

# Body Mass Index Growth Across Childhood and Pubertal Development: The Mediating Role of Sleep Duration

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## Abstract

**Background:** Early pubertal development is associated with a range of adverse outcomes, yet little is known about when and through what mechanisms early-life factors contribute to its advancement.

**Objectives:** This study examined associations between zBMI growth rates across distinct developmental periods and pubertal development, and evaluated whether sleep duration mediates this relationship, with attention to sex-specific and sequential pathways.

**Methods:** Data were drawn from 3,843 participants in the Kids in Taiwan: National Longitudinal Study of Child Development and Care (KIT) Project. Repeated measures of height and weight from birth to age 8 years were used to calculate WHO BMI z-scores (zBMI). Linear spline multilevel models were applied to estimate zBMI growth rates across developmental periods, and structural equation modeling was used to examine direct and indirect pathways linking zBMI growth to pubertal development through sleep duration.

**Results:** Faster zBMI growth was consistently associated with more advanced pubertal development among girls, with the strongest associations observed during the 6–12 and 12–36 month periods ( $B = 1.43$  and  $1.49$ , respectively). Among boys, no significant direct associations were observed. Instead, faster zBMI growth was indirectly associated with more advanced pubertal development through shorter sleep duration, both within specific developmental periods and sequentially across developmental spans.

**Conclusion:** Our findings indicate that zBMI growth during early life is differentially associated with pubertal development in boys and girls, with sleep duration serving as a modifiable behavioral pathway among boys. These results highlight the importance of accounting for sex differences and developmental timing in prevention and intervention efforts targeting early pubertal development.

**Keywords:** BMI growth; pubertal development; sleep duration; sex differences; mediation