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Frequency of Nutrition Counseling in an Overweight and Obese Adolescent Urban Population and its Effect on Health Related Outcomes

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ACCEPTANCE

This thesis, Frequency of Nutrition Counseling in an Overweight and Obese Adolescent Urban Population and its Effect on Health Related Outcomes, by Lisa Sakalik was prepared under the direction of the Master's Thesis Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Master of Science in the Byrdine F. Lewis School of Nursing and Health Professions, Georgia State University. The Master's Thesis Advisory Committee, as representatives of the faculty, certify that this thesis has met all standards of excellence and scholarship as determined by the faculty.

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ABSTRACT

FREQUENCY OF NUTRITION COUNSELING IN AN OVERWEIGHT AND OBESE ADOLESCENT URBAN POPULATION AND ITS EFFECT ON HEALTH RELATED OUTCOMES

By
Lisa Sakalik

Background: Adolescent overweight and obesity is a condition affecting individuals locally and nationwide. Data from the Georgia State Department of Public Health indicate that 31% of high school students are overweight or obese. Contributing factors to this condition include lifestyle and environment, which influence diet and exercise. Through nutrition counseling, these decisions can be addressed and modified to promote a more healthful lifestyle. The purpose of this study is to describe outcomes related to multiple nutrition counseling sessions with an outpatient registered dietitian (RD) compared to only one visit with the RD and a follow up with a Primary Care Physician (PCP).

Methods: As a retrospective chart review, inclusion criteria included overweight and obese boys and girls who were at or above the 85th percentile for age and gender when plotted on the Center for Disease Control and Prevention (CDC) growth charts. Data were collected on patients aged 11-20 years who participated in one of four outpatient clinics located in Atlanta, GA and who had attended one or more sessions with the dietitian from 2/11/13 to 3/23/15. Outcome measures included change in BMI, BMI z-score, serum hemoglobin A_{1c}, serum triglycerides, and serum total cholesterol.

Results: A total of 22 participants were included in the study. Out of the 22 participants, 10 had seen a RD and followed up with a PCP (Group 1) and 12 had seen the RD multiple times (Group 2). The median initial BMI was 25.16(range 24.49-29.53, Group

1) and 33.79(range 30.79-41.37, Group 2). The median initial BMI Z score was 1.69(range 1.52-2.06, Group 1) and 2.38 (range 2.27-2.67, Group 2). The mean age was 13.20 years (Group 1) and 14.58 years (Group 2). Mann Whitney U tests found that there were no significant differences between the groups in change in BMI ($p=0.692$) but change in BMI z-score showed a slower rate of increase in Group 2 compared to Group 1(0.002 vs. 0.115; $p=0.092$).

Conclusions: This study concludes that multiple sessions with the outpatient RD may be beneficial in slowing the rate of BMI z-score increase in an overweight and obese urban adolescent population

FREQUENCY OF NUTRITION COUNSELING IN AN OVERWEIGHT AND OBESE
ADOLESCENT URBAN POPULATION AND ITS EFFECT ON HEALTH RELATED
OUTCOMES

By
Lisa Sakalik

A Thesis

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in
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ABBREVIATIONS

AAP	American Academy of Pediatrics
Academy	The Academy of Nutrition and Dietetics
BMI	Body Mass Index
CDC	The Center for Disease Control and Prevention
CHOA	Children's Healthcare of Atlanta
CVD	Cardiovascular Disease
HDL	High Density Lipoprotein
HgA _{1c}	Hemoglobin A _{1c}
HTN	Hypertension
LDL	Low Density Lipoprotein
MNT	Medical Nutrition Therapy
MRN	Medical Record Number
NHANES III	Third National Health and Nutrition Examination Survey
PCMH	Patient Centered Medical Home
PHI	Protected Health Information
RD	Registered Dietitian
SD	Standard Deviation
TC	Total Cholesterol
TG	Triglycerides
T2DM	Type 2 Diabetes Mellitus
WITH	Wellness Incentive to Health Program

CHAPTER I

INTRODUCTION

Childhood obesity is a condition that is often addressed by healthcare professionals. Pediatric overweight is defined as a body mass index (BMI) for age between the 85th and 95th percentiles on the Center for Disease Control and Prevention (CDC) gender specific growth charts.¹ In comparison, pediatric obesity is defined by a BMI for age above the 95th percentile on a gender specific growth chart. Adolescent obesity in ages between 11-20 years is a problem that is affecting individuals nationwide and worldwide. Locally, in a 2011 data summary of high school students in Georgia, 148,000 students (15%) were obese and 157,000 students (16%) were overweight. This data summary also reports that male students were more likely to be obese than female students and that African American students were more likely to be obese than any other race group.² Nationally, a study by Popkin et al (1998) looked at data from the Third National Health and Nutrition Examination Survey (NHANES III) and the Adolescent Health Study for overweight and obesity prevalence and found that 26.5% of the total 13,783 adolescent participants (aged 12-22) were overweight, as defined by CDC age and gender specific growth chart.³ The researchers also found that 30.9% of the participants that were in the obese category were also black, non-Hispanic, and in grades 7-12.³ These statistics show that this is a topic that affects populations on a local and national level.

The main factors that contribute to the problem of adolescent obesity are lifestyle and environment which strongly influence food choices and exercise patterns.⁴ Psychological factors such as depression can influence obesity in adolescents.⁵ Social

factors involving peers, emotional interactions, and self-esteem can significantly influence obesity in this age population. A study completed by Wang et al (2007) concluded that a population of adolescents aged 12-19 years consumed around 353 calories per day of sugar sweetened beverages and sodas with sodas contributing to 67% of their total sweetened beverage consumption.⁶ This population consumed between 10-15% of their total calories on sugar-sweetened beverages, which is a lifestyle factor that could contribute to obesity.⁶ Another study completed by Landsberg et al (2008) discovered that a group of participants who had a high prevalence of high fat and processed foods consumption such as white bread, soft drinks, sausage, fast food, and sweets had a higher prevalence of being overweight and obese.⁷ Both of these studies demonstrate that eating patterns of adolescents could directly influence his/her risk of being or becoming overweight or obese. Another lifestyle factor that contributes to the problem of adolescent obesity is media time. It has been shown to be positively associated with BMI's at the 50th, 75th, and 90th percentiles which suggest that media time or "screen time" can influence adolescent obesity.⁸

Significance

The problem of adolescent overweight and obesity is significant due to the increased health consequences that are associated with it as an adolescent moves forward into adulthood. The first concern is an increase in health risk markers, such as hypercholesterolemia (or elevated lipids). A study by Romero et al (2013) investigated dyslipidemia and high-density lipoprotein (HDL) in a population of 199 adolescents where 23.1% of the participants were classified as obese.⁹ They found a high prevalence of dyslipidemia (71.4% of participants) and low levels of high-density lipoprotein (40.7%

of participants). The researchers also discovered an association between obesity and HDL and insulin resistance levels that were outside the normal limits. These markers have an impact on the adolescents' health because it can predict an individual's current and future risk of disease. Low HDL cholesterol and elevated triglycerides (TG) can be predictors of heart disease risk, and insulin resistance can be a predictor of Type 2 Diabetes Mellitus (T2DM).¹⁰⁻¹¹

Adolescent overweight and obesity can also lead to the development of health conditions as an adult such as metabolic syndrome, T2DM, cardiovascular abnormalities, and psychosocial abnormalities.¹² Obesity as a child or adolescent can influence the development of obesity into adulthood, meaning that obesity at a younger age is a strong predictor of obesity as an adult.¹³ Adolescent obesity can also impact adult morbidity and risk of premature mortality as seen in a study that showed a significant increase in all cause mortality with obesity as an adolescent between age 14-19 years.¹⁴ Adolescent overweight and obesity have influence on cardiovascular risk factors in adulthood. A study conducted by Freedman et al (1999) investigated disease risk factors over time and the increased prevalence of those risk factors. They found that overweight in children and adolescents (aged 5-17) was highly associated with elevated total cholesterol (2.4), high blood pressure (2.4), high triglycerides (7.1), and high fasting serum insulin (12.6); over half of the study participants had at least one risk factor (58%).¹³ This study suggests that these biochemical factors could potentially increase the risk for cardiovascular disease later on in life. The health consequences that have been discussed are severe and very probable for this population based on the studies conducted. Those consequences makes

the research to solve this problem important to help reduce the prevalence of adolescent obesity and these dire health problems that can develop later on in life.¹³

Purpose and Research Question

The specific aim of the study is to determine the importance of having multiple nutrition counseling sessions with a registered dietitian (RD) compared to one visit with an RD. This will include comparison of improvements in body mass index (BMI), hemoglobin A_{1c} (H_gA_{1c}), total cholesterol (TC), and triglycerides (TG) in patients who receive multiple nutrition counseling sessions versus patients who only receive one assessment from a RD. The research question being asked is “ How does increased frequency of nutrition counseling with a RD compared to only one assessment over the past two years affect improvement in health related outcomes in an urban overweight and obese adolescent population?” We hypothesize that if there is a higher frequency of nutrition counseling with a patient, meaning two or more sessions with a RD, then they will have lower BMI, lower TG, lower H_gA_{1c}, and lower TC compared to patients who only receive an assessment from a RD in the past year and follow up with their primary care physician (PCP)

CHAPTER II

REVIEW OF LITERATURE

Description of Age Group

The age group defined in this study includes overweight and obese adolescents aged 11-20 years. There are three defined stages of adolescence: early (aged 12-14), middle (aged 15-16), and late (aged 17-20).¹⁵ There are small differences between the groups but they all exemplify a movement towards independence, interests and cognitive development, and ethics and self-direction. Studies have been completed in the age groups consisting of all stages of adolescence such as a prescriptive dietary intervention completed in an age group of 10-17 year old obese boys and girls.¹⁶ Another dietary intervention involved carbohydrate restriction included obese adolescents aged 12-18 years old.¹⁷

A study completed by Steinberg et al (2005) looked to explain the cognitive development and affective development (also known as the development of emotional capacity through physiological and behavioral changes) in adolescence, as a critical period of the reorganization of regulatory systems that change how adolescents view things.¹⁸ The investigator reported findings from early to late adolescence. The study found that in early adolescence (13 years old), puberty heightens emotional arousability, sensation seeking, and reward orientation; in middle adolescence there is a period of heightened vulnerability to risk-taking and problems in regulation of affect and behavior; in late adolescence, the final maturation of the frontal lobes facilitate a regulatory

competence that can move them onto adulthood. The researchers also determined that during early adolescence, participants showed improvements in reasoning, information processing, and expertise. This study also demonstrated that rates of performance improved over time, i.e 11-13 year olds versus 14-17 year olds might have differences in performance and abilities related to brain activity. These findings suggest that there may be a difference in cognition and brain function but some of the findings also suggest that there is continuity between the age groups. It is thought that middle adolescents, aged 14-16, have the same logical capacity as adults, but their social and environmental factors lead to differences in decision making. There is an argument that cognition is different throughout the course of adolescence, but the facts state that although performance may differ, logical capacity and improvements in reasoning and processing can be seen early, middle, and late adolescence.¹⁸

Another study looking at the cognition of adolescents completed by Vetter et al (2013) aimed to see if early adolescents (ages 12-15 years old) and late adolescents (aged 18-22 years old) theory of the mind differed. Theory of the mind is defined as the ability to attribute mental states to oneself and to others.¹⁹ The researchers also looked at whether age effects on cognition tasks are influenced by the growth of more simplistic cognitive abilities. They looked at these aims in 60 adolescents aged 12-15 years and 60 adolescents aged 18 to 22 years. When looking at the results, the theory of the mind tests, which look to recognize complex emotions and requires the correct attribution of mental states, they found that the mean proportion of responses were lower in the early adolescent group, but only 3 out of the seven stories involved in the test were considered statistically significant ($p < 0.05$). When they looked at the results for working memory,

they found no significant difference between age groups, which suggests that there is a similar working memory capacity in the early adolescents (mean=0.78; SD=0.14) and later adolescents/ early adults (mean=0.81; SD=0.14). This study showed that although there may be a difference in the emotional abilities and mental states of early adolescents compared to later adolescents, their working memories are similar. Working memory, which is considered short term memory, is an attribute important to the dietary field for dietary recall and recall of specific dietary behaviors which makes this age group even more appropriate for a nutrition related study.¹⁹ These studies suggest that a defined age group of 11-20 is appropriate for study based on the similarities in cognition, interests, and movement towards independence.^{15,18-19}

Nutrition Practices of Adolescents

The nutrition practices that have been found and studied in an overweight and obese adolescent population are very specific and have identified potential areas for intervention. A study completed by Jodkowska et al (2013) investigated sedentary overweight and obese Polish adolescents to determine if their behaviors were associated with dietary habits, physical activity, parental practices, and body mass.²⁰ This study worked with 13 year old teens (n=600) and defined overweight as BMI with ≥ 25 kg/m² and obesity as ≥ 30 kg/m². The investigators also reported BMI z scores.²⁰ The study included self-reporting of TV viewing, computer use, and homework as well as dietary behaviors, physical activity, and parental practices. The results indicated that there were significant negative correlations between screen time and eating breakfast (-0.132, p=0.023 for girls and -0.155, p=0.008 for boys) and screen time and eating meals with

parents (-0.139, $p=0.016$ for girls). The investigators also found significant positive correlations between screen time and eating meals while watching television (0.231, $p<0.001$ for girls and 0.248, $p<0.001$ for boys), eating sweets (0.197, $p=0.001$ for girls and 0.169, $p=0.004$ for boys), eating chips (0.241, $p<0.001$ for girls and 0.318 $p<0.001$ for boys), and eating sweetened carbonated beverages (0.230, $p<0.001$ for girls and 0.185, $p=0.001$ for boys). These findings suggest that dietary behaviors such as eating sweets, chips, and sugar-sweetened beverages are common practice in an overweight and obese adolescent population in that region. This study could be applicable to the population in the United States (US) because both Poland and the US are developed, industrialized countries. Reedy et al (2010) found that the half of the “empty calories” consumed or those calories that do not provide any nutritional value, in US youth come from soda, fruit drink, dairy desserts, grain desserts, pizza, and whole milk.²¹ The results of this study also suggest that these unhealthy dietary behaviors are associated with the amount of screen time watched. The researchers also found that the amount of screen time watched had a significant negative association with the more healthful recommended behaviors such as eating breakfast and eating as a family. That suggests that more healthful eating behaviors may not be as common in this population as compared to a healthy weight adolescent population.²⁰

A study by Hatami et al (2014) investigated dietary behaviors as the main determinants of overweight and obese status in adolescents. They looked at the difference between normal weight adolescent eating behaviors and overweight/obese adolescent eating behaviors with a total of 1,157 Iranian adolescents age ranging from 10-18 years old.²² They obtained information on demographic, socioeconomic status, and frequency

of intake of selected foods such as fruits, vegetables, candy/chocolate, soft drinks, milk, chips, and fried potatoes per week. The results indicated that there was a positive association between normal weight status and all food groups listed, but there was a significant negative association in the overweight/ obese group and consumption of fruits, vegetables, and milk ($p=0.004$). Also adolescents with higher reported energy intake and greater intake from carbohydrates were more likely to be overweight ($n=116$, 31.4 % and $n=95$, 30.2%, respectively). As previously shown,²⁰ the researchers found that low consumption of fruits, vegetables, and milk was associated with overweight/obese status. This study confirms that more healthful dietary behaviors are lower in overweight and obese adolescents from early adolescents to late adolescents.

Ho et al (2013) completed a study that investigated how dietary interventions over the course of one year affected eating behaviors.¹⁶ This study was completed in 109 obese 10 to 17 year old Australian boys and girls that included a structured meal plan which was either moderate carbohydrate and increased protein or high carbohydrate. Both of the diets were prescribed at 1450-1673 calories per day for 10-14 year old participants and 1673-1912 calories per day for 15 to 17 year old participants.¹⁶ The participants also met with a RD 4 times during the 12-week intervention of phase 1. During this phase, the RD detailed the structure of the designated meal plan and the portion sizes and food choices for the plan. During phase 2, the participants received nutrition support via phone, email, or text message every 4 weeks. The participants had a face-to-face meeting at week 26, which was at the halfway point of the 12-month study. The purpose of the meal plans was to evaluate external eating habits, which is known as eating in response to food cues regardless of hunger and satiety. The researchers

evaluated habits such as emotional eating, dietary restraint, and parental pressure to eat during the course of a prescriptive diet. The results showed that there was a significant decrease in the amount of participants who reported emotional eating over the course of the 6-month intervention. They also found that external eating scores, which were depicted in a 4 point Likert scale, decreased 15% after 3 months of the intervention ($p < 0.001$) and remained significantly lower at 6-months. Dietary restraint and parental pressure to eat did not change over the course of the intervention. External eating, emotional eating, dietary restraint, and parental pressure to eat were all high in this population at baseline (17%, 9%, 57%, and 26% respectively). Dietary restraint and parental pressure to eat remained high after the 6-month intervention period was completed (55% and 19% respectively). These psychological aspects of the overweight and obese adolescent population have a significant effect on self-efficacy, which can in turn affect adherence to a behavior change.¹⁶

Van Strien et al (2007) completed research looking at the prevalence of external, restrained, and emotional eating, and the relationship of these types of eating behaviors with perceived parental control of food intake in 596 early adolescent boys and girls aged 7-12 years old who live in the Netherlands.²³ The researchers defined external eating as eating in response to food cues such as sight, smell, and emotion. The study utilized a questionnaire in order to determine if any of these eating behaviors were present using a scale of (1) no, (2) sometimes, or (3) yes. The researchers utilized another questionnaire that looked at two subscales to include (1) pressure to eat and restriction of snacks and (2) controlling the amount of food consumed by the child. The results of the questionnaires found that boys scored significantly higher on external eating ($M=1.93$ for

boys and 1.84 for girls, $p < 0.05$) and girls scored significantly higher on restrained eating ($M = 1.51$ for boys and 1.63 for girls, $p < 0.01$). The study also investigated correlations between these eating behaviors and perceived eating restrictions. They found a significant positive correlation between perceived parental pressure to eat, emotional eating, and external eating for boys (0.17 and 0.20, $p < 0.01$). This indicates that as parental pressure increased, so did the emotional eating and external eating for boys in this specific population. The results of this study suggest that external eating and emotional eating in relation to parental pressure affect the eating behaviors of overweight and obese adolescents.²³

Interventions in Treatment and Management of Adolescent Obesity

There have been numerous interventions that have proven to be effective in the treatment and management of obesity as measured by improvement in health related outcomes such as BMI, lipid values, and glucose values.^{17, 23-29} Based on reports from pediatricians, RDs, and nurses, there are strategies that have been helpful in promoting dietary and behavior change in obese children and adolescents.²⁴ One strategy is the improvement and development of educational tools that improve thoroughness of the medical assessment and prompt screening tests during office visits. s' motivational techniques can also help in the treatment and management of obesity in children and adolescents. The RDs' counseling style should assess readiness to change using the stages of change model and promote "wellness" behaviors such as exercise, eating a more healthful diet, and reducing time watching television.²⁴ This leads into the strategy of reducing sedentary behaviors like television watching and incorporating more physical

activity into an obese adolescent's school or home environment. These strategies have already been successful in this population but need to be researched and discussed even further to elucidate the true efficacy in this population.²⁴ Many of these strategies are employed throughout the literature looking at intervention in the treatment and management of adolescent overweight/obesity.

The American Academy of Pediatrics (AAP) has organized recommendations for the treatment of adolescent obesity.²⁵ They recommend assessing the patient's readiness for change, collecting a diet history, and a physical activity history. The behavioral goals of therapy include the development of awareness of current eating habits, identification of problem behaviors, modification of current behaviors, and continued awareness of behavior and recognitions of problems that arise. The medical goals include improvement of secondary complications of obesity such as an abnormal blood pressure, lipid profile, or HgA1c. The treatment discussed involved early intervention in a family that shows readiness for change. They recommend that clinicians educate families on the complication of obesity and involve the family in the treatment program, making goals of changing eating habits, increasing exercise, or reducing screen time a family goal instead of an individual goal. They suggest making small gradual changes that are updated every two weeks and encourage and empathize the patient to promote change rather than criticize. Recommendations also include utilizing a team approach in order to effectively give treatment, with trained nurses, RDs, physicians, psychologists, and social workers.²⁵

The Academy of Nutrition and Dietetics (Academy) recommend using the skills of the RD and consistent and integrated messages and environmental support to achieve diet and physical activity behavioral change for the prevention and treatment of pediatric

overweight and obesity.²⁶ The Academy assessed a need for pediatric obesity prevention and treatment due to the Healthy People 2020 objectives and “leveling off” obesity prevalence by age group. The obesity prevention recommendations are organized by primary, secondary, and tertiary prevention. The primary prevention included interventions that focus on healthful eating, physical activity and are offered to an entire population through school and community based interventions. Secondary prevention differs because it focuses on children and adolescents who are already overweight/obese. The strategies used in secondary prevention are similar to primary and tertiary, but are more individualized than primary prevention. This level of prevention also uses specific diet interventions such as the Stoplight Diet for food, low carbohydrate diets, and the non-diet approach. Tertiary prevention includes the use of very low calories diets, meal replacements, weight loss medications, and bariatric surgery. This level is reserved for patients who have experienced little improvement during a 3 to 6 month period while participating in a lifestyle intervention program. The recommendations also include comprehensive, multi-component interventions that include diet, physical activity, and behavioral counseling for weight management. Strategies used by RDs’ for adolescents who are overweight and obese include a dietary assessment and intervention that focuses on eating patterns, sedentary activity, and physical activity. These recommendations advise RD’s to be actively involved and engaged as an essential portion of the obesity management team.²⁶

Siegel et al (2009) investigated treatment and management of adolescent obesity by completing a 6- month office based low carbohydrate intervention on 38 obese teens aged 12-18 years old.¹⁷ They collected baseline laboratory data and met with a RD 5

times throughout the intervention. The low carbohydrate intervention consisted of restricting the teen's carbohydrate intake to 50 grams per day. The subjects' families were also counseled not to limit the participant's carbohydrate intake to less than 20 grams per day. The results of the study showed significant improvement in self-esteem in the participants from baseline to 6 months (scores from 16.6 to 15.0, $p < 0.05$, lower scores signify higher self-esteem). The researchers found significant changes in BMI percentiles in two-month intervals (98.4th, 97.6th, and 97.1th, $p < 0.05$). They also found a significant decrease in weight (93.4 kg, 91.6 kg, 90.8 kg, 89.6 kg, and 88.5 kg, $p < 0.005$) and BMI (34.9 kg/m², 34.2 kg/m², 33.8 kg/m², 33.2 kg/m², and 32.7 kg/m², $p < 0.005$) in the participants in all meetings except between the session in month 4 and month 6. With the laboratory data, the researchers found a significant increase in hemoglobin and hematocrit in the participants (+ 0.41 g/dL, $p = 0.03$; +1.26 %, $p = 0.04$); they did not find any significant improvement in HDL, low density lipoprotein (LDL), TG, or TC. This study, while it did not find improvement in lab values, found significant decrease in BMI percentiles, BMI, and weight.¹⁷ This researcher also did a year follow up with the available participants and only saw further decrease in BMI and weight in 4 of the 16 participants in their follow up study.²⁷ The researcher suggested that the rebound in BMI and weight correlated to the fact that there was no RD interaction in the final 6 months of the study, suggesting that RDs may play a crucial role in helping patients maintain dietary adherence.²⁷

A study by Santiprabhob et al (2014) investigated the efficacy of a 1-year group based weight loss program in 115 obese youth aged 8-18 years old.²⁸ The program consisted of a baseline in-patient session and 5 group sessions at the one, two, three, six,

and nine moth marks in the study. The group sessions were created to provide the participants and their families with information about the continual health risks of obesity and the benefits of a lifestyle modification. Changes in waist circumference, weight, BMI, and percentage total body fat were assessed along with the participants and families perceptions of the program. The results showed a significant reduction in all anthropometric values except weight (differences in means stated waist circumference = -3.6 cm, $p < 0.001$; BMI = -1.6 kg/m², $p < 0.001$; percentage total body fat = -3.2%, $p < 0.001$). The researchers also investigated changes in anthropometrics in a subset of participants who attended every session and also saw significant decreases in all measures except weight (differences in means stated waist circumference = -5.8 cm, $p < 0.001$; BMI = -2.6 kg/m², $p < 0.001$; percentage total body fat = -4.3%, $p < 0.001$). The researchers compared changes in biochemical laboratory data and found a significant decrease in TC, LDL, TG, and fasting insulin and a significant increase in HDL (differences in mean stated -9.3mg/dL, $p < 0.001$; -7.5 mg/dL, $p < 0.001$; -19.9mg/dL, $p < 0.001$; -7.0 uU/mL; $p < 0.001$; +2.3 mg/dL; $p = 0.002$). This study found that family based group sessions played a significant role in aiding the participants in the treatment and management of their obesity and caused the health related lab values to significantly decrease.²⁸

Another study completed by Ning et al (2013) examined a lifestyle modification program for the treatment and management of adolescent obesity in 145 participants aged 11-18 years old.²⁹ The lifestyle modification intervention consisted of a 6-month program that included structured nutrition education, supervised physical activity, and behavioral support that enlisted the help of a RD, graduate students studying health psychology, and

fitness trainers. The focus of the study was lifestyle modification, not the weight or BMI, but they did calculate changes in energy intake, energy expenditure, anthropometry, and body composition. The results showed significant changes in total caloric intake (-424.7 kcal/day, $p < 0.001$), weight (-1.4 kg, $p = 0.005$), BMI (1.1 kg/m^2 , $p < 0.001$), BMI percentile (0.4 percentile, $p < 0.001$), and body fat percentage (1.4%, $p < 0.001$). The researchers investigated associations and found that each reduction of energy intake of 100 calories/day was significantly associated with change in weight loss (-0.30 kg, $p = 0.004$) and BMI (-0.1 kg/m^2 , $p = 0.006$) at 6 months. This program demonstrated that lifestyle interventions have a significant effect on an overweight or obese adolescent population and can significantly affect the treatment and management of this condition. The abundance of health care individuals involved in the process made this intervention successful because it provided even further support for the participants to adhere to the lifestyle modifications.²⁹

In a study completed by Hofsteenge et al (2013) there was a similar multidisciplinary outpatient treatment initiated in 122 obese adolescents aged 11-18 years old.³⁰ This particular study split the participants into an intervention group that received a child health questionnaire, a pediatric quality of life inventory, a body esteem scale, and bi-weekly group session with a RD, psychologist, and pediatric endocrinologist compared with a control group who received regular care and the home referral of a RD. The intervention group participated in 7 sessions over a 14 week period then both control and intervention group followed up at 6 and 18 month follow ups. There were 95 participants who finished the study and were included in analysis. The results showed modest improvements in the pediatric quality of life questionnaire under the topics of physical

health (between group difference 5.4; 95% Confidence Interval: 0.3:10.6) and school functioning (between group difference 7.5; 95% Confidence Interval: 1.6: 13.2). These results looked at the quality of life of the participants. One limitation of the study outlined by the researchers was a lack of compliance in the intervention group for attending the group session. Reasons for not attending the sessions included a lack of motivation to change dietary habits, lack of belief of parents in their child potential success, previous unsuccessful diet experience, and travel distance being too far. The results of this study suggests that although the compliance was not as high as anticipated, multidisciplinary approaches are beneficial to the treatment and management of adolescent overweight/obesity and can significantly affect a patients self-perceived health and school functioning.³⁰

Current Interventions in Urban Populations

A study by Groth et al (2011) researched the obesity risk in 742 urban adolescent girls aged 15-19 years.³¹ Their main objective was to investigate correlations between participants' nutritional intentions and health behaviors. The participants completed an audio computer-assisted self-interview that assessed their intentions to consume dairy products, eat fresh fruits and vegetables, include fiber in their diet, and avoid fried food. The responses were self rated on a 4 point Likert scale ranging from definitely will do (1) to definitely will not do (4). The investigators also measured health related behaviors such as physical activity per week, amount of sleep per night, cigarette smoking, alcohol use, and illicit drug use. The results showed that the nutrition intentions of adolescent girls were significantly associated with physical activity ($p < 0.001$) and sleep ($p < 0.001$).

The researchers also found from the interview that dairy consumption was the highest rated nutrition intention (35% of participants responded “definitely will do” compared to avoiding fried foods, which was the lowest rated nutrition intention (8% of participants responded “definitely will do”). These results showed that nutrition intentions are affected by daily activities such as sleep and physical activity, and the nutritional intentions of an urban adolescent population was less healthful, including low fruits, vegetables, and grains and higher dairy and fried foods. Those intentions require the intervention of nutrition professionals like a RD to help provide education and elicit behavior change.³¹

A study completed by Lang et al (2011) looked at an obese demographic of 33 youths aged 11-19 years who were found in an inner city clinic in Oakland and compared their metabolic values to 19 age matched youths of normal weight status.³² They found there were significant increases in C-reactive protein levels of almost 10 times higher, insulin resistance, and homocysteine levels of 62% higher in the urban obese adolescent population when compared to the control group. They also found that diet quality was poor in all children, but obese participants reported significantly fewer servings of dairy products, and fewer fruit servings. The diet quality of these adolescents was lower in potassium, vitamin C, vitamin D, and vitamin A. The researchers suggested although this study was completed in an urban population, the results could be generalized to the entire population of obese adolescents.³²

A study completed by Black et al (2010) researched a 12-week community based health promotion and obesity prevention in 235 urban black adolescents aged 11-16 years.³³ The study was completed with an intervention group who attended weekly

sessions conducted by college-aged mentors (19-25 years) who received 40 hours of training that included motivational interviewing and a control group who did not receive any intervention and only contact at baseline and follow up evaluations. Each intervention session had a different challenge that had a health basis (such as persuade someone to drink water instead of soda) and included taste tests, recipes, and recommendations for physical activity. The results found a 5% decline in overweight/obese status among participants in the intervention group and an 11% increase among control adolescents. This study showed that a health based intervention that included motivational interviewing, a tool used by many RDs in practice, was effective in reducing the amount of overweight/obese adolescents in the study.³³

Neumark-Stainer et al (2010) completed a school based physical activity and nutrition education program in urban adolescent girls. The study was completed in 356 girls (46% overweight/obese) aged 15-16 years and lasted 9 months long.³⁴ There was an intervention group who received 16 weeks of their designed “New Moves” physical education class, individual counseling session using motivational interviewing, weekly lunch get-togethers once a week after the 16 weeks of classes ended, and minimal parent outreach activities and a control group who only participated in the school physical education class. The main outcome measures were percentage body fat, BMI, physical activity, sedentary activity, dietary intake, eating patterns, unhealthy weight control behaviors, and body/self image. The results showed the intervention group experienced a significant increase in their stage of change concerning physical activity ($p=0.039$), goal setting for physical activity ($p=0.021$), and self-efficacy concerning physical activity ($p=0.003$) compared to the control group. They also found a significant decrease in

sedentary activity ($p=0.050$) in the intervention groups compared to the control group. In the intervention groups eating patterns, the results showed significant improvements in the stage of change concerning eating breakfast ($p=0.028$) and portion control ($p=0.006$). These results showed that intervention in an urban population is warranted and can positively improve nutrition related aspects in a normal weight and overweight/obese adolescent.³⁴

The Patient Centered Medical Home

The patient centered medical home (PCMH) for an obese or overweight adolescent consists of care coordinated by a primary physician and the organization of personalized treatment with other providers such as physical therapists, oncologists, and RDs.³⁵ It focuses on healthcare that is patient centered rather than disease centered. Although a physician leads the PCMH, other healthcare providers deliver care to support the patient. The RD can provide care to patients that utilizes techniques of Medical Nutrition Therapy and various counseling techniques that cannot be replicated by any other member of an interdisciplinary care team.³⁵⁻³⁶ A journal article written by RF Khan (2006) showed surveys that practicing physicians believed that nutrition is important in the care of their patients but they feel inadequately trained in providing optimal nutrition counseling.³⁷ That signifies that a RD led intervention through nutrition counseling in an urban overweight and obese adolescent population has a significant purpose. It suggests that the impact of nutrition counseling is a technique that is most beneficial when done by a RD rather than another type of healthcare professional because it is in a RDs skill set to

efficiently deliver evidenced based recommendations for improvement in dietary behaviors to improve and prevent chronic diseases such as obesity and diabetes.

Outpatient Dietitian Intervention at Grady Outpatient Clinics

Based on the statistics outlined by the Robert Wood Johnson Foundation Center to Prevent Childhood Obesity, the overweight and obese adolescent population in Georgia has a significant need for nutrition intervention from a RD.³⁸ The report states that 37% of children in Georgia ages 10-17 years are overweight or obese, with obesity rates of 43,000 middle school students and 62,000 high school students. It also stated that 21% of the obese adolescent population lived in the Metropolitan Atlanta area. Currently there are six outpatient clinics through Grady Health Systems but only four clinics offer nutrition services from one RD in ages ranging from the age of 2 years to adulthood. These clinics are East Point, Kirkwood, North Dekalb, and Asa G. Yancy. These centers advertise that primary care physicians and staff manage chronic illness such as hypertension (HTN), CVD, T2DM, overweight and obesity, metabolic syndrome, renal disease, and asthma. They also advertise disease management and treatment services such as health risk assessment, healthy lifestyle counseling, and care coordination/ communication with Grady subspecialists.³⁹ The RD at these clinics makes an impact in the management of chronic illnesses and management and treatment through healthy lifestyle counseling. This is completed through initial assessments with the RD and follow up sessions as needed. The nutrition counseling session includes taking a weight and height, 24-hour food recall that consists of information on the patients breakfast, lunch, dinner, snacks (day and night), drink intake, and frequency of eating

out, and questions regarding exercise and physical activity. The family approach is utilized often with this population because most adolescents eat food bought by a different family member. The continuity of nutrition counseling with this population of urban overweight and obese adolescents is important to elicit behavior change and improve on health related outcomes. Behavior change is achieved through specific goals, discussing what they are going to change, how they are going to implement change, and the time frame of change. The RD sees patients through referrals made via the medical provider and appointments are scheduled on an individual basis. Continuity of care is maintained between the RD, physicians, and other healthcare providers to help build a team approach while tackling these nutrition related disease states.

Counseling and Behavior Change

Counseling as a part of eliciting behavior change is an aspect that is commonly used in practice and evaluated in research. A study completed by Lubans et al (2011) researched the dietary intakes in 357 adolescent girls from disadvantaged secondary schools with a social cognitive theory intervention. The average age of the girls was between 13-14 years old and they utilized validated social cognitive theory scales that assessed nutrition related self-efficacy, intention, behavior strategies, family support, outcome expectation, and outcome expectancies.⁴⁰ The participants also completed a food frequency questionnaire looking at frequency of core group foods and non-core foods. Core food groups are defined as low energy; nutrient dense items and non-core foods are defined as energy dense, nutrient poor items. The results showed that self-efficacy was positively associated with healthy eating ($\beta=0.36;p<0.001$) and inversely associated with

unhealthy eating ($\beta = -0.19$; $p < 0.01$). The pathway models from intention to behavior were not statistically significant for any circumstance, from self-efficacy to non-core foods ($\beta = 0.18$), core foods ($\beta = 0.19$), or saturated fat ($\beta = 0.20$). Although there was no connection from intention to behavior, which is the main outcome, this study did show this psychological theory caused a change in thoughts and behaviors.⁴⁰

Another study by Schwarz et al (2007) assessed if pediatricians and RD could implement an office based obesity prevention program using motivational interviewing as the primary intervention.⁴¹ There were 15 pediatricians and 5 registered RDs in the study and each were assigned to one of three groups: control, minimal intervention (physician) or intensive intervention (pediatrician and RD). The healthcare professionals working in the minimal and intensive groups received motivational interviewing training and then practiced those techniques on their study participants as the main intervention treatment. There were 91 participants aged 3 to 7 years old who had a BMI in the overweight range. The main outcome measure was a change in the participant's body mass index for age percentile. The results showed that compared to the control group, there was a larger reduction in the participants BMI percentile mean of the intensive group at the end of the 6 months of treatment (-2.6 compared to -0.6). They did not find this statistically significant, but they did find this clinically relevant because it did show a reduction in BMI percentile mean. They also found that there was a higher dropout rate in the intensive group compared to the control or minimal group (50% compared to 10% or 32% in the control and minimal group). Although there was a higher percentage of participants who dropped out in the intensive group, those who stayed reported very high acceptance and that the combination of the RD and pediatrician helped them think about

changing their families food habits (94% of participants agreed “a lot” on the study survey). This study investigated a specific counseling theory and incorporated it into an intervention in order to combat childhood and adolescent obesity. The population in this study was slightly younger, but the same techniques could be incorporated into a overweight or obese adolescent intervention.⁴¹

Increased Prevalence of Nutrition Counseling Sessions Led by a Dietitian

There are also specific interventions that have been led by RDs, physicians, or both in an interdisciplinary fashion that demonstrates the effect on specific outcomes. Henes et al (2009) completed the KIDPOWER study that investigated the impact of developing a standardized medical nutrition therapy protocol to treat overweight children aged 2-20.⁴² This study created a specific protocol including handouts for the population of overweight children and adolescents they served. They assessed if multiple sessions with a RD had an effect on behavior related outcomes such as consumption of sugar-sweetened beverages, intake of fruits and vegetables, frequency of eating out, and hours of TV watched on week days and weekend days. The data collected on these indicators were taken from all participants who had at least 3 medical nutrition therapy (MNT) visits with a RD. The total participants included in the medical chart review study were 109 patients, from 9 outpatient physician offices in a rural community. The results of the study found that there were increases in the amount of vegetable servings per day ($F=6.37, p<0.01$) increases in the amount of fruit serving per day ($F=5.82, p<0.01$), reductions in the amount of time spent eating out per week ($F=3.42, p<0.05$), reductions in the amount of television watched on the weekday and weekend day ($F=4.76, p<0.05$;

F=10.08, $p<0.001$ respectively), and reductions in BMI z scores (F=5.89, $p<0.01$). These results showed that a RD run protocol such as KIDPOWER can be successfully delivered by an RD to overweight youth in their medical home. It shows that counseling from a RD, especially frequency of those meetings, have a significant effect on the behavioral related outcomes of those participants.⁴²

Diaz et al (2010) completed a study investigating an intensive lifestyle intervention for weight management in 42 adolescents aged 9-17 years old.⁴³ The intervention included different tiers of care, including monthly consultations with a physician, and nutrition counseling with a RD (initially each week for the first three months then monthly until the conclusion of the study), and also 12 group sessions in a behavioral change protocol. This is similar to the previous study because it too puts a significant focus on the role of the RD, but this study also involved the physician and group sessions. The control group attended monthly consultation with their primary care physician. The main outcomes for this study were obesity parameters such as reduction in weight, BMI, BMI z score, waist circumference, body fat, and body fat percentage. The results showed that after 6 months of treatment there was a significant reduction in weight (-6.4 kg, $p<0.001$), BMI (-2.5 kg/m², $p<0.001$), BMI z-score (-0.24, $p<0.001$), waist circumference (-6.4 cm, $p<0.001$), body fat (-4.5 kg, $p<0.001$), and body fat percentage (-2.7 %, $p<0.05$). This study showed that an intensive lifestyle intervention in children and adolescents can significantly improve obesity parameters and improve weight status.⁴³ The study data was further analyzed in 2012 to see the impact of this intervention on insulin sensitivity using the insulin sensitivity index.⁴⁴ The result showed that after 6 months of treatment that they found an increase in insulin sensitivity in the

intensive lifestyle intervention group than in the control group (+48.8 +/- 56 vs. +5.6 +/- 47, $p=0.01$). Approximately two-thirds (65%) of the youth in the study increased their insulin sensitivity over 9 units compared to 32% in the control group ($p=0.03$). This study showed that an intensive intervention in children and adolescents looking for weight loss and management could be an alternative model to improve insulin sensitivity in this population. It also shows that meeting with a RD multiple times can have an impact on insulin sensitivity, seeing as the study outlined 15 sessions with a RD in a 3-month period.⁴⁴

DeBar et al (2012) completed a similar study looking at the effect of a multicomponent lifestyle intervention in 208 overweight adolescent girls aged 12 to 17 years.⁴⁵ There was an intervention group who received 90-minute group meetings over a 5-month period, weekly for the first 3 months and biweekly during the fourth and fifth month and a control group who received a packet of materials, resources, and suggested books for healthy lifestyle changes and met with their primary care physician at the study onset. The information in the intervention group included changes in their dietary patterns, physical activity, addressing issues associated with obesity in adolescent girls such as depression, and training participants primary care physicians to support behavioral weight management goals. The intervention group also included parental support meetings for the first three months and study-sponsored training in motivational interviewing for the participating pediatricians. Masters level dietitians, health educators, and doctoral level psychologists conducted the intervention. The main outcome measures consisted of reduction in age adjusted BMI z-score, and secondary outcomes consisted of improvement in metabolic lab values such as total cholesterol and HDL, psychosocial

outcomes such as self esteem and body satisfaction, and health behavior outcomes such as amount of screen time per week and amount of fast food eaten per week. The result showed a significant decrease in the primary outcome of a decrease in the BMI z-score (-0.15 in intervention participants compared with -0.08 among usual care participants $p=0.012$). The researchers also found improvements in specific health behavior outcomes such as lower reduction in frequency of family meals (-0.34 in intervention participants compared to -1.05 in usual care participants, $p=0.028$) and less fast food intake (-0.17 in intervention participants compared to +0.28 in usual care participants, $p=0.021$). This study concluded that a 5-month medium intensity multicomponent behavioral intervention succeeded in sustained decreases in BMI z scores in adolescent girls. The RD played a key role in this study along with additional health professionals by being an active part of the intervention and successfully accomplishing weight loss in an overweight adolescent population.⁴⁵

Young et al (2013) completed a brief study looking to identify the value and usefulness of RDs in an adolescent obesity intervention.⁴⁶ The study consisted of 10 participants aged 15-17 years in the adolescent obesity study titled Wellness Incentive to Health (WITH) program. The participants completed a 30-minute interview with questions asking about their knowledge of RD's, the benefits of RD's in the program, and what they learned from RDs. The results found that 9 of the 10 participants reported little knowledge about RDs before the WITH program. The results also found that the participants perceived RDs as individuals who provided nutrition information such as portion sizes, reading labels, and trying new foods. They also stated that they prefer hands on activities such as cooking activities and tasting foods and want to apply

concepts learned into their daily lives such as learning how to eat healthy with friends, eating healthy in social environments. The participants concluded in the interview that RDs were perceived as useful and provided valuable nutrition expertise. This study was considered small, but it showed that the participants considered RDs a nutrition professional and thought they were a valuable asset to the WITH program.⁴⁶

Summary of Literature Review

In conclusion, there are many different factors that play a role in the treatment and management of urban adolescent aged 11-20 years who are overweight and obese. There is evidence to support that overweight and obese adolescents practice adverse nutrition practices such as eating calorically dense, low nutritional value foods and have an increased amount of screen time.²⁰⁻²² Recommendations have been made by the AAP and the Academy and numerous studies have been implemented to show the effects of dietary or lifestyle interventions in order to improve health status.²³⁻²⁹ Interventions led by RDs have demonstrated significant improvements on health related outcomes through the use of nutrition counseling and MNT techniques to elicit behavior change.³⁸⁻⁴⁴ Statistics describing 37% of adolescents aged 10-17 being overweight or obese and 21% of that population consisting of adolescent living within the Metro Atlanta area showed there is a significant need for intervention.^{30-33,36-37} An intervention that consists of frequent nutrition counseling sessions from a RD has not been completed in an urban population. The literature described supports the purpose of RDs in the pediatric setting in the management and treatment of urban overweight and obese adolescents and the current study will strengthen that literature

CHAPTER III

METHODS

Inclusion and Exclusion Criteria

The inclusion criteria for this study consisted of overweight and obese boys and girls aged 11-20 years who attended the four Grady Health Systems outpatient clinics, named East Point, Kirkwood, North Dekalb, and Asa G. Yancy. The CDC BMI growth charts for age and gender were used to plot BMI. BMI plotted between the 85th and 95th percentile were defined as overweight and those above the 95th percentile were defined as obese. Patients must have attended a session with the RD at their outpatient clinic one or more times from 2/11/13 to 3/23/15. The exclusion criteria included being overweight or obese due to a chronic disease such as hypothyroidism, Cushing's syndrome, Prader-Willi syndrome, or depression and being older than 20 years of age or younger than 11 years of age; patients denying the use of the protected health information (PHI) for research purposes, and not a patient of the Grady Health Systems outpatient clinics.

Data Collection

The research design of this study was a retrospective chart review. There was no patient interaction, no additional intervention, and patients who stated they did not wish for their PHI to be used for research purposes were not included in the study. A sample size of at least 20 patients was anticipated. The medical charts were reviewed at Grady Memorial Hospital via EPIC electronic health records. Charts that include patients who

had opted out of the use of their PHI for research purpose were filtered out via EPIC. Data collected included study identification number, height (cm), weight (kg), age (years), gender, race, and BMI for age percentile at initial visit and date(s) visited with the provider (RD and/or PCP). HgA_{1c}, TG, and TC levels at initial and follow up visits were also collected. BMI was calculated using height and weight from each visit. BMI z-score also computed at initial and follow up visits using the Stokes Chops BMI z-score calculator. Each patient's name and Medical Record Number (MRN) were viewed when gathering information; it was excluded in the data analysis and results.

Data Analysis

The data were described using frequency statistics with a normality testing to determine if the continuous variable data is normally distributed. The change in BMI, BMI z-score, HgA_{1c}, total cholesterol, and triglycerides were determined in patients who had seen the RD multiple times by taking the difference between their most recent visit with the RD and the initial visit; the changes in biomedical values for patients who saw the RD one time were determined by taking the difference of values from their most recent PCP visit. An independent T-test or Mann Whitney U test was used to evaluate changes in BMI and BMI z-scores between patients who had one session with a RD compared with patients who had multiple sessions. The changes in HgA_{1c}, TC, and TG levels between patients who had one session with a RD compared with patients who had multiple sessions will be evaluated as differences. There were two Spearman correlation tests performed with each group to determine the relationship between initial BMI and change in BMI or BMI z-scores. A p-value of <0.05 will be considered statistically

significant. All statistical analyses will be performed using SPSS⁴⁷ (version 21.0, SPSS, Inc., Chicago, IL)

CHAPTER IV

RESULTS

Initial analysis included 37 patients who had at least one visit with the RD. Of those patients who saw the RD for at least one visit, 15 were lost to follow up with their PCP or the RD for an additional visit. Therefore, 22 patients were included in the analysis; 10 patients had at least one visit with the RD (Group 1) and followed up with their PCP, while 12 patients had at least one visit with the RD (Group 2) and followed up with the RD additional times. Changes in biochemical lab values including BMI, BMI z-score, HbA_{1c}, TG, and TC were evaluated at the most recent recorded visit with the RD or PCP compared to their initial visit with the RD. The two highest reported races of the study population were African American (40.9%) and Hispanic (40.9%). (**Table 1**) There were a higher number of males in the study population compared to females (59.1% vs. 40.9%, respectively). The mean age of the study population was 13.95 ±1.99 years.

Table 1. Patient Demographics

Patient Demographics (n=22)		
	N	Percent
Race		
Caucasian	1	4.5
African American	9	40.9
Hispanic	9	40.9
Asian	3	13.6
Gender		
Female	9	40.9
Male	13	59.1

The analysis of demographics, BMI and BMI z-score were reported for the group of patients who saw the RD one time and followed up with their PCP (Group 1, n=10) and the group of patients who saw the RD and followed up with the RD additional times (Group 2, n=12). **(Table 2)** The percentages of males were 40% and 75% for Groups 1 and 2, respectively. The mean ages of patients in Group 1 and Group 2 were 13.20 years and 14.58 years respectively. The mean number of visits was 1.00 and 2.83 for Groups 1 and 2. The median initial BMI for Group 1 was 25.16 kg/m², which was significantly lower than the initial BMI for Group 2, which was 33.79 kg/m² (p=0.015). The median BMI Z-score for Group 1 was also significantly lower than Group 2 (1.69 and 2.38, p=0.035).

Table 2. Demographics of All Patients Who Saw a Registered Dietitian (RD)

Demographics of All Patients Who saw a Registered Dietitian (RD)			
	Group 1^a	Group 2^b	P
	(n=10)	(n=12)	value
Percent Female (n)	60 (6)	25 (3)	
Percent Male (n)	40 (4)	75 (9)	
Mean age in years (SD)	13.20 (1.55)	14.58 (2.15)	NS
Mean number of visits with the RD (SD)	1	2.83 (1.70)	
Mean time between all visits (SD)	10.30 (4.62)	7.08 (5.68)	
Median Initial BMI (kg/m²)	25.16	33.79	0.02*
Interquartile Range (kg/m²)	24.49-29.53	30.79-41.37	
Median Initial BMI z-score	1.69	2.38	0.04*
Interquartile Range	1.52-2.06	2.27-2.67	

^a Patients who had one visit with the RD and followed up with their PCP

^b Patients who had one visit with the RD and followed up with the RD additional times

*P<0.05 is considered statistically significant

Mean changes in BMI and BMI z-score were reported for the group of patients who saw the RD one time (Group 1, n=10) and the group of patients who saw the RD more than one time (Group 2, n=12). **(Table 3)** There was no statistically significant difference between Group 1 and Group 2 in mean change in BMI (p=0.69). The mean

change in BMI z-score was lower for Group 2 when compared to Group 1 and that difference was approaching significance ($p=0.092$).

Table 3. Mean Changes in BMI and BMI Z-Score of All Patients Who Saw a Registered Dietitian (RD)

Mean Change in BMI and BMI Z-Score of All Patients Who Saw a Registered Dietitian (RD)			
	Group 1 (n=10)^a	Group 2 (n=12)^b	P Value
Mean Change in BMI (kg/m²) (SD)	1.33 (0.81)	1.34 (2.14)	0.692
Mean Change in BMI z-score (SD)	0.115 (0.20)	0.002 (0.11)	0.092

^a Patients who had one visit with the RD and followed up with their PCP

^b Patients who had one visit with the RD and followed up with the RD additional times

Changes in biochemical data were reported for the patients in Group 1 and Group 2 who had at least two data points of each lab value. (**Table 4 and Table 5**) Many of the patients in the study did not have multiple lab values recorded in the time frame of the study so they were excluded from this portion of the analysis. The median initial HbA_{1c}, TG, and TC were lower in Group 2 compared to Group 1. (**Table 4**) The mean change in HgA_{1c} and TC were lower for Group 1 compared to Group 2. The mean changes in triglycerides were lower for Group 2 compared to Group 1. (**Table 5**)

Table 4. Median Biochemical Data by Group

Median Biochemical Data by Group		
	Group 1^a (n)	Group 2^b (n)
Median Initial HgA_{1c}	5.6 (6)	5.4 (3)
(Interquartile Range)	(5.4-5.8)	(5.2-5.8)
Median Initial Triglycerides (mg/dL)	111.00 (6)	91.00 (7)
(Interquartile Range)	(67.75-208.50)	(67.00-287.00)
Median Initial Total Cholesterol (mg/dL)	166.00 (5)	140.00 (7)
(Interquartile Range)	(127.50-190.00)	(122.00-169.00)

^a Patients who had one visit with the RD and followed up with their PCP

^b Patients who had one visit with the RD and followed up with the RD additional times

Table 5. Mean Changes of Biochemical Data by Group

Mean Changes of Biochemical Data by Group		
	Group 1 ^a (n)	Group 2 ^b (n)
HgA1c	-0.35 (6)	0.33 (3)
Triglycerides (mg)	100.00 (6)	-60.86 (7)
Total Cholesterol (mg)	-1.40 (5)	2.71 (7)

^a Patients who had one visit with the RD and followed up with their PCP

^b Patients who had one visit with the RD and followed up with the RD additional times

A Spearman's correlation test analyzing the correlation between BMI at initial visit and change in BMI showed a weak positive correlation for the group of patients who had one visit with the RD and followed up with the RD additional times (Group 2, $r=0.441$). An additional Spearman correlation test looking at BMI at initial visit and change in BMI z-score showed a weak positive correlation for the group of patients who saw the RD one time and followed up with their PCP (Group 1, $r=0.370$). All correlations were not statistically significant.

A post hoc analysis was completed because during data collection there were patients in the electronic medical records that met all of the inclusion criteria except they had never seen the outpatient RD at the Grady outpatient clinics. This analysis was completed in 16 patients (Group 3, $n=16$) and evaluated their initial BMI and initial BMI z-score beginning with their earliest visit starting from the year 2013 as well as their change in BMI and change in BMI z-score in the past two years. The average time difference between visits was 12.13 months (range: 5-19 months). The median BMI was 29.79 kg/m² and median BMI z-score was 2.07 respectively. Changes in biochemical lab values including BMI and BMI z-score were evaluated from their most recent recorded

visit with the PCP compared to their initial visit with the PCP starting from the year 2013. The mean changes in BMI and BMI z-score were 0.62 kg/m^2 and -0.0300 respectively. When compared to the group of patients who had multiple sessions with a RD (Group 2, $n=12$) there was no significant difference between groups.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Discussion

This retrospective chart review evaluated the effect of increased frequency of nutrition counseling with a RD compared with only one assessment on health related outcomes and some of the results were significantly impacted by the frequency of nutrition counseling. In the results, although both groups showed an increase in BMI z-score, the increase was much less in the group of patients who saw a RD multiple times compared with the group who saw the RD one time in the past two years. The results reflected that the average time between all visits was 10.30 months for Group 1 and 7.08 months for Group 2, which means that the timespan between visits was shorter for the group of patients who saw the RD multiple times. Also when looking at the mean changes in HgA_{1c}, TC and TG, it was found that the group who saw the RD multiple times showed trends in decreasing blood triglyceride levels over time where as those who only saw the RD once showed increases. Finally, in the results it showed that those who had an increased frequency of nutrition counseling session with the RD had significantly higher initial BMI and BMI z-score than the group that only completed one session.

The results have important implications concerning the change in BMI z-score. Although the difference between BMI z-score is not statistically significant, it is considered clinically relevant in this study. BMI z –score is a measure of how many

standard deviations away from the mean a value is; it is the optimal measure because it standardizes those values for the patient's gender and age. A study by Inokuchi et al. (2011) investigated the optimal measure of annual adiposity in elementary school children and they found that BMI z-score was the optimal measure.⁴⁸ That study confirms that BMI z-score is the best determinant of adiposity and although BMI z-score did not decrease in the group of patients who saw the RD multiple times, slowing the rate of increase to a degree that was trending toward significance reflects that the RD made a significant impact with regard to changes in BMI z-score.

The average time between total visits also provided some implications for this study. The timespan between visits was shorter for the group of patients who saw the RD multiple times but some of those patients' most recent visit in the medical record was from a visit with their PCP, and the timespan between their most recent recorded visit in the medical record and their last visit with the RD was about 12 to 15 months. When investigating this large timespan, it was found that those specific patients actually experienced an increase in BMI and BMI z-score from their last visit with the RD and their most recent recorded visit in the record, which was a visit with their PCP. This could be considered that even in the group of patients' who saw the RD multiple times, the lack of follow up with the RD over time was related to their increase in BMI and BMI z-score.

The results reflecting the decrease in blood triglyceride levels in the group who saw the RD multiple times compared to the increase in those who only saw the RD once are confirmatory of a study completed by Santiprabhob et al (2014) that completed a 1-year group based weight loss program in 115 obese youths aged 8-18. The participants

completed 5 nutrition session in the group setting and found decreases in TC and TG (differences in mean stated -9.3mg/dL , $p<0.001$; -19.9mg/dL , $p<0.001$).²⁸ The results in the current study were reported as means because there was a loss to follow up with regard to these biochemical lab values, which lead to very small sample sizes of 3 to 7 patients per group. The lack of recorded lab values even in patients who came to see the RD or PCP multiple times is reflected in the lack of protocols for lab values in the pediatric population. There are preventative pediatric health care guidelines, which were reported by the AAP, that outline recommendations for taking measurements, assessing the developmental and behavioral status, and physically examining the patient.⁴⁹ The only laboratory values that were recommended were hematocrit or hemoglobin and dyslipidemia screening (TC, LDL, HDL, and TG). The specific recommendations for the dyslipidemia screening stated that only between the ages of 8-11 and 17-21 were these lab values considered mandatory. In all other cases, it was recommended that a risk assessment be performed with appropriate actions to follow if positive. The average age of the patients in this study was 13.95 years, meaning that measuring serum triglycerides or total cholesterol was not mandatory for most of the patients. In the European Journal of Obesity, Baker et al (2010) completed a review of the recommended practices for overweight and obese children and adolescents. They suggested that obese children and adolescents should complete a laboratory evaluation of liver function, fasting lipid profile, and evaluation of glucose metabolism.⁵⁰ They also failed to state a timeframe of repeat lab values, but did recommend seeing at least every 4-6 months. Based on those two recommendations, it is clear that in order to get a depiction of how changes in lab values can be affected by frequency of nutrition counseling, more specific protocols for

the frequency of completing lab workups need to be researched, reviewed, and recommended.

Another interesting implication of this study includes the patients initial BMI and BMI z-score and their perceived health risk. In the results, it showed that those who had an increased frequency of nutrition counseling session with the RD had significantly higher initial BMI than the group that only completed one session (28.41 kg/m² in Group 1 and 33.79 kg/m² in Group 2, p=0.015). There is a psychological model known as the Health Belief Model that explains and predicts health behaviors by helping patients evaluate their perceived susceptibility, severity, benefits, and barriers.⁵¹ Using the concepts of this model, it appears that the patients and their families in the group who only saw the RD once, who had a lower initial BMI, may have considered their perceived severity to be lower and thus their susceptibility to the increased risk of disease lower as well. In a study completed by Wang et al (2009), the researchers investigated the associations between actual body weight status, weight perception, body dissatisfaction, and weight control practices among low income urban African American adolescents and found that the prevalence of overweight and obesity in their sample population was 39.8%, but only 27.2% considered themselves overweight or obese.⁵² That information confirms the perception of this study that patients may think they are of a normal body weight and are not at risk for disease, but if their BMI is outside of the normal range their health risks are still increased.

Although 22 patients were seen by the RD one or more times in the past two years, there were significantly more who required nutrition services for adolescent weight management. There were 37 total patients that were seen by the RD in the past two

years, with 12 patients following up with the RD and 15 not following up with any health professional. Also, there were 16 patients who had a significant need for seeing the dietitian, but they could not be seen for some unforeseen reason. Based on the number of pediatric weight management referrals the RD has received for patients aged 10-19 years, which is an estimated 456 referral per year, there is clearly a need for a pediatric RD at these outpatient clinics. The number of referrals listed above does not include any adult referrals the outpatient RD receives.

Finally, the use of the group of patients who did not see the RD at the Grady outpatient clinics was evaluated as a post hoc analysis. When completing data collection, it was found that there were multiple adolescents who met all of the inclusion criteria except having a nutrition counseling session with the RD in the Grady outpatient clinics in the past two years. The evaluation of their BMI, BMI z-score, mean change in BMI, and mean change in BMI z-score was completed as an additional interests to see if there were any significant relationships or comparisons between groups who had seen the RD and who had not seen the RD. The post hoc analysis also meant to look for significant comparisons between the group who saw the RD one time, and the group who saw the RD multiple times. The results of the post hoc analysis showed no statistical difference between values between groups, but like the evaluation of the total study sample, the group of patients who saw the RD multiple times had significantly higher BMI and BMI z -score when compared to the post hoc group. This could have been reflected because of the perceived severity of the patient's condition or because there was no reported nutrition counseling session, it could be related to a knowledge deficit in the patient and their family. Also it is unknown whether these patients were referred to see the

outpatient RD at Grady but were unable to be contacted or unable to be scheduled. Based on the medical record, there is no report of a nutrition counseling session with the RD in this specific group. That suggests that although they may have never seen a RD, it is unknown whether these specific patients went to a different clinic in the Atlanta area to receive nutrition services. One major hospital system that serves the pediatric population specifically is Children's Healthcare of Atlanta (CHOA). In addition to inpatient services and surgical procedures, CHOA offers nutrition services to overweight and obese children and adolescents such as one on one counseling and summer camps.⁵³

Strengths and Limitations

This study included some strengths and limitations. The strengths included that this study was considered novel, seeing as it was the first time these data have been reviewed. It is also the first time that this specific urban demographic or age range has been looked at regarding a retrospective chart review. The second strength was that the results of this study along with the high amount of pediatric referrals the outpatient RD receives demonstrates a need for a pediatric RD in the Grady outpatients clinics. It is reflected in the results that the RD made a difference in this study sample. Those results impacting a need for more RD's in the field is considered a strength.

This study also included some limitations. About 26.4% of the entire sample was lost to follow up after the first visit with the RD or PCP. 100% of those who dropped out were in the group of patients who only saw the RD once, which re-emphasizes that those in that specific group may not have thought there were any perceived health risks. Additionally, the loss to follow up with the RD or PCP could be attributed to other

environmental factors such as flaws in communication, movement of residency, changing of health insurance, or receiving nutrition counseling from a different clinic in the Atlanta area. When looking through the patient's medical records, any record of any other health system is not recorded, so it is unknown whether they received nutrition services prior to or after their interactions with the RD and PCP at the Grady outpatient clinics. Another limitation of the study was the lack of repeat laboratory values completed in the patients. Around three to six participants per lab value had two data points and could be included in the study, making the sample sizes very small.

Areas of Future Research

In order to pursue statically significant results looking at how increased frequency of nutrition counseling with a RD can affect the improvement in health related outcomes in a urban overweight and obese adolescent population in the future, repeat studies with larger sample sizes and stronger sample retention need to be achieved. A decrease in serum triglyceride indicates the need for further study in the benefits of multiple sessions with the RDN in terms of metabolic outcomes. These studies need to also look at more than just health related outcomes, such as dietary changes and adherence to goals created in the sessions. Future studies could also take this population and look at their change in health related outcomes with a specific nutrition related intervention or curriculum to test such as group session, nutrition education, or a specific type of diet. Finally, these future studies need to be evaluated with more concrete protocols for periodicity of laboratory values in order to get accurate, measurable data points that can be compared in future

studies. This study provided valuable insight on the function and importance of outpatient RD's in an urban overweight and obese adolescent population.

Conclusion

In conclusion, increased frequency of nutrition counseling improved BMI- z score status by slowing down the rate of weight gain over time when compared to the patients who received only one assessment with the RD in the past two years. These changes were not statistically significant but they were clinically relevant. This study also concludes that patients who had increased frequency of nutrition counseling had significantly higher baseline BMI and BMI z score when compared to those who only had an assessment or those who had no reported nutrition counseling session. These conclusions reflect that those who did see the RD showed improvements, thus meaning the RD is helpful in stimulating behavior change in this population. Based on the number of pediatric weight management referrals the RD has received there is clearly a need in these clinics, and these results reflect the impact that RDs can make on this specific population.

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APPENDIX A

Definition of CDC Growth Chart⁵⁴

