlow, 2007; Cote, Harris, Panagiotopoulos, Sandor, & Devlin, 2013; Whitlock, Williams, Gold, Smith, & Shipman, 2005). At week 1, the BMI of children and adolescents exceeded the 95th percentile and although the BMI improved by week 8, they still exceeded the 95th percentile for all participants (Table 1) indicating the need to continue to integrate the intervention into lifestyle. A normal BMI for a female younger than 8.9 years (Group 1) is equivalent to 19 kg/m^2 compared with the BMI values for PAK participants (Table 1).

We analyzed the impact of age, county of residence, and time on all body composition measurements; weight, BMI, body fat and FFM using mixed model analysis. Gender, age, and county of residence significantly influenced body fat and FFM, whereas, weight and BMI were significantly influenced by age and county of residence, although not by gender. This finding needs more exploration. Of note, county of residence significantly affected all four obesity-related variables, suggesting the overall effectiveness of the intervention. The demographics in the four counties were highly variable, although the majority of participants lived in DuPage or Cook County.

Limitations

The research met the intended objectives of the PAK Program, however, the data was obtained from the PAK program with a different objective than the aims of this analysis. Limitations exist with the use of a secondary data set. The heterogeneous applicability of outcomes varied between Cook County and DuPage County, as they comprise a highly different demographic. Furthermore, this study did not distinguish which intervention most significantly improved body composition measurements; parental education, physical activity, or lifestyle coaching.

Conclusion

Pediatric obesity remains a significant health problem, the manifestations of which may potentially reverse the increased life expectancy that took decades to achieve. Efforts to decrease incidence and prevalence have proven ineffective, increasing the need for interventions that demonstrate sustainability, such as the PAK early intervention program. The PAK 8-week program improved body composition in children and adolescents between 5 and 17 years by including the family with youth to improve body composition using behavior modification (lifestyle), nutrition, and physical activity. Future research involving similar strategies in additional settings over a longer duration is currently warranted.

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References

American Academy of Pediatrics (2018). Clinical practice guidelines and policy implementation. https://http://www.aap.org/en-us/professional-resources/qualityimprovement/Pages/Guidelines-and-Policy-Development.aspx, Accessed date: 9 July 2018.

American College of Sports Medicine (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Barlow, S. E. (2007). Expert committee and treatment of child and adolescent overweight and obesity: Expert committee recommendations regarding the prevention. *Pediatrics*, *120*(Suppl. 4), S164–S192.

Bhupathiraju, S. N., & Hu, F. B. (2016). Epidemiology of obesity and diabetes and their cardiovascular complications. *Circulation Research*, *118*(11), 1723–1735.

Centers for Disease Control and Prevention (2016). Physical activity among youth. Physical activity among youth. Centers for Disease Control and Prevention Web site. https://www.cdc.gov/cancer/dcpc/prevention/policies_practices/physical_activity/youth.tm Updated November 29, 2016. Accessed July 9, 2018.

Centers for Disease Control and Prevention (2018a). Prevalence of childhood obesity in the United States, 2011–2014. Centers for Disease Control and Prevention Web site.

https://www.cdc.gov/obesity/data/childhood.html (Updated June 13, 2018. Accessed July 9, 2018).
Centers for Disease Control and Prevention (2018b). BMI. Retrieved from https://www.cdc.gov/BMI.
Chin, J. J., & Ludwig, D. (2014). Increasing children's physical activity during school recess periods. *American Journal of Public Health*, *104*(S2), S208–S213.
Cockrell Skinner, A., Ravanbakht, S. N., Skelton, J. A., Perrin, E. M., & Armstrong, S. C. (2018). Pevalence of obesity and severe obesity in US children, 1999–2016. *Pediatrics*, *141*(3), 1–9.
Cook County Department of Public Health (2017). All data & reports. Retrieved from http://cookcountypublichealth.org/data-reports.
Cote, A. T., Harris, K. C., Panagiotopoulos, C., Sandor, G. G., & Devlin, A. M. (2013). Childhood obesity and cardiovascular dysfunction. *Journal of the American College of Cardiology*, *62*(15), 1309–1319.
DuPage County Health Department (2018). Childhood obesity in DuPage county. Retrieved from http://www.dupagehealth.org/dupagebmi.
Eckstein, K. C., Mikhail, L. M., Ariza, A. J., Thomson, J. S., Millard, S. C., & Binns, H. J. (2006). Parents' perceptions of their child's weight and health. *Pediatrics*, *117*(3), 681–690.
Epstein, L. H., Dearing, K. K., Temple, J. L., & Cavanaugh, M. D. (2008). Food reinforcement and impulsivity in overweight children and their parents. *Eating Behaviors*, *9*(3), 319–327. https://doi.org/10.1016/j.eatbeh.2007.10.007.
Epstein, L. H., Paluch, R. A., Beecher, M. D., & Roemmich, J. N. (2008). Increasing health eating vs. reducing high energy-dense foods to treat pediatric obesity. *Obesity*, *16*(2), 318–326. https://doi.org/10.1038/oby.2007.61.
Epstein, L. H., Yokum, S., Feda, D. M., & Stice, E. (2014 Nov). (2014). Food reinforcement and parental obesity predict future weight gain in non-obese adolescents. *Appetite*, *82*, 138–142. https://doi.org/10.1016/j.appet.2014.07.018.
Erikson, E. H. (1993). *Childhood and society*. WW Norton & Company.
Hudson, E., McGloin, A., & McConnon, A. (2012). Parental weight (mis) perceptions: Factors influencing parents' ability to correctly categorize their child's weight status. *Maternal and Child Health Journal*, *16*(9), 1801–1809.
Johnson, J. A., III, & Johnson, A. M. (2015). Urban-rural differences in childhood and adolescent obesity in the United States: A systematic review and meta-analysis. *Childhood Obesity*, *11*(3), 233–241.
Kane County Health Department (2017). Kane county statistics & data. Retrieved from http://kanehealth.com/statistics.htm.
Klem, M. L., Wing, R. R., McGuire, M. T., Seagle, H. M., & Hill, J. O. (1997). A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *American Journal of Clinical Nutrition*, *Aug;66*(2), 239–246.
Ling, J., Robbins, L. B., & Hines-Martin, V. (2016). Perceived parental barriers to and strategies for supporting physical activity and healthy eating among head start children. *Journal of Community Health*, *41*(3), 593–602.
Mareno, N. (2014). Parental perception of child weight: A concept analysis. *Journal of Advanced Nursing*, *70*(1), 34–45.
McGuire, M. T., Wing, R. R., Klem, M. L., Seagle, H. M., & Hill, J. O. (1998). Long-term maintenance of weight loss: Do people who lose weight through various weight loss methods use different behaviors to maintain their weight? *International Journal of Obesity and Related Metabolic Disorders*, *Jun;22*(6), 572–577.
Mokdad, A. H., Bowman, B. A., Ford, E. S., Vinicor, F., Marks, J. S., & Koplan, J. P. (2001). The continuing epidemics of obesity and diabetes in the United States. *JAMA*, *286*, 1195–1200.
Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., ... Turner, M. B. (2015). Heart disease and stroke statistics–2015 update: A report from the American Heart Association. *Circulation*, *131*(4), e29–e322.
Newson, L., Povey, R., Casson, A., & Grogan, S. (2013). The experiences and understandings of obesity: families' decisions to attend a childhood obesity intervention. *Psychology & Health*, *28*(11), 1287–1305.
Ogden, C. L., Carroll, M. D., Fryar, C. D., & Flegal, K. M. (2015). *Prevalence of obesity among adults and youth: United States, 2011–2014*. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.
Ogden, C. L., & Flegal, K. M. (2010). Changes in terminology for childhood overweight and obesity. *Age*, *12*(12).
Ogden, C. L., Flegal, K. M., Carroll, M. D., & Johnson, C. L. (2002). Prevalence and trends in overweight among US children and adolescents, 1999–2000. *JAMA*, *288*, 1728–1732.
Olshansky, S. J., Passaro, D. J., Hershow, R. C., et al. (2005). *NEJM*, *352*(11), 1138–1145.
Proactive Kids (2018). About proactive kids 8-week program. Retrieved from https://www.proactivekids.org/about-the-program.html.
Siegel, R. M., Haemer, M., & Kharofa, R. Y. (2018, Jun 7). Childhood obesity. *Community healthcare and technology to enhance communication in pediatric obesity care: expert exchange workgroup's views*. https://doi.org/10.1089/chi.2017.0339 [Epub ahead of print].
Strauss, R. S., & Pollack, H. A. (2001). Epidemic increase in childhood overweight, 1986–1998. *JAMA*, *286*, 2845–2848.
Towns, N., & D'Auria, J. (2009). Parental perceptions of their child's overweight: An integrative review of the literature. *Journal of Pediatric Nursing*, *24*(2), 115–130.
Whitlock, E. P., Williams, S. B., Gold, R., Smith, P. R., & Shipman, S. A. (2005). Screening and interventions for childhood overweight: A summary of evidence for the US preventive services task force. *Pediatrics*, *116*(1), e125–e144.
Will County MAPP Collaborative. (2016). Will county community health status assessment. Retrieved from https://www.willcountyhealth.org/DesktopModules/EasyDNNNews/DocumentDownload.ashx?portalid=0&moduleid=681&articleid=570&documentid=1110.
World Health Organization (2018). http://www.who.int/dietphysicalactivity/childhood/tools/en/ (Retrieved June 29, 2018).
Young, P. C., DeBry, S., Jackson, W. D., Metos, J., Joy, E., Templeman, M., & Norlin, C. (2010). Improving the prevention, early recognition, and treatment of pediatric obesity by primary care physicians. *Clinical Pediatrics*, *49*(10), 964–969.