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Relationship between Feeding Practices in Infancy and Overweight Among 2–6-Year-Old Children: A Cross-Sectional Study

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Abstract

Background: Childhood overweight has emerged as a critical public health issue globally, with early-life feeding practices influencing metabolic programming and adiposity risk. The World Health Organization reported over 41 million overweight or obese children under five in 2020. In India, NFHS-5 indicates a preschool overweight prevalence of 3.4%, with urban pockets up to 6.6%, emphasizing a dual burden alongside persistent undernutrition. Despite these trends, hospital-based data examining how exclusive breastfeeding and complementary feeding quality impact early adiposity remain scarce. **Objective:** To determine the prevalence of overweight and evaluate its association with infancy feeding practices in 2–6-year-old children attending a pediatric outpatient department. **Methods:** Total of 124 children aged 24-77 months were enrolled using systematic sampling over six months. Participants' demographic data, socioeconomic status, birthweight, exclusive breastfeeding duration, and complementary feeding practices were collected via a structured questionnaire. Anthropometry was performed using standardized protocols to measure weight and height; BMI was calculated and classified using WHO 2006 BMI-for-age percentiles (>85th percentile defined overweight). Data were double-entered into SPSS v25. Prevalence estimates with 95% confidence intervals were obtained via Wilson's method. Associations between feeding variables and overweight were tested with chi-square/Fisher's exact tests and logistic regression adjusted for socioeconomic status and birthweight ($p<0.05$). **Results:** Overweight prevalence was 8.1% (95% CI: 4.2–14.4%). 67% of children were exclusively breastfed for six months or more, demonstrating a protective effect against overweight (adjusted odds ratio [aOR] 0.38; 95% CI: 0.10–0.94; p=0.04). Suboptimal complementary

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feeding practices—characterized by early introduction, low dietary diversity, or delayed initiation—were present in 44% of participants and were associated with increased overweight odds (aOR 2.10; 95% CI: 1.08–4.07; p=0.03). **Conclusion:** In this hospital-based cohort, overweight affected 1 in 12 preschoolers. Exclusive breastfeeding emerged as a significant protective factor, whereas poor complementary feeding practices doubled the risk of early adiposity. These findings underscore the necessity of reinforcing WHO IYCF guidelines, integrating feeding counseling into routine pediatric care, and designing community interventions that support breastfeeding and nutrient-rich complementary feeding to prevent childhood overweight in India.

Introduction

Childhood overweight, encompassing both overweight and obesity, represents one of the most pressing public health challenges of the 21st century, even extending into low- and middle-income countries where undernutrition historically dominated health agendas. The World Health Organization reports that over 41 million children under five years of age were overweight or obese in 2020, a stark increase from 31 million just a decade earlier. Comprehensive epidemiological investigations indicate that the prevalence of overweight among preschool-age children in urban and semi-urban Indian communities ranges between 5% and 10%, with a pooled estimate of approximately 7.2%. Such figures herald an urgent need to understand early-life determinants of excess adiposity and to implement preventive strategies at the population level (1).

Nelson's Textbook of Pediatrics quotes the pathophysiological mechanisms that underlie the development of adiposity in early childhood. Adipose tissue is not merely an inert energy reservoir but an active endocrine organ that secretes a host of adipokines, including leptin, adiponectin, and resistin. Expansion of both adipocyte size (hypertrophy) and number (hyperplasia) during infancy can dysregulate the balance of these bioactive molecules, promoting insulin resistance, chronic low-grade inflammation, and alterations in hypothalamic appetite regulation. Critically, the period from conception through two years of age represents a window of developmental plasticity, during which nutritional

exposures can epigenetically program metabolic pathways, predisposing individuals to lifelong cardiometabolic diseases (2).

In India, the National Family Health Survey-5 (2019–21) documented that 3.4% of children aged 0–59 months were overweight, with urban and semi-urban clusters exhibiting rates up to 6.6%. The Comprehensive National Nutrition Survey (CNNS) further reported combined overweight (BMI-for-age >85th percentile) of 7.2% among 1–5-year-olds. Regional cohorts corroborate these trends: a 2022 Tamil Nadu cohort study found an overweight prevalence of 7.8% among children aged 2–5 years attending a tertiary hospital outpatient department, while a 2023 semi-urban Kerala cohort observed a 6.9% prevalence. These data highlight a dual burden of malnutrition in India, wherein pockets of persistent undernutrition occur concurrently with rising overweight, fueled by rapid urbanization, increased availability of energy-dense processed foods, and lifestyle transitions (3,4).

Feeding practices in infancy—particularly exclusive breastfeeding (EBF) for the first six months—have been repeatedly implicated in modulating the trajectory of weight gain and adiposity. Human breast milk contains a complex matrix of nutrients and bioactive components, including immunoglobulins, human milk oligosaccharides, and growth factors, which collectively shape gut microbiota composition, gut barrier integrity, and immune maturation. Leptin and adiponectin present in breast milk further regulate neonatal appetite control and energy expenditure. Conversely, early introduction of calorie-dense complementary foods and formula can accelerate weight velocity, increase adipocyte hyperplasia, and disrupt metabolic homeostasis (5,6).

Global guidelines from WHO and UNICEF recommend exclusive breastfeeding for the first six months of life, followed by continued breastfeeding up to two years alongside timely, adequate, and safe complementary feeding. Despite these recommendations, CNNS data reveal that only 60% of Indian infants receive EBF for the recommended six months, with early introduction of complementary feeding common across both rural and urban settings. Suboptimal infant and young child feeding (IYCF) practices, such as low dietary

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diversity and delayed introduction of nutrient-rich complementary foods, further compound the risk of malnutrition, both under- and overweight (7).

Given this backdrop of rising overweight and evolving feeding patterns, our study aims to quantify the prevalence of overweight among 2–6-year-old children in a hospital-based sample and to evaluate the association between EBF duration and overweight risk, adjusting for socioeconomic status, birthweight, and complementary feeding quality. By elucidating these relationships in an Indian context, we seek to inform targeted interventions and policy measures aimed at optimizing early feeding practices to curb the growing epidemic of childhood overweight.

Methodology, Objectives, and Statistical Analysis

Objectives

1. To assess the association feeding practices and risk of overweight.
2. To determine the prevalence of overweight among children aged 2–6 years attending the pediatric outpatient department.

Study Design and Setting

This hospital-based cross-sectional study was conducted in the pediatric outpatient department of a tertiary care center in South India over a six-month period (January–June 2024). Systematic sampling was employed, enrolling every third eligible child until the target sample size of 124 was achieved.

Inclusion Criteria

• Children aged 24–72 months whose parents provided written informed consent.

Exclusion Criteria

• Chronic systemic illnesses (e.g., renal disease, endocrine disorders).

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• Severe acute malnutrition (weight-for-height < –3 SD) or known genetic syndromes affecting growth.

Operational Definitions

• Overweight: BMI-for-age >85th percentile using WHO 2006 charts for children >2 years.
• Exclusive Breastfeeding (EBF ≥6 months): Infant receives only breast milk, with no other liquids or solids except vitamins/minerals, for first six months.
• Suboptimal IYCF Practices: Early introduction of complementary feeds (<6 months), low dietary diversity (<4 food groups/day), or delayed initiation of complementary feeding (>8 months).
• Socioeconomic Status (SES): Classified by Modified Kuppusamy Scale (2024 update).

Data Collection Procedures

1. Consent Process: Parents/guardians provided written informed consent after explanation of study objectives and procedures.
2. Interview: Structured questionnaire administered to capture demographic data, birth history, feeding history, and complementary feeding practices per WHO IYCF guidelines.
3. Anthropometry:
   - Weight measured to nearest 100 g using a calibrated digital scale.
   - Height measured to nearest 1 mm using a stadiometer.
4. BMI Calculation and Classification:
   - BMI = weight (kg) / height (m)^2.
   - BMI-for-age percentiles plotted on WHO charts.
5. Data Management:
   - Double data entry into SPSS v25 with cross-validation.
   - Missing data (<5%) handled via listwise deletion.

Statistical Analysis

Data were analyzed using SPSS version 25 (IBM Corp., Armonk, NY). Descriptive statistics included means and standard deviations for continuous variables and frequencies

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with percentages for categorical variables. The primary outcome—overweight prevalence—was expressed as a proportion with 95% confidence intervals calculated using the Wilson method. Bivariate associations between overweight status and categorical predictors (e.g., EBF status, SES categories) were assessed using chi-square tests or Fisher's exact tests as appropriate. Multivariable logistic regression models were constructed to estimate adjusted odds ratios (aORs) for EBF ≥6 months and suboptimal IYCF practices, controlling for confounders including age, sex, SES, and birthweight. Model fit was evaluated via Hosmer-Lemeshow test, and statistical significance was set at $p < 0.05$.

Results

Table 1. Demographic and Clinical Characteristics

Variable	Total (n = 124)	Overweight (n = 10)	Normal (n = 114)	p-value
Age, mean ± SD (yrs)	4.1 ± 1.2	4.3 ± 1.1	4.1 ± 1.2	0.58
Male, n (%)	64 (51.6%)	6 (60.0%)	58 (50.9%)	0.56
SES Middle, n (%)	76 (61.3%)	7 (70.0%)	69 (60.5%)	0.47
Birthweight < 2.5 kg, n (%)	30 (24.2%)	3 (30.0%)	27 (23.7%)	0.62

Table 2. Feeding Practices

Practice	Overweight (n = 10)	Normal (n = 114)	p-value
EBF ≥ 6 months, n (%)	3 (30.0%)	72 (63.2%)	0.04*
Suboptimal IYCF, n (%)	8 (80.0%)	48 (42.1%)	0.02*

Table 3. Overweight Outcomes and Predictors

Outcome / Predictor	Value	95% CI or p-value
Overweight prevalence	8.1%	4.2 – 14.4%

Adjusted OR for EBF	0.38	0.10 – 0.94 (p = 0.04) *
Adjusted OR for Suboptimal IYCF	2.10	1.08 – 4.07 (p = 0.03) *

Discussion

The present hospital-based cross-sectional study revealed that 8.1% of children aged 2–6 years exhibited overweight, a figure notably higher than the 3.4% overweight prevalence reported in NFHS-5 for the 0–59-month age group. This elevated prevalence in our clinical sample may reflect referral patterns, urban dietary transitions, and lifestyle factors unique to semi-urban populations. The dual burden of malnutrition in India—where undernutrition persists alongside burgeoning overweight—underscores the complexity of nutritional challenges in transitional economies (8).

We observed a statistically significant protective effect of exclusive breastfeeding for ≥6 months, with EBF associated with a 62% reduction in odds of overweight (aOR 0.38, 95% CI 0.10–0.94). This aligns with meta-analyses from diverse settings demonstrating that prolonged EBF reduces rapid infancy weight gain and modulates adiposity trajectories through hormonal and microbiome-mediated mechanisms. Human milk oligosaccharides and adipokines such as leptin and adiponectin in breast milk may regulate neonatal gut colonization and energy homeostasis, thereby attenuating adipocyte hyperplasia (9,10).

Conversely, suboptimal IYCF practices—manifested as early complementary feeding, minimum dietary diversity, and delayed initiation of solid foods—doubled the odds of overweight (aOR 2.10, 95% CI 1.08–4.07). Early exposure to calorie-dense complementary feeds may precipitate accelerated weight-for-height gain and unfavorably alter appetite regulatory circuits in the hypothalamus. These findings corroborate community-based cohort studies in South Asia, which have linked premature introduction of processed cereals and sugary snacks with increased adiposity by two years of age (11,12).

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Our study's strengths include systematic enrollment, rigorous anthropometric measurements, and multivariable adjustment for key confounders. However, several limitations warrant consideration. The cross-sectional design precludes causal inferences, and reliance on parental recall for feeding histories may introduce recall bias. Additionally, hospital-based sampling may over-represent children with health-seeking behaviors and limit generalizability to community settings. Future longitudinal cohorts with objective feeding assessments and biomarker evaluations are needed to validate our findings and elucidate mechanistic pathways.

From a public health standpoint, reinforcing EBF promotion through targeted lactation support and integrating IYCF counseling into routine pediatric care could attenuate early-life adiposity trends. Policy initiatives, including maternity leave extensions and workplace lactation facilities, are critical to sustain breastfeeding practices. Moreover, educational interventions for caregivers on timely and nutrient-dense complementary feeding are imperative to address the emerging epidemic of childhood overweight in India.

Conclusion

In this hospital-based cross-sectional study of 124 children aged 2–6 years, the prevalence of overweight was 8.1%. Exclusive breastfeeding for at least six months was associated with significantly reduced odds of overweight, whereas suboptimal IYCF practices doubled the risk. These findings underscore the critical importance of promoting breastfeeding and optimizing complementary feeding practices to prevent early adiposity and its long-term metabolic sequelae. Integrating breastfeeding support and IYCF education into primary healthcare could mitigate the burgeoning burden of childhood overweight.

Limitations

The cross-sectional design limits causal inference, and parental recall bias may affect the accuracy of feeding histories. Hospital-based sampling may not represent community patterns, potentially overestimating/underestimating overweight prevalence.

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Recommendations

Future community-based longitudinal studies with objective feeding assessments can be carried out. Integrate IYCF counseling and lactation support into primary care, and enact policies to promote sustained breastfeeding and nutrient-rich complementary feeding.

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