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Research Article

Pattern of Growth Disorders among Children Attending Well Baby Clinics-PHCs, Riyadh, Saudi Arabia

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Abstract

Introduction: Normal pediatric growth is an important indicator of well-being, while abnormal growth is associated with adverse physical and psychosocial outcomes. This study evaluates the pattern of growth disorders in children younger than two years. **Methodology:** A cross-sectional study was conducted at the primary healthcare centers affiliated with Prince Sultan Military Medical City (PSMMC), Riyadh, Saudi Arabia, from September 2021 to October 2021. The physician obtained anthropometric measures for each child and administered a questionnaire to the parents to gather information about patient demographics, antenatal history, breastfeeding history, and medical history of the infant. Logistic regression, multivariate analysis, and ANOVA tests were performed. **Results:** 384 children were included in the study with a mean age of 9.4 ± 6.3 months. Age below six months (OR: 0.119, CI: 0.031-0.455, p=0.002), low birth weight (OR: 3.067, CI: 1.135-8.288 p=0.027), and delivery before 37 weeks of gestation (OR=0.372, CI: 0.136-1.012, p=0.053) were strongly associated with stunting. Low birth weight (OR=3.712, CI: 1.111-12.396, p=0.033) and history of cardiovascular disease (OR=3.758, CI: 0.950-14.857, p=0.059) were strongly associated with underweight. **Conclusion:** Age, mother's occupation, low birth weight, delivery before 37 weeks of gestation, and history of cardiovascular disease are important factors associated with children's early growth. Careful evaluation and screening of growth disorders in children visiting healthcare facilities are fundamental to prompt early diagnosis and optimal management.

Keywords: Growth disorder; Children; Pediatric; Saudi; Riyadh

Introduction

Normal growth is a significant indicator of children's well-being and is associated with optimal adult health and productivity [1]. According to the World Health Organization (WHO), 144 million children under five years suffer from short stature worldwide, and 43% of children under five years fail to reach their developmental potential in low- or middle-income countries [1-3]. Growth failure or stunted growth in children is a risk factor for increased morbidity and mortality, reduced neurocognitive function, chronic diseases later in life, and subsequent low health-related quality of life [4]. One of the important outcomes of growth failure (short stature) is psychosocial distress which may be provoked by discrimination, stigmatization, social isolation, and low self-esteem [5].

Growth disorders refer to the conditions that prevent children from developing adequate growth while achieving optimal developmental milestones. Several prenatal and postnatal factors may affect growth and development, including age, gender, mother's occupation, mother's age at the time of pregnancy, gestational diabetes, breastfeeding, low birth weight, gestational age, medical history, family income, and recurrent infections [6]. Human growth and development undergo five significant phases – infancy, toddler, childhood, adolescence, and adulthood, where

infancy and adolescence include maximal growth velocity [7]. Boys and girls respond differently to the same environment due to fundamental variation at cellular and molecular level, e.g., gestational diabetes causes overweight in boys [8]. Parent's work hours, job autonomy, and parenting over-reactivity affect children's social and cognitive outcomes [9]. Breastfeeding is critical and a "golden standard" food for children in their early months of life. The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life [10]. Breastfeeding offers optimal nutrition and has a significant positive effect on a child's cognitive, behavioral, and mental development [11]. Low birth weight and childhood infections are strongly associated with growth, chronic malnutrition, and cognitive development [12,13]. Studies show that gestational diabetes is associated with delayed motor development in children in addition to long-term negative effects on further development [14]. Hence growth and development can be affected by numerous factors which need to be addressed as early as possible to avoid negative consequences.

Growth deficiency or short stature may occur at any level of healthcare - primary, secondary, and tertiary. Therefore, it is a fundamental responsibility of medical professionals to screen and carefully evaluate any growth disorder in children visiting their clinics at each level so that prompt and optimal management can be provided.

11.3% of boys and 10.5% of girls in Saudi Arabia have moderate short stature, while 1.8% of boys and 1.2% of girls have severe short stature [15]. The literature on the pediatric population with growth disorders presented at primary well-baby clinics is lacking in Saudi Arabia. This study was conducted to evaluate the pattern of growth disorders or hormone deficiencies in pediatric patients at primary baby clinics in Riyadh.

Methodology

The design and aims of the study

This study sought to estimate the prevalence and severity of malnutrition and growth disorders in children under two years attending well-baby clinics in Riyadh in the Kingdom of Saudi Arabia. A cross-sectional study was conducted from September 2021 to October 2021 in the primary healthcare centers affiliated with Prince Sultan Military Medical City (PSMMC), Riyadh, Saudi Arabia.

Study population

A sample of 319 was calculated, assuming the prevalence of stunting in the population to be 29.4% [16] to achieve 80% power and 95% confidence with a 5% margin of error. Healthy children attending the well-baby clinics in primary healthcare centers of PSMMC were enrolled in the study using a convenience sampling technique. 384 children who met the inclusion and exclusion criteria to participate in the study were enrolled after obtaining written informed consent from their parents or guardians. Participants under the age of 2 years of either gender who were residents of Saudi Arabia and attended the well-baby clinic in primary health centers were included in the study. Participants with any acute or congenital illnesses were excluded. Children whose parents or guardians did not speak Arabic, did not consent to participate in the study, or were physically or mentally unable to answer the questions were excluded from the study.

Data collection

Anthropometric measurements of the children enrolled in the study were recorded by the primary care physician in the well-baby clinic. Length for age, weight for age, head circumference for age, and body mass index were measured for each child. The physician administered a questionnaire to the parents to gather information about patient demographics, antenatal history, breastfeeding history, and medical history of the infants.

Data analysis

Data were entered in Microsoft Excel and analyzed in SPSS version 22. Frequencies and percentages were calculated for all categorical variables-age groups, gender, family income, maternal history, child medical history, and nutritional status (stunted and underweight). Anthropometric parameters mean and standard deviation were calculated for numerical variables-age, birth weight. Logistic regression was applied to observe the association between possible factors and nutritional status. $P<0.25$ was set for Univariate logistic regression, and $P<0.05$ was considered significant for multivariate. Odds ratios and 95% confidence intervals were also obtained. A comparison of feeding status and BMI was also made by applying the ANOVA test.

Ethical considerations

The study was conducted after obtaining ethical clearance from the Medical Ethics Committee of the Medical Services Department for the Armed Forces Scientific Research Center in Riyadh (Ethics approval number PSMMC HP-01-R079).

Written informed consent was sought from parents or guardians of the children before enrolment in the study, and other guidelines of the Ethics Committee were strictly adhered to. All the collected data were delinked and anonymized to ensure participant confidentiality.

Results

384 children under the age of 2 years were included in the study with a mean age of 9.4 6.3 months. 165 children (43.0%) were female. Most of the children were born at a gestational age of 38-42 weeks (86.5%) with normal birth weight (85.9%) and had no significant medical or surgical illnesses (77.1%). Most children

(56.0%) came from households with a net income of 7,000 to 13,999 Riyal per month. Patient characteristics pertaining to demographics, antenatal history, and medical history are displayed in Tables 1 and 2. The mean height for age percentile was 67.628.4%, and the mean weight for age percentile was 43.230.5%. 10.7% (41) of the children were diagnosed to be stunted, and 6.5% (25) of the participating children were underweight, according to the World Health Organization child growth standards (Figure 1). Cross tabulations of each potential risk factor against stunting and underweight are provided in tables 3 and 4.

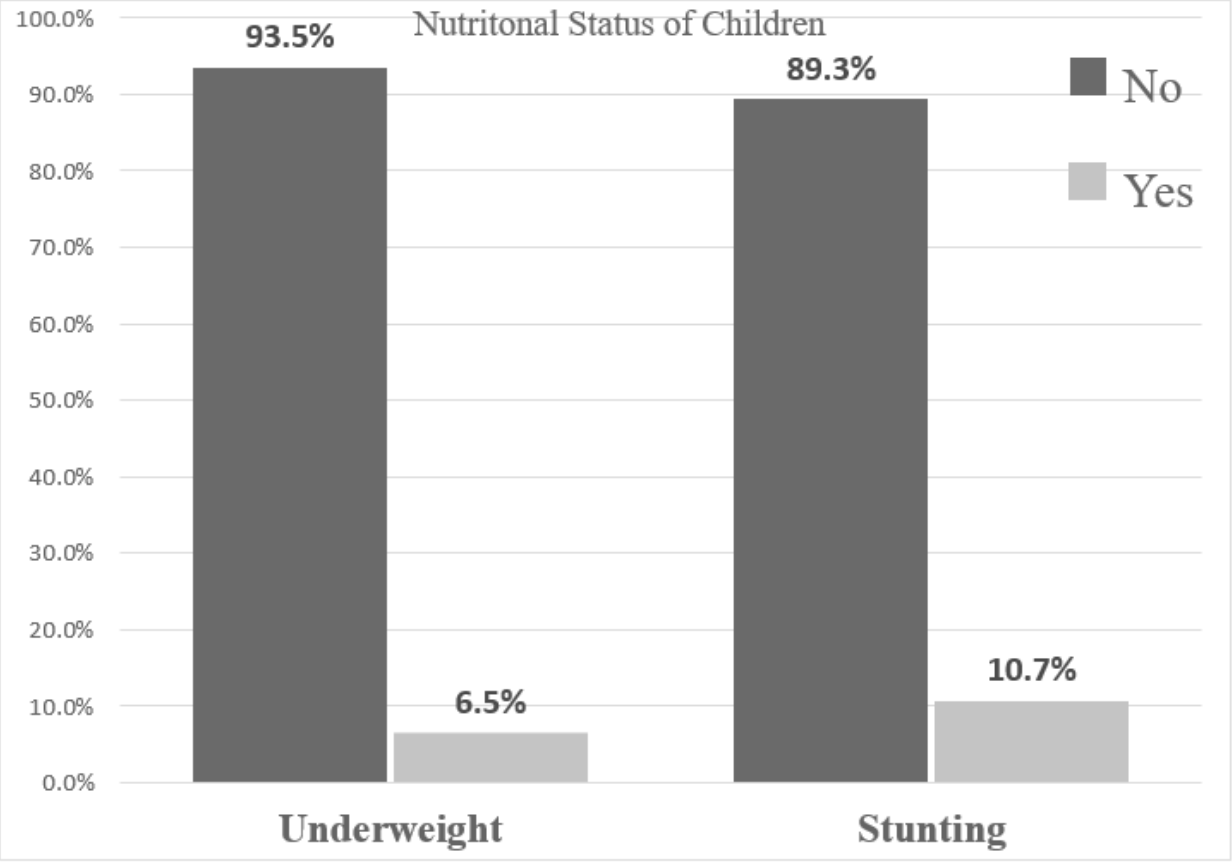

Figure 1: Proportion of children with stunting and underweight.

Study Variables		Frequency (Percentage)
Age Groups	6 months or less	159 (41.4%)
	7-12 months	121 (31.5%)
	More than 12 months	104 (27.1%)
Gender	Female	165 (43.0%)
	Male	219 (57.0%)
Family Income (SAR)	Less than 7,000	75 (19.5%)
	7,000-13,999	215 (56.0%)
	14,000-20000	74 (19.3%)
	More than 20000	20 (5.2%)

Mother's Occupation	Housewives	298 (77.6%)
	Employee	86 (22.4%)
Mother's Age at Pregnancy	Less than 20 years	6 (1.6%)
	20-25	59 (15.4%)
	26-30	107 (27.9%)
	31-35	118 (30.7%)
	36-40	73 (19.0%)
	More than 40 years	21 (5.5%)
Gestational Diabetes Mellitus	No	309 (80.5%)
	Yes	75 (19.5%)
Low Birth Weight	No	330 (85.9%)
	Yes	54 (14.1%)
Gestational Age	Less than 37 weeks	52 (13.5%)
	38-42 weeks	332 (86.5%)
Feeding Status	Fully complete breastfeed	63 (16.4%)
	Partially breast-fed	164 (42.7%)
	Complete formula feeding	157 (40.9%)
Medical History (Child)	No	296 (77.1%)
	Gastrointestinal diseases	15 (3.9%)
	Cardiovascular diseases	24 (6.3%)
	Genetic diseases	7 (1.8%)
	Respiratory diseases	14 (3.6%)
	Hematologic diseases	16 (4.2%)
	Mental diseases	2 (0.5%)
	Neurosurgical diseases	1 (0.3%)
	Nephrological diseases	2 (0.5%)
	Urological diseases	1 (0.3%)
	Neurological diseases	6 (1.6%)
Recurrent Infections	No	362 (94.3%)
	Yes	22 (5.7%)
Total		384 (100.0%)

Table 1: Distribution of study population in different study variables.

Study Variables	Mean	Std. Deviation	Minimum	Maximum
Age (months)	9.4	6.3	0.3	29.0
Birth weight (kg)	3.0	0.6	1.0	4.7
Age of introducing solid food	6.9	1.7	4	12
Mid Parental height (cm)	184.1	161.2	148.5	1775.0
Height for age (cm)	67.6	9.9	41.0	99.0
Height for age Percentile (%)	36.6	28.4	3.0	97
Weight for age (kg)	8.0	2.4	2.2	15.0
Weight for age Percentile (%)	43.2	30.5	3.0	97.0
Head circumference (cm)	43.4	3.7	19.0	53.0
Body mass index (kg/m²)	17.2	2.8	9.9	44.2

Table 2: Descriptive Statistics of quantitative variables.

Risk factors for stunting

Logistic regression was used to identify risk factors for stunting in the population (Table 3). The risk of stunting decreases with older age. Those in the 12-24-month age group had a significantly lower odds of stunting compared to infants less than 6 months old. (OR: 0.119, CI: 0.031-0.455, p=0.002). Children of employed mothers had a statistically significantly 78.5% lower odds of stunting compared to children whose mothers were housewives. (OR: 0.215, CI: 0.06-0.78 p=0.019). Low weight at birth, defined as a birth weight less than 2500g, was strongly associated with a 3-time increase in the odds of stunting (OR: 3.067, CI: 1.135-8.288, p=0.027). Children born after 37 weeks were 62.5% less likely to be stunted than those born before 37 weeks of gestation. (OR=0.372, CI: 0.136-1.012, p=0.053).

Study Variables		Stunted	Crude OR (CI)	Adjusted OR (CI)
Age Groups	6 months or less	23 (14.5%)	1.00 (NA-NA)	1.00 (NA-NA)
	7-12 months	14 (11.6%)	0.77 (0.38-1.57)	0.71 (0.32-1.58)
	More than 12 months	4 (3.8%)	0.24 (0.08-0.70)*	0.12 (0.03-0.46)*
Gender	Female	21 (12.7%)	1.00 (NA-NA)	NA (NA-NA)
	Male	20 (9.1%)	0.69 (0.36-1.32)	NA (NA-NA)
Family Income (SAR)	Less than 7,000	9 (12%)	1.00 (NA-NA)	NA (NA-NA)
	7,000-13,999	24 (11.2%)	0.92 (0.41-2.08)	NA (NA-NA)
	14,000-20000	7 (9.5%)	0.77 (0.27-2.18)	NA (NA-NA)
	More than 20000	1 (5%)	0.39 (0.05-3.24)	NA (NA-NA)
Mother's Occupation	Housewives	38 (12.8%)	1.00 (NA-NA)	1.00 (NA-NA)
	Employee	3 (3.5%)	0.25 (0.07-0.82)*	0.21 (0.06-0.78)*

Mother's age at pregnancy	Less than 20 years	2 (33.3%)	1.00 (NA-NA)	1.00 (NA-NA)
	20-25	5 (8.5%)	0.18 (0.03-1.27)*	0.27 (0.03-2.38)
	26-30	9 (8.4%)	0.18 (0.03-1.14)*	0.35 (0.04-2.90)
	31-35	14 (11.9%)	0.27 (0.04-1.61)*	0.59 (0.08-4.61)
	36-40	9 (12.3%)	0.28 (0.04-1.76)*	0.87 (0.11-7.09)
	More than 40 years	2 (9.5%)	0.21 (0.02-1.97)*	0.55 (0.03-9.19)
Gestational Diabetes Mellitus	No	37 (12%)	1.00 (NA-NA)	1.00 (NA-NA)
	Yes	4 (5.3%)	0.41 (0.14-1.20)*	0.46 (0.14-1.50)
Low birth weight	No	27 (8.2%)	1.00 (NA-NA)	1.00 (NA-NA)
	Yes	14 (25.9%)	3.93 (1.90-8.11)*	3.07 (1.14-8.29)*
Gestational Age	Less than 37 weeks	12 (23.1%)	1.00 (NA-NA)	1.00 (NA-NA)
	38-42 weeks	29 (8.7%)	0.32 (0.15-0.68)*	0.37 (0.14-1.01)
Feeding status	Fully complete breastfeed	7 (11.1%)	1.00 (NA-NA)	NA (NA-NA)
	Partially breast-fed	19 (11.6%)	1.05 (0.42-2.63)	2.01 (0.56-7.21)
	Complete formula feeding	15 (9.6%)	0.84 (0.33-2.18)	0.93 (0.23-3.73)
Medical history (Child)	No	26 (8.8%)	1.00 (NA-NA)	1.00 (NA-NA)
	Gastrointestinal diseases	2 (13.3%)	1.60 (0.34-7.47)	1.08 (0.20-5.95)
	Cardiovascular diseases	4 (16.7%)	2.08 (0.66-6.54)*	0.93 (0.25-3.51)
	Genetic diseases	2 (28.6%)	4.15 (0.77-22.48)*	1.33 (0.12-14.38)
	Respiratory diseases	2 (14.3%)	1.73 (0.37-8.15)	2.49 (0.41-15.19)
	Hematologic diseases	4 (25%)	3.46 (1.04-11.51)*	2.30 (0.45-11.75)
	Mental diseases	1 (50%)	10.38 (0.63-170.92)*	12.46 (0.24-652.26)
	Neurosurgical diseases	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
	Nephrological diseases	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
	Urological diseases	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
	Neurological diseases	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
Recurrent infections	No	37 (10.2%)	1.00 (NA-NA)	1.00 (NA-NA)
	Yes	4 (18.2%)	1.95 (0.63-6.08)*	3.26 (0.68-15.62)

*Significant findings. For Univariate regression analysis, significance level set <0.25; Crude Odds Ratio (OR); For multivariate regression analysis,

Table 3: Comparisons and Logistic regression analysis of significant factors related to stunting among children.

Risk factors for underweight

As detailed in table 4, logistic regression was used to recognize risk factors for the underweight. 4.2% of children with normal birth weight were underweight at the time of examination compared to 20.4% of children with low birth weight. Having a low weight at birth was strongly associated with a nearly 4-times increase in the odds of being underweight for age. (OR=3.712, CI: 1.111-12.396, p=0.033). A higher proportion of children with cardiovascular disease were underweight (5/24, 20.8%) compared to healthy children (10/296, 3.4%). A history of cardiovascular disease was associated with a 3.7-time increase in odds of being underweight compared to healthy children. (OR=3.758, CI: 0.950-14.857, p=0.059).

Study Variables		Underweight	Crude OR (CI)	Adjusted OR (CI)
Age Groups	6 months or less	13 (8.2%)	1.00 (NA-NA)	NA (NA-NA)
	7-12 months	7 (5.8%)	0.69 (0.27-1.78)	NA (NA-NA)
	More than 12 months	5 (4.8%)	0.57 (0.20-1.64)	NA (NA-NA)
Gender	Female	12 (7.3%)	1.00 (NA-NA)	NA (NA-NA)
	Male	13 (5.9%)	0.81 (0.36-1.81)	NA (NA-NA)
Family Income (SAR)	Less than 7,000	9 (12%)	1.00 (NA-NA)	1.00 (NA-NA)
	7,000-13,999	16 (7.4%)	0.59 (0.25-1.40)*	0.92 (0.30-2.78)
	14,000-20000	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
	More than 20000	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
Mother's Occupation	Housewives	24 (8.1%)	1.00 (NA-NA)	1.00 (NA-NA)
	Employee	1 (1.2%)	0.13 (0.02-1.01)*	0.21 (0.02-2.26)
Mother's Age at Pregnancy	Less than 20 years	2 (33.3%)	1.00 (NA-NA)	1.00 (NA-NA)
	20-25	4 (6.8%)	0.14 (0.02-1.05)*	0.23 (0.02-2.26)
	26-30	6 (5.6%)	0.12 (0.02-0.78)*	0.16 (0.01-1.69)
	31-35	8 (6.8%)	0.14 (0.02-0.92)*	0.29 (0.03-2.84)
	36-40	3 (4.1%)	0.09 (0.01-0.67)*	0.24 (0.02-2.73)
	More than 40 years	2 (9.5%)	0.21 (0.02-1.97)*	0.00 (0.00-NA)
Gestational Diabetes Mellitus	No	22 (7.1%)	1.00 (NA-NA)	NA (NA-NA)
	Yes	3 (4%)	0.54 (0.16-1.87)	NA (NA-NA)
Low Birth Weight	No	14 (4.2%)	1.00 (NA-NA)	1.00 (NA-NA)
	Yes	11 (20.4%)	5.77 (2.46-13.53)*	3.71 (1.11-12.40)*
Gestational Age	Less than 37 weeks	8 (15.4%)	1.00 (NA-NA)	1.00 (NA-NA)
	38-42 weeks	17 (5.1%)	0.30 (0.12-0.73)*	0.68 (0.17-2.69)
Feeding Status	Fully complete breastfeed	3 (4.8%)	1.00 (NA-NA)	NA (NA-NA)
	Partially breast-fed	15 (9.1%)	2.01 (0.56-7.21)	NA (NA-NA)
	Complete formula feeding	7 (4.5%)	0.93 (0.23-3.73)	NA (NA-NA)

Medical History (Child)	No	10 (3.4%)	1.00 (NA-NA)	1.00 (NA-NA)
	Gastrointestinal diseases	2 (13.3%)	4.40 (0.87-22.16)*	3.06 (0.47-20.02)
	Cardiovascular diseases	5 (20.8%)	7.53 (2.34-24.24)*	3.76 (0.95-14.86)
	Genetic diseases	3 (42.9%)	21.45 (4.23-108.86)*	NA (0.00-NA)
	Respiratory diseases	1 (7.15)	2.20 (0.26-18.50)	2.97 (0.31-28.45)
	Hematologic diseases	2 (12.5%)	4.09 (0.82-20.44)*	1.65 (0.28-9.74)
	Mental diseases	1 (50%)	28.60 (1.67-490.80)*	NA (0.00-NA)
	Neurosurgical diseases	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
	Nephrological diseases	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
	Urological diseases	0 (0%)	0.00 (0.00-NA)	0.00 (0.00-NA)
	Neurological diseases	1 (16.7%)	5.72 (0.61-53.61)*	3.79 (0.34-42.88)
Recurrent Infections	No	23 (6.4%)	1.00 (NA-NA)	NA (NA-NA)
	Yes	2 (9.1%)	0.68 (0.15-3.08)	NA (NA-NA)

* Significant findings. For Univariate regression analysis, significance level set <0.25; Crude Odds Ratio (OR); For multivariate regression analysis, significance level set <0.05; Adjusted Odds Ratio (OR); CI: 95% Confidence Interval.

Table 4: Comparisons and Logistic regression analysis of significant factors related to underweight among children.

Relationship between the BMI and breastfeeding

The ANOVA test was used to study the association between BMI and breastfeeding, as shown in table 5. The mean BMI among children who were fully breastfed, partially breastfed, and fully fed by a formula was 17.35, 16.94, and 17.45, respectively (Figure 2). However, no significant difference in mean BMI was noted either within or between the 3 groups (p=0.199).

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Fully complete breastfeed	63	17.349	2.1189	0.2670	16.816	17.883	13.8	23.5
Partially breast-fed	164	16.915	2.6252	0.2050	16.510	17.320	9.9	34.5
Complete formula feeding	157	17.452	3.0982	0.2473	16.964	17.941	10.1	44.2
Total	384	17.206	2.7629	0.1410	16.929	17.483	9.9	44.2

Table 5: ANOVA comparing mean BMI by breastfeeding status.

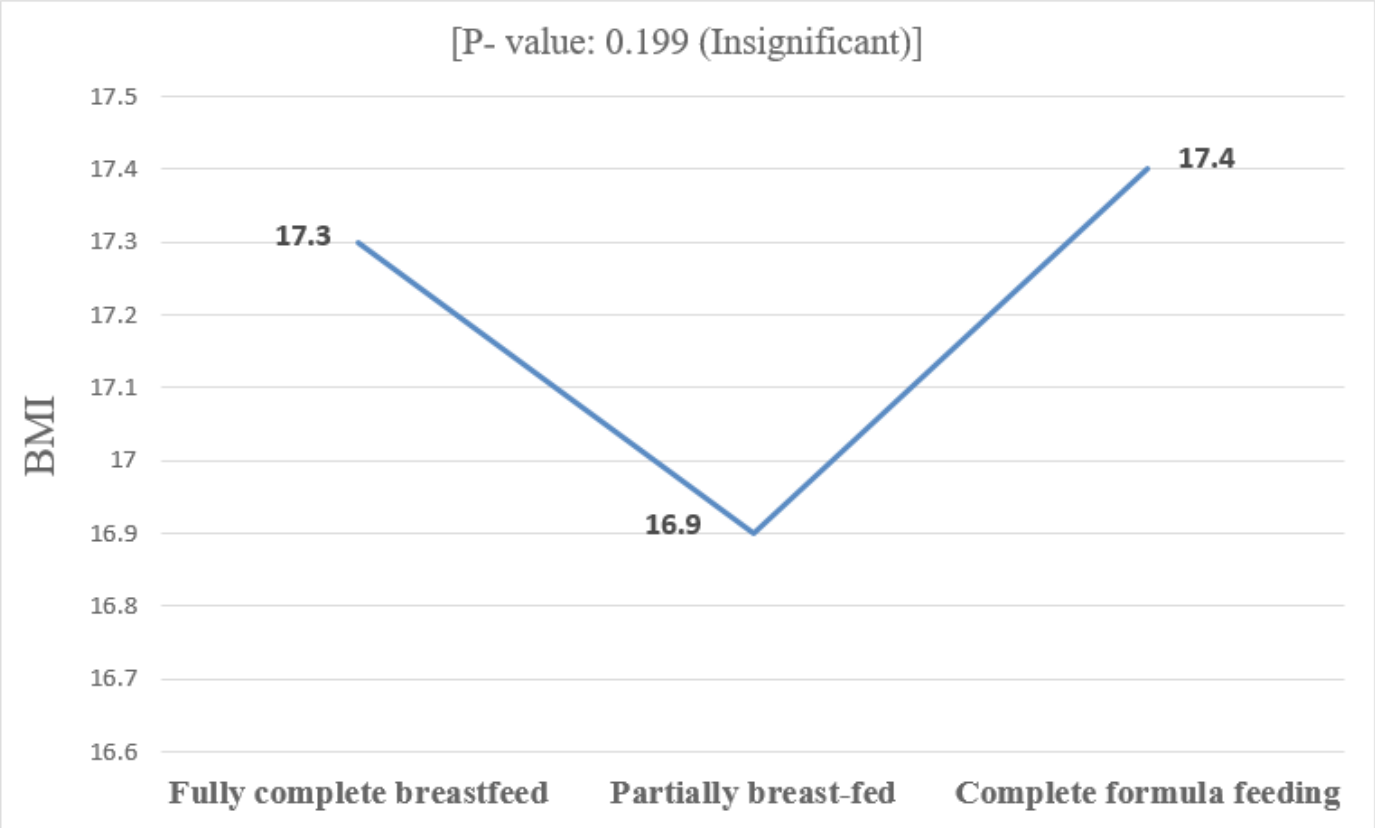

Figure 2: Comparison of average BMI with feeding status.

Discussion

This study evaluated growth disorders, including risk factors for stunting, underweight, and the association between breastfeeding and BMI in children below two years of age in Riyadh, Saudi Arabia. The study reported that age below six months, low birth weight, and delivery before 37 weeks of gestation were strongly associated with stunting. Similarly, low birth weight and a history of cardiovascular disease were strongly associated with being underweight. Mother's employment was associated with reduced stunting compared to children born to housewives. Breastfeeding showed no significant association with BMI.

Titaley, et al. conducted a cross-sectional survey to evaluate the determinants of stunting of children below two years of age in Indonesia [17]. They reported significant stunting in 12-24 months old boys who lived with three or more children under five years or five to seven members in a house, whose mothers attended less than four antenatal visits, and whose birth weight was less than 2,500 grams. The study supported the results of this study in terms of the association of stunting with low birthweight. However, in contrast, the study reported significant stunting in boys compared to girls and maximal stunting for 12-24 months, while this study reported no significant difference in boys and girls while maximal stunting was recorded below six months of age. In another study, Aryastami, et al. reported that children with low birth weight, the male gender, history of neonatal illness, and poverty status were prone to developing stunted growth [18].

The association of maternal employment with the stunted growth of children is controversial. Some studies have reported that maternal employment status was associated with stunted growth, while others argued that the prevalence of stunted growth decreased with maternal employment [19,20]. Amaha and Woldeamanuel [21] recently reported significantly less stunted growth in children having unemployed mothers compared to those having employed mothers in Ethiopia. They also reported that higher maternal education, at least four r antenatal visits, adequate maternal height and weight, and delivery at a health facility were associated with reduced risk of stunting in children.

Chinawa, et al. [22] studied and reported that congenital heart diseases were associated with a significant risk of malnutrition and stunted growth in children under five years of age. It supports the

findings of this study in terms of cardiovascular disease associated with stunted growth. Similarly, Batte, et al. [23] reported that congenital heart diseases were associated with a higher risk of wasting, underweight, and stunted growth. This study revealed no significant effect of breastfeeding on the BMI of children. Controversial or opposite findings have been reported in this context [24,25].

This study is important to encompass patterns and risk factors of stunted growth in the Saudi pediatric population. However, it has some limitations being a single-centered study in a short period.

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