Screening for Obesity in Pediatric Primary Care:

A Review of the Literature

Stephen Cook, MD [1], Eliana M. Perrin, MD, MPH [3], Kori B. Flower, MD, MPH [3], Alice S. Ammerman, DrPH, RD [3], Charles Homer, MD, MPH [5], Michael Weitzman, MD [2], Mark S. Johnson, MD, MPH [4], and Jonathan D. Klein, MD, MPH [1].

1. The University of Rochester Department of Pediatrics,
2. New York University School of Medicine Department of Pediatrics,
3. University of North Carolina at Chapel Hill,
4. University of Medicine and Dentistry of New Jersey,
5. National Initiative for Children's Healthcare Quality

Abstract Word Count: 250

Manuscript Word Count: 3469

This paper was supported by a grant from
The Robert Wood Johnson Foundation.

Keywords: Obesity, Primary Care Pediatrics, Anthropometrics, Systematic Review, Screening

Abstract

Objective: Childhood obesity must be properly identified for prevention and treatment to occur, and this is the task of the pediatric primary care providers. Body mass index (BMI) and BMI growth curves are the recommended method to screen for obesity in pediatrics. This paper will examine the literature on the use of BMI in the pediatric primary care setting, describe barriers to its implementation, and discuss chronic care and collaborative models as possible solutions.

Methods: A systematic review of the literature from 1996 to 2005 focused on studies describing physician practice patterns, ambulatory care, and clinical use of BMI from pediatric samples.

Results: We identified studies with various research methodologies. Providers reported high levels of concern about their patients becoming obese, and recognized its immediate and long term consequences. Providers reported using a variety of methods to screen for obesity but BMI was rarely used and obesity was rarely identified in medical records. Chart reviews showed an under-use of BMI and a significant proportion of overweight children, BMI $\geq 95^{th}$ percentile, who were not identified as such. This occurred among younger children and children with less severe obesity. Providers reported issues with patient motivation, intervention support and reimburse related to next steps of treatment as barriers.

Conclusions: BMI accurately identifies children early in the onset of obesity, and the un-diagnosed children maybe more amenable to simple behavioral changes that can be delivered in the primary care office setting. Providers concerns with downstream interventions may hinder the early steps of identification.

Overweight Children: A Challenge Facing Clinicians

Public officials and the national media have created widespread awareness of profound increases in the prevalence of childhood obesity, and addressing the issue of obesity in the clinical setting has never been more necessary. Obesity in childhood predicts adult obesity (1), it is associated with antecedents of adult cardiovascular disease such as type 2 diabetes and the metabolic syndrome during childhood (2-4), and it is leading to increasing pediatric medical costs (5). Prevention and treatment models are now needed to reverse this epidemic. Childhood obesity is a chronic disease with growing implications for immediate morbidity. It needs to be recognized as such, taking lessons learned from other chronic conditions such as diabetes and hypertension, and socially-mediated diseases, such as tobacco abuse. Although the underlying genetic components may not be modifiable, poor food choices, increased sedentary behaviors and decreased physical activity can be changed. Social and political awareness have led to reexamination of policies and practices related to every-day food consumption and physical activity. Changing the availability and acceptance of these behaviors may allow health providers to have a clearer role and accomplish primary care goals, but the precise clinical activities clinicians should undertake is still under investigation.

The Center for Disease Control has defined "overweight" in children as a BMI ≥ 95% and "at risk of overweight" in children as a BMI between the 85th and 95th percentiles (6). The American Academy of Pediatrics (AAP) has published recommendations about childhood obesity, which include the recommendation to *"calculate and plot BMI once a year in all children and adolescents,"* and the American Academy of Family Physicians (AAFP) also supports calculating BMI at every visit during which weight is assessed (7). The AAP recent policy statement to assist pediatric clinicians in prevention of overweight and obesity (8)

represents the first such statement in over 20 years (9). During this time, childhood overweight tripled (10, 11) with a disproportionate rise in overweight among African Americans and Hispanic populations (12). In 2004, the Institute of Medicine developed a prevention-focused action plan, "Preventing Childhood Obesity: Health in the Balance," which calls for "immediate action" and provides recommendations that are "based on the best available evidence—as opposed to waiting for the best possible evidence." The Institute of Medicine report specifically recommends:

- Health-care professionals should routinely track body mass index (BMI), offer relevant evidence-based counseling and guidance, serve as role models, and provide leadership in their communities for obesity prevention efforts.

However, even when a test meets rigorous criteria for use, barriers to its widespread adoption may be present that require systematic efforts to overcome these barriers and promote high quality care. For obesity, the continuous quality improvement collaborative change model provides a framework for action for both chronic care and prevention (13-15). A common first step for clinical interventions in general is effective screening to identify those at risk or in need of interventions; this was recently recommended by the U.S. Preventive Services Task Force for overweight in children (16). Body mass index (BMI), the calculation of weight in kilograms divided by height in meters squared, is an appropriate option for overweight screening in pediatric primary care since weight and height are often routinely measured in pediatric practices. The purpose of this paper is to review the recent literature on screening for obesity in children in primary care and the use of BMI in the pediatric setting. We also discuss practice models and collaborative efforts that can be specifically applied to recommendations and future efforts to address childhood obesity in the office setting.

Anthropometrical Data in Pediatrics:

Anthropometrical measures have long been used in pediatrics to identify children's nutritional status. As early as the 1880s, infant weight and infant health were linked, though malnourishment, rather than over-nourishment, originally prompted systematic growth assessment (17). In the 1970s, sex- and age-specific growth charts based on national survey data were developed and disseminated for clinical use (6). Most recently, the CDC released Growth Charts in 2000 (18) (available at: http://www.cdc.gov/growthcharts), which include two new charts for Body Mass Index-for-Age for each gender. These allow for assessment of weight adjusted for stature by providing BMI percentiles for children between the ages of 2-20.

The accurate assessment of body composition has become more important as obesity research and technology have evolved. Since true or "in-vivo" body mass measurement can only be accomplished through methods such as chemical cadaver analysis, non-invasive and indirect methods for estimating fat and fat-free mass, such as underwater weighing and dual energy x-ray absorptiometry (DEXA) have been developed. These methods are limited to research centers and not used in everyday clinical or public health practice (19, 20). Such measures provide detailed quantification of body fat mass, fat free mass, and regional fat distribution. They require specialized equipment, specific corrective factors for age and pubertal development, and compliance on behalf of the study subject. Additional practical considerations which may limit the utility of these techniques include 1) initial cost, 2) training of the operator, 3) maintenance and operating costs, 4) precision; and, 5) accuracy (21). There is an extensive literature using BMI to track obesity in adults and children in longitudinal or cross sectional epidemiological studies. BMI shows a good correlation with body fat ($r = 0.50$ to 0.87), measured by either

DEXA or underwater weighing, from studies with both normal and overweight children and adolescents (22-26). Most children with BMI in the highest categories have > 30% body fat (19, 27-30). Many studies have evaluated the sensitivity and specificity of BMI in children and adolescents. The CDC BMI percentiles were compared against DEXA scans in 596 children. BMI percentile $\geq 85^{th}$ was useful for identifying children who may be obese while, BMI $\geq$ 95th percentile had a high specificity (96%) and high Positive Predictive Value, but a modest sensitivity, 65%. In general, BMI percentiles for overweight and/or obesity were moderately sensitive (60-80%) and highly specific (94-99%) with very high Positive Predictive Values (97-99%) for identifying children or teens with high body fat percentage. The high specificity and low false positive rate of BMI percentiles in these studies should reassure clinicians that the vast majority of children found to be overweight truly have an excess of fat tissue.

Methods

Part of the purpose of this paper was to review the literature on issues or barriers to assessing children's BMI or percent ideal body weight in primary care practice. A search of the English-language literature in MEDLINE between 1996 and December 2005 was performed to find references to the use of BMI in clinical practice to assess for obesity in children and adolescents. A series of searches were performed with key words and search terms. These were combined, limited to English language as well as limited to infant, toddler, preschool child, child and adolescent and then followed by manual scanning of titles and abstracts to eliminate review, commentaries, editorials, and case reports. The remaining articles were further examined for primary studies involving the practice of identifying overweight or obese patients in pediatric clinical settings or from surveys of child health clinicians.

The search strategy employed yielded a large number of studies for overweight or obesity in general. Combining this large sample with the groups diagramed below led to smaller samples shown in **Figure 1**. This resulted in less than 50 articles, from which we manually reviewed abstracts and methods for appropriateness. Several studies surveyed physicians about their practices and beliefs about childhood obesity, and a smaller number of studies used chart reviews to examine clinicians' practices towards documentation of overweight and obesity. One study included a quasi experiment design to its survey of physicians comparing weight and height for age to BMI growth curves.

Results

The results of our search are summarized in three tables below. **Table 1** is a summary of studies that performed secondary analysis for assessment or documentation of obesity, including chart reviews and national data sets. **Table 2** summarizes findings from surveys of providers' practices of obesity identification and treatment in children. **Table 3** highlights physician reported barriers to obesity diagnosis and treatment

Studies of more objective measures of clinical practice are reported in **Table 1**, and underscore previous reports by providers. These studies indicate that although rates of overweight and at-risk for overweight among children may be as high as 50% (31-34), children are commonly under-diagnosed and obesity is often poorly documented or treated (31-33, 35, 36). Among children, BMI is underutilized and documentation has been shown to vary by age and degree of obesity, with younger children and those of lower severity being identified less (33-36). Because intervention has been shown to be most (and often only) effective if started early, before the condition has become severe (37, 38), early identification is essential.

Furthermore, while documentation has been associated with higher rates of counseling and intervention, such efforts may often be limited to only general advice (31, 34, 35), possibly warranting the need for further education and skills training (39).

Though rates vary, there were some consistent findings concerning physician attitudes toward obesity identification, summarized in **Table 2**. Physicians indicate that while most feel it is important to identify obesity (40-42) and most used some method to screen for excess weight, including weight-for-age and weight-for-height, few used the preferred screening measures of BMI and BMI percentile (43-46). Many report this is because of feelings of low self-efficacy toward treating obesity (40, 42). However, knowledge of national guidelines was often associated with greater feelings of self-efficacy (44, 45), and BMI charting was associated with greater concern by clinicians than did height and weight charting (45).

According to the studies in **Table 3**, the main barriers to obesity identification and treatment reported by providers can be separated into patient, system, and clinician specific factors. Providers often report difficulty in treatment due to lack of patient motivation and compliance (41, 44, 47), and also because of worries concerning possible treatment-related risks (42). Barriers within the system (41, 42, 44, 47), including lack of time, effective tools, or adequate education on treatment, and lack of reimbursement are often reported, and these factors often coincided with feelings of low self-efficacy on the part of providers (42, 47, 48). Provider self-perception of their own weight status has been found to be related to ease of counseling (48), highlighting a possibly influential but over-looked barrier.

In summary, providers believe obesity in childhood is an important problem, although there have been very few studies of BMI in pediatric primary care setting. While self reported studies suggest high rates of screening for and treatment of obesity, BMI doesn't appear to be

widely used when objective measures of provider practice are examined. There are limitations to several of these studies, including low response rates or limited geographic samples, and the BMI growth curves have only been available for about 5 years. Medical record review studies help overcome the response and recall bias demonstrated by surveys and self-report. However, the under identification in younger children and less overweight children suggests opportunities are being missed in children whose overweight my not be that longstanding. Repeatedly, providers report that patients' lack motivation, that they are frustrated with treatment, and that inadequate reimbursements remain significant barriers to treatment.

Discussion

When addressing the efficacy of any disease process screening or diagnosis, usually screening must be feasible, effective interventions must exist for the condition identified, and individuals must be better off if they are screened or identified early (14, 15, 49-51). As a screen for overweight in pediatrics, BMI is a good screening test, with low start up and maintenance costs, simple training, and good accuracy. While preliminary studies are encouraging, strong evidence for interventions for children in primary care or for child and youth obesity interventions linked to primary care are not yet available (52). Nonetheless, the gravity of the public health problem of obesity suggests a justification for proceeding despite lack of entirely effective treatments (53). There are few logistical impediments to BMI screening, yet the primary obstacles appear to be "downstream" from the actual performance of the test, and are focused more on whether the use of the test results in improved outcomes and whether primary care clinicians use this information to guide weight-related diagnosis, treatment and follow-up in children.

In the review for the USPSTF, the Oregon Evidence-base Practice Center addressed the evidence on effective screening and treatment strategies for child and adolescent obesity (16, 52). They found that BMI is a reasonable measure for identifying children and adolescents who are overweight or at risk for becoming of overweight. They also reported that there was fair evidence that overweight youth 8 years and older are at increased risk for becoming obese adults. Nonetheless, the Task Force concluded that there was insufficient evidence to recommend for *or* against screening for overweight in children and adolescents as a means to prevent adverse health outcomes. While other methods exist to screen for excess weight in children, BMI is recommended method for adult and universal adoption should greatly facilitate the smooth transition of care from adolescence to adulthood. Also, the current literature only uses BMI as the metric to examine associations and show causality for adolescent and adult morbidity and mortality.

Implications for Identifying Barriers for Providers

Promoting adoption of BMI requires acknowledgement of the evidentiary basis for action, and will also require messages, tools, and support to address the barriers limiting child healthcare providers' ability to incorporate preventive care recommendations into practice. Although tools are increasingly available, clinicians may remain unaware of a variety of available resources such as growth charts designed to easily derive BMI (54), to body mass index calculation wheels (www.trowbridge-associates.com/BMI.html), programs for personal digital assistants (e.g. www.statcoder.com/growthcharts.htm), and Web-based BMI calculation and interpretation programs (e.g. www.halls.md/body-mass-index/av.htm). Barriers to physician adherence to guidelines can be thought of as *internal* or *external* barriers (55).

Potential *internal* barriers to use of BMI for screening of overweight include lack of awareness, familiarity, or agreement with the recommendation. Internal barriers related to attitudes include lack of outcomes expectancy, self-efficacy, and lack of motivation. These potential barriers need to be better characterized in future studies in order to fully understand the factors that may prevent clinicians from using BMI to screen children for overweight. Lack of awareness could be a particularly important barrier; providers may feel challenged, given time constraints in primary care settings, to rapidly calculate, interpret, and record BMI as recommended. Potential barriers to BMI use *external* to clinicians include lack of time or financial resources to implement new recommendations, lack of access to appropriate materials (e.g., up-to-date growth charts), and lack of capability or willingness of non-provider staff to implement recommendations. For example, lack of systematic measurement, or lack of accuracy in height and weight measurements could be barriers to calculation and interpretation of BMI in some practice settings. Despite their potential importance, these external barriers also have been under-explored to date, but can be characterized by a knowledge-attitudes-behavior framework.

This framework is useful in identifying where further research regarding barriers to BMI use is needed, and suggests ways that the Wagner's Chronic Care Model (CCM) for prevention and intervention may be applied to childhood obesity. The CCM provides a conceptual basis to organize quality improvement strategies in five specific areas that are readily applicable to obesity: patient self-management, clinical decision support, delivery system re-design, clinical information systems, and partnerships with community organizations.

Using BMI to screen for overweight is an appropriate first step in applying breakthrough collaborative methods and principles of chronic disease management to childhood overweight. If primary care practices identify populations of overweight children, clinicians will be better

able to implement interventions systematically, track health outcomes in overweight children continuously, and initiate improvements in the quality of overweight children's care. Importing the care model's multiple components previously mentioned into the management of childhood overweight is a promising, albeit untested, approach to the long-term management of this chronic problem. Studies are needed to test the application of each of these components of the chronic care model in the management of childhood overweight.

Implications for Clinical Care and Preventive Services

Using BMI to assess for childhood overweight in primary care settings is a first step that is necessary but not sufficient to further evaluate children's medical needs and connect families to overweight treatment resources. As previously discussed, though BMI has been widely recommended to screen for overweight in primary care settings, it has been infrequently adopted by clinicians; (34, 35, 43-45) thus the impact of this recommendation is currently under-realized.

To optimize clinical care for overweight children, clinicians also need clear, evidence-based guidance on the medical evaluation and treatment of overweight children. While this report is focused on screening and its implementation, studies on effective prevention and treatment are needed so that clinicians are motivated to screen, in the belief that they can offer something to those who are identified. Once physicians have identified children as overweight, families need guidance regarding diet and physical activity changes. Strong recommendations exist for diet and exercise counseling in adults (50, 51), and parent weight loss is the strongest predictor of child weight loss (56, 57). Yet, physicians may not currently feel that they have they have had adequate nutrition training or tools to help with nutritional guidance. Practice tools to help physicians counsel about nutrition, such as innovative medical curricula, and the 5 A's

based behavioral guidance, are needed to prepare physicians for giving nutritional guidance to overweight child and their families (58). Effective models to link office screening to community resources and interventions are similarly needed.

Implications for future interventions

Identifying overweight children through BMI screening could form the basis for collaborative continuous quality improvement interventions to help improve the care of overweight children. Office systems-based changes have led to improvements in pediatric primary care in other areas, including immunization and delivery of other preventive services (59, 60), and in clinical preventive services for adolescents in community health centers (61). Office systems-based improvement strategies (i.e., National Initiative for Children's Healthcare Quality Practical Guide to Implementing Office Systems for Anticipatory Guidance, or Joint Commission on Accreditation of Healthcare Organizations' Clinical Improvement Action Guide) could be similarly applied to identification and management of childhood overweight with existing local or national clinical collaborative models. Since childhood overweight disproportionately affects low-income and minority children, it will be essential for future interventions focused on overweight to include practices that serve these children.

Efforts to lower barriers to adoption of BMI screening, such as better reimbursement for time spent counseling about obesity, may lower the threshold for adoption of screening. However, reducing these barriers may not outweigh clinicians' confidence (or lack thereof) in the effectiveness of their interventions. Nonetheless, diffusion of interventions that address obesity in primary care can benefit both from the CCM and from the use of theoretically-grounded strategies and evidence-based interventions.

A broad approach involving continued intervention research, demonstration projects to implement interventions, policy interventions to address community and the environment, and quality improvement collaboration to identify best practices for real-life clinical settings represent a logical approach to this highly complex condition. Interventions that link health care with better community resources, implement systems to track children and support interventions, provide decision support and promote patient (or family) self-management will lead to innovations that result in measurable outcomes. These in turn should lead to greater effectiveness, and sustained use of successful strategies for interventions in greater numbers of sites.

Collaboration of providers, health care institutions and other community partners to promote availability of community and decision support resources also needs support. Incremental effects of interventions on issues of reimbursement, linkages between clinical settings and schools or childcare, and provider education and skill development can be evaluated in an ongoing manner. Ongoing surveillance of clinician behaviors and changes in attitude, practice and community resource availability are needed to track successful implementation and dissemination of effective interventions. The universal use of BMI can provide some standardization to tracking its performance, and also tracking weight changes, as outcomes of these interventions.

Investment in a variety of demonstration projects that test different components of child obesity prevention and treatment, from intensive community change addressing all elements of physical activity and nutrition for children and families, to incremental implementation of different elements of effective clinical practice. The linkage between clinical self-management support and community resources appears to be key issue for childhood obesity, as the role of

clinical intervention in leveraging health insurer and community policy changes remains a priority for primary care organizations and their members. Application of the care model to other behavior change issues has laid the groundwork for rapid application of these techniques to both preventive and intervention strategies. Pursuit of interventions addressing childhood obesity, coupled with careful evaluation, will help achieve the goal of engaging clinicians in more effectively addressing this critical public health problem.

Table 1: Study of Chart Audits of Ambulatory Visits for Obesity Identification and Treatment

Reference	Sample & Methods	Findings	Limitations/Relevant conclusions
Denen, 1993 (32)	115 adults, 113 children seen consecutively in an internal medicine/pediatrics residency, chart audit	44% of children and 50% of adults were overweight or obese by body mass index. Residents were less likely to document children as being obese (18%), and did so significantly less often than they did adults (53%, p<. 001)	Study pre-dated the existence of the current BMI growth curves
Hamilton, 2003 (33)	231 inner-city children from the southwest LA area, retrospective medical record review	58 patients (36%) were identified as overweight (OW) or at-risk for overweight (AROW), as defined by BMI $\geq$ 90th %tile; only 29% percent of affected children, 2-18 yrs of age, were identified; none of the children under 2 yrs of age, with weight/height ratio $\geq$ 90th %tile were documented or offered intervention	Limitations: Small sample size, retrospective study design and limited area of selection
Drobac, 2004 (36)	~997 children, 10-18 yrs of age, from the Chicago area, predominately low income, Mexican-American minority, retrospective medical record review	26% of patients were OW and 22% were AROW, based on age, gender specific BMI %tiles; BMI charted for only 9% of subjects, BMI %tile plotted only 1%.	Limitation: Only inner-city practice in limited geographic area, mostly Hispanic. Primary aim was screening for type 2 diabetes but lack of obesity screening a more significant issue that was also associated with less counseling.
O'Brien, 2004 (34)	~2500 charts, chart review from an academic primary care clinic from an tertiary care center	Obesity documented in over half the charts of children meeting criteria (BMI $\geq$ 95th percentile for age and gender on CDC growth curves.) Documentation varied by child age and degree of obesity, with preschool-aged children documented the least and adolescents the most. Notation found in only 18% in the lowest quartile BMI still above 95th percentile, increasing to 82% in the top quartile. Greater documentation of obesity	Limited to an inner-city population at a single practice Identified first steps of counseling and referral if found to be obese

		associated with higher rates documentation of diet and activity histories, and education, screening, and dietary referral.	
Dorsey, 2005 (35)	600 medical records from 4 pediatric clinics in the New Haven, Connecticut region, medical chart review	BMI documented only 0.05% charts and only 20% of AROW or OW children had documentation of diagnosis, and only 17% had documentation of treatment. Treatment was identified as general advice	Limited geographic area, but study involved 4 practices with good sample size
Quattrin, 2005 (37)	~600 children referred to a pediatric endocrinology group for obesity; retrospective chart review	Previous growth records indicated 80% were obese before age 6; referrals, occurring a prolonged interval after onset, appeared ineffective in obesity treatment; underscores need for early identification to enable pediatricians to target "at risk for overweight" or newly overweight preschool children	Limited to patients only seen at a pediatric endocrine clinic.
Miller, 2002 (38)	Comparison of age at referral, 50 randomly selected charts at a Failure to Thrive (FTT) clinic	Ave age FTT children was 21 months and 'Mild FTT" by their % IBW while obese children were 10.3 yrs of age and at 'Severely Obese' range by % IBW;	Limited to patients only seen at a Pediatric GI clinic for failure to thrive or obesity, findings highlight the need for earlier identification and referral for obese children.
Cook, 2005 (31)	Pooled sample of 32,000 visits by 2-18 yr olds, National Ambulatory Survey	Nationally weight sample of ambulatory visits from 1996-2000 but only 0.78% of visits carried diagnosis of obesity, morbid obesity or excess weight gain, diet and exercise counseling rates increased 10-12 fold with documentation	Nationally representative for pediatric ambulatory visits, no measures of weight or height in the dataset. Relied on diagnostic coding.

Table 2: Surveys of Providers Practices of Obesity Identification and Treatment

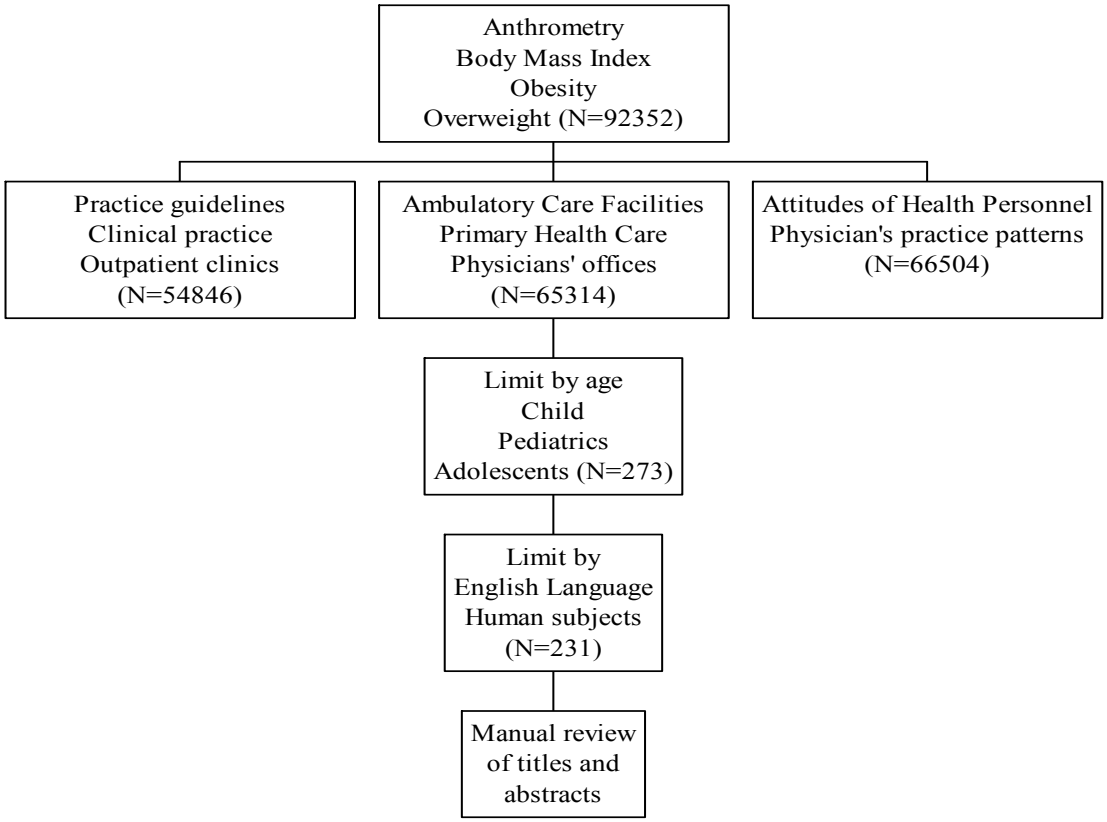
Reference	Sample & Methods	Findings	Limitations/Strengths
Barlow, 2002 (43)	202 pediatricians, 293 peds NPs, 444 registered dieticians, national mailing	80% use 'visual impression', 19% BMI, and only 12% use BMI percentile to screen for excess weight	Limitations: Reporting bias of providers very interested in obesity, only 20% response rate for pediatricians
Perrin, 2004 (45)	356 pediatricians/med-ped physicians North Carolina, mailed survey	11% 'always' used BMI, 31% 'never' used BMI , 21% 'always' used visual impression. Providers with clinical vignette that gave a girl's BMI as opposed to her height and weight charts rated her with higher level of fatness and higher level of concern.	Limitations: limited to North Carolina pediatricians and hypothetical case; Strengths: Response rate ~71%, used a quasi-experimental design that physicians got a clinical case with either a BMI or weight and height growth curve
Price, 1989 (40)	500 pediatricians, random national sample mailing survey	83% felt physicians are obligated to counsel parents of obese children about health risks of obesity, 70% believed designing programs and counseling children about weight loss was difficult, 11% felt counseling children & parents on weight loss professionally gratifying and pediatricians received most of their weight control information from medical journals (70%) and past experience (68%).	Strength: 68% response rate
Rattay, 2004 (46)	813 pediatricians, computer-assisted telephone survey with follow-up mailing, national sample	50% 'Always' counsel about healthy weight, were more likely women and spend more time during annual well child visits	Strength: 80% response rate
Story, 2002 (41)	202 pediatricians, 293 peds NPs, 444 RDs, national mailing	Respondents felt that childhood obesity was a condition that needs treatment (78%), and affects chronic disease risk (87%)	Limitations: Reporting bias of providers very interested in obesity,

		and future quality of life (93%)	only 19% response rate for pediatricians
Kolagotta, 2004 (44)	700 pediatricians, 507 family physicians, national survey	BMI use reported at a much higher level than in previous surveys. However, while BMI was used by 30% of pediatricians and 49% of family physicians for adolescents, only 5% of family physicians and 15% of pediatricians used BMIs for children 3-7 years of age. 19% of physicians were aware of national recommendations, and knowledge of guidelines was associated with more positive attitudes toward personal counseling proficiency and the overall effectiveness.	Limitations: 28% response rate Strength: Surveyed both pediatricians and family physicians.

Table 3: Surveys of Providers and Barriers to Obesity Identification and Treatment

Reference	Sample & Methods	Findings	Limitations/Relevant conclusions
Jelalian, 2003 (42)	1243 pediatricians (62%) and family physicians (30%) from Southern New England area	25% providers feel they are not at all or only slightly competent/comfortable treating obesity. Factor analysis of respondents replies indicated two factors acting as barriers: Perceived Systems Barriers (associated with limited resources: including time, available staff, reimbursement, and training) and Perceived Treatment-Related Risks (associated with risks from addressing obesity, such as eating disorders and impact on growth and self-esteem.)	~40% response rate, 35% met screening criteria, responses limited by geographic area and due to self-report
Perrin, 2005a (47) Amb Peds	356 pediatricians/med-ped physicians North Carolina, mailed cross-sectional survey	Most pediatricians feel ineffective treating obesity; most frequently encountered barriers included availability of soft-drinks (95%) and fast food (97%), though practice based barriers were most strongly associated with feelings of low self-efficacy among providers; most (96%) expressed desire for better counseling tools	Response rate good at ~71%, though geographically limited. Indicated that practice-based tool kits may improve self-efficacy.
Story, 2002 (41)	202 pediatricians, 293 peds NPs, 444 registered dieticians, national mailing	Providers expressed the most frequent barriers were lack of parent involvement (~81%), lack of patient motivation (~86%), and lack of support services (60%)	Reporting bias of providers very interested in obesity, only 19% response rate for pediatricians
Kolagota, 2004 (44)	700 pediatricians, 507 family physicians, national survey	Poor patient motivation (97%), patient noncompliance (95%), and treatment futility (78%) were perceived as the most frequently encountered barriers to obesity treatment	Limited by 28% response rate
Perrin, 2005b (48) Ob Research	356 pediatricians/med-ped physicians North Carolina, mailed cross-sectional survey	~50% overweight pediatricians did not identify themselves as such; men misclassified more frequently; those self-classified as “thin” or “overweight” reported 6x’s and 4x’s more difficulty counseling, respectively	Response rate good at ~71%, though geographically limited.

Figure 1 – literature search strategy



We would like to acknowledge the Robert Wood Johnson Foundation for their support of this review and discussion project. We would like to thank Terry L. Bazzarre, Ph.D., M.S., and C. Tracy Orleans, Ph.D., for their thoughtful insight and commentary on this report. We would also like to thank all the attendees to the "Health Strategies Conference for Childhood Obesity" for their reviews and comments during the discussion of the findings of this paper. This report was presented as part of a White Paper for a Conference on "Improving Health Services to Prevent Obesity in Children" sponsored by the Robert Wood Johnson Foundation held in Washington DC on June 6th, 2004.

References

1. Guo SS, Roche AF, Chumlea WC, Gardner JD, Siervogel RM. The predictive value of childhood body mass index values for overweight at age 35 y. American Journal of Clinical Nutrition 1994; 59:810-9.

2. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988-1994. Archives of Pediatrics & Adolescent Medicine 2003; 157:821-7.

3. McGill HCJ, McMahan CA, Herderick EE, Zieske AW, Malcom GT, Tracy RE et al. Obesity accelerates the progression of coronary atherosclerosis in young men. Circulation 2002; 105:2712-8.

4. Pinhas-Hamiel O, Dolan LM, Daniels SR, Standiford D, Khoury PR, Zeitler P. Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. Journal of Pediatrics 1996; 128:608-15.

5. Wang G, Dietz WH. Economic burden of obesity in youths aged 6 to 17 years: 1979-1999. Pediatrics 2002; 109:E81.

6. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z et al. 2000 CDC Growth Charts for the United States: methods and development. Vital & Health Statistics - Series 2002; 11:Data-190.

7. Moran R. Evaluation and treatment of childhood obesity. American Family Physician 1999; 59:861-8.

8. Krebs NF, Jacobson MS, AAP Committee on Nutrition. Prevention of pediatric overweight and obesity. Pediatrics 2003; 112:424-30.

9. American Academy of Pediatrics, Committee on Nutrition. Nutritional aspects of obesity in infancy and childhood. Pediatrics 1981; 68:880-3.

10. Hedley A, Ogden C, Johnson C, Carroll M, Curtin L, Flegal K. Prevalence of Overweight and Obesity Among US Children, Adolescents, and Adults, 1999-2002. JAMA 2004; 291:2847-50.

11. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. JAMA 2002; 288:1728-32.

12. Strauss RS, Pollack HA. Epidemic increase in childhood overweight, 1986-1998. JAMA 2001; 286:2845-8.

13. Wagner EH. Chronic disease management: what will it take to improve care for chronic illness? Effective Clinical Practice 1998; 1:2-4.

14. U.S.Preventive Services Task Force. *Guide to Clinical Preventive Services*. Washington, DC: Office of Disease Prevention and Health Promotion; 2005.

15. McTigue KM, Harris R, Hemphill B, Lux L, Sutton S, Bunton AJ et al. Screening and interventions for obesity in adults: summary of the evidence for the U.S. Preventive Services Task Force. Annals of Internal Medicine 2002; 139:933-49.

16. US Preventive Services. Screening and Interventions for Overweight in Children and Adolescents: Recommendation Statement. Pediatrics 2005; 116:205-9.

17. Brosco JP. Weight charts and well-child care: how the pediatrician became the expert in child health. Archives of Pediatrics & Adolescent Medicine 2001; 155:1385-9.

18. Ogden CL, Kuczmarski RJ, Flegal KM, Mei Z, Guo S, Wei R et al. Centers for Disease Control and Prevention 2000 growth charts for the United States: improvements to the 1977 National Center for Health Statistics version. Pediatrics 2002; 109:45-60.

19. Ellis KJ. Selected body composition methods can be used in field studies. Journal of Nutrition 2001; 131:1589S-95S.

20. Goran MI. Measurement issues related to studies of childhood obesity: assessment of body composition, body fat distribution, physical activity, and food intake. Pediatrics 1998; 101:505-18.

21. Garrow JS, Webster J. Quetelet's index (W/H2) as a measure of fatness. International Journal of Obesity 1985; 9:147-53.

22. Daniels SR, Khoury PR, Morrison JA. The utility of body mass index as a measure of body fatness in children and adolescents: differences by race and gender. Pediatrics 1997; 99:804-7.

23. Deurenberg P, Weststrate JA, Seidell JC. Body mass index as a measure of body fatness: age- and sex-specific prediction formulas. British Journal of Nutrition 1991; 65:105-14.

24. Goran MI, Driscoll P, Johnson R, Nagy TR, Hunter G. Cross-calibration of body-composition techniques against dual-energy X-ray absorptiometry in young children. American Journal of Clinical Nutrition 1996; 63:299-305.

25. Gutin B, Litaker M, Islam S, Manos T, Smith C, Treiber F. Body-composition measurement in 9-11-y-old children by dual-energy X-ray absorptiometry, skinfold-thickness measurements, and bioimpedance analysis. American Journal of Clinical Nutrition 1996; 63:287-92.

26. Roche AF, Sievogel RM, Chumlea WC, Webb P. Grading body fatness from limited anthropometric data. American Journal of Clinical Nutrition 1981; 34:2831-8.

27. Reilly JJ, Dorosty AR, Emmett PM, Avon Longitudinal Study of Pregnancy and Childhood Study Team. Identification of the obese child: adequacy of the body mass

index for clinical practice and epidemiology. International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity 2000; 24:1623-7.

28. Neovius M, Linne Y, Barkeling B, Rossner S. Sensitivity and specificity of classification systems for fatness in adolescents. Am J Clin Nutr 2004; 80:597-603.

29. Pietrobelli A, Faith MS, Allison DB, Gallagher D, Chiumello G, Heymsfield SB. Body mass index as a measure of adiposity among children and adolescents: a validation study. Journal of Pediatrics 1998; 132:204-10.

30. Field AE, Laird N, Steinberg E, Fallon E, Semega-Janneh M, Yanovski JA. Which Metric of Relative Weight Best Captures Body Fatness in Children? Obes Res 2003; 11:1345-52.

31. Cook S, Weitzman M, Auinger P, Barlow SE. Screening and Counseling Associated With Obesity Diagnosis in a National Survey of Ambulatory Pediatric Visits. Pediatrics 2005; 116:112-6.

32. Denen ME, Hennessey JV, Markert RJ. Outpatient evaluation of obesity in adults and children: a review of the performance of internal medicine/pediatrics residents. Journal of General Internal Medicine 1993; 8:268-70.

33. Hamilton JL, James FW, Bazargan M. Provider practice, overweight and associated risk variables among children from a multi-ethnic underserved community. Journal of the National Medical Association 2003; 95:441-8.

34. O'Brien S, Holubkov R, Reis E. Identification, Evaluation, and Management of Obesity in an Academic Primary Care Center. Pediatrics 2004; 114:e154-e159.

35. Dorsey KB, Wells C, Krumholz HM, Concato JC. Diagnosis, Evaluation, and Treatment of Childhood Obesity in Pediatric Practice. Arch Pediatr Adolesc Med 2005; 159:632-8.

36. Drobac S, Brickman W, Smith T, Binns HJ. Evaluation of a Type 2 Diabetes Screening Protocol in an Urban Pediatric Clinic. Pediatrics 2004; 114:141-8.

37. Quattrin T, Liu E, Shaw N, Shine B, Chiang E. Obese Children Who Are Referred to the Pediatric Endocrinologist: Characteristics and Outcome. Pediatrics 2005; 115:348-51.

38. Miller LA, Grunwald GK, Johnson SL, Krebs NF. Disease severity at time of referral for pediatric failure to thrive and obesity: time for a paradigm shift? Journal of Pediatrics 2002; 141:121-4.

39. Chamberlain LJ, Sanders LM, Takayama JI. Child Advocacy Training: Curriculum Outcomes and Resident Satisfaction. Arch Pediatr Adolesc Med 2005; 159:842-7.

40. Price JH, Desmond SM, Ruppert ES, Stelzer CM. Pediatricians' perceptions and practices regarding childhood obesity. American Journal of Preventive Medicine 1989; 5:95-103.

41. Story MT, Neumark-Stzainer DR, Sherwood NE, Holt K, Sofka D, Trowbridge FL et al. Management of child and adolescent obesity: attitudes, barriers, skills, and training needs among health care professionals. Pediatrics 2002; 110:210-4.

42. Jelalian E, Boergers J, Alday CS, Frank R. Survey of physician attitudes and practices related to pediatric obesity. Clinical Pediatrics 2003; 42:235-45.

43. Barlow SE, Dietz WH, Klish WJ, Trowbridge FL. Medical evaluation of overweight children and adolescents: reports from pediatricians, pediatric nurse practitioners, and registered dietitians. Pediatrics 2002; 110:222-8.

44. Kolagotla L, Adams W. Ambulatory management of childhood obesity. Obes Res 2004; 12:275-83.

45. Perrin EM, Flower KB, Ammerman AS. Body mass index charts: Useful yet underused. The Journal of Pediatrics 2004; 144:455-60.

46. Rattay KT, Fulton JE, Galuska DA. Weight Counseling Patterns of U.S. Pediatricians. Obes Res 2004; 12:161-9.

47. Perrin EM, Flower KB, Garrett J, Ammerman AS. Preventing and treating obesity: pediatricians' self-efficacy, barriers, resources, and advocacy. Ambulatory Pediatrics 2005; 5:150-6.

48. Perrin EM, Flower KB, Ammerman AS. Pediatricians' Own Weight: Self-perception, Misclassification, and Ease of Counseling. Obes Res 2005; 13:326-32.

49. U.S.Preventive Services Task Force. Screening for obesity in adults: recommendations and rationale. Annals of Internal Medicine 2003; 139:930-2.

50. U.S.Preventive Services Task Force. Behavioral Counseling in Primary Care To Promote Physical Activity: Recommendation and Rationale. Ann Intern Med 2002; 137:205-7.

51. U.S.Preventive Services Task Force. Behavioral counseling in primary care to promote a healthy diet: Recommendations and rationale. American Journal of Preventive Medicine 2003; 24:93-100.

52. Whitlock EP, Williams SB, Gold R, Smith PR, Shipman SA. Screening and Interventions for Childhood Overweight: A Summary of Evidence for the US Preventive Services Task Force. Pediatrics 2005; 116:e125-e144.

53. Koplan JP, Liverman CT, Kraak VI. Preventing childhood obesity: Health in the balance: Executive summary. Journal of the American Dietetic Association 2005; 105:131-8.

54. Frankel HM. Body mass index graphs for children. Pediatrics 2004; 113:425-6.

55. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA 1999; 282:1458-65.

56. Wrotniak BH, Epstein LH, Paluch RA, Roemmich JN. Parent Weight Change as a Predictor of Child Weight Change in Family-Based Behavioral Obesity Treatment. Arch Pediatr Adolesc Med 2004; 158:342-7.

57. Wrotniak BH, Epstein LH, Paluch RA, Roemmich JN. The Relationship Between Parent and Child Self-Reported Adherence and Weight Loss. Obes Res 2005; 13:1089-96.

58. Walker WA. Innovative teaching strategies for training physicians in clinical nutrition: an overview. Journal of Nutrition 2003; 133:541S-3S.

59. Margolis PA, Lannon CM, Stuart JM, Fried BJ, Keyes-Elstein L, Moore DEJ. Practice based education to improve delivery systems for prevention in primary care: randomised trial. BMJ 2004; 328:388.

60. Chaudron LH, Szilagyi PG, Kitzman HJ, Wadkins HIM, Conwell Y. Detection of Postpartum Depressive Symptoms by Screening at Well-Child Visits. Pediatrics 2004; 113:551-8.

61. Klein JD, Allan MJ, Elster AB, Stevens D, Cox C, Hedberg VA et al. Improving adolescent preventive care in community health centers. Pediatrics 2001; 107:318-27.