

OVERLAP AND HIDDEN ADIPOSITY IN ADOLESCENTS ACROSS BMI-DEFINED WEIGHT CATEGORIES

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Background: Standard BMI screenings often overlook adolescents with hidden health problems due to high body fat despite a normal BMI or very low body fat levels.

Objective: This study aimed to analyse adiposity in adolescents across BMI-defined weight categories: underweight (UNW), normal weight healthy (NWH) normal weight obese (NWO) and overweight or obese (OVOB), focusing on distributional variability, overlap, and sex differences.

Subjects and methods: Data were collected from 5,740 Polish adolescents (49.6% male) aged 10–18 years from the ADOPOLNOR project. Body composition was measured using bioelectrical impedance analysis to determine fat mass percentage (FMP), fat mass index (FMI), and fat-to-muscle mass ratio (FMR). Density plots were used to visualise the distributions of these indicators and overlap coefficients (OVL) were calculated to measure the similarity between adjacent groups and capture heterogeneity within BMI categories.

Results: Median values of all adiposity indicators increased from UNW to OVOB in both sexes ($p < 0.001$), with higher values in females, particularly in the NWO group (effect size $r \geq 0.65$). Substantial within-category variability was observed, consistent for both sexes. Overlap analyses revealed little similarity between NWO and NWH ($OVL \leq 0.24$), indicating clear separation despite similar BMI, but substantial similarity between NWO and OVOB ($OVL \geq 0.62$), demonstrating similar adiposity despite different BMI. Two adiposity clusters emerged: UNW/NWH (lower adiposity) and NWO/OVOB (higher adiposity), independent of BMI. Classification confirmed high adiposity in all NWO and most OVOB adolescents, while UNW and NWH were mostly average or low. A small proportion of underweight adolescents also showed high adiposity (5.3% males, 0.5% females).

Conclusions: BMI reflects general adiposity trends but does not capture variability within categories. Overlap between BMI groups suggests that BMI alone can misclassify adolescents, supporting the use of direct body composition assessment alongside BMI.

Keywords: Adolescents; BMI; Adiposity indicators; Adiposity heterogeneity.