Title: Pros and cons of child obesity research in specialty clinics: 1904 outpatients seen by medical center pediatric specialists

Running Title: Pros and cons of child obesity research in specialty clinics

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Abstract

Objective: To get ample samples of children for obesity studies, researchers often recruit in specialty clinics treating obesity co-morbidities. Samples from one specialty could include patients very different from those in others, limiting finding generalizability. We assessed if the overweight/obese outpatients seen at one academic medical center differ across specialties.

Methods: 8 specialty outpatient clinics participated; all see patients with obesity or related conditions. Data were from clinical records (mostly paper). BMI and BMI percentile on 2-18 year olds, seen from 1/06-1/07, were calculated from recorded values. Data from patients with BMI >85th percentile were abstracted for: date of birth, sex, height, weight, and blood pressure. Results obtained (±6 months of the visit) were accessed from the hospital computer system for fasting glucose, insulin, and lipids; and alanine aminotransferase. ICD diagnoses were obtained later, after full implementation of an electronic medical record system. Chi-square and Fisher's Exact tests were used to evaluate associations.

Results: Subjects were 53% male. Median age was 9.9. Mean BMI percentile was 95; median was 96; with 29% of subjects >99. Only 61 subjects were seen in >1 clinic. Age, BMI and lab measurements varied substantially across clinics. Lab results were very incomplete. Most patients had no obesity diagnosis recorded.

Conclusions. Overweight/obese patients seen in a single specialty are unrepresentative of all overweight/obese medical center patients. Medical records were not adequate for even basic description of overweight/obese patients. These findings indicate design needs for future research on overweight/obese children in multiple specialty settings.

What's New

Specialty clinics, which see large numbers of severely affected obese children, care for different subsets of patients and gather different information on them. Therefore, research on obese children must involve multiple specialty settings; this is a challenging goal.

Introduction. Childhood obesity is common[1] and is associated with significant co-morbidities [2]. Yet research on the natural history of obesity and on its complications—and the response of both to treatment over time—is challenging, as most clinical settings interact with relatively few severely affected children. Because specialty clinics can provide research access to more concentrated groups of severely affected children with co-morbidities, they are frequent settings for research on childhood obesity. But there have been no studies that explore the characteristics of obese children seen in specialty clinics, or that indicate the extent of potential generalizability of findings from specialty clinics to all severely affected obese children.

To address this information gap, we studied patients seen in 8 specialty outpatient clinics at our children's hospital that were interested in collaboration on this project. We compared characteristics of patients in the various clinics, and assessed opportunities and obstacles to generalizable research on child obesity in these settings. This report summarizes key findings of our study, to guide those seeking to conduct childhood obesity research in specialty settings. We address these questions: 1) What are the demographic, BMI, and diagnostic characteristics of the patients seen? How do these differ across clinics and other subgroups? 2) What can be gleaned from BP and lab data from these clinics? 3) What do others need to take into consideration when studying overweight and obese children in specialty clinic settings?

Methods. Eight specialty outpatient clinics were identified that were involved seeing patients with obesity or related conditions: Allergy/Asthma (related to asthma), Endocrinology (related to insulin resistance and diabetes), Kidney Disease (related to hypertension), Liver (related to fatty liver), Nutrition, Sleep (related to obstructive sleep ap-

84 nea), Sports Medicine (related to injuries[3]), and the Cancer Long-term Survivor Clinic[4].
85 Study subjects were aged 2-18 years with BMI ≥85th percentile, seen at one of these clin-
86 ics during the study period (1/3/06-1/31/07). The study was approved by the Children's
87 Memorial Hospital Institutional Review Board (# 2006-12763).

88 Data were obtained from clinical records: paper records in most cases, as the
89 study pre-dated full implementation of the electronic health record. To identify study
90 subjects, BMI and BMI percentile on patients aged 2-18 years attending a study clinic
91 were calculated from recorded height and weight using Health Indicators Analyzer (HIA)
92 software (© 2003, Children's Memorial Hospital, Chicago, IL), which uses CDC 2000
93 growth chart interpretations. Data from patients with BMI ≥85th percentile (about 1/3 of
94 all seen) were abstracted.

95 For study subjects, patient date of birth, sex, height, weight, and blood pressure
96 were recorded from each specialty clinic visit during the study period. When multiple
97 values were available during the study period, the first was used. Selected lab results ob-
98 tained within 6 months before or after the clinic visit were accessed from the hospital
99 computer system; labs done elsewhere were not available. The laboratory values includ-
100 ed were fasting glucose, insulin, and lipids; and alanine aminotransferase (ALT).
101 HOMA-IR was calculated as in index of insulin resistance. Patient diagnoses were ob-
102 tained from the electronic medical record system during manuscript preparation a few
103 years after original data collection and so after full implementation of an outpatient elec-
104 tronic medical record; multiple diagnoses were included. Race/ethnicity, not routinely
105 available, is not in the data set.

Three BMI percentile categories (85th-94th percentile, 95th-98th percentile, and ≥99th percentile) and 3 age categories (2-6 years, 7-11 years, and 12-18 years) were analyzed. Blood pressure (BP) and laboratory values were categorized, as feasible (Table 1).[5, 6, 7, 8, 9] Diagnoses were grouped into International Classification of Diseases (ICD) categories for analyses.[10]

Demographics, weight category, BP, and lab were described using frequency for categorization variables, and means and standard deviation of continuous variables. Chi-square and Fisher's Exact tests were used to evaluate associations. Associations with diagnoses groups were limited to those groups including at least 100 patients. Conclusions were made at the 0.05 level of significance. Data analysis was conducted using SAS, version 9.1 (SAS Inc., Cary, NC).

Results. Sample demographic and BMI characteristics. Data were collected on 1904 patients; 53% male. Median age was 9.9 years (25th percentile; 6.2 years; 75th percentile, 13.6 years). The mean BMI percentile was 95; the median was 96 (25th percentile, 91; 75th percentile, 99). Overall, 29% of subjects had a BMI ≥99th percentile. Only 61 subjects were seen in more than one clinic.

How characteristics varied across clinics. Both BMI and age distributions varied substantially by clinic. Figure 1a shows the distribution of patients by weight category, by clinic. Allergy had the largest number of overweight/obese patients in the sample (59% of total), while Nutrition Clinic had the highest proportion with BMI ≥99th percentile. Figure 1b shows age distribution by participating clinic. Allergy and Nutrition had the highest percentage of patients < 6 years; Sports Medicine and the Cancer Long-term Survivor clinic had the highest percentage ≥ 12 years.

Table 2 lists the most frequent 8 diagnostic groupings and shows that the children seen with overweight/obesity had varied diagnosed medical problems. Patterns of diagnosis varied by age and BMI category. Endocrine/metabolic/nutritional diagnoses were the most common. These were increasingly frequent with rising BMI and least common in 2-6 year olds. Only a few diagnoses varied with BMI or age. Of note, musculoskeletal diagnoses were most common for BMI 95th-98th percentile and increased with increasing age.

We looked specifically at ICD diagnoses for overweight (mutually exclusive in this database: 278, obesity unspecified; 278.01, morbid obesity; 278.02, overweight, and 783.1, abnormal weight gain). Only 30% of subjects had a recorded overweight diagnosis.

Completion of targeted measurements. BP was available most often (58%) and fasting insulin least often (4%); fewer than 16% had ALT, fasting lipids, or fasting glucose. Only 71 patients had corresponding fasting glucose and insulin values measured in the hospital laboratory to permit HOMA calculation; the median was 3.6, indicating that this was an insulin resistant sub-group.[13]

Measurement documentation differed substantially by participating clinic. For example, ALT was ordered in 45.8% of Liver clinic patients vs. 9.0% of Endocrine clinic patients; 22.8% of ALT measurements were from Liver clinic patients and 23.2% were from Nutrition clinic. Because of incomplete documentation of the measures of interest, the values obtained are not presented in this brief report.

Discussion. This is the first report describing overweight/obese pediatric patients seen at multiple specialty clinics at one medical center; they were seen for over-

152 weight/obesity, for conditions that are associated with overweight/obesity, or for unrelat-
153 ed conditions. The data allow several observations about children seen in these settings,
154 which are of importance to those planning to study overweight/obese children for infor-
155 mation concerning natural history, patterns of co-morbidities, response of overweight and
156 co-morbidities to interventions, and the like.

157 Patient characteristics and their variation across clinics. Overweight and obese
158 children were seen in our specialty clinics, including children with a wide variety of di-
159 agnoses. Severe obesity was prevalent at our medical center clinics. The age of patients
160 and the degree of overweight both varied by clinic. Only a few patients were seen in mul-
161 tiple clinics.

162 Most children with elevated weight did not have a recorded obesity diagnosis. We
163 have found similar low prevalence of diagnosis of obesity among an inpatient sample at
164 our hospital (20% obese [≥95th BMI percentile] but only 1% had an obesity diagnosis)[11].
165 Absence of a recorded diagnosis of overweight/obesity in specialty patients could reflect
166 the fact that weight issues did not always come up in the course of morbidity-focused
167 care. We know that this happened at least sometimes, as it resulted in poor success in re-
168 cruiting patients with BMI >97th percentile from this database into other studies: many
169 families contacted said that to their knowledge, their children were not overweight. On
170 the other hand, colleagues attest that specialists, consulting on referred obese patients,
171 sometimes address obesity in encounters in which it is not documented as an ICD code. If
172 ICD codes are to be used to monitor medical center patient obesity levels, more complete
173 recording will be necessary; perhaps such diagnoses can be electronically generated by
174 BMI calculations and posted for review at every visit.

These findings indicate that that multiple specialty clinics must be included in research to obtain a full and generalizable picture of overweight and obese children. Discharge diagnoses cannot be relied on to identify affected children.

What can be gleaned from the patient BP and lab data from these clinics? BP was obtained on many patients during a specialty clinic visit, but missing in many. Blood tests of interest were ordered and documented inconsistently, and the pattern of documentation varied by age, BMI, and clinic. Providers likely had information on lab tests done at other institutions, but these were not consistently available for abstracting and so were not included. While many tested patients had documented abnormalities, spotty information makes their analysis and comparisons across clinics suspect.

These findings indicate that to identify all common obesity-related medical problems facing overweight children, consistent documentation of co-morbidities work-ups is needed, unconstrained by clinical site of presentation or sources of lab values.

Study limitations. Patients at only 8 specialty clinics were included, and may not be representative of all specialty patients (or the ones that would have participated at another medical center). Even though 8 clinics were studied for a year and the overall sample size is large, cell sizes were often small. The data we report were obtained through medical record review, and have related limitations. It is likely that some eligible patients were missed. Measurements, including weight and height, were done to clinical, not research standards. Information on testing done for co-morbidities was sorely incomplete. Conclusions concerning diagnosis codes are limited by inaccuracy of documentation, including the absence of weight diagnoses in most patients in the database. We have no information on how representative of children's medical centers ours is, in terms of preva-

198 lence and management of overweight and obesity. There is no particular reason to assume
199 that it is unusual. Indeed, some of the problems facing our study—incomplete EHR im-
200 plementation, independent function of different specialty clinics that deal with obesity co-
201 morbidities—likely occur elsewhere too. These limitations don't undermine what is pre-
202 sented.

203 What the study suggests regarding childhood obesity care delivery and related
204 research. To assure consistency of clinical evaluation for appropriate management, coor-
205 dination of assessment is needed across clinics. Full assessment of patients is also needed
206 for accurate research on the effects of treatment provided on weight and co-morbidities.

207 To assure that overweight patients who present to the medical center are fully as-
208 sessed, novel care approaches and enhanced coordination with referring primary care cli-
209 nicians will be needed. This will likely require development of financial incentives for
210 practices to undertake such changes, e.g., increased reimbursement for visits with chil-
211 dren with multiple abnormalities and evaluations by multiple disciplines. Use of the elec-
212 tronic record to flag obese patients and suggest a standard test battery could be useful as
213 well. The development of cost-effective approaches will be needed for patients with mul-
214 tiple problems, who are likely to require care for years to come. Since children with var-
215 ied diagnoses are seen in the specialty clinics, investment in improved systems will be of
216 value to many disciplines.

217 The risk of obesity related lab abnormalities increase with both age and BMI, as
218 documented in population[12] and primary care[13] data. These associations predict that the
219 large segment of the child population that is now obese will develop increasing co-
220 morbidities over time. Thus medical center-based specialists will likely see rising num-

221 bers of older and severely obese patients with multiple co-morbidities in the coming
222 years. Systems to cost-effectively identify and manage these patients are needed, within
223 and across specialties.

224 Conclusions: 1. Overweight/obese patients seen in different specialty clinics differ
225 substantially. Therefore, multiple specialty clinics must be included in research to obtain
226 a full and generalizable picture of overweight and obese children. 2. Discharge diagnoses
227 cannot be relied on to identify affected children. Other means are needed, such as search-
228 able automatically calculated BMI. 3. To identify all obesity-related abnormalities of
229 overweight/obese children seen clinically, consistent documentation of co-morbidities
230 work-ups—on site and elsewhere—is needed, unconstrained by clinical site of presenta-
231 tion or sources of lab values.

232 Implications. Researchers, clinical planners, and policy makers must be wary of
233 using the results of studies on obese children that are conducted in single specialty clin-
234 ics. Weight management and studies are needed that cut across specialty clinics; this is
235 likely to require substantial reorganization of clinical care.

236

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Figure 1a

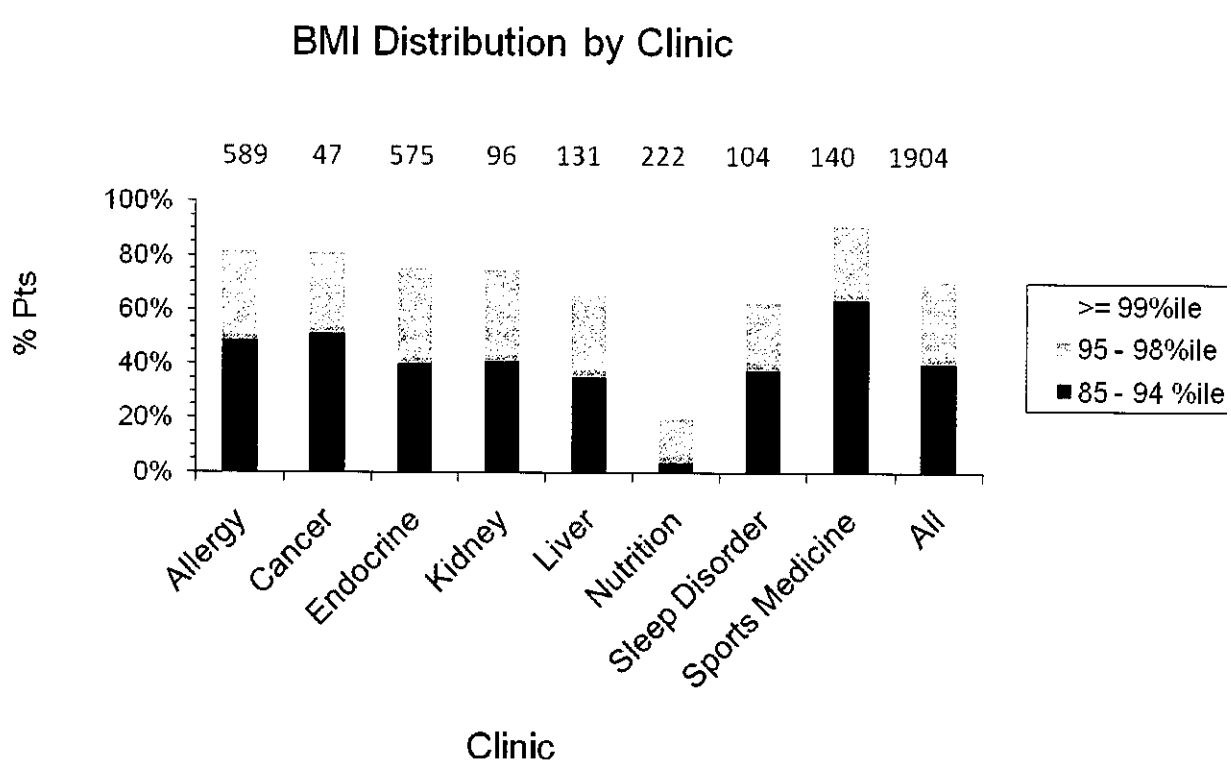

BMI Distribution by Clinic
589
47
575
96
131
222
104
140
1904
100%
80%
60%
40%
20%
0%
% Pts
>= 99%ile
95 - 98%ile
85 - 94 %ile
Allergy
Cancer
Endocrine
Kidney
Liver
Nutrition
Sleep Disorder
Sports Medicine
All
Clinic

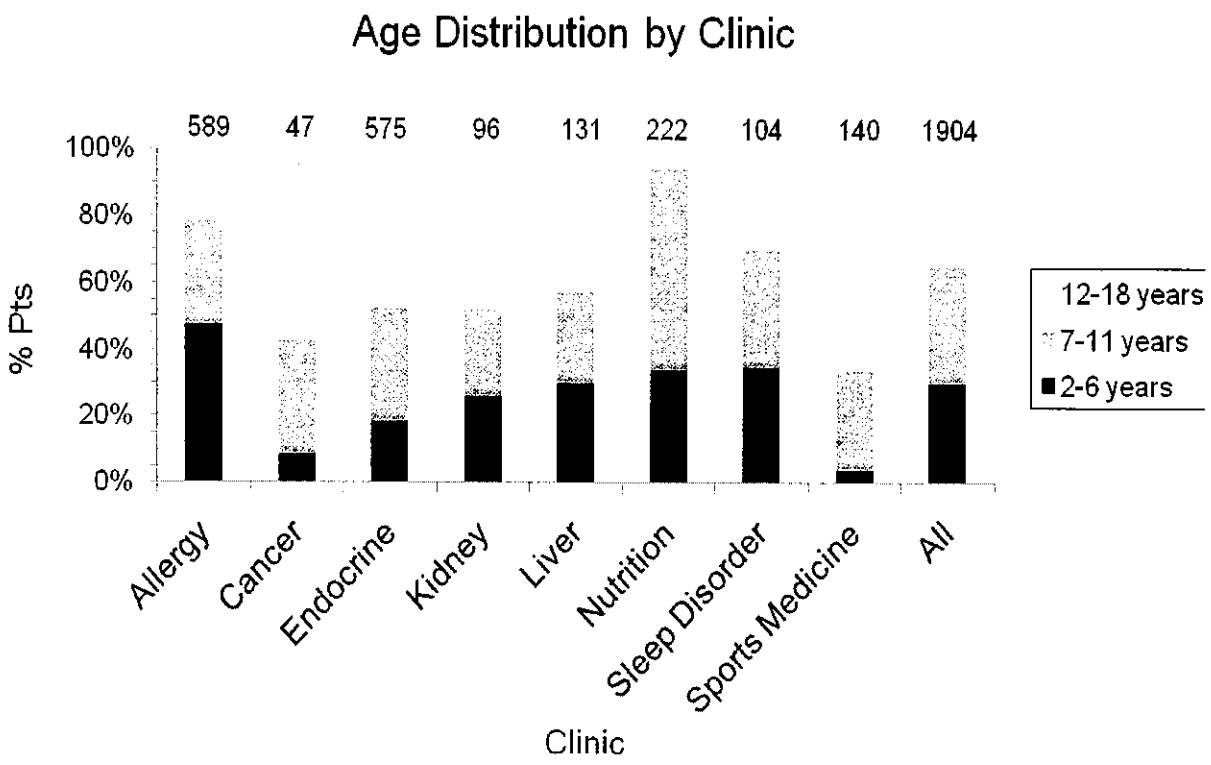
Table : Diagnoses by BMI and Age

ICD group*	BMI percentile^						Age^					
	85-94		95-98		≥99			2-6		7-11	12-18	
	n	(%)	n	(%)	n	(%)	*p*	n	(%)	n (%)	n (%)	*p*
Endocrine/metabolic/nutritional	308	(40)	276	(47)	**324**	**(58)**	***<0.001***	203	(36)	**356 (53)**	349 (52)	***<0.001***
Nervous/sensory/mental	181	(24)	165	(28)	155	(28)	*0.12*	157	(28)	173 (26)	171 (26)	*0.67*
Respiratory	279	(37)	208	(36)	175	(31)	*0.13*	**272 (48)**		225 (34)	165 (25)	***<0.001***
Digestive	134	(18)	105	(18)	114	(20)	*0.37*	118	(21)	116 (17)	119 (18)	*0.24*
Skin	204	(27)	143	(25)	151	(27)	*0.60*	**187 (33)**		152 (23)	161 (24)	***<0.001***
Musculoskeletal	125	(16)	**120**	**(20)**	81	(15)	***0.02***	**66 (12)**		107 (16)	153 (23)	***<0.001***
Congenital	126	(17)	89	(15)	86	(15)	*0.76*	**109 (19)**		88 (13)	104 (16)	***0.01***
Injury/poison	**169**	**(22)**	97	(17)	82	(15)	***0.001***	117	(21)	107 (16)	124 (19)	*0.11*

^The highest proportion is bolded when differences are significant.

ICD Codes: Infectious and parasitic diseases 001-139 ; Neoplasm 140-239; Endocrine, nutritional, metabolic diseases 240-279; Mental disorders 290-319; Diseases of the nervous system and sense organs 320-389; Diseases of the circulatory system 390-459; Diseases of the respiratory system 460-519; Diseases of the digestive system 520-579; Diseases of the genitourinary system 580-629; Diseases of the skin and subcutaneous tissue 680-709; Diseases of the musculoskeletal and connective tissue 710-739; Symptoms, signs, and ill-defined conditions 780-799; Injury and poisoning 800-999; All other diagnoses/ unknown – Includes diseases of the blood and organs (280-289); complications of pregnancy, childbirth, and the puerperium; (630-677); congenital anomalies (740-759); certain conditions originating in the perinatal period (760-779)

Figure 1b


Age Distribution by Clinic
589
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60%
40%
20%
0%
% Pts
12-18 years
7-11 years
2-6 years
Allergy
Cancer
Endocrine
Kidney
Liver
Nutrition
Sleep Disorder
Sports Medicine
All
Clinic