Archives of the Balkan Medical Union
vol. 61, no. 2, pp. 223-229
June 2026
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ORIGINAL PAPER

IMPACT OF BREASTFEEDING ON INFANT WEIGHT GROWTH IN THE SAIDA REGION, ALGERIA

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Received 13th April 2026, Accepted 05th June 2026
https://doi.org/10.31688/ABMU.2026.61.2.09

Abstract

Introduction. Breastfeeding is a natural physiological process through which mothers provide their infants with breast milk, supplying essential nutrients required for optimal growth and development. Depending on individual circumstances, feeding may be exclusive (natural), mixed, or substituted by artificial feeding.
The objective of the study. This cross-sectional study aimed to assess the impact of different breastfeeding modes (exclusive, mixed, and artificial) on infant weight gain during the first months of life.
Materials and methods. Our study included 198 infants, divided into three groups according to feeding mode: 62 breastfed infants, 69 artificially fed infants, and 67 infants who received mixed feeding. We compared weight gain according to age and mode of breastfeeding across the three studied groups. In addition, an analysis of clinical and sociodemographic parameters, as well as the dietary habits of breastfeeding mothers, was also conducted.
Results. The results showed that maternal dietary habits were significantly associated with the infant's feeding mode ($p < 0.001$). Artificial feeding was associated with a higher mean weight during the first months of life (1–4 months), whereas breastfeeding was characterized by a more gradual and steady weight gain, mixed feeding occasionally exceeded the other feeding modes at certain ages (8–12 and 12–16 months).

Résumé

Impact de mode d'allaitement sur la croissance pondérale des nourrissons dans la region de Saida, Algérie

Introduction. L'allaitement maternel est un processus physiologique naturel par lequel les mères fournissent à leurs nourrissons du lait maternel, apportant les nutriments essentiels nécessaires à une croissance et à un développement optimal. Selon les circonstances individuelles, l'alimentation peut être exclusive (naturelle), mixte ou remplacée par une alimentation artificielle.
L'objectif de l'étude. Cette étude transversale vise à évaluer l'impact des différents modes d'allaitement (exclusif, mixte et artificiel) sur la prise de poids des nourrissons au cours des premiers mois de vie.
Matériels et méthodes. Notre étude a inclus 198 nourrissons, répartis en trois groupes selon le mode d'alimentation : 62 nourrissons allaités au sein, 69 nourrissons alimentés artificiellement et 67 nourrissons ayant reçu un allaitement mixte. Nous avons comparé la prise de poids en fonction de l'âge et du mode d'allaitement dans les trois groupes étudiés. De plus, une analyse des paramètres cliniques et sociodémographiques, ainsi que des habitudes alimentaires des mères allaitantes, a également été réalisée.
Résultats. Les résultats ont montré que les habitudes alimentaires maternelles étaient significativement

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Conclusions. The mode of breastfeeding does not have an uniform or major impact on weight, but contributes variably to infants' weight gain.

Keywords: breastfeeding, infant, feeding mode, weight gain.

List of abbreviations:
WAZ – weight-for-age Z scores
BMI - body mass index

associées au mode d'alimentation du nourrisson ($p < 0.001$). L'alimentation artificielle était associée à un poids moyen plus élevé au cours des premiers mois de vie (1–4 mois), tandis que l'allaitement maternel se caractérisait par une prise de poids plus progressive et régulière. L'allaitement mixte dépassait parfois les autres modes d'alimentation à certains âges (8–12 et 12–16 mois).
Conclusions. Le mode d'allaitement n'a pas un effet uniforme ou majeur sur le poids, mais contribue de manière variable à la prise de poids des nourrissons.

Mots-clés: allaitement maternel, nourrisson, mode d'alimentation (naturel, mixte, artificiel), prise de poids.

Introduction

Breastfeeding remains a widely promoted practice worldwide, yet its prevalence varies considerably across regions and socio-economic contexts. Globally, approximately 48% of infants under six months of age are exclusively breastfed[1]. In Algeria, breastfeeding practices remain a concern: fewer than 3% of infants are exclusively breastfed at six months[2], and only 23% still receive breast milk at 22–23 months, with a median duration of breastfeeding estimated at 12 weeks[3]. In contrast, formula feeding has been associated with more rapid growth, potentially increasing the risk of infant obesity and long-term metabolic disorders[4,5] .

Recent research indicates that exclusively breastfed infants generally exhibit higher weight-for-age Z scores (WAZ) compared to formula-fed infants during the early months of life[6]. A longitudinal study conducted in 2024 reported that exclusively breastfed infants had significantly higher WAZ values than those fed with formula[7] (coefficient = 0.329, $p < 0.05$), although formula-fed infants tended to surpass their peers in weight after eight months of age. These findings highlight the complex influence of feeding modes on weight development during infancy[8,9].

The choice of infant feeding mode is influenced by a combination of socio-cultural, economic, and health-related factors. Socio-cultural determinants include cultural norms, family beliefs, and social influences that may either encourage or discourage breastfeeding[10,11].

Economically, a family's financial resources can affect access to commercial infant formula, which is often costly, making breastfeeding a more economical option[12]. Finally, maternal health conditions (such as infections, postpartum depression, or obstetric complications)[13,14] and infant health issues (such as prematurity or congenital anomalies) may render breastfeeding difficult or impossible, thereby increasing reliance on mixed or formula feeding[15,16].

The objective of the study was to explore the impact of infant feeding mode on weight growth trajectories by comparing the weight development of infants who were breastfed, formula-fed, or mixed-fed, in order to better understand these relationships and their implications for infant health.

Materials and methods

This analytical cross-sectional study was conducted in the Pediatrics–Maternity Department of Saida, Algeria, from February to April 2025, and included 220 infants. A total of 198 participants were retained, of whom 62 infants were exclusively breastfed, 67 received mixed feeding, and 69 were formula-fed.

The inclusion criteria were: infants aged 0 to 24 months, residents of the Saida region, and provision of signed informed consent to participate in the study. The exclusion criteria were infants with prolonged hospitalizations, incomplete medical records or missing data, and lack of consent to participate.

The study protocol was conducted in accordance with the ethical principles of the Declaration of Helsinki (1975). Written informed consent was obtained from the parents of each infant included in the study. The study was approved by the institutional ethics committee of the Faculty of Natural and Life Sciences, Dr. Moulay Tahar University of Saïda, Algeria (approval no. 2025/017, dated February 15, 2025).

Data were collected through face-to-face interviews with the infants' mothers and review of medical records, allowing the collection of anthropometric, sociodemographic, and clinical information on both mothers and their infants.

Body mass index (BMI) was calculated as the ratio of weight (kg) to height squared (m^2). Infants were classified into different BMI categories according to the World Health Organization global classification:

BMI < 13.5 kg/m² (3rd percentile) (underweight), 13.5–17.5 kg/m² (3rd to 85th percentile) (normal), 17.5–18.5 kg/m² (85th to 97th percentile) (overweight), and > 18.5 kg/m² (>97th percentile) (obesity). Biochemical analyses were performed at the maternity hospital laboratory.

Collected data were coded, entered, and analyzed using SPSS version 20. Statistical analyses included the calculation of percentages, means, and standard deviations. Comparisons of means were performed using ANOVA and Student's *t*-test. A *p*-value ≤ 0.05 was considered statistically significant.

Results

Our study population was divided into three groups according to the feeding mode: 62 infants were exclusively breastfed, 67 received mixed feeding, and 69 were formula-fed. The mean age was 6.11±3.57 months, 6.01±3.07 months, and 6.14±3.60 months, respectively, for the three groups. Baseline characteristics are presented in Table 1.

A chi-square test of independence was performed to assess associations between categorical variables and group membership. Significant associations were

Table 1. Fundamental characteristics of the study population

Parameters	*Artificial feeding n(%)*	*Mixed feeding (%)*	*Breastfeeding* n(%)	*p-value*
		Infants		
Mean age (months)	6.11 ± 3.57	6.01 ± 3.07	6.14 ± 3.60	0.974
BMI (Kg/m²)				
Underweight	7 (10%)	4 (6%)	2 (3%)	
Normal	37 (54%)	56 (84%)	48 (78%)	
Overweight	9 (13%)	3 (4%)	5 (8%)	0.006
Obesity	16 (23%)	4 (6%)	7 (11%)	
Origin				
Urban	50 (72%)	47 (70%)	25 (40%	< 0.001
Rural	19 (28%)	20 (30%)	37 (60%	
		Mothers		
Mothers'occupation				
Housewife	21 (30%)	37 (55%)	40 (65%)	
Worker	48 (70%)	30 (45%)	22 (35%)	< 0.001
Paternal smoking				
Yes	40 (58%)	45 (67%)	35 (56%)	
No	29 (42%)	22 (33%)	27 (44%)	
Alcohol consumption				
Yes	2 (3%)	3 (4%)	2 (3%)	
No	67(97%)	64 (96%)	60 (97%)	0.395
Personal medical history				
HBP	15 (21.74%)	4 (5.97%)	3 (4.91%)	0.002
Diabete	13 (18.84%)	6 (8.95%)	2 (3.28%)	0.013
Family history				
HBP	35 (51%)	42 (62%)	32 (50.81%)	0.302
Diabete	34 (49%)	25 (38%)	27 (44.26%)	0.372
Delivery mode				
Vaginal delivery	33 (48%)	40 (60%)	52 (84%)	< 0.001
Cesarean section	36 (52%)	27 (40%)	10 (16%)	
Physical activity				
Yes	4 (6%)	10 (15%)	2 (3%)	0.035
No	65 (94%)	57 (85%)	60 (97%)	
Stress				
Yes	66 (96%)	61 (91%)	54 (87%)	0.216
No	3 (4%)	6 (9%)	8 (13%)	

Legend: BMI – body mass index, HBP – high blood pressure.

Table 2. Distribution of maternal dietary habits

Food Group	*Feeding Mode*	*Every day n(%)*	*Sometimes n(%)*	*Rarely n(%)*	*p-value*
Protein sources	Maternal	41 (66%)	19 (31%)	2 (3%)	< 0,001
	Mixed	45 (30%)	51 (34%)	4 (3%)	
	Artificial	4 (6%)	63 (91%)	2 (3%)	
Cereals / Starches	Maternal	38 (61%)	15 (24%)	9 (15%)	0.005
	Mixed	46 (69%)	16 (24%)	5 (7%)	
	Artificial	35 (52%)	24 (36%)	8 (12%)	
Dairy products	Maternal	49 (79%)	7 (11%)	6 (10%)	0.041
	Mixed	45 (67%)	20 (30%)	2 (3%)	
	Artificial	43 (64%)	13 (19%)	11(17%)	
Fruits & vegetables	Maternal	30 (48%)	30 (48%)	2 (4%)	< 0,001
	Mixed	54 (80%)	13 (19%)	1 (1%)	
	Artificial	50 (72%)	19 (27%)	1 (1%)	

Protein sources: Meat, fish, eggs/ Dairy products: Milk, yogurt, cheese

observed for BMI, origin, occupation, personal history of high blood pressure, diabetes, delivery mode ($p < 0.001$), and physical activity ($p = 0.035$), indicating that these factors differed significantly between groups. In contrast, age and stress did not show statistically significant associations with group membership (stress: $p = 0.216$), suggesting similar distributions of these variables across the groups. All other variables also demonstrated no statistically significant differences ($p \geq 0.05$) (Table 1).

A chi-square test of independence was conducted to assess the association between maternal dietary habits and infant feeding mode. Significant associations were observed for the consumption frequency of protein sources ($p < 0.001$), cereals/starches ($p = 0.005$), dairy products ($p = 0.041$), and fruits & vegetables ($p < 0.001$), indicating that these dietary habits differed significantly between the feeding groups. These results suggest that maternal dietary patterns vary according to infant feeding mode (Table 2).

Statistical analysis: Impact of breastfeeding mode on the weight of infants

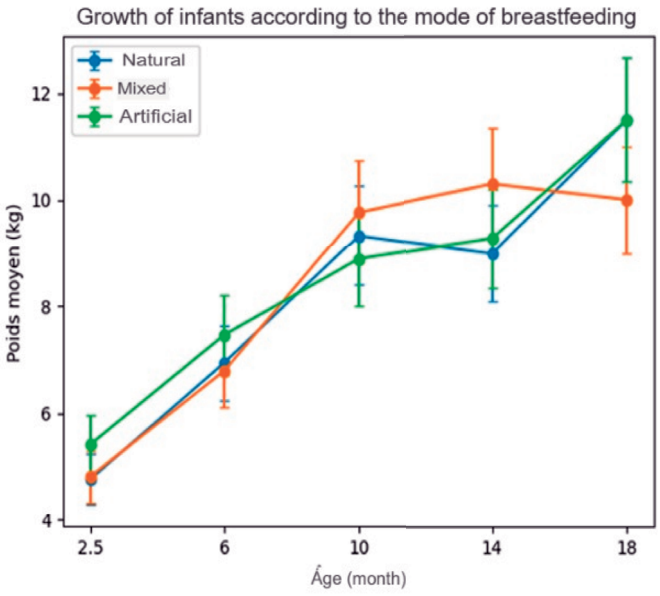


Figure 1. Impact of breastfeeding mode on neonates' weight

The curve showed that artificial feeding was associated with a higher mean weight during the early months of life (1–4 months). Mixed feeding occasionally exceeded the other feeding modes, particularly in the age ranges of 8–12 months and 12–16 months. In contrast, breastfeeding was characterized by a more regular pattern of weight gain. Furthermore, breastfed infants generally exhibited slower weight gain during the first year of life compared to formula-fed infants, although an acceleration in weight gain was observed after approximately three months.

Our results indicated that the mode of feeding could exert a limited influence on infant weight, although these differences were not consistently observed across all age groups (Figure 1).

Discussion

One study revealed that the exclusive breastfeeding rate was only 32% in Ho Chi Minh City and Vietnam, indicating that exclusive breastfeeding is not the predominant feeding practice[17] . These findings highlight the influence of social and occupational conditions on mothers' breastfeeding choices[18].

Breastfeeding tends to decline with the infant's age in favor of mixed and artificial feeding, influenced by maternal return to work and the perceived insufficiency of breast milk[19]. This observation is consistent with our findings, which showed that the majority of mothers practicing mixed and artificial feeding were employed (48% and 30%, respectively).

In Iran, an increase in parental stress has been reported among mothers, particularly those experiencing mixed or artificial feeding patterns, with higher stress levels associated with a lower likelihood of exclusive breastfeeding[20] . In Sweden, maternal stress and psychological difficulties are associated with a decrease in breastfeeding duration[21]. These findings are consistent with our results.

Fathers who smoke, although not directly involved in breastfeeding, expose their infants to an increased risk of respiratory complications and growth retardation because of passive smoking. This exposure may be detrimental to the child's overall health, affecting both growth and development[22].

Furthermore, Patel et al.[23] and Sahu et al.[24] reported that nicotine exposure, even indirectly, can alter the composition of breast milk by reducing its immunological and nutritional properties. This, in turn, may negatively impact the infant's long-term health, particularly growth and physical development.

Thus, our statistical results revealed a significant association between maternal dietary habits and breastfeeding practices ($p < 0.001$), consistent with the findings of Choudhary et al.[25] and Hasan et al.[26], who highlight the importance of maternal nutrition as a key determinant of breastfeeding practices and, indirectly, infant growth.

Our results indicated that formula feeding was associated with a higher mean weight during the first months of life (1–4 months), whereas breastfeeding was characterized by a more gradual and steady weight gain. These observations are consistent with the findings of Azevedo et al.[27], Ali et al.[28], who reported that breastfed infants exhibit slower weight gain compared with those receiving formula feeding, with the latter tending to present higher body mass indices. This difference may be related to the composition of infant formula, which is generally richer in protein and energy, as well as to reduced self-regulation of intake[29].

As presented in Figure 1, breastfeeding was associated with slower growth during the first year of life, followed by an acceleration after the initial months. According to Bhutta et al.[30] and Wood et al.[31], this growth profile is considered physiological and protective, as multiple studies have shown that breastfeeding is associated with a reduced risk of excessive weight gain and later obesity.

Regarding mixed feeding, our results highlight considerable variability, with periods in which it surpasses other feeding modes, particularly between 8 and 16 months. Johnson et al.[32] and Lee et al.[33] have shown that some studies suggest mixed feeding may be associated with intermediate weight gain, and in some cases even higher weight gain depending on feeding practices and the relative proportion of breast milk and formula administered. This variability reflects the inherent heterogeneity of this feeding mode, which depends on the combination of milk sources and the introduction of complementary foods[34,35].

Conclusions

The mode of feeding exerts a limited and variable influence on infants' weight gain. Indeed, formula feeding is associated with higher weight gain during the first months of life, whereas breastfeeding is characterized by a more gradual and steady growth pattern. Mixed feeding, on the other hand, shows an intermediate and fluctuating pattern across different age groups. In our study, the mode of feeding had a moderate but not consistently significant impact, as weight gain remained influenced by multiple factors.

Author Contributions:

Conceptualization, D.H. and D.C.; methodology, D.H.; software, D.C; validation D.H. and formal analysis, D.C.; data curation, D.H. and D.C.; writing–original draft preparation, D.H.; writing–review and editing, D.H, D.C. All the authors have read and agreed with the final version of the article.

Compliance with Ethics Requirements:

"To meet ethical considerations, we ensured confidentiality and respect for all participants during this research after explaining to pregnant women the objectives of the study and their implications, the survey was carried out in the form of interview with each pregnant woman individually. Before starting the study, we requested authorization from the health director of the wilaya of Saida, who authorized us to work with pregnant women at the Hamdane Bakhta maternity ward of the Wilaya. Thus, we certify that the study was carried out in accordance with ethical standards and confirm that all participants consented to participate in this study. The Algerian Law No. 18-11 of July 2, 2018 relating to health establishes general rules in the field of health and includes provisions on clinical trials and biomedical research involving human beings, with requirements for informed consent, protection, and ethical agreements."

"We certify that this research complied with ethical standards, following the Helsinki Declaration (1975, revised in 2013) and relevant national regulations."

"No funding for this study"

Acknowledgments

The authors sincerely thank all mothers and their infants included in this study and the maternity manager Hamdane Bakhta for their efforts to carry out this study.

Data availability

Data are available upon reasonable request

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