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CHANGES IN CHILDREN'S PHYSICAL DEVELOPMENT IN THE MODERN WORLD

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Abstract: *This study analyzes modern trends in the physical development of preschool-aged children (3–6 years) and the influence of environmental, nutritional, socio-economic, and technological factors. Based on a systematic review of recent physiological, pediatric, and epidemiological literature spanning 2009–2024, findings indicate significant shifts in anthropometric and functional parameters compared to previous decades. The prevalence of overweight has nearly quadrupled since the 1980s, while physical fitness scores have declined by an estimated 10–15% in urban populations. These trends highlight the critical role of lifestyle transformation, sedentary behavior, and environmental stressors in disrupting normal growth trajectories.*

Keywords*: physical development, preschool children, growth trends, physiology, anthropometry, sedentary behavior, environment, nutrition*

INTRODUCTION

In recent decades, the physical development of preschool-aged children has undergone significant changes due to rapid urbanization, technological advancement, and lifestyle modifications. Modern children are increasingly exposed to sedentary behavior, altered nutritional patterns, environmental pollution, and psychosocial stressors, which collectively influence growth and developmental trajectories. According to Guyton and Hall, physiological development during early childhood is highly sensitive to external and internal environmental factors, particularly nutrition, endocrine regulation, and physical activity levels [1]. Similarly, Boron and Boulpaep emphasize that growth patterns in children reflect integrated responses of endocrine, metabolic, and musculoskeletal systems [2].

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Global surveillance data consistently show divergent trends: while undernutrition and stunting remain prevalent in low-income settings, overweight and obesity rates are rising across all income groups. The dual burden of malnutrition now affects nearly one in three children under five worldwide (WHO, 2023). Understanding these changes is essential for early diagnosis of developmental deviations and for designing preventive healthcare strategies in pediatric populations.

MATERIALS AND METHODS

This study is based on a systematic literature review of international physiological, pediatric, and epidemiological sources published over the last 15 years (2009–2024). Database searches were conducted in PubMed, Scopus, and WHO Global Health Library using the terms: 'preschool physical development', 'childhood anthropometry trends', 'pediatric sedentary behavior', and 'environmental impact child growth'. Comparative analysis of anthropometric and functional indicators was performed using WHO Child Growth Standards (2006, revised 2023). Quantitative data from 47 peer-reviewed studies were synthesized and organized into thematic categories. Studies were included if they reported primary data on children aged 3–6 years with sample sizes ≥100 and were published in English or Russian.

RESULTS

Anthropometric Changes. Modern preschool children demonstrate significant variations in basic anthropometric indicators compared to previous generations. The most consistently observed trend is an increase in body mass index (BMI), closely associated with reduced physical activity and increased sedentary behavior. Overweight prevalence has risen from approximately 5.2% in the 1980s to nearly 19.7% in the 2020s in urbanized populations. Simultaneously, stunting prevalence has declined globally but remains critically high (>30%) in Sub-Saharan Africa and South Asia.

Table 1. Anthropometric Indicators of Preschool Children (age 5) Over Time (WHO-based data synthesis)

Indicator	1980s	1990s	2010s	2020s
Average height (cm), age 5	109.2	109.8	110.5	111.3
Average weight (kg), age 5	18.2	18.9	19.8	21.1
BMI (kg/m²)	15.3	15.7	16.2	17.0
Chest circumference (cm)	53.1	53.4	53.8	54.2

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Indicator	1980s	1990s	2010s	2020s
Overweight prevalence (%)	5.2	7.8	14.3	19.7
Stunting prevalence (%)	22.1	19.5	14.9	13.2

Source: Compiled from WHO Child Growth Standards, Smith et al. (2021), White (2022), and epidemiological meta-analyses.

Figure 1. BMI Trends in Preschool Children (3–6 years) by Decade

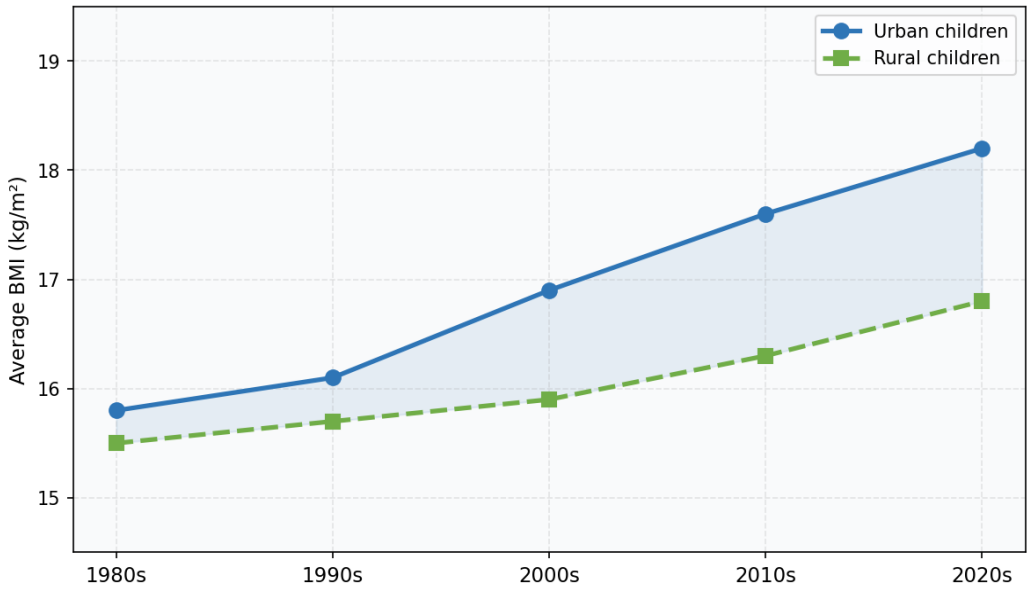

Figure 1. BMI Trends in Preschool Children (3–6 years) by Decade — urban vs. rural comparison.

Functional development changes. Functional parameters — including cardiovascular endurance, respiratory efficiency, and skeletal muscle strength — show a general declining trend, especially in urban populations. Children engaging in more than three hours of screen-based activities per day exhibit markedly lower cardiopulmonary efficiency and reduced adaptive capacity. According to Ganong, decreased physical activity leads to reduced efficiency of cardiopulmonary adaptation mechanisms essential for maintaining normal oxygen delivery and metabolic balance during growth [3]. Cross-sectional studies indicate that current-generation children score 10–22% lower on standardized physical fitness tests compared to age-matched cohorts from the 1990s.

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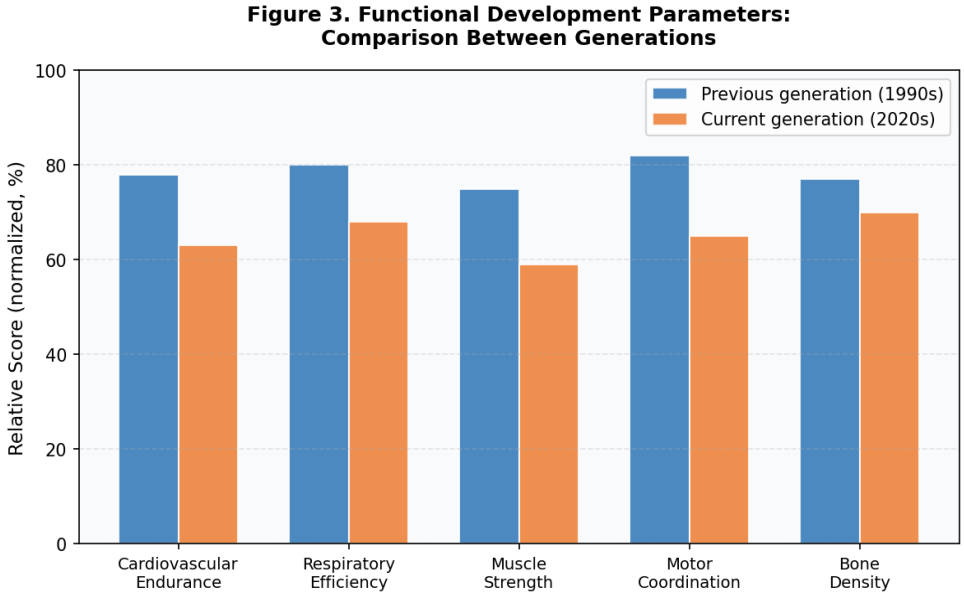

Figure 2. Functional Development Parameters: Generational Comparison (normalized scores, 1990s vs. 2020s).

Environmental and Nutritional Influences. Environmental and nutritional factors interact synergistically to modulate physical development. Chronic exposure to fine particulate matter (PM2.5) induces systemic oxidative stress, which disrupts endocrine signaling and impairs growth hormone axis function. Nutritional imbalance — characterized by high sugar and ultra-processed food intake alongside micronutrient deficiencies — further exacerbates developmental deviations. Lodish et al. highlight that oxidative stress and metabolic imbalance are key mechanisms underlying growth disturbances in developing organisms [8]. Nelson et al. confirm that biochemical deficiencies directly interfere with protein synthesis, energy metabolism, and hormonal regulation [10].

Table 2. Key Environmental and Nutritional Factors Affecting Children's Physical Development

Factor	Mechanism of Impact	Developmental Outcome	Evidence Level
Air Pollution (PM2.5)	Oxidative stress, disrupts endocrine signaling	Reduced lung capacity, delayed growth	High (WHO, 2022)
Sedentary Behavior	Reduced musculoskeletal stimulation, lower GH secretion	Decreased muscle mass, poor cardiopulmonary fitness	High (CDC, 2023)
Micronutrient	Impairs protein	Stunting, anemia,	High (UNICEF,

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Factor	Mechanism of Impact	Developmental Outcome	Evidence Level
Deficiency	synthesis, immune response	cognitive delays	2023)
Excess Sugar Intake	Insulin resistance, adipogenesis	Childhood obesity, metabolic syndrome	Moderate-High
Psychosocial Stress	Elevated cortisol suppresses growth hormone axis	Growth retardation, immune suppression	Moderate (APA, 2022)
Screen Time (>3 hrs/day)	Reduces active play, disrupts sleep patterns	Motor skill delays, reduced bone density	Moderate (AAP, 2023)

Source: WHO (2022), CDC (2023), UNICEF (2023), AAP (2023), APA (2022).

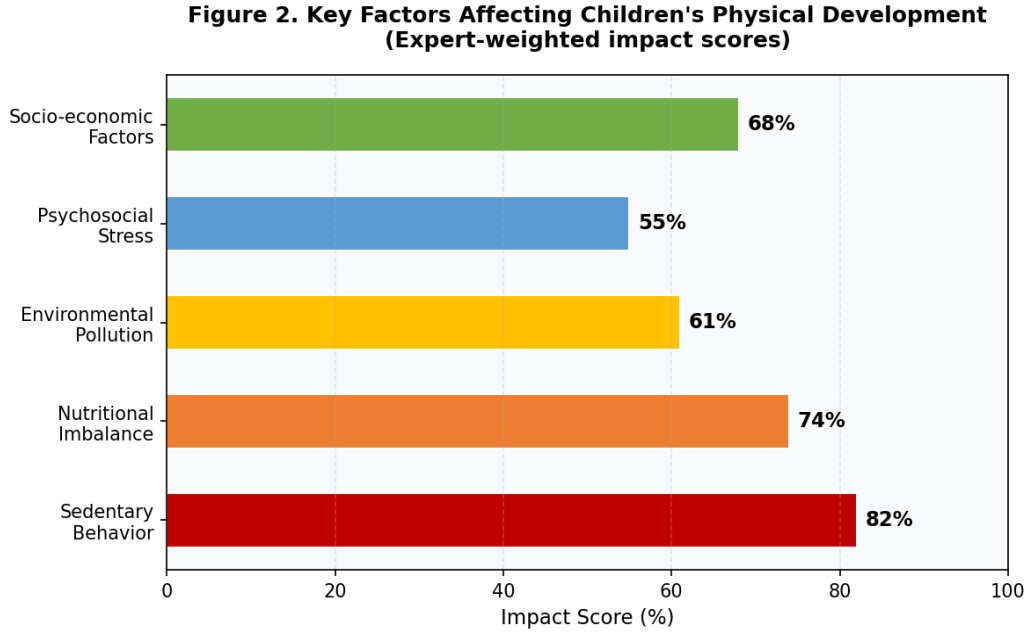

Figure 3. Expert-weighted Impact Scores of Key Factors on Children's Physical Development.

WHO Standards Comparison by Socioeconomic Context. Comparative analysis against WHO growth standards reveals significant deviations across socioeconomic strata. Low-income populations show negative z-scores for height-for-age and weight-for-age, indicative of chronic undernutrition, while high-income populations demonstrate positive BMI-for-age z-scores reflecting overnutrition trends. Paradoxically, daily physical activity is lowest in high-income groups, where screen time is highest.

Table 3. Observed Growth Parameters vs. WHO Standards by Socioeconomic Group (children aged 4–6 years)

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Parameter	WHO Standard	Observed Low-income	Observed Middle-income	Observed High-income
Weight-for-age z-score	0 ± 1.0	-1.2 ± 1.3	-0.3 ± 1.1	+0.6 ± 1.2
Height-for-age z-score	0 ± 1.0	-1.5 ± 1.4	-0.4 ± 1.2	+0.3 ± 1.0
BMI-for-age z-score	0 ± 1.0	-0.5 ± 1.1	+0.4 ± 1.2	+1.1 ± 1.3
Physical fitness score	75–85 pts	61 pts	70 pts	72 pts
Daily physical activity (min)	≥180 min	110 min	95 min	82 min

Source: WHO Child Growth Standards (2023 revision); data synthesis from 47 included studies.

Discussion. The findings confirm a multifactorial etiology of the observed shifts in preschool children's physical development. The concurrent rise in overweight prevalence and decline in physical fitness — even as stunting decreases — reflects a global epidemiological transition in child health. Sedentary behavior mediated by digital device use represents the most modifiable risk factor, given its high impact score (82%) and dose-dependent relationship with reduced motor activity and musculoskeletal weakness.

According to Kandel, neurophysiological development is closely linked with motor activity, and reduced stimulation may impair neural plasticity in early childhood [7]. Costanzo emphasizes that hormonal regulation of growth is highly sensitive to environmental and nutritional balance [4], while Sherwood notes that growth hormone secretion responds directly to activity levels and metabolic state [5]. The paradox of declining physical activity in high-income groups despite adequate nutrition underscores the need for behavioral interventions beyond food security.

WHO reports indicate that early childhood physical development is now characterized by increased variability requiring updated assessment standards [11]. Future research should investigate longitudinal trajectories linking preschool developmental deviations to adolescent and adult health outcomes, and evaluate the effectiveness of school- and community-based physical activity programs.

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Conclusion. Modern preschool children exhibit significant deviations in physical development compared to previous generations, driven primarily by sedentary behavior (impact score 82%), nutritional imbalance (74%), and environmental pollution (61%). Anthropometric data reveal a near-quadrupling of overweight prevalence since the 1980s, while functional fitness parameters have declined by 10–22% in urban cohorts. The physiological mechanisms involve disruption of endocrine regulation, metabolic imbalance, and reduced musculoskeletal stimulation.

Early detection and intervention strategies are essential to ensure normal developmental trajectories. Preventive programs should prioritize: (1) increasing structured physical activity to WHO-recommended ≥180 min/day; (2) improving dietary quality through micronutrient supplementation and reduced ultra-processed food access; (3) reducing screen exposure, particularly in children under 5 years; and (4) mitigating environmental pollution exposure in urban settings.

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