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Contact address:
No.284, Luong Ngoc Quyen Str., Phan Dinh Phung Ward, Thai Nguyen Province

Email:
jstmp_editorial@tnmc.edu.vn

NUTRITIONAL STATUS OF PRETERM AND SMALL FOR GESTATIONAL AGE CHILDREN

Phuong Thi Nguyen*, Son Van Nguyen, Huong Thi Xuan Nguyen, Dung Thi Kim Le, Thang Toan Nguyen
TNU- University of Medicine and Pharmacy
* Author contact: nguyenthiphuong@tnmc.edu.vn

ABSTRACT

Background: Preterm and small for gestational age (SGA) remain significant public health concerns worldwide. **Objectives:** We investigated the nutritional status of preterm and SGA children compared with term appropriate for gestational age (AGA) children from birth to 10-11 years. **Methods:** Children born to women who participated in a double-blinded randomized controlled trial of preconception micronutrient supplementation in Vietnam were classified into three groups: preterm AGA (n = 130), full-term SGA (n = 165) and full-term AGA (n = 1072). Anthropometric data (weight and height) were collected prospectively at birth, 3, 6, 12, 18, 24 months and at 6-7 and 10-11 years. **Results:** The mean gestational age was 34.9, 39.5 and 40.5 weeks for preterm, AGA and SGA infants, respectively. The rates of underweight were consistently higher in the SGA group in all periods. Preterm children consistently exhibited a higher rate of underweight compared to AGA children from birth through 6-7 years of age. Compared with AGA children, SGA children had a lower prevalence of overweight/obesity across all stages. **Conclusions:** Compared with AGA children, SGA children have higher rates of underweight and stunting. While preterm children have higher rates of

malnutrition in early life, by adolescence their rates of overweight and obesity exceed those of AGA children.
Keywords: Preterm; Small for gestational age; Underweight; Overweight/Obesity; Stunting

TÌNH TRẠNG DINH DƯỠNG CỦA TRẺ SINH NON VÀ TRẺ NHẸ CÂN SO VỚI TUỔI THAI

Nguyễn Thị Phượng*, Nguyễn Văn Sơn, Nguyễn Thị Xuân Hương, Lê Thị Kim Dung, Nguyễn Toàn Thắng
Trường Đại học Y - Dược, Đại học Thái Nguyên
* Tác giả liên hệ: nguyenthiphuong@tnmc.edu.vn

TÓM TẮT

Đặt vấn đề: Trẻ sinh non và trẻ nhẹ cân so với tuổi thai (SGA) vẫn là những vấn đề sức khỏe trên toàn cầu. **Mục tiêu:** Nghiên cứu nhằm đánh giá tình trạng dinh dưỡng của trẻ sinh non trẻ SGA so với trẻ sinh đủ tháng, cân nặng phù hợp với tuổi thai (AGA) từ khi sinh đến 10 - 11 tuổi. **Phương pháp:** Trẻ em trong nghiên cứu là con của các bà mẹ tham gia một thử nghiệm lâm sàng ngẫu nhiên có đối chứng, mù đôi về bổ sung vi chất trước khi mang thai tại Việt Nam được phân thành 3 nhóm: trẻ sinh non AGA (n = 130), trẻ sinh đủ tháng SGA (n = 165) và trẻ sinh đủ tháng AGA (n = 1072). Các chỉ số nhân trắc (cân nặng và chiều cao) được thu thập tiến cứu tại thời điểm lúc sinh, 3, 6,12,18, 24 tháng và khi trẻ được 6 - 7 tuổi và 10 - 11 tuổi. **Kết quả:** Tuổi thai trung bình lần lượt là 34,9; 39,5; và 40,5 tuần ở các nhóm trẻ sinh non, AGA và SGA. Tỷ lệ nhẹ cân ở nhóm SGA luôn cao hơn trong tất cả các giai đoạn theo dõi. Trẻ sinh non liên tục có tỷ lệ nhẹ cân cao hơn trẻ AGA từ khi sinh đến 6 - 7 tuổi. So với trẻ AGA, trẻ SGA có tỷ lệ thừa cân/béo phì thấp

hơn ở tất cả các giai đoạn. **Kết luận:** So với trẻ AGA, trẻ SGA có tỷ lệ nhẹ cân và thấp còi cao hơn. Mặc dù trẻ sinh non có tỷ lệ suy dinh dưỡng cao hơn trong giai đoạn đầu đời, nhưng đến tuổi vị thành niên, tỷ lệ thừa cân và béo phì của nhóm trẻ này lại vượt quá trẻ AGA.
Từ khóa: Trẻ sinh non; Nhẹ cân so với tuổi thai; Nhẹ cân; Thừa cân/Béo phì; Thấp còi

INTRODUCTION

Preterm (birth before 37 weeks of gestation) and small for gestational age (SGA, birthweight less than 10th percentile for gestational age) are significant public health concerns worldwide. It is estimated that 15 million infants were born preterm (11% of livebirths) each year, with 81% of them residing in Asia and sub-Saharan Africa [1]. In addition, 32.4 million infants were born SGA (27% of livebirths) with two thirds of them being born in Asia [2,3].

Most evidence on growth patterns and catch-up growth, however, comes from upper-middle or high-income countries, while information on growth patterns of growth of preterm and SGA from low-or middle-income countries is scant with shorter follow-up time.

Vietnam is located in Southeast Asia where the rate of preterm birth ranges from 5% to 9% and the rate of SGA infants ranges from 10% to 20% [4]. The objectives of this study were to *describe the nutritional status (underweight, stunting, and overweight/obesity) of preterm children and SGA during the school age years*.

METHODS

Subjects

Children in this study are offspring of women who participated in a double-blind randomized controlled

trial (PRECONCEPT; NCT: 01665378), which evaluated the effects of preconception micronutrient supplementation on maternal and child health outcomes [5].

Participants were divided into the following 3 groups:

1. *Pre-term newborn (gestational age < 37 weeks; $n = 147$).*
2. *Full-term SGA newborn: gestational age ≥ 37 weeks and birth weight below the 10th percentile ($n = 180$).*
3. *Full-term AGA newborn (gestational age ≥ 37 weeks and birthweight above the 10th percentile) ($n = 1243$).*

There were only 9 preterm SGA children - therefore, we excluded them from the analysis.

The study was conducted from 2011 - 2023 in 20 communes of Thai Nguyen province.

Study design: Cohort study.

Study indicators

- The prevalence of underweight among preterm and SGA children.
- The prevalence of stunting among preterm and SGA children.
- The prevalence of overweight/obesity among preterm and SGA children.

Preterm and SGA

Preterm was defined as a birth that occurs before 37 completed weeks (less than 259 days) of pregnancy.

Naked weight was measured using a UNICEF Beam type scale for infants and readings were made to the nearest 10 g. SGA was defined as a birth weight below the 10th percentile for gestational age and sex based on the multi-country INTERGROWTH-21st Project.

Anthropometric measurements and nutritional status
Child weight and height were measured at birth, 3 months, 6 months, 12 months, 18 months, 2 years, 6 - 7 years and 10 - 11 years [6]. Child's weight was measured using electronic weighing scales, precise to 10g. Child supine length (from birth to 2 years) and child height (after 2 years) were measured with collapsible length boards, which were precise to 1 mm. The average of duplicate measurements of height and weight was then converted into height-for-age z-scores (HAZ), weight-for-age z-scores (WAZ), and body-mass-index for-age z-scores (BMIZ) according to INTERGROWTH-21st for postnatal growth of preterm infants [7], 2006 WHO child growth standards [8] and growth reference data for 5-19 years [9]. Stunting and underweight were defined as HAZ and WAZ below-2 Z-score, respectively. Overweight/obese was defined as BMIZ above 1 Z-score [9].

Statistical analysis: All data analyses were performed using STATA version 17. Results were considered significant when $p < 0.05$.

RESULTS

Table 1. Characteristic of study sample born preterm, SGA and AGA

	AGA (n = 1243)	Preterm (n = 147)	SGA (n = 180)
Mother characteristics			
Mother's age at birth	26.0 (4.3)	25.8 (4.8)	25.3 (4.1)
Mother education			
Completed primary school	91 (7.3)	19 (12.9)	16 (8.9)
Completed secondary school	666 (53.6)	85 (57.8)	98 (54.4)
Completed high school	324 (26.1)	30 (20.4)	47 (26.1)
College or higher	162 (13.0)	13 (8.8)	19 (10.6)
Occupation			
Work as farmers	976 (78.5)	120 (81.6)	154 (85.6)

Other jobs	267 (21.5)	27 (18.4)	26 (14.4)
Household characteristics			
Socio-economic status			
High	408 (32.9)	50 (34.0)	74 (41.1)
Middle	410 (33.0)	46 (31.3)	61 (33.9)
Low	423 (34.1)	51 (34.7)	45 (25.0)
Child characteristics			
Birthweight (g)	3183 (389)	2874 (460)	2571 (264)***
Birth weight Z-score (WAZ)	- 0.3 (0.7)	- 0.9 (1.0)	- 1.6 (0.7)***
Birth length, cm	49.3 (2.8)	48.7 (2.9)	47.0 (3.1)***
Birth length Z-score (HAZ)	- 0.1 (1.3)	- 0.5 (1.2)	- 1.3 (1.3)***
Gestational age (weeks)	39.5 (1.3)	34.9 (1.7)	40.5 (1.7)***
Sex (female)	622 (50.0)	65 (44.2)	87 (48.3)

At birth, women were on average 26 years and > 90% gave birth to the second child.

As expected, children born SGA and preterm had significantly ($p < 0.001$) lower mean birth weight, WAZ, birth length, HAZ compared to the AGA group. The mean gestational age was 34.9, 39.5 and 40.5 weeks for preterm, AGA and SGA infants, respectively.

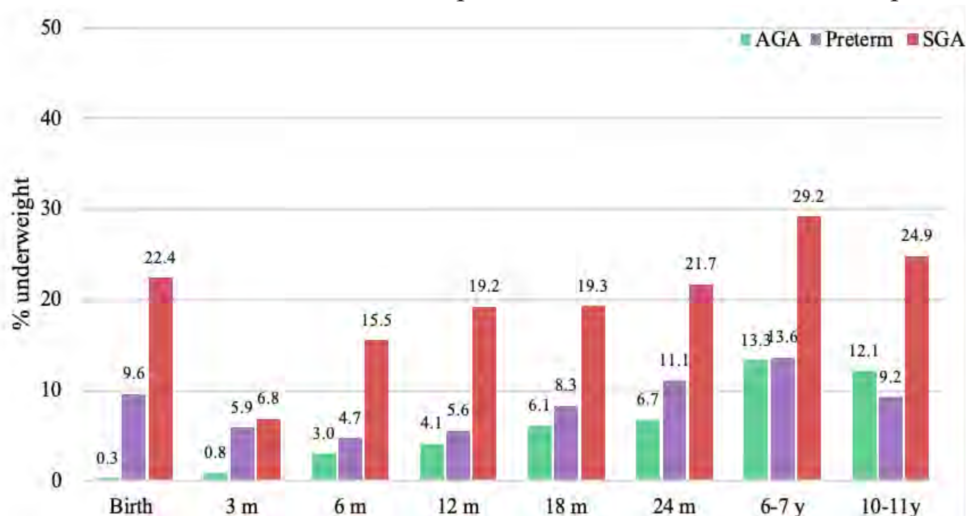

Figure 1. Child underweight in preterm, SGA and AGA children

Compared with the AGA group, the SGA group had consistently higher rates of underweight in all periods. Preterm children consistently exhibited a higher rate of underweight compared to AGA children from birth through 6 - 7 years of age.

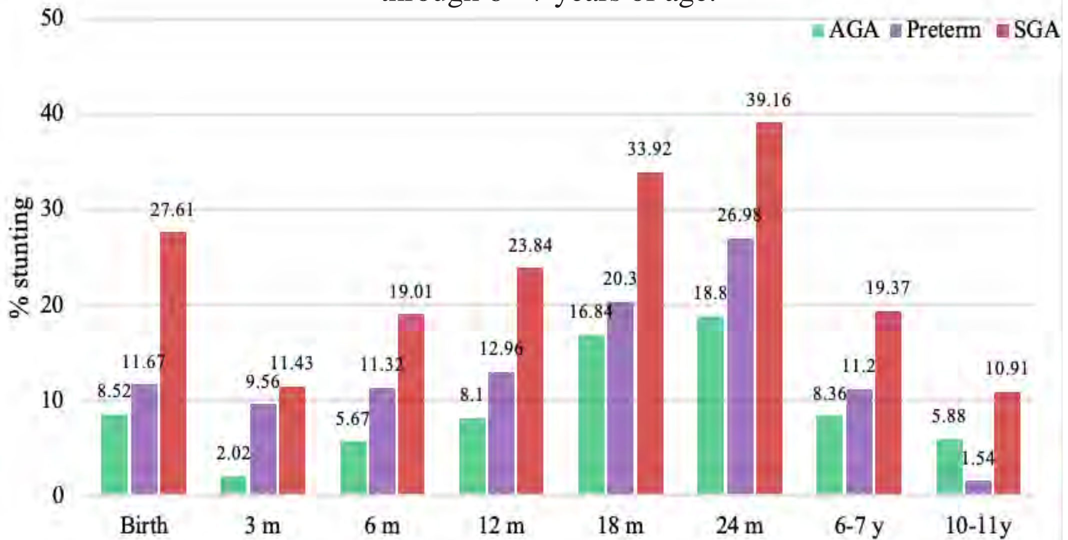

Figure 2. Child stunting in preterm, SGA and AGA children

Compared with the AGA group, stunting rates were consistently higher in the SGA group in all periods.

Figure 3. Overweight/obesity in preterm, SGA and AGA children

Compared with AGA children, SGA children had a lower prevalence of overweight/obesity across all stages. In contrast, preterm children had a lower rate of overweight during the first three months of life; however, this rate gradually increased and exceeded that of AGA children at 6 months of age. It then declined from 24 months to 6 years, but by adolescence, preterm children demonstrated a higher prevalence of overweight/obesity compared to AGA children.

DISCUSSION

At birth, the mean maternal age was 26 years. There were no significant differences in maternal age at delivery, educational level, or occupation. Both SGA and preterm infants had singnificantly lower mean birth weight and length compared with AGA infants. The mean gestational ages were 34.9; 39.5; and 40.5 weeks for preterm, AGA, and SGA infants, respectively. The mean birth weights were 3183 grams for term iinfants, 2874 grams for preterm infants, and 2570 grams for SGA infants. The weight and length of AGA infants met the WHO growth standards; therefore, using AGA children as the comparison group for assessing growth and development in preterm and SGA children is entirely appropriate. Among the preterm group, most were classified as late preterm. The preterm infants in our study sample represent the population of viable preterm infants according to WHO criteria. The gestational age distribution and birth weight in our study were consistent with previous national studies, internaltional findings, and WHO statistis.

Every child has the right to receive optimal nutrition and care to develop their potential fully. In recent years, the world has witnessed significant achievements in improving maternal and child health, including a one-third reduction in the prevalence of stunting among children. However, the three burdens of nutritional status - stunting, wasting, and overweight/obesity - continue to threaten the survival and development of children in general, and particularly of vulnerable newborns with low gestational age and low birth weight. Our study indicates that children born SGA consistently have a higher prevalence of malnutrition compared with AGA children throughout childhood. Stunting is the most severe consequence of poor nutritional status beginning in the fetal period and continuing through early childhood. Children who are stunted may never reach their full adult height potential. The proportions of low birth weight and stunting are highest among the SGA group (22% and 28%, respectively), followed by preterm infants (10% and 12%, respectively), and the AGA group (0.3% and 9%, respectively). These rates remain the highest in the SGA group across all subsequent stages. Among preterm infants, during the first two years of life, the prevalence of underweight and stunting is higher compared with AGA children. Specifically, at 24 months, preterm infants have an underweight prevalence of 11% and a stunting prevalence of 27%, whereas these rates in AGA children are 7% and 19%, respectively. By 10 years of age, while SGA children still exhibit higher rates of malnutrition compared with AGA children, the prevalence in preterm children decreases to levels lower than those in AGA children (9% vs. 12% and 2% vs. 6%, respectively).

SGA children often exposed to early environmental stress involving variable nutritional restriction in utero, thus it has been hypothesized that these children may suffer from relative resistance to some hormones (such as GH, IGF-I, and insulin) or the defect of receptors (IGF-I receptor defect or a post-receptor-mediated defect) which may be the basis for an alteration of endocrine programming resulting [10]. Therefore, being born with SGA is not only associated with postnatal growth failure but also possibly an increased risk of metabolic syndrome and cardiovascular diseases in later life.

Being born preterm or SGA has been identified as a risk factors for overweight/obesity in later life due to the in utero imprinting which result in resistance to multiple hormones [11]. Additionally, rapid catch-up growth in these children placed them at higher risks of childhood obesity. In our study, however, we did not observe any association between birth condition and overweight /obesity at 6 - 7 years or 10 - 11 years. Whether these association may happen in later life will require longer follow-up because preterm birth has been found associated with higher fat mass in males at age 30 years [12], and faster weight gain in the first 3 months was positively associated with body fat percentage and waist circumference at 21 years [13].

In conclusion, despite global commitments in the last 30 years, limited progress has been made to reduce the burden of adverse birth outcomes such as preterm delivery and fetal growth restriction [2]. Recent recommendations propose a new definition for the “small vulnerable newborn”, bringing preterm birth, SGA and low birth weight together, for a better

focus on the health of mothers and fetuses. Efforts to reduce the burden of these conditions is needed with studies that continue to document the preventable adverse consequences, and that with investments to improve access to timely, high-quality care for women of reproductive age and their offspring from birth through adulthood.

CONCLUSION

Compared with AGA children, SGA children have higher rates of underweight and stunting. While preterm children have higher rate of malnutrition in early life, by adolescence their rates of weight and obesity exceed those of AGA children.

RECOMMENDATION

Special care and nutrition should be provided for preterm infants and infants born small for gestational age to help them achieve growth comparable to that of full-term infants appropriate for gestational age.

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