

Clinical Management and Patient Outcomes Among Children and Adolescents Receiving Telemedicine Consultations for Obesity

Ulfat Shaikh, M.D., M.P.H.,¹ Stacey L. Cole, M.B.A.,² James P. Marcin, M.D., M.P.H.,¹ and Thomas S. Nesbitt, M.D., M.P.H.¹

¹University of California Davis, School of Medicine, Sacramento, California.

²Center for Health and Technology, University of California Davis, School of Medicine, Sacramento, California.

Abstract

Rural residents report lower likelihood of exercising, and higher rates of obesity, heart disease, and diabetes compared to their urban counterparts. Our goals were to (1) investigate the outcomes of telemedicine consultations for pediatric obesity on changes/additions to diagnoses, diagnostic evaluation or treatment, and (2) determine whether changes in diagnostic and management recommendations made by the consultant were associated with improvements in patient nutrition, activity level, and weight. We conducted a retrospective medical record review of patients referred to a University-affiliated Children's Hospital Pediatric Telemedicine Weight Management Clinic for a diagnosis of obesity. Of the 139 children and adolescents who received pediatric weight management consultations during the study period, 99 patients met inclusion criteria. Weight management consultations resulted in changes/additions to diagnoses in 77.8% of patients and changes/additions to diagnostic evaluation in 79.8% of patients. Of patients seen more than once, 80.7% showed improvement in clinical outcomes. Of patients seen more than once, 80.6% improved their diet, 69.4% increased activity levels, 21.0% showed slowing of weight gain or weight maintenance, and 22.6% showed weight reduction. Improvements in clinical outcomes were not associated with changes/additions to diagnoses (Odds Ratio [OR] = 0.98; 95% Confidence Interval [CI] = 0.25–3.98) and were weakly

associated with changes/additions to diagnostic evaluations (OR = 2.23; 95% CI = 0.58–8.73). However, changes/additions to treatment were associated with improvement in weight status (OR = 9.0; 95% CI = 1.34–76.21). Obesity consultations were associated with changes/additions to diagnoses, diagnostic evaluation, and treatment. Treatment changes were associated with improvement in weight status. Telemedicine weight management consultations have the potential to result in modifications in patient care plans and outcomes.

Key words: obesity, children and adolescents, weight management consultations, rural patients, outcome improvement

Introduction

Obesity is a public health “epidemic” in the United States affecting approximately 16% of children, with an additional 16% of children considered overweight.^{1,2} Childhood obesity is a risk factor for the development of multiple pediatric health problems, including type 2 diabetes, hypertension, hypercholesterolemia, obstructive sleep apnea, asthma and orthopedic problems, as well as psychological consequences such as lower self-esteem, poor body image, social alienation, anxiety, and depression.^{3–8} In addition, elevated childhood body-mass index (BMI) values are important risk factors for adult obesity and its complications.^{9,10}

Obesity appears to be more prevalent in rural compared to urban areas. Rural populations have poorer access to healthcare and face significant health disparities compared to urban populations.^{11–16} Rural residents report less access to pediatric and specialty care, greater travel time to healthcare providers, lack of insurance, lower likelihood of exercising, and higher rates of obesity, heart disease, and diabetes compared to their urban counterparts.^{17–20} Unique challenges faced by rural healthcare providers include professional isolation, reduced access to medical information and continuing edu-

cation, and lack of communication with subspecialists and ancillary support services.^{21,22}

Telemedicine has been successfully used in specialties such as dermatology, psychiatry, pulmonary medicine, and cardiology, and has consistently led to strong patient satisfaction with care.²³⁻²⁶ Although there is a growing body of literature on the clinical effectiveness and outcomes of telemedicine, applications in the fields of obesity and nutrition have only recently been described.²⁷⁻³¹ Moreover, most research into the effectiveness and outcomes of telemedicine interventions has been conducted in adults.²⁹⁻³¹ To assess whether clinical consultations delivered by telemedicine improve quality of care, the effect of consultations on objective measures, namely, diagnostic and management decisions and clinical outcomes, must be measured.^{29,30} Hence, the first goal of this study was to investigate the effects of telemedicine consultations for pediatric obesity on the above fundamental outcomes. The second goal of this study was to determine whether telemedicine-driven changes in diagnosis and management decisions were associated with improvements in clinical outcomes in patients who had more than one consultation. Our hypotheses were that telemedicine consultations for pediatric obesity would result in changes/additions to diagnoses and diagnostic evaluation, as well as improvement in patient diet, activity level, and weight status.

Materials and Methods

SETTING

The study was conducted at a University-affiliated Children's Hospital (the Center for Health and Technology [CHT] at the University of California Davis Medical Center [UCDMC]). California covers approximately 175,000 square miles and is the third largest and the most populous state in the union. Approximately 90% of the California land mass is considered rural.³² According to 2000 Census data, rural California includes 5 million residents or 14.8% of the total population of California, and this population is increasing.³³

Since the establishment of the telemedicine program at UCDMC in 1996, the CHT has provided nearly 17,000 live interactive video-conference medical consultations in more than 40 specialties to more than 80 rural and remote sites in California. Eighteen percent of these consultations have been provided to children and adolescents.

OFFICE OF HUMAN RESEARCH PROTECTION

This research protocol was reviewed and approved by the Office of Human Research Protection at the UCDMC prior to the initiation of this study.

INCLUSION CRITERIA

Telemedicine weight management consultations provided to children and adolescents 18 years of age and younger were identified using the UCDMC Telemedicine Clinical Consultation Database. Between January 2000 and September 2004, 139 children and adolescents at 18 rural clinics in California received such consultations from a UCDMC pediatric weight management specialist.

The Telemedicine Clinical Consultation Database was used to determine patient age, gender, International Classification of Diseases (ICD) 9th Edition diagnoses codes, length of time from referral to telemedicine consultation, and number of days in the telemedicine treatment program. Our analyses were restricted to patients referred for diagnoses of obesity, morbid obesity, overweight, or abnormal weight gain (ICD 9th Edition classification codes 278.0, 278.01, 278.02, or 783.1, respectively). Patient medical records were reviewed by either a pediatric weight management specialist not involved with any of the telemedicine consultations, or by a research associate at the UCDMC.

TELEMEDICINE CONSULTATIONS

Telemedicine consultations consisted primarily of one-on-one patient evaluations provided by a weight management specialist and/or endocrinologist with a rural healthcare provider present at the remote site. All consultations were initiated by primary care providers at the rural clinics. Consultations were performed in accordance with the UCD Health System telemedicine policies and procedures.³⁴ Video consultations were performed at 384 kilobits per second by either Internet Protocol (IP) or Integrated Services Digital Network (ISDN).^{35,36}

PATIENT OUTCOMES

A retrospective review of patient medical records was conducted to determine whether outpatient telemedicine weight management consultations for obese children and adolescents resulted in (1) changes or additions to patient diagnoses, (2) changes or additions to diagnostic evaluation, (3) changes or additions to treatment, and (4) improvement in patient diet (increased consumption of fruits and/or vegetables, reduced consumption of sugar sweetened beverages, reduced fat consumption, or more structured meal patterns), activity level (increased physical activity and/or reduced sedentary activities), and weight status (weight maintenance, weight loss, or slowing of rate of weight gain). Coding guidelines for the first three outcomes were based on a previously published study conducted by researchers at the UCDMC-CHT, which examined the effectiveness of telemedicine consultations in dermatology, endocrinology, and psychiatry.³⁷

CHANGES OR ADDITIONS TO PATIENT DIAGNOSES

Referral forms and patient charts were reviewed to determine whether there were changes made to patient diagnoses, or whether additional diagnoses related to co-morbidities of obesity were made by the consultant (for example, dyslipidemia, acanthosis nigricans, insulin resistance, type 2 diabetes, hypertension, depression, obstructive sleep apnea, and asthma). We coded this information as (1) changes/additions to diagnosis, (2) no changes/additions to diagnosis, or (3) diagnosis pending test results, as best as can be determined from chart. A more specific diagnosis made by the consultant was coded as a “change” (for example, “snoring” versus “obstructive sleep apnea”). If the referring diagnosis from the referring provider did not include the consultant’s diagnosis, it was coded it as a “change.” No change in diagnosis was coded if the consultant confirmed the referring provider’s diagnosis and did not add any other diagnosis relevant to obesity. If the consultant’s note did not include any specific diagnosis due to pending (laboratory, radiological, or other) test results, we coded it as “diagnosis pending test results.” In most cases this category was not used because there was typically at least one diagnosis that was added or changed.

CHANGES OR ADDITIONS TO DIAGNOSTIC EVALUATION

Notes from the consulting provider were reviewed to determine changes or additions to the diagnostic evaluation. A change or addition to diagnostic evaluation was coded if the consultant modified or added to laboratory, radiological or other test plans. Referral to other consultants (for example psychiatry, pulmonology, endocrinology or cardiology) was also coded as a change or addition to evaluation, as was screening the patient for psychosocial issues like depression or anxiety, using self-administered questionnaires. No change or addition to diagnostic evaluation was noted when no other tests or subspecialist referrals were recommended by the consultant.

CHANGES OR ADDITIONS TO TREATMENT

Similarly, notes from the consultant were reviewed to determine whether any changes were made to treatment. A change in treatment was documented if there were any changes made by the consultant to the patient’s medication regimen, including initiation of new medications, discontinuation of current medications, or modifications of doses of current medications. This included changes in over-the-counter as well as prescription medications. We also coded changes or additions to treatment if the consultant documented behavior modification strategies utilized at the visit or made recommendations for referral to subspecialty services such as endocrinology, cardiology, pulmonology, or psychiatry. We coded no changes or additions to treatment if no medications were added, modified, or discontinued.

IMPROVEMENT IN DIET, ACTIVITY, AND WEIGHT STATUS

Only patients who had two or more visits documented in their charts were included in analyses for nutrition, activity, and clinical improvement. Improvement was measured by comparing clinical outcomes between the first and last visits for changes in patient dietary habit, activity level, and weight status. Improvement in diet was coded if the consultant documented increased consumption of fruits and/or vegetables, reduced consumption of sugar-sweetened beverages, reduced fat consumption, or more structured meal patterns. Improvement in activity level was coded if the consultant documented increased physical activity and/or reduced sedentary activity. Improvement in weight status was coded if the consultant documented or the reviewer noted weight maintenance, weight loss, or slowing of rate of weight gain between the first and last visits. If there was no note by the consultant of diet or activity level improvement or if the consultant or the reviewer did not document improvement in weight status, it was coded as “no improvement.”

INTERRATER RELIABILITY

Two reviewers reviewed a randomly selected subset of eligible patient charts to evaluate coding reliability, accuracy, and interrater reliability. The first reviewer was an attending physician at the face-to-face weight management clinic at UCDMC who was not involved in the telemedicine consultations included in this study. The second reviewer was an experienced telemedicine research assistant who had reviewed patient charts in a published study with similar outcomes in other telemedicine specialty clinics. Each reviewer independently abstracted information on all outcome variables. A reabstraction was conducted on 23% of the charts to measure interrater reliability using a Kappa statistic.

STATISTICAL ANALYSIS

Odds ratios (ORs) and 95% confidence intervals (CIs) were computed to determine the association between clinical improvement in patient diet, activity and weight status, and changes or additions to diagnoses, diagnostic evaluation, and treatment. Interrater reliability was calculated using the Kappa statistic. Statistical analyses were performed using SPSS 14.0 for Windows © 1989–2005 (SPSS Inc., Chicago, IL).

Results

During the study time period (January 2000–September 2004), 139 children and adolescents received pediatric weight management consultations. Of these patients, 99 met study inclusion criteria. Patients who did not meet study inclusion criteria were those referred to the

pediatric weight management clinic for primary diagnoses of failure to thrive, undernutrition, or short stature. There were 62 patients with two or more visits.

DEMOGRAPHICS

Patients ranged from 1 to 17 years of age at their first visit, with a mean age of 10 ± 3.9 years old. Forty percent of patients were between 12 and 16 years old at the time of their first consultation. Sixty-two percent of patients were female and 37% were male. Patients had a mean number of 2.6 ± 2.0 telemedicine consultation visits with the pediatric weight management specialist, with a range of between 1 and 11 visits per patient. Approximately 71 ± 46 days elapsed between the initial consultation and the second among the 62 patients who had more than one visit.

INTERRATER RELIABILITY

Kappa values between the reviewers in each of the four primary categories ranged between substantial to almost perfect agreement.³⁸ Kappa values for changes/additions to diagnoses, changes/additions to diagnostic evaluation, changes/additions to treatment, and patient lifestyle and weight improvement were calculated at 0.881, 0.617, 1.0, and 0.889, respectively.

CHANGES/ADDITIONS TO DIAGNOSIS

Weight management consultations resulted in changes/additions to diagnoses in more than three quarters ($n = 77$, 77.8%) of patients (Table 1). Changes/additions to diagnoses often resulted from other diagnoses made by the consultant that included, but were not limited to, obstructive sleep apnea ($n = 10$), acanthosis nigricans ($n = 6$), and hyperlipidemia ($n = 9$).

Table 1. Outcomes of Telemedicine Consultations for Pediatric Obesity (N = 99)

OUTCOME	NO.	%
Change in diagnosis	77	77.8
Change in diagnostic evaluation	79	79.8
Change in treatment	86	86.9
Parenting skills education	15	15.2
New medication initiated	15	15.2
Behavior modification strategies initiated	76	76.8
Parent education material provided	63	63.6
Additional consultation(s) recommended	28	28.3
Other	1	1.0

CHANGES/ADDITIONS TO DIAGNOSTIC EVALUATION

Weight management consultations resulted in changes in diagnostic evaluation in 79.8% ($n = 79$) of cases (Table 1). Changes in diagnostic evaluation included requesting sleep studies to diagnose obstructive sleep apnea, conducting diagnostic testing for depression and anxiety disorder using validated questionnaires, as well as ordering laboratory tests to diagnose associated co-morbidities such as high cholesterol and type 2 diabetes.

CHANGES/ADDITIONS TO TREATMENT

Change in treatment included parental education on behavior modification strategies, referral to other subspecialists (such as psychiatrists, pulmonary specialists, cardiologists and otolaryngologists), and medication initiation. After weight management consultations, 86.9% ($n = 86$) of patients underwent changes in treatment plans (Table 1). Parenting skills education and behavior modification counseling was conducted in 15.21% ($n = 15$) and 76.8% ($n = 76$) of patients, respectively. It was often assessed that the parents and children were unaware of underlying factors that contributed to the child's obesity. Parents and children were specifically educated on meal structure, meal planning, appropriate portion size, and self-monitoring of diet and activity. Referral to another specialist was made if the weight management specialist assessed the presence of symptoms or signs related to the patient's obesity that would require additional specialty care.

IMPROVEMENT IN DIET, ACTIVITY AND WEIGHT STATUS

Of the 62 patients seen more than once by weight management specialists, 80.6% ($n = 50$) showed improvements related to lifestyle or weight on subsequent visits. Of patients seen more than once, 80.6% ($n = 50$) showed improvements in their diet, 69.4% ($n = 43$) increased their activity levels, 21.0% ($n = 13$) showed slowing of rate of weight gain or weight maintenance, and 22.6% ($n = 14$) showed weight reduction (Table 2).

Table 2. Lifestyle and Weight Status Improvement in Patients with >1 Consultation (N = 62)

OUTCOME	NO.	%
Any lifestyle and weight status improvement	50	80.6
Improvement in diet	50	80.6
Increase in activity level	43	69.4
Slowing of weight gain/weight maintenance	13	21.0
Weight reduction	14	22.6

BIVARIATE ANALYSIS

The association of improvements in lifestyle and weight status with changes/additions to diagnosis, diagnostic evaluation, and treatment is described in *Table 3*. Improvements in lifestyle and weight status did not correlate with changes/additions to diagnosis (OR = 0.98; 95% CI = 0.25–3.98) and only weakly correlated with recommendations for diagnostic evaluations (OR = 2.23; 95% CI = 0.58–8.73). Overall improvements in lifestyle and weight status did not correlate with change in treatment plan (OR = 0.55; 95% CI = 0.12–2.33). However, the change in treatment plans was associated with improvements in weight status (weight maintenance, slowing of rate of weight gain or weight reduction,) with an OR = 9; 95% CI = 1.34–76.21), when improvements in diet and activity level were excluded from the analysis. For patients seen more than once by weight management specialists, improvements in lifestyle and weight status did not correlate with the number of telemedicine visits.

Discussion

In a review of 99 children and adolescents who received weight management consultations for obesity delivered by telemedicine, we found that a majority of consultations were associated with changes or additions to diagnoses (77.8%), diagnostic evaluation (79.8%), and treatment (86.9%). Most patients (80.6%) treated by the weight management specialist showed improvements in their diet, activity level, or weight while in treatment. Specific counseling for changes in diet and activity levels was conducted by the consultant for nearly all patients. Hence, when these two variables were included in “change in treatment,” we did not note any association of change in treatment with improvement in weight status. When diet and activity level counseling was excluded in “change in treatment,” we noted that change in treatment was highly associated with improvement in weight status.

Our results are consistent with other research that demonstrates changes in diagnoses, diagnostic evaluations, and treatment after specialty consultations, including those made after telemedicine consultations.^{39–44} Behavioral interventions, nutritional counseling, and specialist referrals for pediatric obesity treatment have demonstrated variable short-term as well as long-term success with respect to weight loss or maintenance, depending on the content and intensity of intervention components.^{45–49} Patients included in our study did demonstrate significant short-term improvements in diet, activity and weight status while patients were in treatment.

One limitation of our study is that we did not include a control group that did not receive telemedicine weight management consultations or that received face-to-face consultations. However, our results are consistent with other studies that reported changes in diagnoses and treatment in face-to-face specialty consultations.^{40,50–52} Patients included in our study resided in rural and remote areas of California, and faced disparities with respect to healthcare access and socioeconomic status. Therefore, it is possible that our results may not be generalizable to telemedicine weight management programs in urban or more affluent populations. It is important to consider that the number of days in treatment per patient ranged from 6 days to 540 days. Due to the chronic nature of obesity as well as variable patient compliance with recommendations, long-term follow-up of patients is necessary to demonstrate the success of weight management interventions. We did not collect follow-up data on whether positive lifestyle behaviors or weight outcomes were sustained long term. Moreover, due to the retrospective nature of the study, conducted by medical record review, the data generated should be considered preliminary and exploratory. Future prospective randomized controlled trials may provide more conclusive assessment of the efficacy of telemedicine weight management consultations and their impact on quality of care and clinical outcomes.

Table 3. Association of Clinical Improvement with Changes/Additions to Diagnoses, Diagnostic Evaluation, and Treatment, (n) %

	IMPROVEMENT IN DIET	IMPROVEMENT IN ACTIVITY LEVEL	SLOWING OF RATE OF WEIGHT GAIN/ WEIGHT MAINTENANCE	WEIGHT REDUCTION
Changes/additions to diagnosis	41 (66)	36 (58)	11 (18)	10 (16)
Changes/additions to diagnostic evaluation	44 (71)	37 (60)	12 (19)	10 (16)
Changes/additions to treatment (including diet and activity counseling)	50 (81)	43 (69)	13 (21)	14 (23)
Changes/additions to treatment (excluding diet and activity counseling)	45 (73)	40 (65)	12 (19)	14 (23)

In spite of these limitations, our study makes important contributions to the existing literature on telemedicine applications in pediatrics. We have demonstrated that telemedicine weight management services can contribute specialty expertise to the care of children and adolescents in rural areas with geographic disparities in access to healthcare. These services have the potential to result in modifications in patient care plans. One implication of this finding is that weight management “outreach clinics” could be replaced with telemedicine clinics. Moreover, patients who previously had to travel to tertiary care facilities from rural or remote locations could be reassured about the ability of telemedicine weight management consultations to contribute to patient care plans.

Weight management consultative services at our university-affiliated hospital have so far been limited to providing one-on-one consultations for the treatment of extremely obese pediatric patients. The weight management specialist’s role can potentially be extended to offering pediatric obesity prevention consultations for children at risk for overweight or obesity, as well as those with high-risk family histories for obesity and related co-morbidities. Additionally, telemedicine could play a role in delivering continuing education, training, and support for pediatric obesity prevention and management to rural providers and staff.

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Address reprint requests to:

Ulfat Shaikh, M.D., M.P.H.

University of California Davis, School of Medicine

2516 Stockton Boulevard, Suite 340

Sacramento, CA 95817

E-mail: ushaikh@ucdavis.edu

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