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The Missed Diagnosis and Mis-Diagnosis of Pediatric Obesity

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Targeted prevention and early intervention work to address pediatric obesity must, as a prerequisite, identify children with overweight/obesity. The American Academy for Pediatrics (AAP) recommends screening children and adolescents for overweight/obesity [1, 2] and specifies overweight (85^{th}–95^{th}) and obesity (>95^{th}) using sex-specific BMI-for-age percentiles; additionally, a new category of extreme obesity (>120% of the 95^{th}) has been proposed and occurs in an estimated 7.8% of American adolescents (12–19 years) [3]. Nationally-based analyses of obesity screening (using a 2005–2007 sample) found height and weight recordings at 63% of visits [4], but marked *under*-diagnosis with only 18% of children with obesity receiving an appropriate diagnosis [5]. The current study examined whether overweight/obesity remained under-diagnosed at well-child visits when height and weight were available, and explored characteristics of children receiving an appropriate obesity diagnosis.

Medical records for children (9–18 years) attending well-child visits (in which height, weight, sex, and age were recorded during the same visit, N=23,879) within the Yale hospital system between November 2011 and May 2015 were evaluated for appropriate overweight/obesity diagnosis (i.e., if the BMI percentile suggested a diagnosis of overweight or obesity was warranted, whether that diagnosis was assigned by the provider at that visit). Sex-specific BMI-for-age percentiles were calculated and categorized as no overweight/obesity (<85^{th}), overweight (85^{th}–95^{th}), and obesity (>95^{th}). Youth were also categorized by whether they exceeded the threshold for extreme obesity (>120% of the 95^{th}) [3]. This study was approved as a retrospective medical record review by Yale's institutional review board.

Chi-square tests compared proportions of assigned and warranted diagnoses (no overweight/obesity, overweight, obesity). Among all visits (N=23,879), 11.32% (n=2,703) of visits were assigned an overweight/obesity diagnosis, yet 37.87% (n=9,044) of visits warranted an overweight/obesity diagnosis. Only 11.03% of encounters that *should* (n=4,199) have had an overweight diagnosis *received* (n=463) an overweight diagnosis. Only 37.17% of encounters that *should* (n=4,845) have had an obesity diagnosis *received* (n=1,801) an obesity diagnosis. Among children surpassing the extreme obesity threshold (n=1,664), 54.27% (n=903) received an appropriate diagnosis of obesity. Healthcare providers were more likely to miss a diagnosis of overweight (n=3,633 missed out of n=4,199) than obesity (n=2,689 missed out of n=4,845; Z=28.63, p<.001), and were more likely to misdiagnose obesity as

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overweight (n=355; 7.33%), than misdiagnose overweight as obesity (n=73; 1.74%; Z= −12.48, p<.001).

Table 1 summarizes binary logistic regression analyses for appropriate obesity diagnosis using the following variables: sex (boys, girls), race (White[reference], Black, Asian, American-Indian, Hawaiian, Other, Missing), ethnicity (Hispanic, Not Hispanic), and age (9–12, 13–18 years). Boys (Odds Ratio: 0.69 [95% CI 0.61–0.78]) and adolescents (0.89 [0.79–0.998]) were significantly *less* likely to receive an obesity diagnosis; Black race (2.34 [1.96–2.79]), Other race (1.36 [1.12–1.64]), and Hispanic ethnicity (2.09 [1.76–2.48]) had *greater* likelihood of receiving an obesity diagnosis. Hierarchical logistic regression analyses (step 1: percent above 95th; step 2: sex, race, ethnicity, age) examined whether results would persist after adjusting for relative body size. Findings persisted after this adjustment and Asian race became a significant contributor to likelihood of receiving obesity diagnosis.

The pediatric well-child visit allows for regular monitoring of children's health and surveillance for potential development of health problems. AAP recommends screening children for overweight/obesity following, in part, evidence that specific counseling and behavioral interventions for obesity in youth can produce positive benefits [1, 2]. Unfortunately, it appears that pediatric overweight and obesity remain markedly under-diagnosed, even when necessary anthropometric information is available at routine medical visits, even within a top-ranked academic medical system. Moreover, missed diagnoses are quite common even among youths meeting the proposed severity specifier of "extreme obesity."

Obesity treatment does not *end*, but rather *begins*, with identification and diagnosis. Missing an obesity diagnosis at well-child visits is not trivial—diagnosis is associated with greater likelihood of diet/exercise counseling [6, 7], and blood pressure and cholesterol measurement [7]. It is possible that providers may discuss but not document obesity, yet recent evidence suggests obesity is under-discussed as well as under-diagnosed [8]. Straightforward explanations of missed diagnoses include providers' oversight of overweight/obesity, limited time with patients, discomfort discussing weight, or prioritization of medical concerns that supplant obesity. Providers may also assess weight visually, rather than by using growth charts, which has been shown to result in under-diagnosis [6]. Our findings compel us to highlight the pressing need for programs to improve and expand training so that future healthcare providers are prepared to treat pediatric obesity [9, 10]. Chiefly, we note that providers may not assess or may not diagnose obesity because they lack confidence in *providing* treatment for pediatric obesity [9], or lack confidence in the *effectiveness* of pediatric obesity treatments [9]. Educating clinicians-in-training in evidence-based obesity interventions can improve the former [10], and educating clinicians-in-training about the evidence base can improve their confidence in the child-health benefits of screening and the effectiveness of obesity interventions [2]; together, this could reduce the gap of missed diagnoses in a step towards alleviating the public health burden of obesity.

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Table 1

Logistic regression examining associations among patient characteristics and the likely of receiving a diagnosis of obesity among patients all exceeding the 95th BMI percentile

	χ^2	*df*	*p*	Nagelkerke R^2	Odds Ratio	95% CI	Odds Ratio
Model	**234.40**	**7**	**<.001**	**.064**			0 0.5 1 1.5 2 2.5 3
Male					0.692***	(0.613-0.779)	
Adolescent					0.885*	(0.785-0.998)	
Black					2.341***	(1.963-2.790)	
Asian					1.616	(0.888-2.941)	
Other					1.355**	(1.117-1.642)	
Hispanic					2.086***	(1.758-2.477)	
Model	**645.64**	**8**	**<.001**	**.170**			0 0.5 1 1.5 2 2.5 3 3.5 4 4.5
Step 1:	413.08	1	<.001				
%>95th BMI Percentile					1.626***	(1.547-1.709)	
Step 2:	232.57	7	<.001				
%>95th BMI Percentile					1.652***	(1.569-1.740)	
Male					0.607***	(0.535-0.689)	
Adolescent					0.839**	(0.740-0.952)	
Black					2.150***	(1.790-2.582)	
Asian					2.367**	(1.279-4.380)	
Other					1.415**	(1.156-1.731)	
Hispanic					1.940***	(1.621-2.321)	

Note. *N*=4,845, representing all visits when the patient had a BMI > 95th percentile. Significant odds ratios (*p<.05, **p<.01, ***p<.001) greater than 1 indicate increased likelihood of receiving a warranted obesity diagnosis; odds ratios between 0 and 1 indicate decreased likelihood of receiving a warranted obesity diagnosis.