

Differences in Classification of Overweight/Obesity by BMI Percentile versus Percent Body Fat in Youth with Type 1 Diabetes According to Pubertal Status

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Background

- Type 1 Diabetes (T1D) is a chronic condition that commonly manifests in childhood and poses a significant risk for morbidity and premature mortality, primarily due to macrovascular complications.
- Overweight/obesity is a well-recognized risk factor for the development of cardiovascular disease.
- Thus, youth with T1D and unrecognized adiposity are at significant risk for future complications.
- Body mass index (BMI) is used globally to estimate adiposity in children and adults due to its ease of use and minimal cost.
- Dual-energy X-ray absorptiometry (DXA) is the gold standard for body composition measurement. However, its widespread use in clinical practice is limited by cost.

Objective

To evaluate concordance in classification of overweight/obesity by BMI percentile compared with percent body fat by DXA in youth with T1D according to pubertal development at baseline and after 12 months.

Methods-1

- Secondary analysis of data from a longitudinal study in youth with T1D (N=115)
- Eligibility Criteria:
 - 8-16 years old
 - T1D duration ≥1 year
 - HbA1c 6.5% to 10.0%
- Parents/youth provided written informed consent/assent prior to start of study.
- Data collection (baseline and 12-months):
 - Medical/diabetes management data were obtained from interview and medical records.
 - Height and weight were measured using a calibrated stadiometer and scale.
 - Percent body fat was measured by DXA scan (Hologic).
- Statistical analyses were performed with SAS 9.4 (Cary, NC).

Methods-2

Classification of Weight Status by BMI %ile

- Classification based on age- and sex-specific BMI percentiles derived from the 2000 CDC growth charts (www.cdc.gov/growthcharts).

Weight Classification	CDC BMI Percentile
Normal Weight	<85 th percentile
Overweight	≥85 th to <95 th percentile
Obese	≥95 th percentile

Classification of Weight Status by % Body Fat

- Classification based on age- and sex-specific cutoffs derived from Taylor et al. (*Am J Clin Nutr* 2002;76:1416)

Age (yrs)	Males		Females	
	BMI=25	BMI=30	BMI=25	BMI=30
8	19	30	24	34
9	20	33	26	37
10	21	35	28	41
11	22	36	30	43
12	22	35	32	46
13	23	35	33	46
14	23	34	34	46
15	22	32	34	46
16	22	30	34	45
17	21	28	34	43

BMI=25: 85th to <95th %ile
 BMI=30: ≥95th %ile

- At baseline and 12 months, concordance and discordance in overweight/obese status were determined by comparing classification by BMI percentile to classification by percent body fat by DXA, both overall and by pubertal status.

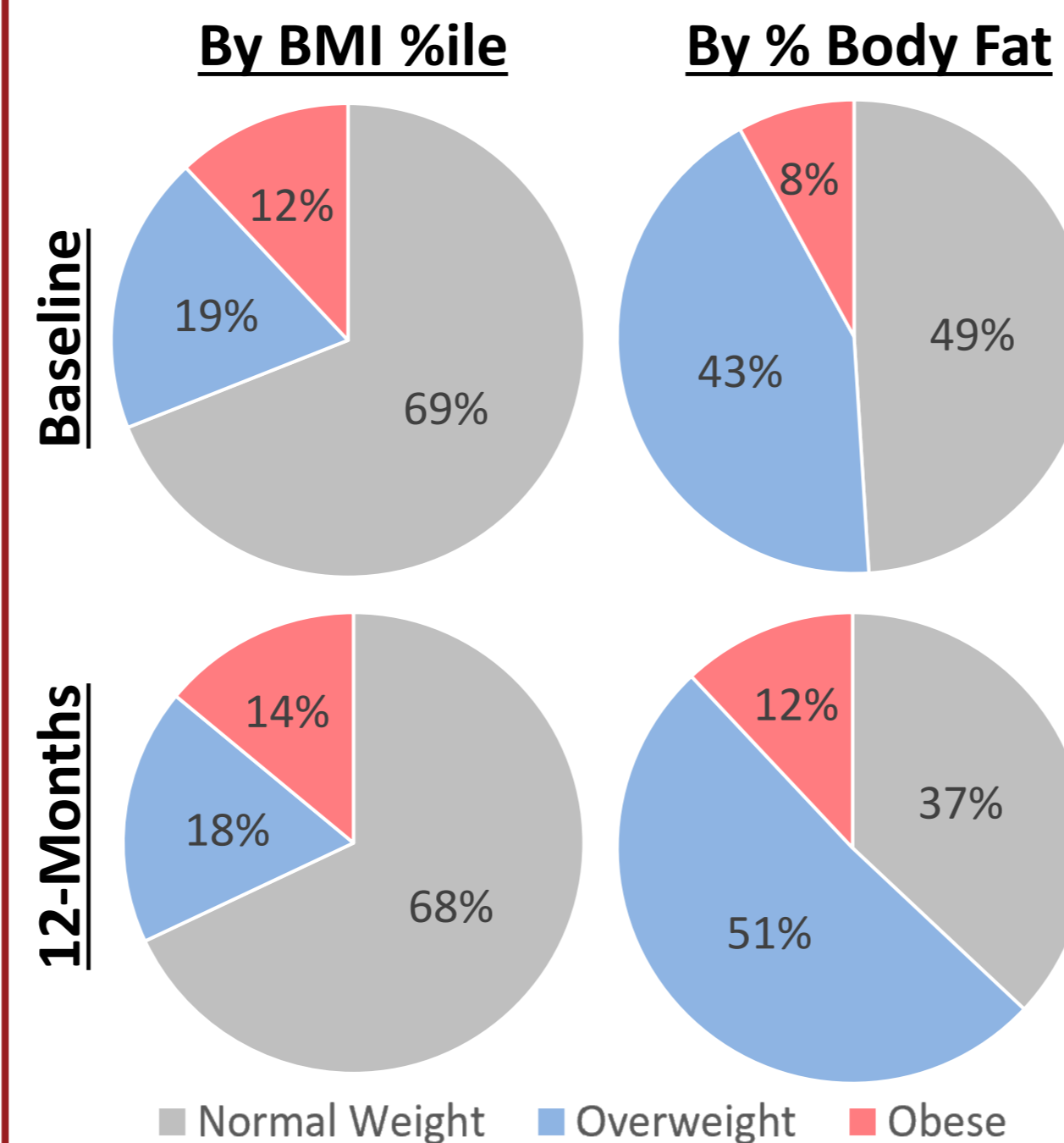
Classification of Pubertal Status

Pubertal Classification	Tanner Stage(s)
Pre-pubertal	Tanner 1
Pubertal	Tanner 2-4
Post-pubertal	Tanner 5

Baseline Characteristics

N=115	M±SD or %
Age (years)	12.9±2.5
Sex (% female)	50
Pubertal status (% pre/pubertal/post)	33/41/26
Race/ethnicity (% non-white)	11
Diabetes duration (years)	6.1±3.2
Insulin regimen (% pump)	73
Daily insulin dose (U/kg)	0.9±0.3
BG monitoring frequency (times/day)	5.6±2.4
HbA1c (%)	8.1±1.1
BMI percentile	70±23
Percent body fat	27.7±7.9

Results: Classification of Weight Status



- Classification of overweight/obese by BMI %ile remained stable at baseline and 12 months (baseline: 31%, 12 months: 32%).
- However, the proportion of overweight/obese by percent body fat increased over the study period (baseline: 51%, 12 months: 63%).

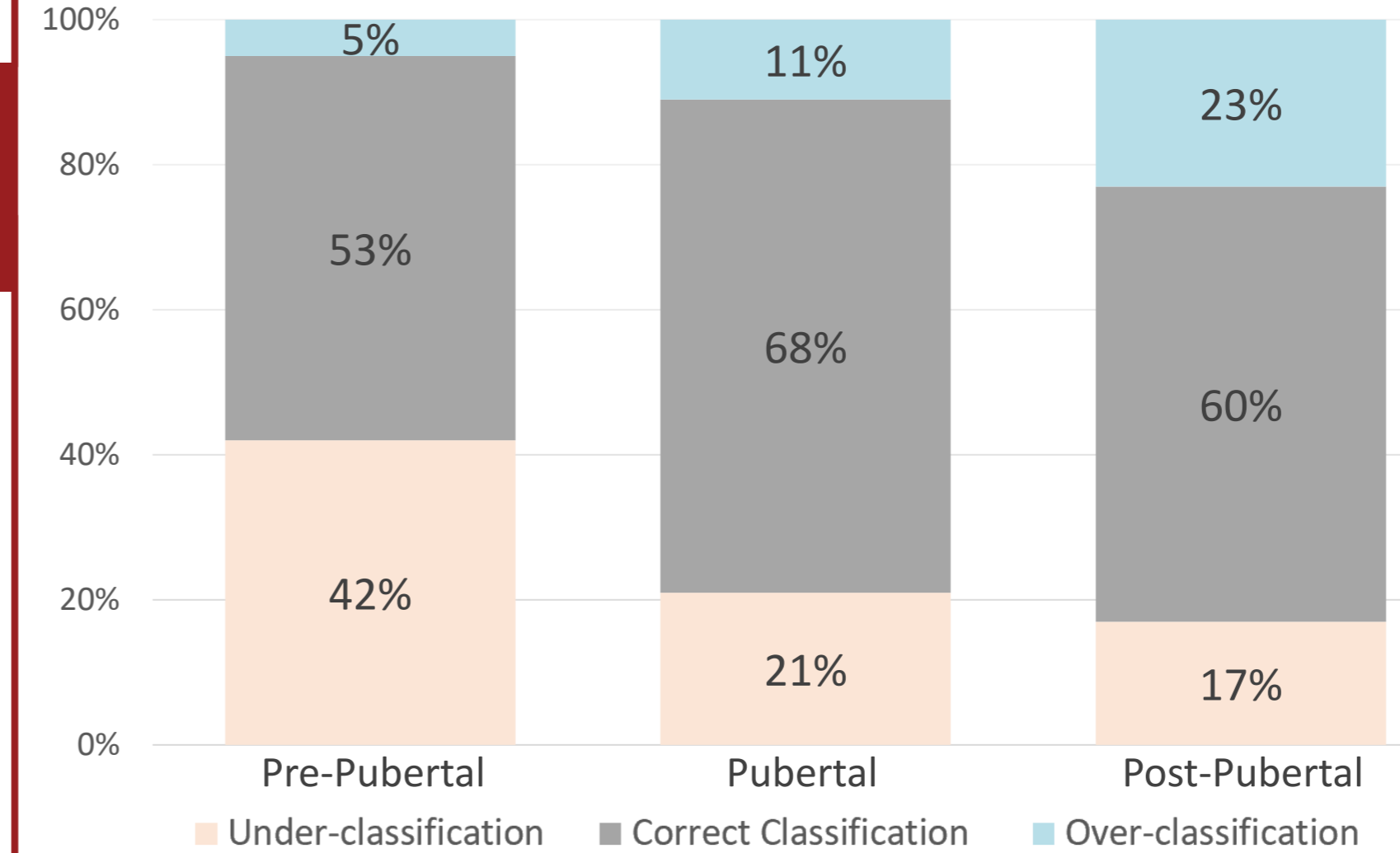
Results: Comparison by Pubertal Status

Baseline

		% Body Fat (DXA)		
		Normal weight	Overweight	Obese
BMI %ile	Normal weight	42%	26%	1%
	Overweight	7%	12%	0%
	Obese	0%	5%	7%

Under-classification 27% Correct Classification 61% Over-classification 12%

Classification of Overweight/Obesity by BMI Percentile vs. Percent Body Fat According to Pubertal Status at Baseline



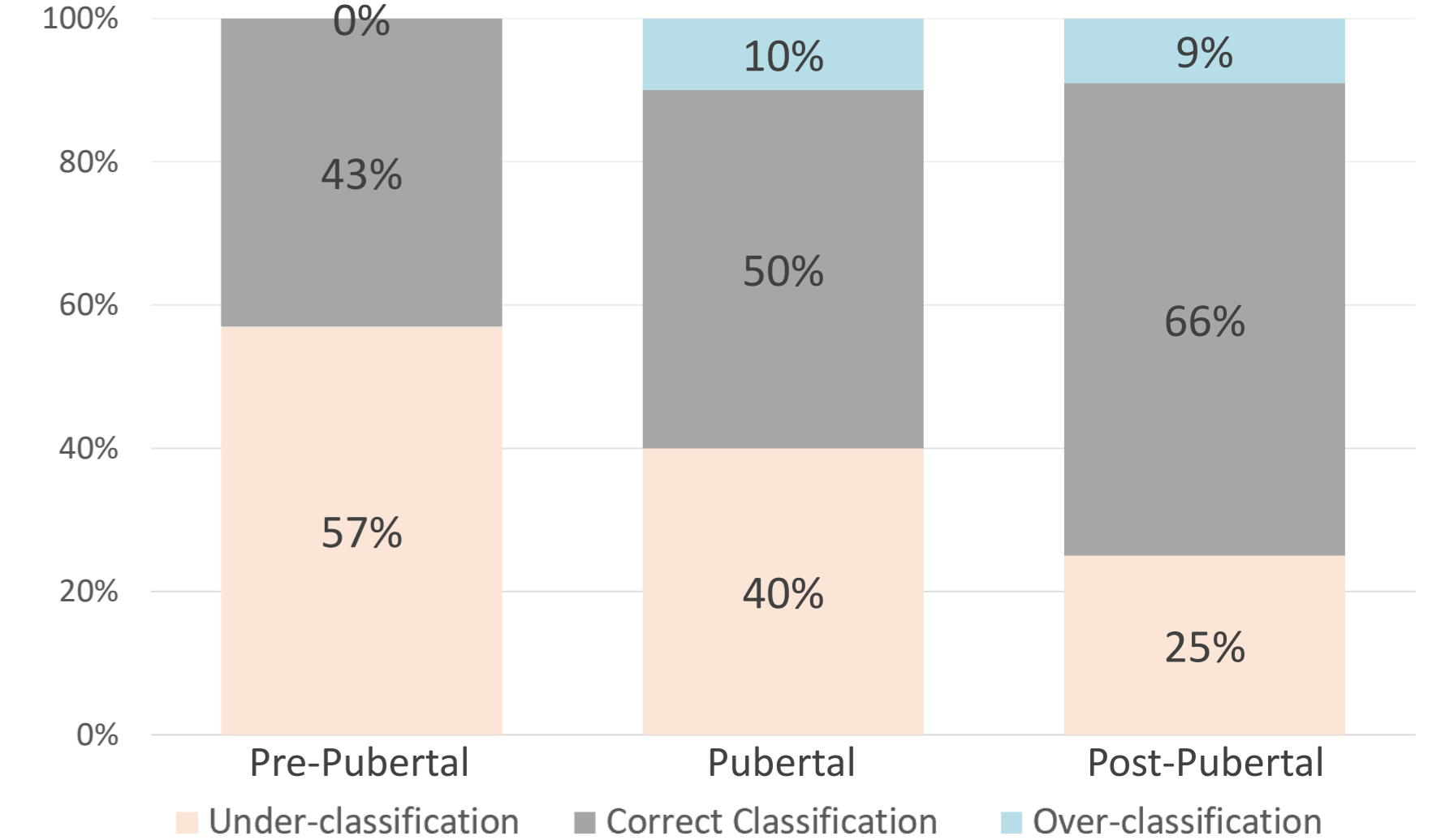
- Concordance in overweight/obese classification between BMI percentile and percent body fat was 53%, 68%, and 60% in pre-pubertal, pubertal, and post-pubertal youth, respectively.
- Adiposity was most likely to be underclassified by BMI compared to percent body fat in pre-pubertal youth (42%) and most likely to be overclassified by BMI compared to percent body fat in post-pubertal youth (23%).

12-Months

		% Body Fat (DXA)		
		Normal weight	Overweight	Obese
BMI %ile	Normal weight	32%	36%	0%
	Overweight	4%	12%	2%
	Obese	0%	3%	10%

Under-classification 38% Correct Classification 54% Over-classification 7%

Classification of Overweight/Obesity by BMI Percentile vs. Percent Body Fat According to Pubertal Status at 12-Months



- Concordance in overweight/obese classification between BMI percentile and percent body fat was 43%, 50%, and 66% in pre-pubertal, pubertal, and post-pubertal youth, respectively.
- Adiposity was most likely to be underclassified by BMI compared to percent body fat in pre-pubertal youth (57%), while most likely to be overclassified by BMI compared to percent body fat in both pubertal (10%) and post-pubertal (9%) youth.

Summary and Implications

- These data suggest that BMI may significantly underestimate adiposity in youth with T1D, particularly in pre-pubertal youth.
- There was a minimal amount of overclassification, mainly in post-pubertal youth. This may be due to accrual of lean body mass in males.

- These results indicate a need for cautious interpretation of BMI in clinical practice in order to correctly identify youth with increased adiposity and consequently higher cardiovascular risk.
- Unrecognized adiposity may have significant consequences for youth with T1D. Thus, the ability to correctly identify adiposity and implement timely risk reduction strategies is of utmost importance in youth with T1D.

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