

Frequent Early-Life Antibiotic Use Associated with Increased Likelihood of Childhood Obesity

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Last updated 15 July 2025 • Check for updates at EpicResearch.org

Key Findings:

- Children prescribed 5 to 9 courses of antibiotics before age 5 are 7% more likely to be obese at age 6 compared to those with no antibiotic exposure. Those prescribed 10 or more antibiotics before age 5 are 14% more likely to become obese at age 6.
- Limited antibiotic exposure (1-4 courses) before age 5 was not significantly associated with obesity at age 6.

Antibiotics, particularly broad-spectrum classes, are known to alter the gut microbiome, which plays a critical role in metabolism and energy regulation.¹ Previous studies have shown mixed results, with some linking frequent antibiotic use to increased obesity risk and others finding negligible effects.^{1,2}

To further understand the relationship between childhood antibiotics and obesity, we studied 483,290 children, looking at their antibiotic courses prescribed before age 5 and their BMI at age 6. We considered patient demographics, childhood infections, diabetes, maternal obesity, and regional and socioeconomic variables in our analysis. Children who received antibiotics in the hospital were excluded.

We found that children who received 1 to 4 antibiotic courses before age 5 were not significantly more likely to be obese at age 6 compared to those who received no antibiotics before age 5, as seen in Figure 1. Conversely, children who received 5 to 9 antibiotic courses before age 5 were 7% more likely to be obese at age 6, and those with 10 or more prescriptions were 14% more likely.

Likelihood of Obesity at Age 6 by Early Childhood Antibiotic Courses

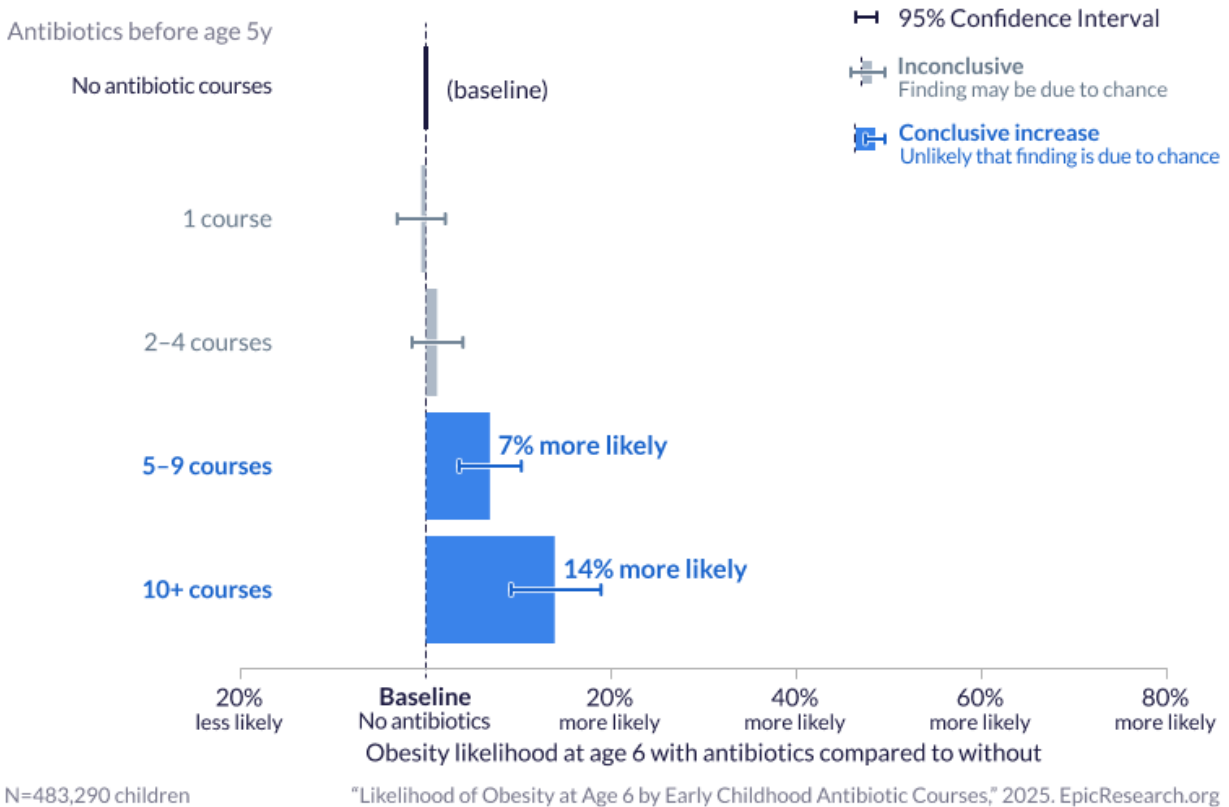


Figure 1. The likelihood of a child being obese at age 6 by the number of antibiotic courses they received before age 5.

These data come from Cosmos, a dataset created in collaboration with a community of Epic health systems representing more than 300 million patient records from 1,700 hospitals and more than 40,000 clinics from all 50 U.S. states, Lebanon, and Saudi Arabia. This study was completed by two teams that worked independently, each composed of a clinician and research scientists. The two teams came to similar conclusions. Graphics by Brian Olson.

References

1. Trasande L, Blustein J, Liu M, Corwin E, Cox LM, Blaser MJ. Infant antibiotic exposures and early-life body mass. *Int J Obes (Lond)*. 2013;37(1):16-23. doi:10.1038/ijo.2012.132
2. Bailey LC, Forrest CB, Zhang P, Richards TM, Livshits A, DeRusso PA. Association of antibiotics in infancy with early childhood obesity. *JAMA Pediatr*. 2014;168(11):1063-1069. doi:10.1001/jamapediatrics.2014.1539

Data Definitions

Term	Definition
Study period	1/1/2015 to 3/1/2025
Study population: inclusion	Patients with: <ul style="list-style-type: none"> • A birth in Cosmos • At least one outpatient face-to-face encounter every two years through age 6

	<ul style="list-style-type: none"> At least one BMI reading while age 6 that was recorded on an outpatient face-to-face encounter
Study population: exclusion	<p>Patients with:</p> <ul style="list-style-type: none"> Any antibiotic administered during an inpatient admission before age 7 Antibiotic use between ages 5 and 7 A legal sex that isn't male or female
Outpatient face-to-face	An encounter with a type of Emergency, Office Visit, Well Child, Follow-up, Telemedicine, Urgent Care, Walk-In, Routine Prenatal, Postpartum Visit, or Fetal Care Consult
Exposures	Antibiotic courses prescribed before age 5
Antibiotic	An antibiotic prescription with a route of "intramuscular" or "oral" and a pharmaceutical class of "Penicillin antibiotics;" "Cephalosporin antibiotics - 2nd generation;" "Cephalosporin antibiotics - 3rd generation;" "Cephalosporin antibiotics - 4th generation;" "Macrolide antibiotics;" "Tetracycline antibiotics;" "Periodontal collagenase inhibitors;" "Quinolone antibiotics;" "Aminoglycoside antibiotics;" "Amebicides;" "Absorbable sulfonamide antibacterial agents;" "Vancomycin antibiotics and derivatives;" "Lincosamide antibiotics;" "Antibiotics, miscellaneous, other;" "Polymyxin antibiotics and derivatives;" "Carbapenem/Penem Antibiotics;" "Anaerobic antiprotozoal-antibacterial agents;" "Antiparasitics;" "Oxazolidinone antibiotics;" "Rifamycins and related derivative antibiotics;" "2nd gen. Anaerobic antiprotozoal-antibacterial;" "Nitrofurantoin derivatives antibacterial agents;" "Antibiotic, antibacterial, misc.;" or "Antitubercular antibiotics"
Outcomes	The highest BMI value during age 6, classified as not obese (BMI <95 th percentile) or obese (>=95 th percentile)
Confounders	<p>Legal sex</p> <p>Social Vulnerability Index quintile</p> <p>RUCA: Metropolitan, Micropolitan, Small Town, Rural</p> <p>Census Region: S, W, MW, NE</p> <p>Race and ethnicity</p> <ul style="list-style-type: none"> Black White Asian Hispanic (Ethnicity) Other Multiracial <p>Mother's history of obesity (BMI >30) between one year before and 30 days after gestation start date</p> <ul style="list-style-type: none"> Max if there are multiple readings <p>Childhood infections</p> <p>Type 1 diabetes prior to age 7: ICD-10-CM: E10*</p> <p>Type 2 diabetes prior to age 7: ICD-10-CM: E11*</p>
Race and ethnicity	Patients were classified by self-reported race and ethnicity as Hispanic (any Race), multiracial (more than one recorded race, any ethnicity), White (White race, any ethnicity), Black (Black race, any ethnicity) Asian (Asian Race, any ethnicity), other (other race not categorized above, any ethnicity), or unknown (absent/undocumented).

Model specifications	Logistic regression
Childhood infections	Otitis media: ICD-10-CM code H65* or H66* Strep throat: ICD-10-CM code J02.0, J03.00, or J03.01 or a positive Lab result with LOINC code 11268-0, 76581-8, 101300-2, 60489-2, 68954-7, 6556-5, 18481-2, 78012-2, or 6557-3 UTI: ICD-10-CM code N39.0, N30*
Social Vulnerability Index	The social vulnerability quintile for the ZIP Code of the patient's most recent address
RUCA	Rural-Urban Commuting Area is a classification of geographic areas based on population density, urbanization, and daily commuting. It ranges from 1 to 10, with lower values indicating more urban areas and higher values indicating more rural areas.

Table 1. Likelihood of Obesity at Age 6 by Early Childhood Antibiotic Courses

Antibiotic Courses	Odds Ratio	Lower CI	Upper CI
No Antibiotics			
Has Any Antibiotic (>0)	1.013	0.989	1.037
Has 1 Antibiotic Course	0.995	0.969	1.021
Has 2-4 Antibiotic Courses	1.012	0.985	1.04
Has 5-9 Antibiotic Courses	1.069	1.036	1.103
Has 10+ Antibiotic Courses	1.139	1.092	1.189