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The relationship between adult caregiver health literacy and child body mass index outcomes in a childhood obesity intervention program

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Abstract

From 2011-2014, 17% of U.S. children aged 2-19 years were with obesity, with rates increasing with age, and higher among Hispanic youth.[1] Lower parental health literacy has been associated with poorer weight outcomes in children. This study aimed to analyze the effect of caregiver health literacy on standardized body mass index (zBMI) reduction in children aged 4-10 years participating in a 6-month family-based childhood obesity intervention (Prevention Plus) in 35 families with complete measures. Child height and weight data were gathered from 0 and 6 month assessments, and zBMI was calculated. The short assessment of health literacy (SAHL) test was conducted at 6 months to determine adult caregiver health literacy level, and a correlational analysis was conducted using Statistical Package for the Social Sciences (SPSS). A reduction in child zBMI occurred from 0 to 6 months (-0.06 ± 0.24). There was no significant relationship between the level of adult caregiver health literacy and child zBMI reduction ($r=0.015$, $p=0.933$). The Prevention Plus program was effective in reducing child zBMI over a 6-month period, regardless of the health literacy level of the adult caregiver.

Keywords: childhood obesity, health literacy, nutrition intervention

Introduction

Obesity is an epidemic in the United States. From 1999-2000 through 2013-2014, the obesity prevalence in youth and adults increased significantly.[1] From 2011-2014, 17% of U.S. children aged 2-19 were obese, with rates increasing with age.[1] The prevalence of obesity among Hispanic children in the U.S. is considerably higher, at 21.9% of Hispanic youth having obesity.[1] Childhood overweight and obesity is a major health concern that can cause complications later in life, and without intervention, overweight and obese children are likely to become overweight or obese adults.[2]

Addressing the problem of childhood obesity often involves nutrition interventions that require some basic health knowledge and literacy skills. The efficacy of these interventions may be impacted by varying levels of health literacy, as adequate health literacy provides participants with the ability to read nutrition labels, understand body mass index and follow treatment requirements.[3]

What is health literacy?

According to *Healthy People: 2010,* health literacy is "the degree to which an individual has the capacity to obtain, communicate, process, and understand basic health information and services to make appropriate health decisions."[4] According to the National Action Plan to Improve Health Literacy,[5] almost 9 in 10 adults in the United States find it difficult to use available health information provided in health care facilities, media, communities, and retail outlets.[5] Only 12 percent of the adults surveyed in the National Assessment of Adult Literacy (NAAL) demonstrated proficient health literacy.[5] Health literacy can be measured with various assessments, including the Newest Vital Sign, the Short Assessment of Functional Health

Literacy, the Oral Health Literacy-Adults Questionnaire, and the Rapid Estimate of Adult Literacy in Medicine.

Populations at risk of having low health literacy

According to the National Action Plan to Improve Health Literacy, groups that are more likely to have limited health literacy include adults ≥65 years old, non-white individuals, recent refugees and immigrants, people without a high school degree or General Education Diploma, people living at or below the poverty level, and non-native English speakers.[5] In 2000, the Census found that Latinos in the United States were more likely to have less than a fifth-grade education than non-Latino whites, with the proportion of 25 years or older Latino adults with less than a fifth-grade education being 14 times that of non-Latino whites. This population has a more severely low health literacy problem when combined with limited English proficiency.[6]

Childhood obesity is more prevalent in the Hispanic population as compared to non-Hispanic whites in the United States. According to the National Center for Health Statistics, Hispanic children were 1.8 times more likely than non-Hispanic white children to be overweight from 2011-2014.[7] The percentage of Hispanic children aged 2-19 years having obesity from 2011-2014 was 22.8% while the percentage of non-Hispanic white children of the same age having obesity from 2011-2014 was 19.6%.[7]

The relationship between health literacy and health

Low health literacy has been shown to negatively affect health outcomes, such as body mass index, in both children and adults. Low health literacy reduces use of health care services,

which can impact negatively on health. Low health literacy may also hinder ability to implement and maintain treatment regimes.[8]

Health literacy and use of health care services

According to a systematic literature review, poorer health outcomes were associated with low literacy, with health literacy describing skills required to function in a health care environment.[8] This literature review also presented that a lower reading ability corresponded with a lack of participant knowledge and use of health services. It highlighted that Medicare enrollees with lower literacy, after controlling for age, gender, race, education, and income, had greater odds of not having a mammogram for two or more years and never having a Pap smear than patients who had higher literacy.[8] After adjusting for age, gender, race, education, and income, patients were more likely to report not having influenza or pneumococcal immunizations if they had lower reading ability than patients with higher literacy.[8]

In one study, low health literacy was associated with less usage of preventative health care and greater usage of emergency care.[8] The study correlated low health literacy with more hospitalizations and fewer screenings, vaccinations, health-related behaviors, and poor adherence to medication recommendations.[8] Health literacy in this study was assessed using The Newest Vital Sign (NVS), a 6-item self-report measure of health literacy that involved responding to questions about the nutritional information about the nutrition label on an ice-cream container.[8]

Health literacy and understanding the impact on weight

Health literacy may impact weight management in many ways. Health literacy may impact attitudes about weight management, readiness to lose weight, and implementation of

intervention. For example, according to a study examining the relationship between parental health literacy and attitudes about child weight control, higher health literacy was positively associated with endorsing ideal weight loss strategies, such as increasing fruit and vegetable intake and physical activity and decreasing fat intake.[9]

In readiness to lose weight, one study found that in lower-literacy patients, being ready to lose weight occurred less frequently than in patients with higher literacy, and they were not as likely to understand that losing weight could cause health benefits, or that their health is affected by their weight. Literacy was assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM).[9] This test requires subjects to read aloud 66 words about health, and they are categorized into reading grade levels (low, marginal, and adequate) based on the number correctly pronounced.[10] This paper suggests that a lower literacy level may contribute to a lack of understanding how important it is to lose weight.[10]

Lower literacy may cause a patient to struggle in implementing components of intervention needed for weight loss. Disease management is complicated if the patient lacks the knowledge and skills to gather information about, measure, and monitor their health.[9] When receiving treatment from a dietitian, patients are regularly asked to categorize and measure their dietary intake via a food diary, which requires the patient to perform health literacy tasks that require skills such as reading, writing, and numeracy.[10] Lower literacy skills make it more difficult to accurately determine food portion sizes. Huizinga et al. found that portion size estimation was inaccurate in individuals with low literacy skills.[11] Literacy was assessed in this study using the REALM,[11] as described in a previous study. This study reiterates that it remains difficult for patients to follow medical instructions, understand health information and manage

their own conditions with low literacy skills. This can contribute to lower knowledge of their conditions and poorer clinical outcomes.[11]

Child health literacy and weight

One health outcome that low health literacy has been associated with is higher weight status. In children, child health literacy has been shown to negatively correlate with child weight status. In a study by Sharif et al., health literacy was assessed using the Short Test of Functional Health Literacy (STOFHLA)[12], which is a brief test that measures reading comprehension by presenting two reading passages with a blank in place of 1 or 2 missing words. Respondents are prompted to choose the word that fits best in the blank out of 4 given choices.[11] Scores ranged 0 to 36 with a score of 23 or higher indicating adequate health literacy.[12] In this study, a higher child health literacy correlated with a lower body mass index (BMI).[12]

Parental health literacy and child weight

Parental health literacy has also been associated with child weight status. One study showed that parental factors, such as parental obesity and parental health literacy, are two factors most associated with child obesity.[13] Health literacy was assessed using the NVS, as described earlier, and it was administered to both the parent and child.[13]

According to Johri et al., when assessing child nutrition status in India, when mothers had high health literacy, children were about half as likely to have severely stunted growth or be severely underweight as compared to children whose mothers had low health literacy.[14] This study developed a method to assess health literacy using Indian child health promotion materials, asking participants simple questions about 3 images: an immunization promotion poster, an oral

rehydration salts promotion poster for diarrhea, and the Indian immunization card, which contains words and images.[14] First, the participant was asked to report the topic of each image without a prompt. Next, surveyors read a description of the image and the meaning of the image in addition to correct answers. Finally, the surveyor asked 2 questions based on the description to measure the respondent's comprehension.[14] Respondents were classified as having high, medium, or low health literacy.[14]

Specific Aims

This study investigated the relationship between adult caregiver health literacy and BMI outcomes in a 6-month family-based intervention for children with overweight and obesity who receive care at Cherokee Health Systems (CHS) clinics. CHS is a healthcare provider and provides services to the underserved and a high percentage of individuals who self-report minority status, such as Hispanic or Latino. It was hypothesized that higher maternal health literacy scores on the Short Assessment of Health Literacy (SAHL) were associated with a greater decrease in child standardized body mass index (zBMI) from baseline to 6-month assessment.

Methods

Study design

This is a secondary data analysis examining the effect of a childhood overweight and obesity intervention on zBMI in underserved children. For the original study, the University of Tennessee (UT) and CHS partnered to design an evidence-based childhood obesity intervention that fits underserved families' needs. Prevention Plus is the recommended childhood obesity

treatment for primary care settings.[15] It targets energy balance behaviors (i.e., fruit and vegetable intake, physical activity) and recommends behavior modification techniques like self-monitoring and reinforcement.[15] It is a family-based intervention, meaning the caregiver also changes her energy balance behaviors.[15] Prevention Plus has been evaluated to optimize zBMI reduction in children of ages 4 to 10 years by determining the ideal combination of energy balance behaviors and frequency and mode of contact.[16,17] Optimal outcomes have occurred when the behaviors targeted are fruit, vegetable, and sugar sweetened beverage intake, physical activity, and screen time, and contact is 3 in-person sessions and 3 over-the-phone sessions, each occurring every other month, over 6 months.[17] Primary care delivery of these recommendations has not yet been evaluated.

The study was a randomized controlled trial that examined the delivery of Prevention Plus by primary care providers at CHS and its effect on child zBMI in underserved children with overweight or obesity who received primary care at CHS. Eligible families had an adult female caregiver and a child aged 4 to 10 years who is $\geq 85^{th}$ percentile BMI, and were randomized to 1 of 2, 6-month conditions: 1) Prevention Plus with caregiver energy balance behavior goals (PP+); and 2) Prevention Plus without caregiver energy balance behavior goals (PP-). Prevention Plus program was implemented through the electronic health record (EHR) and delivered by Behavioral Health Consultants (BHCs). Child and caregiver assessments at 0 and 6 months included anthropometrics, and the assessment at 6 months included adult caregiver health literacy.

This study investigated the relationship between health literacy and 6-month zBMI changes in families participating in the intervention. Thirty-eight families who had completed the 6-month assessment by Fall 2017 were included in the study.

Participants

CHS patients were recruited from five clinics (Alcoa, Knox County Pediatrics, Maynardville, Seymour, and Talbott). To be eligible, the child must have been aged 4 to 10 years, have a BMI $\geq 85^{th}$ percentile, and have a female caregiver aged 18 or older.

During patient visits, the EHR alerted the primary care physicians if a family was eligible, prompting the physician to refer the family to the BHC in the clinic to begin enrollment in the Prevention Plus program. The BHC informed the patients' families about the program, and if interested, asked them to write their names and phone numbers on an eligibility form to be contacted by Dr. Raynor's research team. Patients received a flyer about the program and informed BHCs of reasons why they may not want to participate in the program. Once completed, eligibility forms and reasons not to participate forms were sent to the lead BHC and Dr. Raynor's research team. The research team contacted and phone screened potential families for eligibility. If eligible, families were invited to an orientation to the program where the adult caregiver signed a consent form (if interested), and the child provided written or verbal assent. Researchers from Dr. Raynor's team collected anthropometric measures and demographic information at the orientation. Diet and physical activity measures were collected for three days over the phone.

Families were stratified by household food security status, child gender, minority status, clinic, and weight status (85^{th} to 94^{th} percentile BMI and $\geq 95^{th}$ percentile BMI), and were randomly assigned to one of the two conditions, PP+ or PP-, in a 1:1 ratio. After the baseline assessment was completed, CHS staff contacted families to schedule their first session with the BHC, where the families learned their condition assignment.

Intervention

PP+

This condition that meets the Prevention Plus Guidelines has produced the largest change in child zBMI.[16] Children received standard care at CHS and received a monthly newsletter for 6 months, written at a fifth-grade reading level, that focused on topics such as: MyPlate, physical activity recommendations, energy balance, fruits and vegetables, reducing television, and reducing high energy-dense, low nutrient-dense foods from the diet. Families were provided with a scale, wall growth chart for measuring height, a BMI wheel to calculate BMI, a BMI-for-age growth chart, a binder for intervention materials, a self-monitoring diary to record child's monthly height, weight, BMI and BMI percentiles; and picture-based diaries to monitor energy balance behaviors daily. The EHR template for each session included additional family materials. At each session, the materials (written at a fifth-grade reading level) outlined information about how children grow, a process to measure growth, and behavioral parenting strategies to change child energy balance behavior, including self-monitoring, modeling (in this condition, caregivers were asked to monitor and perform the same behavior changes as their child), stimulus control, and positive reinforcement. These strategies are based on Social Cognitive Theory.

During months 1, 3, and 5, participants met with a BHC for 35 minutes at their respective CHS clinic. Child height and weight was recorded at each session, and BMI was plotted on the BMI-for-age growth chart. The BHC provided feedback to the families on their child's growth and weight status, and reviewed session materials and encouraged behavioral parenting strategies to focus on changing two of the child's dietary and two leisure time activity behaviors. The caregivers also changed two dietary and two leisure time activity behaviors to model healthy

behavior to the child. This helps the child learn new behaviors related to their weight. The caregiver and the child used picture-based diaries to change and self-monitor energy balance. BHCs assisted the family in achieving goals by suggesting behavioral parenting strategies. Families were encouraged to monitor and change targeted behaviors with incentives for bringing in picture-based diaries and achieving goals on at least two weeks during the prior month, such as stickers and water bottles.

During months 2, 4, and 6, BHCs completed a 20-minute session over the phone with the caregivers. Prior to the call, the caregivers were asked to measure their child's height and weight, calculate BMI, and plot BMI on the BMI-for-age growth chart. The BHC provided feedback during the phone call regarding changes in the child's growth since the previous session. The BHC also discussed the family's progress in meeting energy balance behavior goals and implementing behavioral parenting strategies.

Energy balance goals for the child were to consume < 3 sugar-sweetened beverages (e.g., regular carbonated soft drinks, sports drinks, lemonades, ice teas, flavored milk, juice drinks < 100% juice, and punches) servings per week, ≥1 ½ cups per day of whole vegetables and ≥ 1 cup per day of whole fruit, engage in ≥ 60 minutes per day of moderate- to vigorous-intensity physical activity, and reduce TV viewing to < 2 hours per day. Energy balance goals for the caregiver were to consume < 3 sugar-sweetened beverage servings per week, ≥ 2 ½ cups per day of whole vegetables and ≥ 1 ½ cups per day of whole fruit, engage in ≥ 150 minutes of moderate- to vigorous-intensity physical activity per week, and reduce TV viewing to < 10 hours per week.

The goals were increased each month to increase self-efficacy, with full program goals implemented at month four. Children were also asked to achieve at least three out of the five

goals per day, and caregivers were asked to achieve at least three out of the five goals per week. The BHC provided low-cost options for achieving goals in all sessions.

PP-

This condition is the same as PP+, excluding the energy balance behavior goals and self-monitoring for caregivers. This means that modeling healthy behavior changes was not a behavioral parenting strategy implemented in this condition. Rather, caregivers focused on stimulus control, positive reinforcement, and helping the child self-monitor energy-balance behaviors to help the child change the targeted behaviors. Although adult caregivers may have altered energy-balance behaviors on their own, the BHC did not discuss or reinforce these behaviors with the adult caregivers, rather, they focused the session on supporting child changes using behavioral parenting strategies.

Measures

Measurements were taken by a trained researcher, blinded to treatment assignment, from Dr. Raynor's team at the clinic where the family received care. At 6 months, health literacy was assessed using the Short Assessment of Health Literacy-Spanish and English.[18] This assessment was administered by presenting 18 words about health (kidney, occupation, medication, nutrition, miscarriage, infection, alcoholism, pregnancy, seizure, dose, hormones, abnormal, directed, nerves, constipation, diagnosis, hemorrhoids, syphilis) to adult caregivers to determine comprehension and pronunciation of each term.[18]

Child's height and weight measurements were taken at baseline (0 months) and at the end of the intervention (6 months) by research assistants in the Department of Nutrition at the

University of Tennessee. Participant weight was measured using an electronic scale, and height was measured using a stadiometer, while participants wore light clothing and no shoes. BMI was calculated by weight in kg/ height in m^2. Child z-BMI scores were calculated based on the 50^{th} BMI percentile and the standard deviation for age and sex on the Centers for Disease Control growth charts.[19] Change scores were calculated by subtracting the 6-month measure from the 0-month measure.

A correlation analysis was performed using SPSS Statistical software to examine the relationship between adult health literacy and change in child zBMI from baseline to 6 months. Analyses were 2-tailed, with an alpha-level set at 0.05.

Results

Baseline and 6 month measurements were obtained from a total of 38 participants. There were 3 participants who did not have health literacy scores, leaving 35 participants that were studied. The adult caregivers were prominently female, Caucasian, and Hispanic, with the majority having obtained at least a secondary school education. Most caregivers were the mother of the child participant. The majority of child participants were Hispanic or Latino (81.6%). All participants had a household income below $50,000 annually. Health literacy scores ranged from 0 to 18 (Table 1) with 0 being the lowest possible score and 18 being the highest possible score. The mean change in zBMI at 6 months was -0.06 with a standard deviation of 0.24 (Table 1), indicating an overall decrease in zBMI across the sample. There was no significant relationship between caregiver health literacy and 6-month zBMI change in children with overweight or obesity in the Prevention Plus program. $r=0.015$, $p=0.933$ (Table 2).

Table 1. Child and caregiver age, child zBMI and zBMI percentile at baseline and 6 months, caregiver health literacy score, and change in child zBMI at 6 months.

Descriptive Statistics	N	Minimum	Maximum	Mean	Standard Deviation
Child Age	38	4.8	10.7	8.3	1.7
Caregiver Age	38	26.0	61.0	37.8	8.5
Baseline zBMI	38	1.04	2.79	2.04	0.43
Baseline BMI percentile	38	85.0	97.0	95.7	2.7
6 month zBMI	38	0.13	2.79	1.98	0.53
6 month zBMI percentile	38	54.3	97.0	94.5	7.5
Health Literacy Score	35	0	18	13.7	4.6
Change in zBMI at 6 months	38	-1.32	0.17	-0.06	0.24
Valid N	35				

zBMI = standardized body mass index

Table 2. Correlation between female caregiver health literacy score and 6-month child zBMI reduction.

		First Entry	6-month zBMI
Health Literacy Score	Pearson Correlation	1	0.015
	Sig. (2-tailed)		0.933
	N	35	35
6-month zBMI	Pearson Correlation	0.015	1
	Sig. (2-tailed)	0.933	
	N	35	38

zBMI = standardized body mass index

Discussion

The purpose of this study was to observe the relationship between adult caregiver health literacy and 6-month change in child zBMI. It was hypothesized that higher maternal health literacy scores on the Short Assessment of Health Literacy (SAHL) would be associated with a greater decrease in child zBMI from baseline to 6-month assessment. In this study, caregiver health literacy did not have an impact on the effectiveness of the Prevention Plus program. These

findings demonstrate that the Prevention Plus program is effective in reducing zBMI in children over a 6-month period, regardless of the health literacy level of the child's female caregiver.

Previous research suggests a correlation between maternal literacy level and outcomes in childhood health conditions. One possible explanation for this study's findings is that this study used the SAHL tool to measure health literacy, testing the ability of subjects to read health words and their knowledge of certain health conditions. Literacy in general, rather than specifically health literacy, may be a more significant predictor of success in BMI reduction, as the skills needed for some of the tasks include reading materials and recording food intake and physical activity using words and numbers.

Another factor that may have contributed to these findings is that the study analyzed literacy scores linearly rather than dichotomously, as it did not have a specific cutoff for health illiteracy vs. health literacy. That is to say, there was no distinction on whether, for example, a score of 12 constituted a health literate or health illiterate participant, or whether a participant is considered illiterate only if they scored 0 on the SAHL. This study's sample had a mean health literacy level of around 13.7 with a standard deviation of 4.6 (Table 1), so the sample's health literacy was relatively high. This lack of lower health literacy levels may have also contributed to the absence of association with child zBMI reduction, as there was not an even distribution of scores across the spectrum.

Future studies are necessary to further investigate the possible association between caregiver health literacy level and effectiveness of overweight and obesity-related nutrition interventions in children.

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