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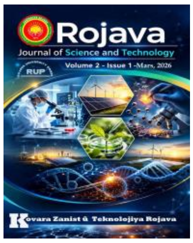

Prevalence and Etiology of Abnormal Physical Growth among Syrian Children Living in North and East Syria: A Cross-Sectional Study

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Abstract

Childhood growth abnormalities are a significant public health concern, particularly in conflict-affected regions. This study aims to assess the prevalence and etiological factors of abnormal physical growth among Syrian children aged 0-5 years in North and East Syria. The findings will provide evidence-based recommendations for preventive and management strategies. A cross-sectional study design was employed, enrolling 208 children. Anthropometric assessments included measurements of height, weight, and head circumference. Additionally, caregiver questionnaires captured socio-economic status, healthcare access, and dietary habits, while healthcare records provided data on medical history. Growth abnormalities were identified using standard growth charts, and statistical analysis determined prevalence rates and associated risk factors. The study revealed that 39.9% of children were categorized as short, 26% were underweight, 20.2% were overweight, and 12% were obese. Additionally, 11.1% had microcephaly, while 30% had macrocephaly. Socioeconomic factors played a critical role, with underweight children predominantly residing in urban areas (87%). Complications during pregnancy (35.6%) and low breastfeeding rates (35.1%) were significant determinants of poor growth outcomes. Despite the high burden of chronic illnesses (50.2%), no significant association was found with growth abnormalities. Gender differences were minimal, except for a borderline significant association between male children and macrocephaly. Growth monitoring was notably low (17.8%), though it showed a positive impact on weight outcomes among underweight children. Growth abnormalities are prevalent among Syrian children in North and East Syria, with significant associations with prenatal and early-life factors. Public health interventions should focus on improving maternal healthcare, promoting breastfeeding, and enhancing growth monitoring programs. Further research is needed to explore long-term developmental outcomes and evaluate the effectiveness of targeted interventions. Strengthening healthcare infrastructure and community support is crucial to modifying childhood growth disorders in conflict-affected settings.

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1. Introduction

Normal growth and development include motor, cognitive, and sexual development, along with physical growth assessed through anthropometric measures such as weight, height, body proportions, head circumference, dentition, and bone age (Gilbert and King 1973). Developmental delays occur when a child does not achieve expected milestones within the typical age range. These milestones serve as key indicators of a child's growth and progression (Vasudevan and Suri 2017).

Developmental delays can appear from infancy to early school years, resulting from factors such as medications, malnutrition, chronic disease, trauma, genetics, chromosomal abnormalities, endocrine or metabolic disorders, and, in some cases, unknown causes (Johnson and Smith 2020). Growth disorders are categorized into three types: primary growth disorders, which stem from intrinsic growth process issues like skeletal dysplasia and dysmorphic syndromes; secondary growth disorders, which arise due to external factors such as endocrine imbalances (e.g., growth hormone deficiency), chronic conditions (e.g., Crohn’s disease, renal disease), or malnutrition; and idiopathic growth disorders, where no identifiable cause can be determined (Olusanya et al. 2018).

Assessing growth through anthropometric methods—measuring weight, height, and BMI—is essential for evaluating nutritional status and detecting growth abnormalities. Reference data play a crucial role in diagnosing conditions such as undernutrition, obesity, and endocrine-related disorders, guiding healthcare professionals and policymakers in child health management (Khadilkar and Khadilkar 2011).

Developmental delays are prevalent in approximately 1-3% of children under five globally (Mithyantha et al. 2017). A 2016 systematic analysis estimated that around 52.9 million children worldwide experience developmental delays, with 95% residing in low- and middle-income countries (LMICs), where healthcare resources are scarce (Salomone et al. 2019). Furthermore, 43% of children in LMICs are at an increased risk of not reaching their developmental potential due to factors like stunting, poverty, and socioeconomic disadvantage (Black et al. 2017).

In Syria, children face multiple risk factors, including malnutrition, limited healthcare access, and environmental stressors, all contributing to an increasing burden of abnormal physical growth. Despite this, no recent comprehensive study has assessed the extent of these developmental challenges or their underlying causes within the Syrian context.

For all these reasons, this research project aims to provide valuable insights into the prevalence and etiological factors of abnormal physical growth among Syrian children living in North and East Syria. The findings will contribute to developing evidence-based strategies for preventing and managing abnormal physical growth among Syrian children.

2. Materials and methods

2.1. Study design:

The study was an observational cross-sectional study conducted in North and East Syria, from December 2023 to June 2024.

2.2. Study population and sampling techniques:

- The target population was Syrian children aged 0-5 years living in North and East Syria.

- There is no previous exact registry about the prevalence of abnormal physical growth among Syrian children. However, it was recorded that developmental delay is prevalent in approximately 1-3% of children under the age of 5 worldwide (Mithyantha et al. 2017). The required sample was calculated based on statistical software EPI-INFO version 3, considering the prevalence of children's growth retardation in Syria (3 %), a confidence interval of 95%, and a maximum acceptable error of 5%. Accordingly, the minimum sample size needed was 150 children; however, to increase the validity and power of the study, we tried to increase the sample size. A total of 208 children were included in the study.

- The study was conducted at:
  - Kobani Hospital, Kobani city, East of Euphrates
  - Amal Hospital, Kobani City, East of Euphrates

- Nurseries at Kobani city and its countryside, East of the Euphrates

- Shiran Clinic, Kobani City, East of Euphrates

- Official permissions were obtained from the Rojava University administration and the university's scientific ethical committee. The study protocol was approved by the Ethics Committee of Rojava University.

- Before data collection, informed written consent was obtained from the participants' parents.

2.3. Research Strategy

- All participants were subjected to history taking and clinical examination through:

1. Questionnaire:

The questionnaire included:

- **Socio-demographic characteristics:** Sex, age in years, place of residence (urban/rural), family size, children born at full-term or preterm, breastfeeding, teeth eruption (normal/delayed), child's typical daily diet, physical activity, child's growth regular monitoring, child nutritional status, parents' education level

- Medical history: complications during pregnancy, health issues during infancy, or children's illness or infection.

2. Anthropometric measurements:

- Body weight (in kilograms): Children younger than 12 months were weighed on a scale after removing the clothes, shoes, and diaper, and recorded to the nearest 0.01 kg. Children older than infancy were measured measured without shoes, with little or no outer clothing, and recorded to the nearest 0.1 kg (Argall 2003).

- Height (in centimeters): For children less than two years old or children with severe cerebral palsy, length is the ideal way of measuring stature. Length is measured by placing the child supine on an infant measuring board. For children aged more than two years, standing height is measured in the stadiometer after removing shoes (Stevenson 1995).

- Body mass index (BMI): This calculator provides body mass index (BMI) and the corresponding BMI-for-age percentile based on CDC growth charts for children and teens ages 2 through 19 years. BMI is calculated with the following formula (Center for Disease Control and Prevention, 2024):

B.M.I. = weight in kilograms / (height in meters)2

- The weight-to-length ratio:

The weight-to-length ratio is an alternative for body mass index predicting adiposity in less than two years (Foundation Internet Services, LLC, 2022).

- Head circumference or occipitofrontal circumference:

It is assessed by measuring the largest area from the prominent site at the back (occiput) to the frontal prominence above the supraorbital ridge (Bhushan and Paneth 1991).

2.4. Statistical methods:

Data was analyzed using IBM SPSS version 27. Quantitative data were expressed as mean ± SD, and categorical data as numbers and percentages. Relationships between variables and outcomes were tested using the chi-square or Fisher's exact test for categorical data, independent sample t-tests, and ANOVA for numerical data.

3. Results

3.1. Prevalence of different growth features:

Among 208 cases, 39.9% were short, 54.8% had normal height, and 5.3% were tall, with a statistically significant difference ($p < 0.001$) (Figure 1).

For weight based on BMI and weight-to-length ratio, 26% were underweight, 41.8% had normal weight, 20.2% were overweight, and 12% were obese, also showing a significant difference ($p < 0.001$) (Figure 2).

Among 90 cases, 11.1% had microcephaly, 58.9% had normal head circumference, and 30% had macrocephaly, with a significant difference ($p < 0.001$) (Figure 3).

For teeth eruption (193 cases), 43.5% had normal eruptions, while 56.5% experienced delays, though this was not statistically significant ($p = 0.072$) (Figure 4).

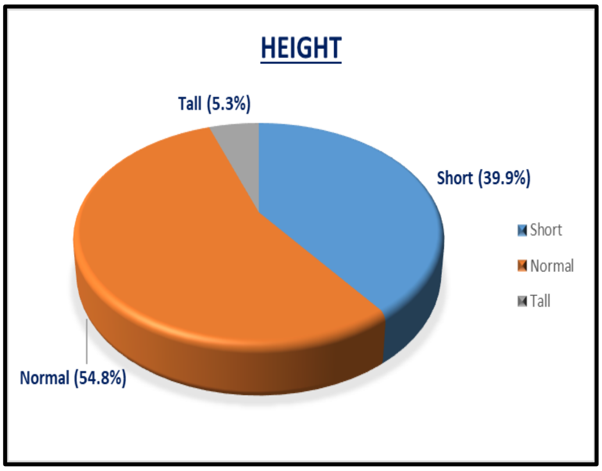

Figure 1: *Prevalence of height categories*

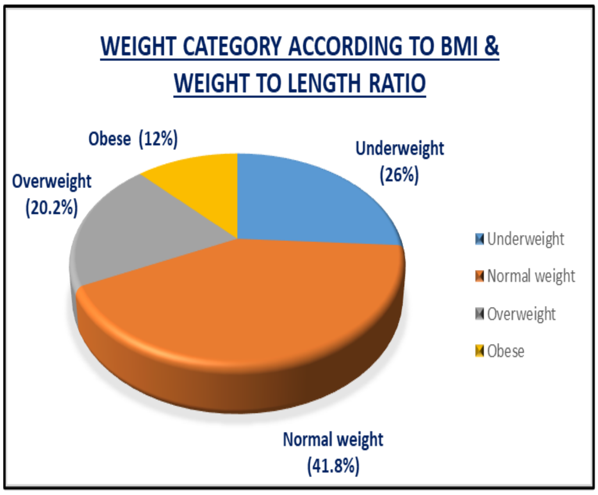

Figure 2: *Prevalence of weight categories*

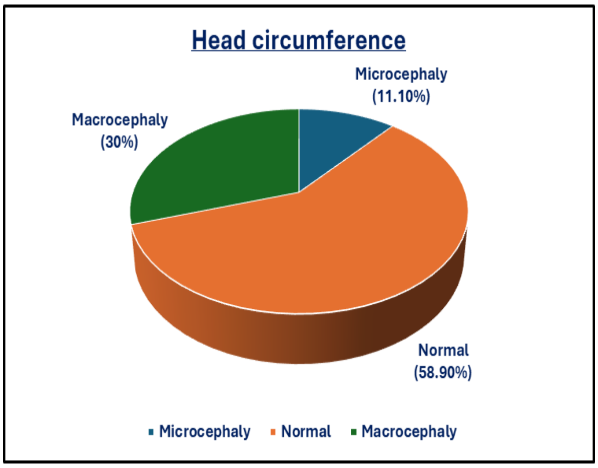

Figure 3: *Head circumference categories*

3.2. Distribution of growth features according to gender:

Among height categories, 30 females and 53 males were short, 53 females and 61 males had normal height, and 3 females and 8 males were tall, with no significant gender association ($X^2 = 3.35$, $p = 0.187$) (Figure 5).

For weight categories, 26 females and 28 males were underweight, 31 females and 56 males had normal weight, 18 females and 24 males were overweight, and 11 females and 14 males were obese, with no significant gender association ($X^2 = 2.314$, $p = 0.510$) (Figure 5).

Among 90 children, 1 female and 9 males had microcephaly, 22 females and 31 males had normal head circumference, and 6 females and 21 males had macrocephaly, showing a borderline significant gender association ($X^2 = 5.591$, $p = 0.050$) (Figure 5).

For teeth eruption, 38 females and 46 males had normal eruption, while 44 females and 65 males had delays, with no significant gender association ($X^2 = 0.461$, $p = 0.497$) (Figure 5).

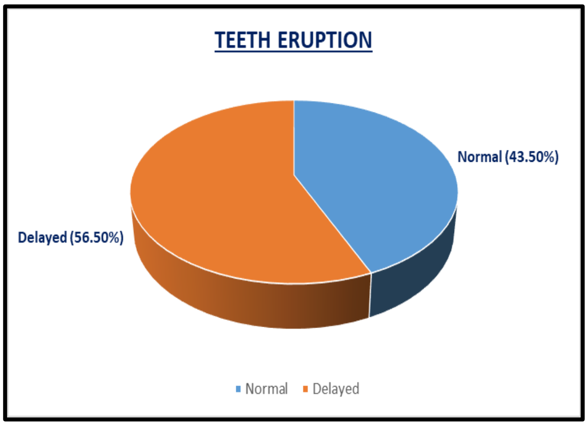

Figure 4: *Teeth eruption categories*

Overall, only head circumference showed a borderline significant gender association, while height, weight, and teeth eruption did not.

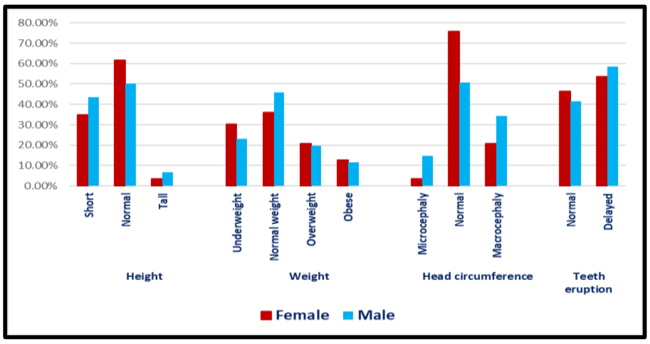

Figure 5: Distribution of growth features according to gender

3.3. Distribution of child height categories in relation to socioeconomic and medical factors

No significant association was found between height categories and place of residence, with most children across all height groups living in urban areas ($p = 0.807$) (Table 6). Similarly, birth at full term showed no significant link to height ($p = 0.987$). However, complications during pregnancy or delivery were significantly associated with height categories ($p = 0.024$), reported in 29.3% of short, 41.2% of normal-height, and 18.2% of tall children (Figure 6).

Breastfeeding showed a borderline significant relationship with height ($p = 0.050$), with 41.5% of short, 30.7% of normal-height, and 36.4% of tall children breastfed. Health issues during infancy were more common among short children (81.7%) but were not statistically significant ($p = 0.224$). Chronic illnesses or infections also showed no significant difference across height groups ($p = 0.812$) (Figure 6).

A significant association was found between height and diet ($p = 0.040$), as all tall children (100%) consumed a balanced diet, compared to 86.6% of short and 86.0% of normal-height children. Physical activity levels did not significantly differ by height ($p = 0.354$), with most children reporting moderate activity (Figure 6).

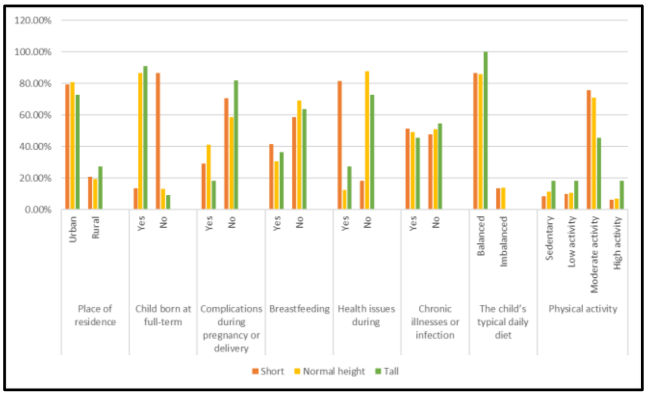

Figure 6: Distribution of child height categories in relation to socioeconomic and medical factors

3.4. Distribution of child weight categories in relation to socioeconomic and medical factors:

Analysis of child weight categories in North and East Syria revealed key socioeconomic and medical factors. Most underweight children (87%) lived in urban areas, though this was not statistically significant. However, birth at full-term was significantly related to weight, with 92.6% of underweight children born preterm (Table 1).

Complications during pregnancy or delivery were significantly linked to underweight status (74.1%), as was breastfeeding, with only 29.6% of underweight children breastfed, compared to higher rates in other groups, especially overweight children (57.1%) (Table 1).

No significant association was found between weight and health issues during infancy, chronic illnesses, or diet. However, physical activity showed a significant relationship, with underweight children being more sedentary (18.5%), while moderate activity was more common in other groups (Table 1).

These findings highlight birth status, pregnancy complications, breastfeeding, and physical activity as key factors influencing child weight, suggesting areas for targeted health interventions.

	Weight				**Chi-Square**	**Significance**
	Underweight (Number = 54)	**Normal weight (Number = 87)**	**Overweight (Number = 42)**	**Obese (Number = 25)**		
Place of residence - Urban - Rural	47 (87.0%) 7 (13.0%)	69 (79.3%) 18 (20.7%)	29 (69.0%) 13 (31.0%)	21 (84.0%) 4 (16.0%)	5.055	p-value 0.147
Child born at full-term - Yes - No	4 (7.4%) 50 (92.6%)	77 (88.5%) 10 (11.5%)	32 (76.2%) 10 (23.8%)	22 (88.0%) 3 (12.0%)	6.036	p-value 0.050*
Complications during pregnancy or delivery - Yes - No	40 (74.1%) 14 (25.9%)	31 (35.6%) 56 (64.4%)	18 (42.9%) 24 (57.1%)	11 (44.0%) 14 (56.0%)	3.578	p-value 0.035*
Breastfeeding - Yes - No	16 (29.6%) 38 (70.4%)	24 (27.6%) 63 (72.4%)	24 (57.1%) 18 (42.9%)	9 (36.0%) 16 (64.0%)	11.833	p-value 0.033*
Health issues during infancy - Yes - No	39 (72.2%) 15 (27.8%)	15 (17.2%) 72 (82.8%)	5 (11.9%) 37 (88.1%)	2 (8.0%) 23 (92.0%)	2.076	p-value 0.560
Chronic illnesses or infections - Yes - No	36 (66.7%) 18 (33.3%)	46 (52.9%) 41 (47.1%)	21 (50.0%) 20 (47.6%)	12 (48.0%) 13 (52.0%)	0.643	p-value 0.447
Child’s typical daily diet - Balanced diet - Imbalanced diet	45 (83.3%) 9 (16.7%)	76 (87.4%) 11 (12.6%)	38 (90.5%) 4 (9.5%)	22 (88.0%) 3 (12.0%)	1.124	p-value 0.779
Physical activity - Sedentary - Low activity - Moderate activity - High activity	10 (18.5%) 8 (14.8%) 33 (61.1%) 3 (5.6%)	10 (11.5%) 9 (10.3%) 61 (70.1%) 7 (8.1%)	2 (4.8%) 3 (7.1%) 34 (81.0%) 3 (7.1%)	1 (4.0%) 2 (8.0%) 20 (80.0%) 2 (8.0%)	8.843	p-value 0.005*

p-value ≤ 0.05 indicates a significant difference between the variables.
* Significant difference between the variables.

3.5. Distribution of underweight children in relation to various parental lifestyle factors affecting growth, and different medical and lifestyle factors related to growth:

Out of 54 underweight children, most (87.0%) lived in urban areas, but no significant association was found. Only 7.4% were born preterm, with no significant link to underweight status. However, complications during pregnancy (74.1% vs. 25.9%), health issues during infancy (72.2% vs. 27.8%), and chronic illnesses (66.7% vs. 33.3%) were significantly associated with underweight status (Figures 7, 8).

Dietary habits and physical activity levels showed no significant relationships ($p > 0.05$). Regular growth monitoring was linked to underweight status (40.7% monitored). Most children (92.6%) received nutrition information from non-healthcare sources, with no significant association found. Parental education showed a significant association with underweight child status. These findings highlight key risk factors, including pregnancy complications, infancy health issues, chronic illnesses, growth monitoring, and parental education (Figures 7, 8).

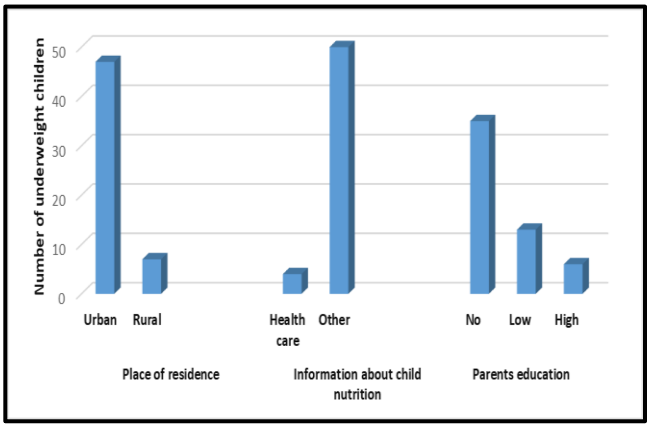

Figure 7: *Distribution of underweight children in relation to various parental lifestyle factors affecting growth*

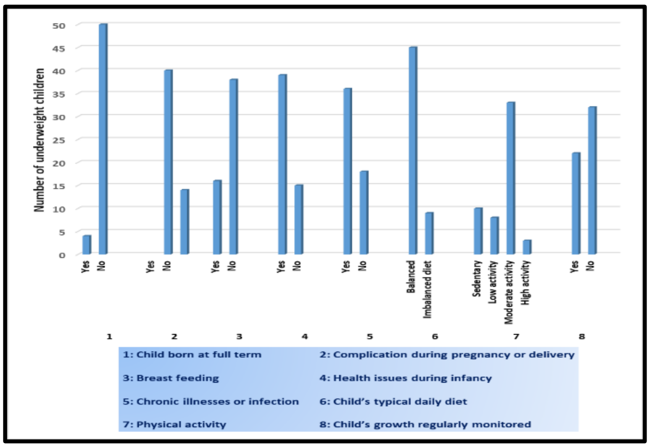

Figure 8: *The distribution of underweight children in relation to different medical and lifestyle factors related to growth*

4. Discussion

This study provides critical insights into the sociodemographic, familial, and medical risk factors influencing child growth in North and East Syria, contributing to global and regional understandings of child health, growth patterns, and healthcare access.

Growth parameters such as height, weight, head circumference, and tooth eruption reflect complex interactions between genetics, nutrition, and environment. The study found that 39.9% of children were short, 54.8% were normal, and 5.3% were tall, highlighting the impact of malnutrition and genetic predispositions, consistent with global findings on stunting caused by chronic undernutrition and infections (Black et al. 2013). Weight distribution showed 26% underweight, 41.8% normal, 20.2% overweight, and 12% obese, reflecting the "double burden of malnutrition" due to dietary shifts and socioeconomic disparities (Popkin, Corvalan, and Grummer-Strawn 2020; "Nutrition" 2024).

The head circumference assessment revealed that 11.1% had microcephaly, linked to neurodevelopmental impairments (Hanzlik and Gigante 2017), while 30% exhibited macrocephaly, associated with conditions like hydrocephalus or neurodevelopmental disorders (Bhansali et al. 2016). Regular monitoring is crucial as these abnormalities can have significant developmental implications (Accogli et al. 2022). Tooth eruption, essential for oral health, was influenced by factors like vitamin D deficiency and endocrine disorders (Newberry et al. 2014). Although the observed delay was not statistically significant, it underscores the need for regular dental check-ups and further research (Yao, Du, and Jiang 2024).

Globally, stunting affects 22% of children under five, with the highest prevalence in low- and middle-income countries (Perkins et al. 2017). Syria mirrors these trends, with height and weight differences exacerbated by conflict-driven food insecurity and healthcare gaps (Zamlout et al. 2022). In the Middle East, stunting is lower than global averages, but the dual burden of malnutrition is rising due to urbanization and dietary shifts, as seen in Jordan and Iraq (Braillon 2020; Alruwaili et al. 2024). Syria's healthcare disruptions have worsened child health indicators, aligning with challenges faced by displaced populations (Swace Digital 2020).

This study found no significant association between gender and child height, weight categories, or teeth eruption, indicating that these growth parameters were largely independent of sex differences. This aligns with research showing that while genetics, nutrition, and environment significantly influence growth, gender alone is not a significant factor (Boushey et al. 2020).

Height distribution between male and female children showed no statistical differences, consistent with findings that early childhood growth variations often equalize over time (Ferguson et al. 2013). Similarly, weight categories assessed through BMI and weight-to-length ratio showed no gender-related differences, reinforcing the greater impact of diet, physical activity, and socioeconomic status on childhood weight (Bixby, Mishra, and Martinez 2024).

Teeth eruption patterns also showed no gender association, supporting the idea that dental development is primarily influenced by genetic and environmental factors rather than sex (Rhena Reifa Hariadi et al. 2023). Delayed eruption has been linked to nutritional deficiencies and systemic conditions, but gender-based differences remain inconsistent (Yao, Du, and Jiang 2024).

A borderline significant association was observed between gender and head circumference, suggesting males may exhibit greater variability in cranial growth, including both microcephaly and macrocephaly. This aligns with studies indicating male infants are more susceptible to developmental variations due to genetic and prenatal factors (Broere-Brown et al. 2016). While not strongly statistically significant, further investigation is needed, as head circumference is a key indicator of neurocognitive outcomes (Accogli et al. 2022).

Height, a key indicator of child growth, reflects genetic potential, nutrition, and environmental factors. Unlike global trends where rural-urban disparities affect height, no significant association was found in Syria, likely due to conflict-related disruptions affecting both populations (Black et al. 2013; Ismail & Aboushala 2019).

Maternal health plays a critical role, as complications during pregnancy, such as pre-eclampsia, significantly impact child growth (Mendola et al. 2015). This aligns with Middle Eastern studies linking maternal health to malnutrition and stunting (Alkema et al. 2016).

Although breastfed children had higher rates of short stature, breastfeeding's relationship with growth is complex, influenced by maternal nutrition, feeding duration, and complementary food introduction (Boushey et al. 2020). Some studies suggest slower early growth in exclusively breastfed infants, with catch-up growth later (Precious et al. 2023; Wit & Boersma 2002). Socioeconomic conditions and dietary diversity are also crucial (Tareke et al. 2024). Further research is needed to clarify whether breastfeeding itself or other factors contribute to shorter stature (Lind et al. 2018).

Acute illnesses were more common in short children (81.7%), but their lack of statistical significance suggests that chronic malnutrition and repeated infections are stronger determinants of stunting (Wu et al. 2017). Diet quality was significantly associated with height, as short children had nutrient-deficient diets, while taller children had diverse, protein-rich diets (Boushey et al. 2020; Precious et al. 2023). Poor-quality diets can contribute to stunting even when caloric intake is adequate (Tareke et al. 2024), and delayed introduction of nutrient-rich complementary foods can affect long-term height outcomes (Lind et al. 2018).

Globally, stunting affects 25% of children under five, with higher rates in low- and middle-income countries (Perkins et al. 2017). In Syria, the 39.9% prevalence reflects malnutrition exacerbated by conflict (Swace Digital 2020). Stunting rates in the Middle East vary, with war-torn nations like Yemen and Iraq experiencing higher rates, while wealthier countries like the UAE report lower rates (Braillon 2020). Syria's unique crisis affects both urban and rural areas, creating a uniform challenge for child growth.

While no significant link was found between height and socioeconomic factors, this may reflect the principal impact of conflict (Zamlout et al. 2022). Physical activity was not a major determinant, emphasizing the importance of nutrition and healthcare access. Notably, all tall children in the study (100%) had balanced diets, reinforcing the strong correlation between adequate nutrition and optimal growth (Boushey et al. 2020). Malnutrition, especially protein-energy deficiency, remains a leading cause of stunting (Precious et al. 2023; Muriithi & Kiu 2024).

An analysis of weight categories among children in North and East Syria reveals critical socioeconomic and medical factors influencing underweight and other growth disparities. Weight is status underweight, normal, overweight, and obese shaped by genetics, environment, and behavior. The study found a significant link between pregnancy complications and underweight status, as maternal hypertension, anemia, and infections can impair fetal nutrition, leading to low birth weight and growth challenges (Black et al. 2013).

Breastfeeding played a key role, with only 29.6% of underweight children being breastfed, supporting evidence that it provides essential nutrients for healthy growth (Victora et al. 2016). Overweight children had higher breastfeeding rates (57.1%), suggesting that while breastfeeding is beneficial, improper complementary feeding may contribute to excessive weight gain (Boushey et al. 2020).

Physical activity was significantly related to weight categories, with underweight children being more sedentary (18.5%). Malnutrition can reduce energy levels, leading to inactivity, while chronic illnesses like diarrhea and respiratory infections impair nutrient absorption and growth (Dewey & Mayers, 2011; Wu et al., 2017). The study also found a strong association between chronic illnesses and underweight status, emphasizing the need for improved healthcare interventions.

Globally, underweight status affects 14% of children under five, while overweight and obesity are rising due to dietary shifts and urbanization (World Health Organization 2019; Popkin et al. 2020). Syria reflects this dual burden, with 26% of children underweight, 20.2% overweight, and 12% obese. Conflict-affected areas like Yemen and Syria experience high underweight prevalence due to food insecurity and healthcare disruptions (Braillon 2020). Notably, 87% of underweight children lived in urban areas, where economic disparities and limited access to nutrient-rich diets contribute to malnutrition (Boushey et al. 2020; Vilar-Compte et al. 2021). Overcrowding and displacement further strain resources in Syrian cities (Ibrahim et al. 2022).

Parental education also influenced underweight status, as lower maternal education correlates with poor nutrition knowledge and limited healthcare access (Alkema et al. 2016). Addressing undernutrition requires targeted interventions, including maternal healthcare improvements, exclusive breastfeeding promotion, and enhanced primary healthcare services. Nutrition-specific programs, such as food supplementation and parental education initiatives, could significantly reduce underweight prevalence (Black et al. 2013).

In conclusion, this study highlights substantial growth disparities in height, weight, head circumference, and dental development, shaped by genetics, nutrition, and environmental factors. The high prevalence of short stature (39.9%), underweight status (26%), and head circumference abnormalities underscores the lasting impact of malnutrition and prenatal health risks. Findings align with global trends of the "double burden of malnutrition," where undernutrition and obesity coexist due to dietary shifts and socioeconomic inequalities. Key determinants of child growth include pregnancy complications, breastfeeding patterns, and dietary intake. While gender was not significantly linked to height, weight, or dental development, a borderline association with head circumference suggests possible biological influences requiring further research. The study underscores the need for nutritional interventions, improved maternal healthcare, and early growth monitoring to moderate risks of stunting, underweight status, and obesity. Given Syria's ongoing conflict, reasonable access to healthcare and nutrition remains critical. Future longitudinal studies should explore the long-term effects of early-life health determinants on child development.

Reference

1. "Nutrition." 2024. Food and Agriculture Organization of the United Nations. 2024. https://www.fao.org/nutrition/conflict.
2. Accogli, Andrea, Ana Filipa Geraldo, Gianluca Piccolo, Antonella Riva, Marcello Scala, Ganna Balagura, Vincenzo Salpietro, et al. 2022. "Diagnostic Approach to Macrocephaly in Children." *Frontiers in Pediatrics* 9 (January): 794069. https://doi.org/10.3389/fped.2021.794069.
3. Alkema, Leontine, Doris Chou, Daniel Hogan, Sanqian Zhang, Ann-Beth Moller, Alison Gemmill, Doris Ma Fat, et al. 2016. "Global, Regional, and National Levels and Trends in Maternal Mortality between 1990 and 2015, with Scenario-Based Projections to 2030." *Obstetric Anesthesia Digest* 36 (4): 191. https://doi.org/10.1097/01.aoa.0000504718.91214.7d.
4. Alruwaili, Bashayer Farhan, Duaa Fahad Bayyumi, Ohud Saud Alruwaili, Razan Saud Alsadun, Amal Sulaiman Alanazi, Amal Hadi, Nada Kareem S. Alruwaili, Ashokkumar Thirunavukkarasu, Norah Farhan Aldaghmani, and Aljawharah Abdulrahman Alrayes. 2024. "Prevalence and Determinants of Obesity and Overweight among Children and Adolescents in the Middle East and North African Countries: An Updated Systematic Review." *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy* 17: 2095–2103. https://doi.org/10.2147/DMSO.S458003.
5. Argall, J A W. 2003. "A Comparison of Two Commonly Used Methods of Weight Estimation." Archives of Disease in Childhood 88 (9): 789–90. https://doi.org/10.1136/adc.88.9.789.
6. Bhansali, Anil, Anuradha Aggarwal, Girish Parthan, and Yashpal Gogate. 2016. "Disorders of Growth and Development: Clinical Perspectives." *Springer EBooks*, January, 1–44. https://doi.org/10.1007/978-81-322-2815-8_1.
7. Bhushan, Vidya, and Nigel Paneth. 1991. "The Reliability of Neonatal Head Circumference Measurement." Journal of Clinical Epidemiology 44 (10): 1027–35. https://doi.org/10.1016/0895-4356(91)90004-s.
8. Bixby, Honor, Anu Mishra, and Andrea Rodriguez Martinez. 2024. "Worldwide Levels and Trends in Childhood Obesity," 21–40. Academic Press. https://doi.org/10.1016/B978-0-443-21975-7.00002-2.
9. Black, Maureen M, Susan P Walker, Lia C H Fernald, Christopher T Andersen, Ann M DiGirolamo, Chunling Lu, Dana C McCoy, et al. 2017. "Early Childhood Development Coming of Age: Science through the Life Course." The Lancet 389 (10064): 77–90. https://doi.org/10.1016/s0140-6736(16)31389-7.
10. Black, Robert E, Cesar G Victora, Susan P Walker, Zulfiqar A Bhutta, Parul Christian, Mercedes de Onis, Majid Ezzati, et al. 2013. "Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries." *The Lancet* 382 (9890): 427–51. https://pubmed.ncbi.nlm.nih.gov/23746772/.
11. Boushey, Carol, Jamy Ard, Lydia Bazzano, Steven Heymsfield, Elizabeth Mayer-Davis, Joan Sabaté, Linda Snetselaar, et al. 2020. *Dietary Patterns and Growth, Size, Body Composition, And/or Risk of Overweight*

or Obesity: A Systematic Review. *PubMed*. Alexandria (VA): USDA Nutrition Evidence Systematic Review. https://pubmed.ncbi.nlm.nih.gov/35129906/.

12. Braillon, Alain. 2020. "Rural-Urban Disparities in Health Care." *Health Affairs* 39 (3): 537–37. https://doi.org/10.1377/hlthaff.2019.01822.
13. Broere-Brown, Zoe A., Esme Baan, Sarah Schalekamp-Timmermans, Bero O. Verburg, Vincent W. V. Jaddoe, and Eric A. P. Steegers. 2016. "Sex-Specific Differences in Fetal and Infant Growth Patterns: A Prospective Population-Based Cohort Study." *Biology of Sex Differences* 7 (1). https://doi.org/10.1186/s13293-016-0119-1.
14. Centers for Disease Control and Prevention. 2024. "Child and Teen BMI Calculator." BMI. July 22, 2024. https://www.cdc.gov/bmi/child-teen-calculator/index.html.
15. Ferguson, Kim T., Rochelle C. Cassells, Jack W. MacAllister, and Gary W. Evans. 2013. "The Physical Environment and Child Development: An International Review." *International Journal of Psychology* 48 (4): 437–68. https://doi.org/10.1080/00207594.2013.804190.
16. Foundation Internet Services, LLC. 2022. "WHO Infant Weight for Length Percentiles (<24 Months)." Msdmanuals.com. 2022. https://www.msdmanuals.com/iframe/manual/medical-calculators/whoinfantweightforlength.htm.
17. Gilbert, Lawrence I, and David Shaw King. 1973. "PHYSIOLOGY of GROWTH and DEVELOPMENT: ENDOCRINE ASPECTS." Elsevier EBooks, January, 249–370. https://doi.org/10.1016/b978-0-12-591601-1.50012-0.
18. Hanzlik, Emily, and Joseph Gigante. 2017. "Microcephaly." *Children* 4 (6): 47. https://doi.org/10.3390/children4060047.
19. Ibrahim, Batoul, Barend Wind, and Karel Maier. 2022. "Future Urban Development Scenarios for Post-Conflict Syria. How Will Returning Refugees Shape the Future?" *Habitat International* 119 (January): 102499. https://doi.org/10.1016/j.habitatint.2021.102499.
20. Ismail, Salah Haj, and Meryem Aboushala. 2019. "Rural Areas in Post War Syria: Challenges and Possibilities for Resilience and Sustainability." *2nd International Conference of Contemporary Affairs in Architecture and Urbanism*, May. https://www.researchgate.net/publication/337403533_Rural_Areas_in_Post_War_Syria_Challenges_and_possibilities_for_Resilience_and_sustainability.
21. Johnson, Emily R., and Mark T. Smith. *Pediatric Developmental Disorders: Causes and Diagnosis*. New York: Academic Press, 2020.
22. Khadilkar, Vaman, and Anuradha Khadilkar. 2011. "Growth Charts: A Diagnostic Tool." Indian Journal of Endocrinology and Metabolism 15 (7): 166. https://doi.org/10.4103/2230-8210.84854.
23. Lind, Mads Vendelbo, Anni Larnkjær, Christian Mølgaard, and Kim F. Michaelsen. 2018. "Breastfeeding, Breast Milk Composition, and Growth Outcomes." *Recent Research in Nutrition and Growth* 89: 63–77. https://doi.org/10.1159/000486493.
24. Mendola, Pauline, Sunni L. Mumford, Tuija I. Männistö, Alexander Holston, Uma M. Reddy, and S. Katherine Laughon. 2015. "Controlled Direct Effects of Preeclampsia on Neonatal Health after Accounting for Mediation by Preterm Birth." *Epidemiology* 26 (1): 17–26. https://doi.org/10.1097/ede.0000000000000213.
25. Mithyantha, Renuka, Rachel Kneen, Emma McCann, and Melissa Gladstone. 2017. "Current Evidence-Based Recommendations on Investigating Children with Global Developmental Delay." Archives of Disease in Childhood 102 (11): 1071–76. https://doi.org/10.1136/archdischild-2016-311271
26. Newberry, Sydne J., Mei Chung, Paul G. Shekelle, Marika Suttorp Booth, Jodi L. Liu,

Alicia Ruelaz Maher, Aneesa Motala, et al. 2014. “Vitamin D and Calcium: A Systematic Review of Health Outcomes (Update).” *Evidence Report/Technology Assessment*, no. 217 (September): 1–929. https://doi.org/10.23970/AHRQEPCERTA217.

27. Olusanya, Bolajoko O., Adrian C. Davis, Donald Wertlieb, Nem-Yun Boo, M.K.C. Nair, Ricardo Halpern, Hannah Kuper, et al. 2018. “Developmental Disabilities among Children Younger than 5 Years in 195 Countries and Territories, 1990–2016: A Systematic Analysis for the Global Burden of Disease Study 2016.” The Lancet Global Health 6 (10): e1100–1121. https://doi.org/10.1016/s2214-109x(18)30309-7.
28. Perkins, Jessica M., Rockli Kim, Aditi Krishna, Mark McGovern, Victor M. Aguayo, and S.V. Subramanian. 2017. “Understanding the Association between Stunting and Child Development in Low- and Middle-Income Countries: Next Steps for Research and Intervention.” *Social Science & Medicine* 193 (November): 101–9. https://doi.org/10.1016/j.socscimed.2017.09.039.
29. Popkin, Barry M, Camila Corvalan, and Laurence M Grummer-Strawn. 2020. “Dynamics of the Double Burden of Malnutrition and the Changing Nutrition Reality.” *The Lancet* 395 (10217): 65–74. https://doi.org/10.1016/s0140-6736(19)32497-3.
30. Precious, Fadele Kehinde, Greatman Adiela Owhor, Muhammad-Olodo Abdulmujeeb Opeyemi, Stephen Chukwuemeka Igwe, Ojumah Chika Beauty, Frances Ann R. Sy, Prose Ivy G. Yepes, Dauda Ayuba, Jerico B. Ogaya, and Don Eliseo Lucero-Prisno. 2023. “Chapter Six - Why Nutrition Programs for Children Remain Important.” Edited by Marc J. Cohen. ScienceDirect. Elsevier. January 1, 2023. https://www.sciencedirect.com/science/article/abs/pii/S2452263523000095.
31. Rhena Reifa Hariadi, Tania Saskianti, Siti Nur Lestari, Soegeng Wahluyo, and Leviena Merlynike Leo. 2023. “Various Delayed Tooth Eruption in Children, Management and Outcome: A Case Series.” *World Journal of Advanced Research and Reviews* 19 (3): 1058–63. https://doi.org/10.30574/wjarr.2023.19.3.1899.
32. Salomone, Erica, Laura Pacione, Stephanie Shire, Felicity L. Brown, Brian Reichow, and Chiara Servili. 2019. “Development of the WHO Caregiver Skills Training Program for Developmental Disorders or Delays.” Frontiers in Psychiatry 10 (November). https://doi.org/10.3389/fpsyt.2019.00769.
33. Stevenson, Richard D. 1995. “Use of Segmental Measures to Estimate Stature in Children with Cerebral Palsy.” Archives of Pediatrics & Adolescent Medicine 149 (6): 658. https://doi.org/10.1001/archpedi.1995.02170190068012.
34. Swace Digital. 2020. “Hidden Hunger in Syria: A Look at Malnutrition across Syria with a Focus on Under-Twos | Save the Children’s Resource Centre.” sa’s Resource Centre. 2020. https://resourcecentre.savethechildren.net/pdf/hidden_hunger_in_syria-cc-2020.pdf/.
35. Tareke, Amare Abera, Edom Getnet Melak, Bezawit Ketsela Mengistu, Jafar Hussen, and Asressie Molla. 2024. “Association between Maternal Dietary Diversity during Pregnancy and Birth Outcomes: Evidence from a Systematic Review and Meta-Analysis.” *BMC Nutrition* 10 (1). https://doi.org/10.1186/s40795-024-00960-9.
36. Vasudevan, Pradeep, and Mohnish Suri. 2017. “A Clinical Approach to Developmental Delay and Intellectual Disability.” Clinical Medicine 17 (6): 558–61. https://doi.org/10.7861/clinmedicine.17-6-558.
37. Vilar-Compte, Mireya, Soraya Burrola-Méndez, Annel Lozano-Marrufo, Isabel Ferré-Eguiluz, Diana Flores, Pablo Gaitán-

Rossi, Graciela Teruel, and Rafael Pérez-Escamilla. 2021. "Urban Poverty and Nutrition Challenges Associated with Accessibility to a Healthy Diet: A Global Systematic Literature Review." *International Journal for Equity in Health* 20 (1). https://doi.org/10.1186/s12939-020-01330-0.

38. Wit, Jan-Maarten, and Bart Boersma. 2002. "Catch-up Growth: Definition, Mechanisms, and Models." *Journal of Pediatric Endocrinology & Metabolism: JPEM* 15 Suppl 5 (December): 1229–41. https://pubmed.ncbi.nlm.nih.gov/12510974/.
39. World Health Organization. 2019. "Malnutrition Is a World Health Crisis." Www.who.int. September 26, 2019. https://www.who.int/news/item/26-09-2019-malnutrition-is-a-world-health-crisis.
40. Wu, Xiu Yun, Li Hui Han, Jian Hua Zhang, Sheng Luo, Jin Wei Hu, and Kui Sun. 2017. "The Influence of Physical Activity, Sedentary Behavior on Health-Related Quality of Life among the General Population of Children and Adolescents: A Systematic Review." Edited by Jacobus P. van Wouwe. *PLOS ONE* 12 (11): e0187668. https://doi.org/10.1371/journal.pone.0187668.
41. Yao, En Hui, Jia Hui Du, and Xin Quan Jiang. 2024. "Tooth Root Development and Homeostasis during Eruptive and Post-Eruptive Movement." *The Chinese Journal of Dental Research* 27 (4): 273–89. https://doi.org/10.3290/j.cjdr.b5860254.
42. Zamlout, Ali, Kamal Alwannous, Ali Kahila, Majd Yaseen, Raneem Albadish, Morhaf Aleid, Karina Hamzah, et al. 2022. "Syrian National Growth References for Children and Adolescents Aged 2-20 Years." *BMC Pediatrics* 22 (1): 282. https://doi.org/10.1186/s12887-022-03331-0.