

Breastfeeding Practice in Tunisia: Combined Results of Multiple Indicator Cluster Surveys (2000-2018)

Global Pediatric Health
Volume 11: 1–25
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DOI: 10.1177/2333794X241288743
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Abstract

Introduction. Breastfeeding practices fall short of optimal levels globally, despite its known health benefits and World Health Organization endorsements. We aimed through this study to firstly estimate the global prevalence of principal indicators of breastfeeding practice in Tunisia. Secondly, we aimed to identify their associated factors and to assess the temporal trend of breastfeeding practice in Tunisia from 2000 to 2018. **Methods.** We extracted data from all available reports of Multiple Indicator Cluster Surveys (MICS) surveys conducted in Tunisia (MICS2000, 2006, 2012 and 2018) that were publicly available on the MICS UNICEF website prior to 2024. **Results.** Never breastfeeding prevalence was 4% (95% CI [3%-7%]) with a significant increase ($P < 10^{-3}$) from 2000 (2.4%) to 2018 (7.8%). The prevalence of early breastfeeding initiation was 56% (95% CI [20%-87%]) with a significant decrease ($P < 10^{-3}$) from 2006 (87.4%) to 2018 (31.5%). The prevalence of exclusive breastfeeding was 15% (95% CI [5%-35%]) with a significant decrease ($P < 10^{-3}$) from 2000 (46.4%) to 2018 (13.4%). The prevalence of predominant breastfeeding was 41% (95% CI [31%-51%]) with a significant decrease ($P < 10^{-3}$) from 2000 (50.5%) to 2018 (30.4%). The prevalence of continued breastfeeding up to the age of 2 years was 19% (95% CI [16%-22%]) with no significant decrease from 2000 to 2018 ($P = .09$). The mother educational level was significantly associated with early breastfeeding initiation, exclusive and predominant breastfeeding. A higher prevalence of exclusive breastfeeding was found among mothers from rural areas. **Conclusions.** Tunisia has been experiencing low rates of breastfeeding practice, with a concerning decline observed over the years. Addressing this issue effectively necessitates a comprehensive, multi-faceted approach that encompasses various aspects of society, healthcare, and policymaking.

Keywords

breastfeeding, exclusive breastfeeding, prevalence, Tunisia

Received June 24, 2024. Received revised September 7, 2024. Accepted for publication September 16, 2024.

Introduction

Breastfeeding is an ideal, safe, and ecological source of nutrients and immune factors promoting optimal growth and development while reducing the risk of infections and chronic diseases such as obesity and diabetes.^{1,2} It provides many health benefits for both infant and mother health.^{3,4} It has been demonstrated that breastfeeding can have long-term repercussions on health even in adulthood.^{5,6} Not breastfeeding increased infant mortality, especially in low and middle-income countries, due to infections and illness such as pneumonia and diarrhea.⁷

The United Nations International Children's Emergency Fund (UNICEF) and The World Health Organization (WHO) advocates for early initiation of breastfeeding within 1 hour after birth, for exclusive

breastfeeding during the first 6 months of life, and for continued breastfeeding until 2 years and beyond.⁸

Breastfeeding practices fall short of optimal levels recommended by the WHO, despite its known health benefits. According to the WHO, fewer than half (44%) of infants aged 0 to 6 months worldwide are exclusively breastfed which falls below the global WHO target of 50% by 2025 and at least 70% by 2030.⁸ Many children do not start breastfeeding early enough, are not exclusively breastfed for the recommended 6 months, or stop breastfeeding too early. Breastfeeding frequency tends to decline rapidly a few months after birth with early introduction of foods and reliance on breast-milk substitutes as an easy alternative which may contribute to the early cessation of breastfeeding.^{9,10}



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In Tunisia, there is a lack of recent studies on breastfeeding prevalence, and the few existing ones are not updated and conducted on small, non-representative samples, among diverse settings in various regions of the country, with no standardized study designs and outcomes definitions.¹¹⁻¹³ According to these studies, the practice of exclusive breastfeeding for 6 months appears to be low and varies widely from 1.9% to 41.5%.^{11,12}

While few studies have assessed the prevalence and determinants of breastfeeding in various regions of Tunisia, there is a need to consolidate existing data and provide a comprehensive understanding of breastfeeding practices nationwide.

Multiple Indicator Cluster Surveys (MICS) are national surveys conducted in Tunisia regularly from 2000 and the last one dates from 2018. These surveys essentially estimate prevalence of standard breastfeeding indicators.

Aggregating all the breastfeeding relating data available from MICS surveys, will enable us to enhance our understanding of breastfeeding behaviors from national standardized surveys, visualizing temporal trends and understanding the factors influencing breastfeeding practices across the country from a large representative sample size.

We aimed through this study to firstly estimate the pooled prevalence of principal indicators of breastfeeding practice (never breastfeeding, early initiation of breastfeeding within the first hour following birth, exclusive and predominant breastfeeding during the first 6 months, continued breastfeeding up to the age of 2 years), in Tunisia. Secondly, we aimed to identify the associated factors of practicing breastfeeding and to assess the temporal trend of principal indicators of breastfeeding practice in Tunisia from 2000 to 2018.

Methodology

Study Design, Data Source and Study Population

This was a review study of all MICS surveys conducted in Tunisia, utilizing information solely available from the official UNICEF MICS website.

MICSs are population-based cross-sectional household surveys using similar sampling strategies and standardized

questionnaires carried out at approximately 6-year intervals in Tunisia since 2000. We extracted data from all available reports of MICS surveys conducted in Tunisia (MICS 2000, 2006, 2012 and 2018) that were publicly available on the MICS UNICEF website¹⁴ prior to 2024.

MICS data were collected in standardized face-to-face interviews with respondents, using the method of Computer-Assisted Personal Interviewing (CAPI) and based on a set of globally recommended standardized questionnaires. The questionnaires are tested on a small sample of households before starting the data collection.

The study sample of all MICS surveys comprised all mothers who had a live birth in the 24 months preceding the survey.

Measurement of Outcomes

The main outcomes of interest for this study were the pooled prevalence of 5 principal indicators of breastfeeding practice:

-Never breastfeeding defined as:

Number of children who were never breastfed/ Number of last-born children born alive in the last 2 years.

-Early breastfeeding initiation within the first hour following birth defined as: Number of children who were breastfed early within the first hour following birth/ Number of last-born children born alive in the last 2 years.

-Exclusive breastfeeding during the first 6 months defined as:

Number of infants who were exclusively breastfed during the first 6 months/ Number of infants aged between 0 and 5 months.

***Exclusive breastfeeding:** Infants receiving breast milk and not receiving any other liquids or foods except oral rehydration solution, vitamins, mineral supplements, and medications.

-Predominant breastfeeding during the first 6 months defined as:

Number of infants who receive breastfeeding as the predominant source of food / Number of infants aged between 0 and 5 months

*** Predominant breastfeeding:** Infants who receive breast milk and some fluids (water and water-based drinks, fruit juices, ritual fluids) but do not receive anything else (especially animal milk and liquid foods)

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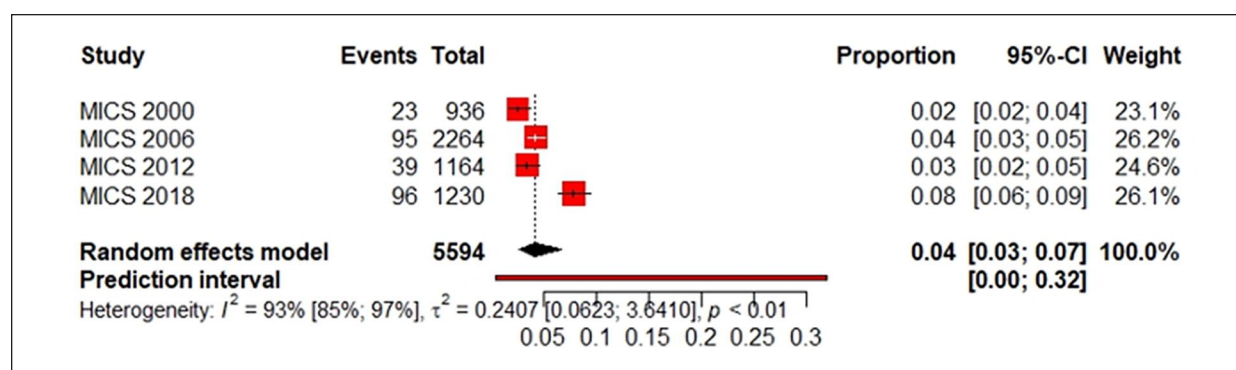


Figure 1. Forest plot of pooled prevalence of children who were never breastfed according to the MICS Tunisian surveys (2000-2006-2012-2018).

-Continued breastfeeding up to the age of 2 years defined as:

Number of children aged 20 to 23 months who continue to receive breastmilk/ Number of infants aged between 20 and 23 months

Data Collection

Data for our study was extracted from the included MICS studies reports and the following information were reported for each study whenever it was available: the year of conduction; the prevalence of breastfeeding indicators (never breastfeeding, early breastfeeding initiation, exclusive breastfeeding, predominant breastfeeding and continued breastfeeding up to the age of 2 years) for each MICS study; the stratified prevalence of each breastfeeding indicator, by infant sex, region, environment of residence, place of birth, mother educational level and economic well-being index.

Data Analysis

The prevalence of each of the 5 breastfeeding indicators was combined by applying a random-effects model meta-analysis using the inverse variance method with implementation of logit transformations of proportions.¹⁵

Breastfeeding indicators were assessed with the following risk factors (binary variables) whenever it was possible, and information was available from included MICS reports:

- Infant sex: Male or female.
- Region of the country: North or center/south.
- Environment of residence: Urban or rural.
- Place of birth: Public or private healthcare structure.
- Mother educational level: Illiterate /primary or secondary/Higher.
- Economic well-being index: The poorest or other status (Second/medium/fourth/the richest).

Associations between these risk factors and each breastfeeding indicator were assessed using pooled odds ratios (OR) as outcome measures using random-effects models. A P -value $\leq .05$ was considered as significant.

Between-studies heterogeneity was assessed using Higgins's I-Squared statistic (I^2) and Cochran's Q-statistics (Q test).¹⁶ Statistical significance for Q test is set at $P < .05$.¹⁷

Pearson's Chi-squared Test was used to assess if there is a significant difference for each breastfeeding indicator between the latest and the oldest MICS study.

All analyses were performed with the statistical R-Software (version 4.2.3; R Core Team, 2020), using package meta.

Ethical Approval and Informed Consent

The ethical approval was not needed because all data utilized are published, openly accessible and thoroughly anonymized.

Results

Breastfeeding Indicators and Their Associated Factors

Never breastfeeding indicator

Pooled prevalence of children who were never breastfed. The pooled prevalence of children who were never breastfed was 4% (95% CI [3%-7%]), among an overall sample size of 5594 (from MICS 2000, 2006, 2012 and 2018). The results were heterogenous ($I^2=93\%$; 95% CI [85% -97%]; $P < .01$), (Figure 1).

The stratified pooled prevalence of never breastfeeding is represented in Table 1. The pooled prevalence of never breastfeeding was higher in urban than rural environment (5% [4%-7%] and 3% [1%-6%] respectively). At regional level, results were comparable with prevalence variation from 4% to 5%. A higher prevalence of 36% was reported

Table 1. Stratified Pooled Prevalence of Never Breastfeeding by Socioeconomic and Demographic Characteristics of Mothers (Data From Tunisian MICS 2000-2006-2012-2018).

Breastfeeding indicator	Stratified prevalence of children who were never breastfed (%)						
	Pooled prevalence (ALL MICS)			Prevalence from MICS 2000 (%)	Prevalence from MICS 2006 (%)	Prevalence from MICS 2012 (%)	Prevalence from MICS 2018 (%)
	% [CI _{95%}]	Heterogeneity I ² (%)	Heterogeneity P				
Environment of residence							
Rural	3 [1-6]	90	<.01	0.88	2.1	2.7	7.3
Urban	5 [4-7]	82	<.01	3.89	5.4	3.8	8.1
Region of the country							
District of Tunis	5 [3-8]	60	.06	2.7	5.7	3.5	8.3
Northeast	5 [4-7]	0	.69	3.4	5.2	3.9	5.8
Northwest	4 [2-8]	71	.02	0.8	2.4	3.5	8.9
Center East	4 [3-7]	68	.02	3.7	2.9	3.1	7.1
center West	5 [2-10]	85	<.01	2.7	2.9	2.8	11.5
Southeast	5 [2-9]	59	.06	1.4	7.1	1.9	6.5
Southwest	4 [2-7]	1	.39	0.8	2.6	7.3	3.5
Mother Educational level							
Illiterate	36 [2-95]	99	<.01	-	4.6	4.5	15.3
Primary	4 [3-6]	0	.81	-	4.1	4.8	4.8
Secondary or Higher	4 [2-8]	92	<.01	-	4.0	2.5	7.9
Place of birth							
Public structure	5 [2-10]	92	<.01	-	-	3.5	7.3
Private structure	5 [1-18]	86	<.01	-	-	2.6	9.5
economic well-being index (quintile)							
the poorest	5 [4-8]	0	.58	-	-	4.6	6.1
Second	6 [2-15]	85	.01	-	-	3.1	8.9
Medium	5 [4-8]	0	.36	-	-	4.4	6.1
Fourth	4 [1-22]	92	<.01	-	-	1.6	9.7
the richest	6 [3-11]	63	.10	-	-	3.7	7.6

among illiterate mothers compared to other mother educational levels. When considering place of birth, this prevalence was 5% in both public and private structures. This prevalence varied between 4% and 6% within the different levels of economic well-being index.

Associated factors to never breastfeeding

1. Place of birth:

Two MICS studies (2012-2018) were included in the analysis with a total of 2371 mothers. The place of birth (Public structure compared private structure) was not significantly associated with never breastfeeding (pooled OR=0.85; 95% CI [0.53-1.37]; $P=.5$; Table 2). According to the Q-test, the result was homogenous ($P=.29$) and $I^2=9\%$. The Forest plot is illustrated in Figure 2A.

2. Mother educational level:

Three MICS studies (2006-2012-2018) were included in the analysis with a total of 4657 mothers. The mother

educational level (Primary or less compared to secondary or higher) was not significantly associated with never breastfeeding (pooled OR=4.48; 95% CI [0.22-90.28]; $P=.32$; Table 2). According to the Q-test, the result was heterogenous ($P<.01$) and $I^2=99\%$. The Forest plot is illustrated in Figure 2B.

3. Environment of residence:

Four MICS studies (2000-2006-2012-2018) were included in the analysis with a total of 5592 mothers. The environment of residence (Urban compared to rural) was significantly associated with never breastfeeding with a higher prevalence in urban area (pooled OR=1.89; 95% CI [1.08-3.29]; $P=.02$; Table 2). According to the Q-test, the result was heterogenous ($P=.02$) and $I^2=68\%$. The Forest plot is illustrated in Figure 2C.

4. Region of the country:

Four MICS studies (2000-2006-2012-2018) were included in the analysis with a total of 5590 participants.

Table 2. Associated Factors to Never Breastfeeding (Combined Results From Tunisian MICS Surveys).

Factors	Pooled OR [95% CI]	P value	Heterogeneity	
			I ² (%) [95% CI]	P
Place of birth		.5	9 [-]	.29
Public structure	0.85 [0.53-1.37]			
Private structure	reference			
Mother Educational level		.32	99 [99-99]	<.01
Illiterate/Primary	4.48 [0.22-90.28]			
Secondary or Higher	reference			
Environment of residence		.02	68 [8-89]	.02
Urban	1.89 [1.08-3.29]			
Rural	reference			
Region of the country		.41	0 [0 - 85]	.70
North	1.11 [0.86-1.43]			
Center/South	reference			
Economic well-being level		.97	58 [0-90]	.12
The poorest	1.01 [0.50-2.06]			
Second/medium/ fourth/the richest	reference			

The never breastfeeding was not significantly different between regions (North of the country compared to the center/south). The pooled OR=1.11; 95% CI [0.86-1.43]; $P=.41$; Table 2). According to the Q-test, the result was homogenous ($P=.7$) and $I^2=0\%$. The Forest plot is illustrated in Figure 2D.

5. Economic well-being level:

Two MICS studies (2012-2018) were included in the analysis with a total of 2394 mothers. The economic well-being level (the poorest compared to other levels) was not significantly associated with never breastfeeding (pooled OR=1.01; 95% CI [0.50-2.06]; $P=.97$; Table 2). According to the Q-test, the result was homogenous ($P=.12$). The Forest plot is illustrated in Figure 2E.

Early breastfeeding initiation indicator

Pooled prevalence of early breastfeeding initiation. The pooled prevalence of early breastfeeding initiation was 56% (95% CI [20%-87%]), among an overall sample size of 4658 (from MICS 2006, 2012 and 2018). The

results were heterogenous ($I^2=100\%$; 95% CI [100%-100%]; $P<.01$; Figure 3).

The stratified pooled prevalence of early breastfeeding initiation is represented in Table 3. The lowest prevalence of early initiation of breastfeeding was noted in private healthcare facilities with a prevalence of 27% [21%-34%]. This prevalence was lower in urban (54%) compared to rural environment, in the Northwest region of the country (48%) compared to other regions, among mothers having a secondary or higher educational level (52%) compared to other educational levels, among mothers who have given birth in a private facility (27%) compared to public facility and among mothers having the richest economic well-being index (31%) compared to other economic levels.

Associated factors to early breastfeeding initiation

1. Place of birth:

A total of 2 MICS studies (2012-2018) were included in the analysis with a total of 2389 mothers. The place of birth (Public structure compared private structure) was not significantly associated with early breastfeeding initiation (pooled OR=1.2 (95% CI: 0.97-1.47); $P=.08$; Table 4). According to the Q-test, the result was homogenous ($P=.31$) and $I^2=2\%$. The Forest plot is illustrated in Figure 4A.

2. Mother educational level:

A total of 3 MICS studies (2006-2012-2018) were included in the analysis with a total of 4657 mothers. The mother educational level (Primary or less compared to secondary or higher) was significantly associated with early breastfeeding initiation higher prevalence among mothers who are illiterate or having a primary educational level (pooled OR=1.39 (95% CI: 1.05-1.84); $P=.02$; Table 4). According to the Q-test, the result was heterogenous ($P=.03$) and $I^2=72\%$. The Forest plot is illustrated in Figure 4B.

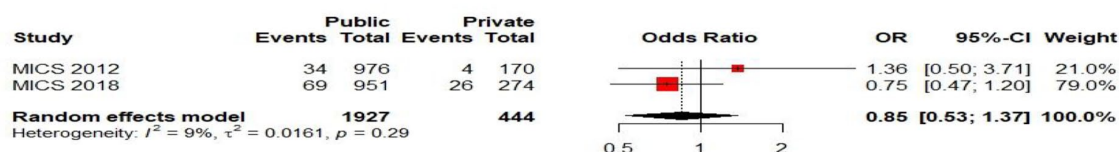
3. Environment of residence

A total of 3 MICS studies (2006-2012-2018) were included in the analysis with a total of 4656 mothers. The environment of residence (rural compared to urban) was not significantly associated with early breastfeeding initiation (pooled OR=1.25 (95% CI: 0.86-1.81); $P=.24$; Table 4). According to the Q-test, the result was heterogenous ($P=.001$) and $I^2=85\%$. The Forest plot is illustrated in Figure 4C.

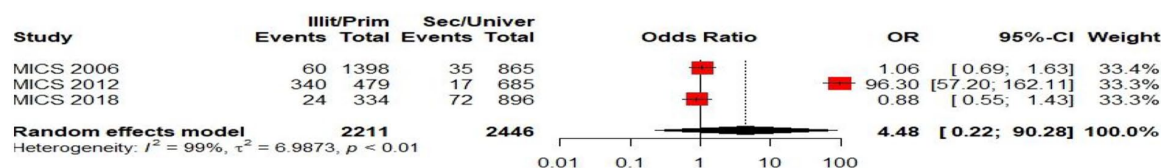
4. Region of the country:

A total of 3 MICS studies (2006-2012-2018) were included in the analysis with a total of 4657 mothers.

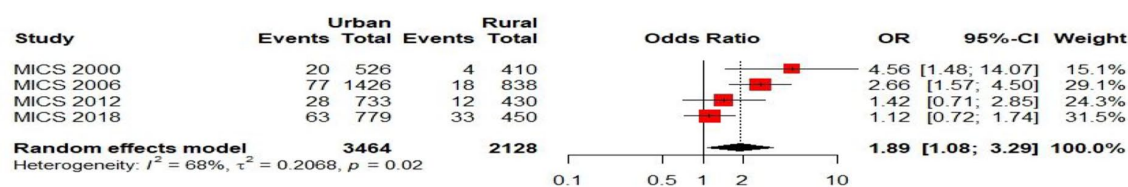
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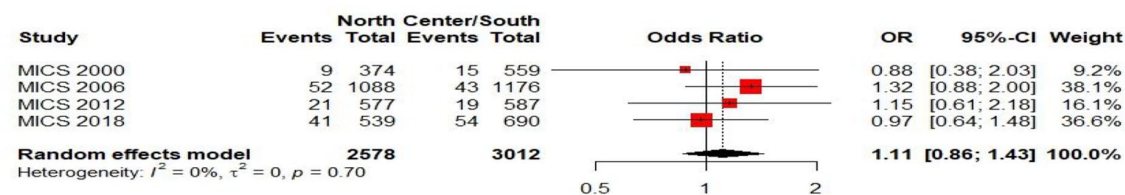
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C



D



E

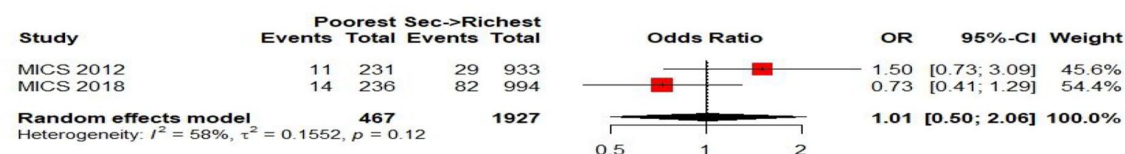


Figure 2. Forest plots of the pooled OR estimating the association between Never breastfeeding and: (A) Place of birth; (B) Mother Educational level; (C) Environment of residence; (D) Region of the country; (E) economic well-being level.

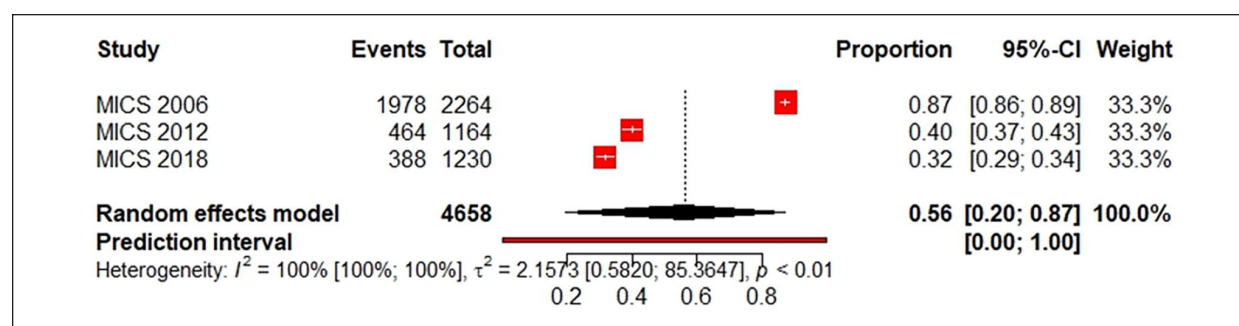


Figure 3. Forest plot of pooled prevalence of early breastfeeding initiation according to the MICS Tunisian surveys (2006-2012-2018).

Table 3. Stratified Pooled Prevalence of Early Breastfeeding Initiation by Socioeconomic and Demographic Characteristics of Mothers (Data From Tunisian MICS 2000-2006-2012-2018).

Breastfeeding indicator	Stratified prevalence of early breastfeeding initiation (%)						
	Pooled prevalence (ALL MICS)			Prevalence from MICS 2000 (%)	Prevalence from MICS 2006 (%)	Prevalence from MICS 2012 (%)	Prevalence from MICS 2018 (%)
	% [CI _{95%}]	Heterogeneity I ² (%)	Heterogeneity P				
Environment of residence							
Rural	60 [20-90]	100	<.01	-	90.0	46.5	29.5
Urban	54 [19-86]	100	<.01	-	85.9	36.1	32.8
Region of the country							
District of Tunis	53 [22-83]	99	<.01	-	83.0	32.6	39.2
Northeast	59 [16-91]	99	<.01	-	91.3	44.9	25.5
Northwest	48 [15-83]	98	<.01	-	81.6	40.4	20.6
Center East	59 [14-93]	99	<.01	-	93.0	34.5	28.9
center West	58 [21-87]	99	<.01	-	86.6	51.8	27.0
Southeast	63 [24-91]	98	<.01	-	91.0	45.0	39.3
Southwest	60 [32-83]	94	<.01	-	81.7	36.9	54.2
Mother Educational level							
Illiterate	64 [27-90]	99	<.01	-	89.8	48.3	40.9
Primary	59 [19-90]	99	<.01	-	90.0	43.4	30.4
Secondary or Higher	52 [20-83]	100	<.01	-	83.4	36.6	31.2
Place of birth							
Public facility	37 [27-48]	96	<.01	-	-	42.8	92.7
Private facility	27 [21-34]	58	.12	-	-	23.5	90.5
economic well-being index (quintile)							
the poorest	39 [27-52]	88	<.01	-	-	45.5	32.0
Second	37 [23-53]	92	<.01	-	-	45.3	29.5
Medium	36 [31-41]	17	.27	-	-	38.6	33.7
Fourth	35 [30-40]	26	.25	-	-	37.4	32.6
the richest	31 [27-36]	0	.67	-	-	32.1	30.2

The early breastfeeding initiation was significantly different between regions (Center or south of the country compared to the North) with higher prevalence in the center or south of the country compared to the North.

The pooled odds ratio OR was equal to 1.22 (95% CI: 1.03-1.44); $P = .02$), (Table 4). According to the Q-test, the result was homogenous ($P = .23$) and $I^2 = 32\%$. The Forest plot is illustrated in Figure 4D.

Table 4. Associated Factors to the Early Initiation of Breastfeeding (Combined Results From Tunisian MICS Surveys).

Factors	Pooled OR [95% CI]	P value	Heterogeneity	
			I ² (%) [95% CI]	P
Place of birth		.08	2 [-]	.31
Public structure	1.2 [0.97-1.47]			
Private structure	reference			
Mother Educational level		.02	72 [7-92]	.02
Illiterate/Primary	1.39 [1.05-1.84]			
Secondary or Higher	reference			
Environment of residence		.24	85 [54-95]	.001
Rural	1.25 [0.86-1.81]			
Urban	reference			
Region of the country		.02	32 [0-93]	.23
Center/South	1.22 [1.03-1.44]			
North	reference			
Economic well-being level		.22	34 [-]	.22
The poorest	1.17 [0.91-1.52]			
Second/medium/fourth/the richest	reference			

5. Economic well-being level:

A total of 2 MICS studies (2012-2018) were included in the analysis with a total of 2394 mothers. The economic well-being level (the poorest compared to other levels) was not significantly associated with early breastfeeding initiation (pooled OR=1.17 (95% CI: 0.91-1.52); $P=.22$; Table 4). According to the Q-test, the result was homogenous ($P=.22$) and $I^2=34\%$. The Forest plot is illustrated in Figure 4E.

Exclusive breastfeeding during the first 6 months

Pooled prevalence of exclusive breastfeeding during the first 6 months. The pooled prevalence of exclusive breastfeeding during the first 6 months was 15% (95% CI [5%-35%]), among an overall sample size of 1841 (from MICS 2000, 2006, 2012 and 2018). The results were heterogenous ($I^2=99\%$; 95% CI [98% -99%]; $P<.01$; Figure 5).

The stratified pooled prevalence of exclusive breastfeeding during the first 6 months is represented in Table 5.

This prevalence was lower in urban (14%) compared to rural environment, in the Northeast region of the country (9%) compared to other regions, among mothers having a secondary or higher educational level (7%) compared to other educational levels and among mothers having a medium economic well-being index (5%) compared to other economic levels.

Associated factors to exclusive breastfeeding during the first 6 months

1. Infant sex:

A total of 3 MICS studies (2006-2012-2018) were included in the analysis with a total of 905 mothers. The infant sex (male compared to female) was not significantly associated with exclusive breastfeeding practice during the first 6 months (pooled OR=1.07 (95% CI: 0.68-1.70); $P=.76$; Table 6). According to the Q-test, the result was homogenous ($P=.39$) and $I^2=0\%$. The Forest plot is illustrated in Figure 6A.

2. Mother educational level:

A total of 3 MICS studies (2006-2012-2018) were included in the analysis with a total of 897 mothers. The mother educational level (Primary or less compared to secondary or higher) was significantly associated with exclusive breastfeeding practice during the first 6 months with higher prevalence among mothers who are illiterate or having a primary educational level (pooled OR=2.27 (95% CI: 1.36-3.79); $P=.001$; Table 6). According to the Q-test, the result was homogenous ($P=.61$) and $I^2=0\%$. The Forest plot is illustrated in Figure 6B.

3. Environment of residence

A total of 4 MICS studies (2000-2006-2012-2018) were included in the analysis with a total of 1841 mothers. The environment of residence (rural compared to urban) was significantly associated with exclusive breastfeeding practice during the first 6 months with higher prevalence among mothers from rural area (pooled OR=1.27 (95% CI: 1.01-1.59); $P=.04$; Table 6). According to the Q-test, the result was homogenous ($P=.65$) and $I^2=0\%$. The Forest plot is illustrated in Figure 6C.

4. Region of the country:

A total of 3 MICS studies (2000-2012-2018) were included in the analysis with a total of 1527 mothers. The exclusive breastfeeding practice during the first 6 months was not significantly different between regions (Center or south of the country compared to the North). The pooled

A

Study	Public		Private		Odds Ratio	OR	95%-CI	Weight
	Events	Total	Events	Total				
MICS 2012	105	231	360	933		1.33	[1.00; 1.78]	50.2%
MICS 2018	303	951	83	274		1.08	[0.81; 1.44]	49.8%
Random effects model	1182		1207			1.20	[0.97; 1.47]	100.0%

Heterogeneity: $I^2 = 2\%$, $\tau^2 = 0.0004$, $p = 0.31$

0.75 1 1.5

B

Study	Illit/Prim		Sec/Univer		Odds Ratio	OR	95%-CI	Weight
	Events	Total	Events	Total				
MICS 2006	1257	1398	721	865		1.78	[1.38; 2.28]	33.5%
MICS 2012	214	479	251	685		1.40	[1.10; 1.78]	34.3%
MICS 2018	109	334	280	896		1.07	[0.82; 1.41]	32.2%
Random effects model	2211		2446			1.39	[1.05; 1.84]	100.0%

Heterogeneity: $I^2 = 72\%$, $\tau^2 = 0.0448$, $p = 0.03$

0.5 1 2

C

Study	Rural		Urban		Odds Ratio	OR	95%-CI	Weight
	Events	Total	Events	Total				
MICS 2006	754	838	1225	1426		1.48	[1.13; 1.94]	32.7%
MICS 2012	200	430	265	733		1.54	[1.21; 1.96]	33.9%
MICS 2018	133	450	256	779		0.86	[0.67; 1.10]	33.5%
Random effects model	1718		2938			1.25	[0.86; 1.81]	100.0%

Heterogeneity: $I^2 = 85\%$, $\tau^2 = 0.0904$, $p < 0.01$

0.75 1 1.5

D

Study	Center/South		North		Odds Ratio	OR	95%-CI	Weight
	Events	Total	Events	Total				
MICS 2006	1051	1176	928	1088		1.45	[1.13; 1.87]	31.9%
MICS 2012	244	587	220	577		1.15	[0.91; 1.46]	34.8%
MICS 2018	223	690	165	539		1.09	[0.85; 1.39]	33.3%
Random effects model	2453		2204			1.22	[1.03; 1.44]	100.0%

Heterogeneity: $I^2 = 32\%$, $\tau^2 = 0.0070$, $p = 0.23$

0.75 1 1.5

E

Study	Poorest Sec->Richest				Odds Ratio	OR	95%-CI	Weight
	Events	Total	Events	Total				
MICS 2012	105	231	360	933		1.33	[1.00; 1.78]	51.5%
MICS 2018	76	236	313	994		1.02	[0.75; 1.39]	48.5%
Random effects model	467		1927			1.17	[0.91; 1.52]	100.0%

Heterogeneity: $I^2 = 34\%$, $\tau^2 = 0.0117$, $p = 0.22$

0.75 1 1.5

Figure 4. Forest plots of the pooled OR estimating the association between early breastfeeding initiation and: (A) Place of birth; (B) Mother Educational level; (C) Environment of residence; (D) Region of the country; (E) economic well-being level.

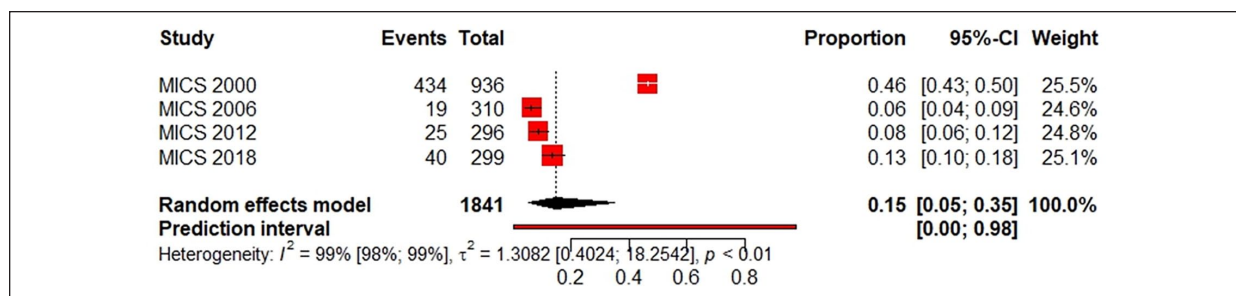


Figure 5. Forest plot of pooled prevalence of exclusive breastfeeding during the first 6 months according to the MICS Tunisian surveys (2000-2006-2012-2018).

Table 5. Stratified Pooled Prevalence of Exclusive Breastfeeding During the First 6 Months by Socioeconomic and Demographic Characteristics of Mothers (Data From Tunisian MICS 2000-2006-2012-2018).

Breastfeeding indicator	Stratified prevalence of exclusive breastfeeding during the first 6 months (%)						
	Pooled prevalence (ALL MICS)			Prevalence from MICS 2000 (%)	Prevalence from MICS 2006 (%)	Prevalence from MICS 2012 (%)	Prevalence from MICS 2018 (%)
	% [CI _{95%}]	Heterogeneity I ² (%)	Heterogeneity <i>P</i>				
Environment of residence							
Rural	16 [5-40]	97	<.01	50.3	5.2	8.6	16.3
Urban	14 [6-33]	98	<.01	43.4	6.7	8.4	12.1
Region of the country							
District of Tunis	14 [5-34]	91	<.01	38.5	11.1	3.0	14.0
Northeast	9 [1-39]	89	<.01	42.7	0.0	2.4	12.6
Northwest	10 [2-38]	91	<.01	48.7	2.7	2.0	5.0
Center East	16 [6-35]	93	<.01	41.9	11.2	5.8	13.5
center West	31 [14-56]	91	<.01	53.3	-	17.7	20.4
Southeast	27 [10-57]	89	<.01	51.9	-	22.1	9.9
Southwest	30 [10-62]	82	<.01	56.5	-	16.0	18.9
Mother Educational level							
Illiterate	9 [2-28]	66	.09	-	3.5	15.5	-
Primary	13 [9-18]	0	.41	-	10.3	14.0	17.0
Secondary or Higher	7 [3-14]	81	<.01	-	3.8	5.2	12.7
Infant sex							
Male	9 [5-16]	79	<.01	-	6.7	7.1	15.2
Female	9 [6-13]	34	.22	-	5.4	10.2	11.5
economic well-being index (quintile)							
the poorest	17 [11-25]	0	.70	-	-	15.7	17.6
Second	12 [7-20]	0	.33	-	-	9.2	15.1
Medium	5 [1-21]	57	.13	-	-	1.4	9.2
Fourth	12 [7-19]	15	.28	-	-	9.1	15.3
the richest	9 [4-16]	0	.62	-	-	7.1	10.6

OR=1.82; 95% CI [0.87-3.79]; $P=.1$; Table 6). According to the Q-test, the result was heterogenous ($P=.05$) and $I^2=66\%$. The Forest plot is illustrated in Figure 6D.

5. Economic well-being level:

A total of 2 MICS studies (2012-2018) were included in the analysis with a total of 596 mothers. The economic

well-being level (the poorest compared to other levels) was significantly associated with exclusive breastfeeding practice during the first 6 months with higher prevalence among mothers having the poorest economic level (pooled OR=1.86 (95% CI: 1.03-3.36); $P=.04$; Table 6). According to the Q-test, the result was homogenous ($P=.39$) and $I^2=0\%$. The Forest plot is illustrated in Figure 6E.

Table 6. Associated Factors to the Exclusive Breastfeeding Practice During the First 6 Months (Combined Results From Tunisian MICS surveys).

Factors	Pooled OR [95% CI]	P value	Heterogeneity	
			I ² (%) [95% CI]	P
Infant sex		.76	0 [0–90]	.39
Male	1.07 [0.68-1.70]			
Female	reference			
Mother Educational level		.001	0 [0–90]	
Illiterate/Primary	2.27 [1.36-3.79]			
Secondary or Higher	reference			
Environment of residence		.04	0 [0–85]	.65
Rural	1.27 [1.01-1.59]			
Urban	reference			
Region of the country		.1	66 [0–90]	
Center/South	1.82 [0.87-3.79]			
North	reference			
Economic well-being level		.04	0 [-]	.39
The poorest	1.86 [1.03-3.36]			
Second/medium/ fourth/the richest	reference			

Predominant breastfeeding during the first 6 months

Pooled prevalence of predominant breastfeeding during the first 6 months. The pooled prevalence of predominant breastfeeding during the first 6 months was 41% (95% CI [31%-51%]), among an overall sample size of 1841 (from MICS 2000, 2006, 2012 and 2018). The results were heterogenous ($I^2=94\%$; 95% CI [88%-97%] with $P<.01$; Figure 7).

The stratified pooled prevalence of predominant breastfeeding during the first 6 months is represented in Table 7. The lowest prevalence of predominant breastfeeding during the first 6 months was noted among mothers having the richest level of economic well being with a prevalence of 23% [16%-32%]. This prevalence was lower in urban (39%) compared to rural environment, in the Center East region of the country (33%) compared to other regions and, among male infant sex (34%) compared to female and among mothers having a secondary or higher educational level (33%) compared to the other educational levels.

Associated factors to predominant breastfeeding during the first 6 months**1. Infant sex:**

A total of 3 MICS studies (2006-2012-2018) were included in the analysis with a total of 905 mothers. The infant sex (male compared to female) was not significantly associated with predominant breastfeeding during the first 6 months (pooled OR=0.82 (95% CI: 0.61-1.09); $P=.16$; Table 8). According to the Q-test, the result was homogenous ($P=.34$) and $I^2=8\%$. The Forest plot is illustrated in Figure 8A.

2. Mother educational level:

A total of 3 MICS studies (2006-2012-2018) were included in the analysis with a total of 897 mothers. The mother educational level (Primary or less compared to secondary or higher) was significantly associated with predominant breastfeeding during the first 6 months with higher prevalence among mothers who are illiterate or having a primary educational level (pooled OR=1.39 (95% CI: 1.04-1.85); $P=.02$; Table 8). According to the Q-test, the result was homogenous ($P=.96$) and $I^2=0\%$. The Forest plot is illustrated in Figure 8B.

3. Environment of residence

A total of 4 MICS studies (2000-2006-2012-2018) were included in the analysis with a total of 1841 mothers. The environment of residence (rural compared to urban) was not significantly associated with predominant breastfeeding during the first 6 months (pooled OR=1.19 (95% CI: 0.88-1.62); $P=.26$; Table 8). According to the Q-test, the result was heterogenous ($P=.09$) and $I^2=54\%$. The Forest plot is illustrated in Figure 8C.

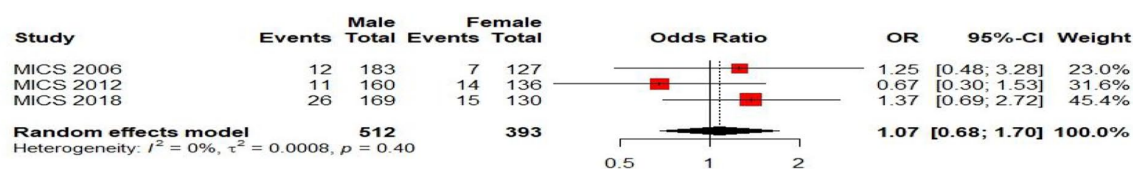
4. Region of the country:

A total of 3 MICS studies (2000-2012-2018) were included in the analysis with a total of 1527 mothers. The predominant breastfeeding during the first 6 months was significantly different between regions (North of the country compared to center or south) with a higher prevalence in the North. The pooled odds ratio (OR) was equal to 1.31 (95% CI: 1.06-1.61); $P=.01$; Table 8). According to the Q-test, the result was homogenous ($P=.93$) and $I^2=0\%$. The Forest plot is illustrated in Figure 8D.

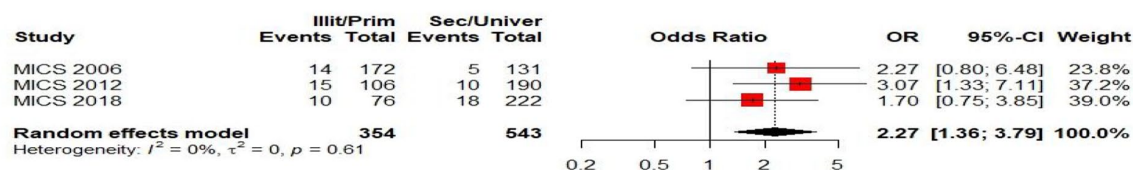
5. Economic well-being level:

A total of 2 MICS studies (2012-2018) were included in the analysis with a total of 596 mothers. The economic

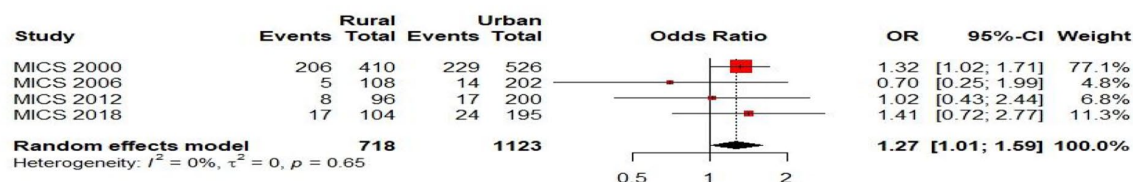
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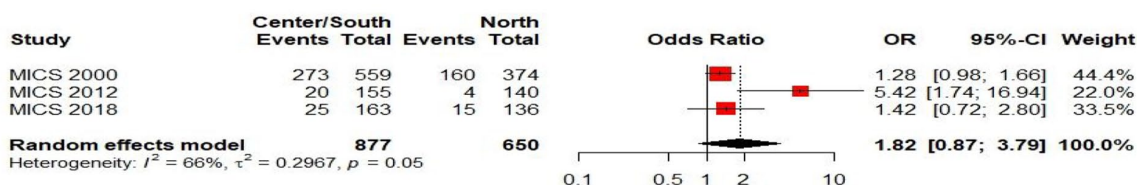
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C



D



E

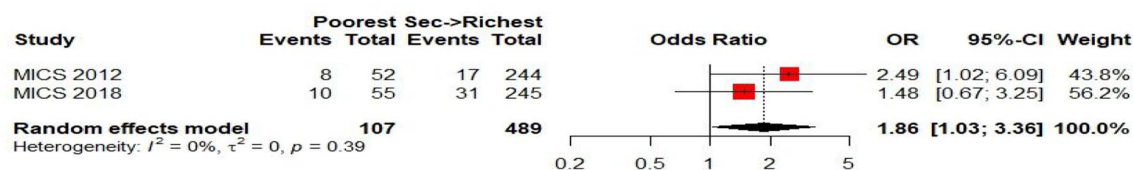


Figure 6. Forest plots of the pooled OR estimating the association between exclusive breastfeeding practice and: (A) Infant sex; (B) Mother Educational level; (C) Environment of residence; (D) Region of the country; (E) economic well-being level.

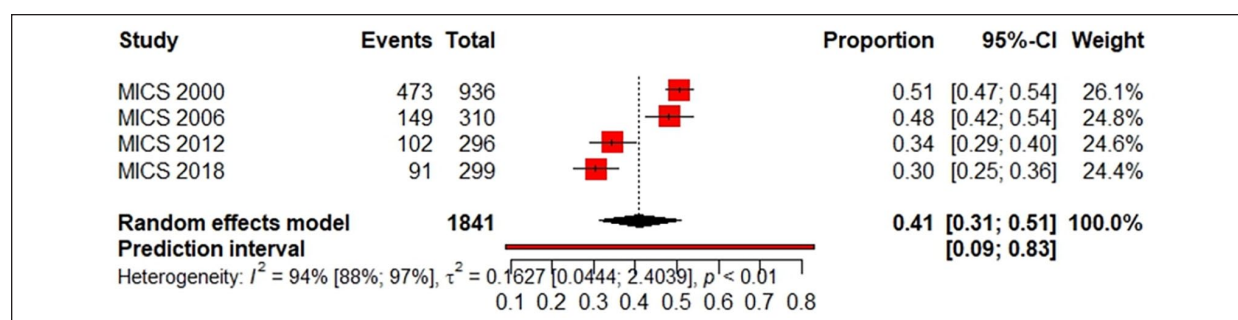


Figure 7. Forest plot of pooled prevalence of predominant breastfeeding during the first 6 months according to the MICS Tunisian surveys (2000-2006-2012-2018).

Table 7. Stratified Pooled Prevalence of Predominant Breastfeeding During the First 6 Months by Socioeconomic and Demographic Characteristics of Mothers (Data From Tunisian MICS 2000-2006-2012-2018).

Breastfeeding indicator	Stratified prevalence of predominant breastfeeding during the first 6 months (%)						
	Pooled prevalence (ALL MICS)			Prevalence from MICS 2000 (%)	Prevalence from MICS 2006 (%)	Prevalence from MICS 2012 (%)	Prevalence from MICS 2018 (%)
	% [CI _{95%}]	Heterogeneity I ² (%)	Heterogeneity P				
Environment of residence							
Rural	45 [38-52]	63	.04	48.6	52.8	41.5	35.2
Urban	39 [28-51]	94	<.01	52.1	45.5	31.5	27.9
Region of the country							
District of Tunis	42 [29-55]	84	<.01	57.9	37.8	41.4	27.5
Northeast	49 [41-57]	36	.19	52.6	59.6	40.8	41.7
Northwest	41 [29-54]	63	.04	50.4	48.2	19.8	35.4
Center East	33 [19-51]	91	<.01	54.3	38.0	19.3	23.7
center West	42 [36-48]	0	.4	43.9	-	44.4	34.3
Southeast	40 [29-51]	47	.15	46.2	-	39.9	23.3
Southwest	39 [29-50]	0	.76	41.8	-	33.9	32.0
Mother Educational level							
Illiterate	52 [41-62]	0	.63	-	53.4	49.3	-
Primary	44 [35-53]	54	.11	-	50.5	35.9	42.4
Secondary or Higher	33 [25-43]	77	.01	-	42.8	31.7	27.5
Infant sex							
Male	34 [23-48]	90	<.01	-	47.6	29.5	29.8
Female	40 [31-50]	75	.02	-	48.8	40.8	31.3
economic well-being index (quintile)							
the poorest	42 [33-52]	0	.66	-	-	43.4	39.9
Second	39 [30-48]	0	.97	-	-	38.8	38.0
Medium	28 [21-37]	0	.78	-	-	30.1	26.8
Fourth	32 [21-44]	60	.12	-	-	37.3	25.8
the richest	23 [16-32]	0	.97	-	-	23.3	23.7

well-being level (the poorest compared to other levels) was significantly associated with predominant breastfeeding during the first 6 months with a higher prevalence among mothers having the poorest economic level (pooled OR = 1.62 (95% CI: 1.06-2.50); $P = .02$; Table 8). According to the Q-test, the result was homogenous ($P = .88$) and $I^2 = 0\%$. The Forest plot is illustrated in Figure 8E.

Continued breastfeeding up to the age of 2 years

Pooled prevalence of continued breastfeeding up to the age of 2 years. The pooled prevalence of continued breastfeeding up to the age of 2 years was 19% (95% CI [16%-22%]), among an overall sample size of 1272 (from MICS 2000, 2006, 2012 and 2018). The results were not homogenous ($I^2 = 44\%$; 95% CI [0%-81%] with $P = .15$), (Figure 9).

Table 8. Associated Factors to Predominant Breastfeeding During the First 6 Months (Combined Results From Tunisian MICS Surveys).

Factors	Pooled OR [95% CI]	P value	Heterogeneity	
			I ² (%) [95% CI]	P
Infant sex		.16	8 [0 – 90]	.34
Male	0.82 [0.61-1.09]			
Female	reference			
Mother Educational level		.02	0 [0 – 90]	.95
Illiterate/Primary	1.39 [1.04-1.85]			
Secondary or Higher	reference			
Environment of residence		.26	54 [0 – 85]	.09
Rural	1.19 [0.88-1.62]			
Urban	reference			
Region of the country		.01	0 [0 – 90]	.93
North	1.31 [1.06-1.61]			
Center/South	reference			
Economic well-being level		.02	0.0 [-]	.88
The poorest	1.62 [1.06-2.50]			
Second/medium/ fourth/the richest	reference			

The stratified pooled prevalence of continued breastfeeding up to the age of 2 years is represented in Table 9. The lowest prevalence of continued breastfeeding up to the age of 2 years was noted among mothers having a secondary or higher educational level with a prevalence of 12% [7%-19%]. This prevalence was lower in urban (17%) compared to rural environment, in the Northeast region of the country (16%) compared to other regions and among mothers having fourth level of economic well being (13%) compared to the other economic levels.

Associated factors to continued breastfeeding up to the age of 2 years

1. Infant sex:

A total of 4 MICS studies (2000-2006-2012-2018) were included in the analysis with a total of 1273 mothers. The infant sex (male compared to female) was not significantly associated with continued breastfeeding up to the age of 2 years (pooled OR=0.96 (95% CI: 0.73-1.27);

$P=.79$; Table 10). According to the Q-test, the result was homogenous ($P=.57$) and $I^2=0\%$. The Forest plot is illustrated in Figure 10A.

2. Mother educational level:

A total of 4 MICS studies (2000-2006-2012-2018) were included in the analysis with a total of 1267 mothers. The mother educational level (Primary or less compared to secondary or higher) was not significantly associated with continued breastfeeding up to the age of 2 years (pooled OR=2.13 (95% CI: 0.95-4.78); $P=.06$; Table 10). According to the Q-test, the result was heterogeneous ($P=.007$) and $I^2=75\%$. The Forest plot is illustrated in Figure 10B.

3. Environment of residence

A total of 4 MICS studies (2000-2006-2012-2018) were included in the analysis with a total of 1272 mothers. The environment of residence (rural compared to urban) was not significantly associated with continued breastfeeding up to the age of 2 years (pooled OR=1.4 (95% CI: 0.98-2.02); $P=.06$; Table 10). According to the Q-test, the result was homogenous ($P=.32$) and $I^2=15\%$. The Forest plot is illustrated in Figure 10C.

4. Region of the country:

A total of 3 MICS studies (2000-2006-2018) were included in the analysis with a total of 1085 mothers. The continued breastfeeding up to the age of 2 years was not significantly different between regions (Center or south of the country compared to the North). The pooled OR was equal to 0.78 (95% CI: 0.56-1.09); $P=.14$; Table 10). According to the Q-test, the result was homogenous ($P=.38$) and $I^2=0\%$. The Forest plot is illustrated in Figure 10D.

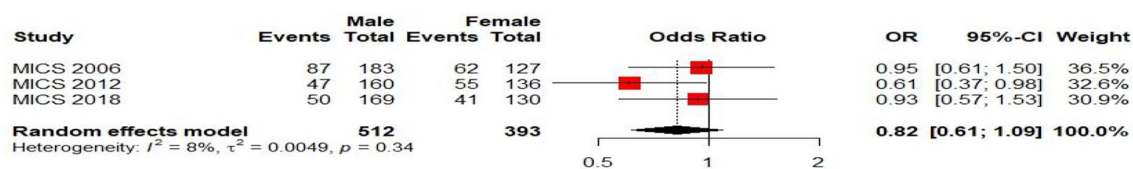
5. Economic well-being level:

A total of 2 MICS studies (2012-2018) were included in the analysis with a total of 407 mothers. The economic well-being level (the poorest compared to other levels) was not significantly associated with continued breastfeeding up to the age of 2 years (pooled OR=1.12 (95% CI: 0.52-2.42); $P=.76$; Table 10). According to the Q-test, the result was homogenous ($P=.2$) and $I^2=39\%$. The Forest plot is illustrated in Figure 10E.

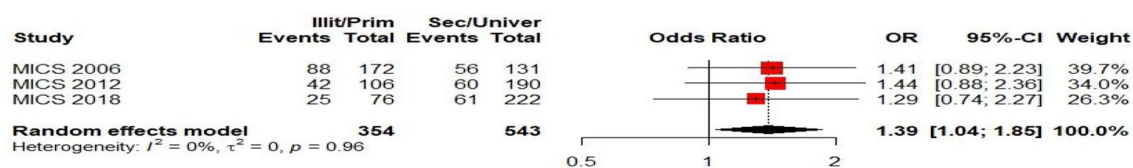
Breastfeeding Trends

Temporal trend of never breastfeeding. The prevalence of children who were never breastfed increases significantly ($P < 10^{-3}$) from 2000 (2.4%) to 2018 (7.8%); (Figure 11).

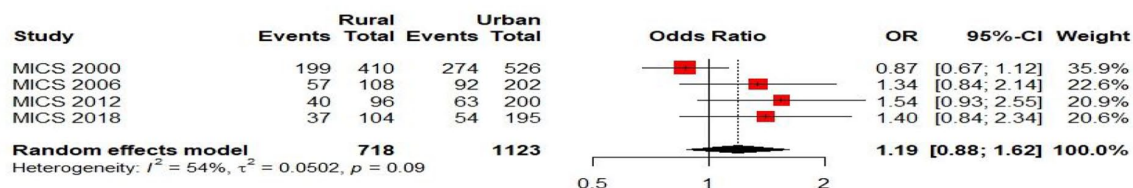
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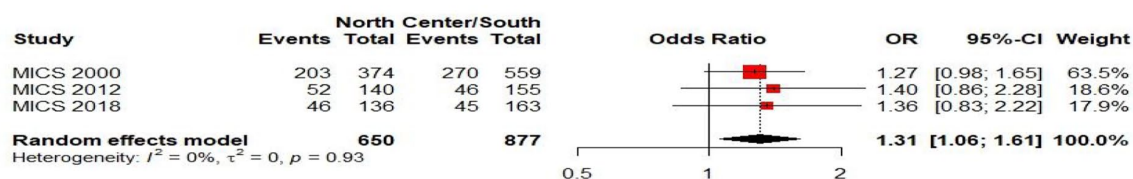
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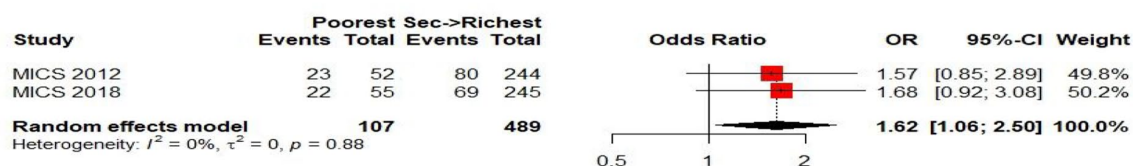


Figure 8. Forest plots of the pooled OR estimating the association between predominant breastfeeding practice and: (A) Infant sex; (B) Mother Educational level; (C) Environment of residence; (D) Region of the country; (E) economic well-being level.

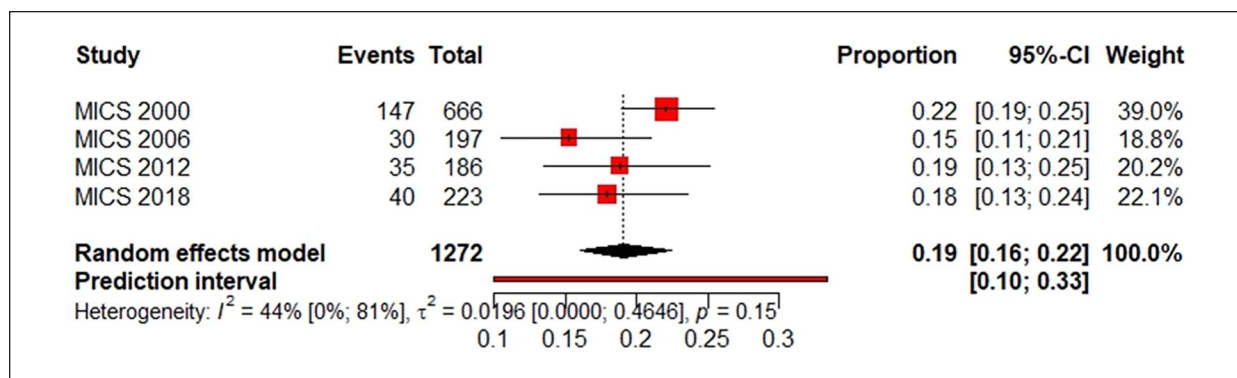


Figure 9. Forest plot of pooled prevalence of continued breastfeeding up to the age of 2 years according to the MICS Tunisian surveys (2000-2006-2012-2018).

Table 9. Stratified Pooled Prevalence of Continued Breastfeeding up to the Age of 2 Years by Socioeconomic and Demographic Characteristics of Mothers (Data From Tunisian MICS 2000-2006-2012-2018).

Breastfeeding indicator	Stratified prevalence of continued breastfeeding up to the age of 2 years (%)						
	Pooled prevalence (ALL MICS)			Prevalence from MICS 2000 (%)	Prevalence from MICS 2006 (%)	Prevalence from MICS 2012 (%)	Prevalence from MICS 2018 (%)
	% [CI _{95%}]	Heterogeneity I ² (%)	Heterogeneity P				
Infant sex							
Male	20 [17-23]	14	.32	21.3	12.9	19.4	20.5
Female	20 [16-24]	13	.33	22.9	17.6	18.7	15.4
Environment of residence							
Rural	22 [17-29]	52	.10	28.5	17.0	19.9	18.6
Urban	17 [15-20]	0	.86	17.4	14.6	18.5	17.9
Region of the country							
District of Tunis	21 [15-30]	47	.15	16.0	22.2	-	30.5
Northeast	16 [09-27]	30	.24	21.4	8.0	-	15.3
Northwest	27 [15-42]	58	.09	34.5	30.3	-	14.4
Center East	22 [17-28]	52	.13	22.1	0.0	-	24.2
center West	18 [13-24]	0	.76	19.2	17.4	-	14.2
Southeast	17 [09-29]	32	.23	21.0	16.8	-	3.3
Southwest	18 [07-39]	30	.24	27.6	10.8	-	8.6
Mother Educational level							
Illiterate	31 [25-37]	0	.90	31.3	27.5	31.1	-
Primary	22 [18-26]	0	.73	23.3	22.1	17.3	20.4
Secondary or Higher	12 [07-19]	68	.02	10.5	18.2	17.9	15.2
economic well-being index (quintile)							
the poorest	19 [11-32]	38	.21	-	-	25.6	15.0
Second	19 [12-29]	0	.65	-	-	16.3	21.7
Medium	19 [12-30]	0	.67	-	-	17.2	21.4
Fourth	13 [07-23]	0	.37	-	-	15.9	11.1
the richest	22 [14-32]	0	.78	-	-	19.5	23.5

Temporal trend of early breastfeeding initiation. The prevalence of early breastfeeding initiation decreases significantly ($P < 10^{-3}$) from 2006 (87.4%) to 2018 (31.5%); (Figure 12).

Temporal trend of exclusive breastfeeding during the first 6 months. The prevalence of exclusive breastfeeding during the first 6 months decreases significantly ($P < 10^{-3}$) from 2000 (46.4%) to 2018 (13.4%); (Figure 13).

Table 10. Associated Factors to Continued Breastfeeding up to the Age of 2 Years (Combined Results From Tunisian MICS Surveys).

Factors	Pooled OR [95% CI]	P value	Heterogeneity	
			I ² (%) [95% CI]	P
Infant sex		.79	0 [0 – 85]	.57
Male	0.96 [0.73-1.27]			
Female	reference			.007
Mother Educational level		.06	75 [30-91]	
Illiterate/Primary	2.13 [0.95-4.78]			
Secondary or Higher	reference			
Environment of residence		.06	15 [0-87]	.32
Rural	1.4 [0.98-2.02]			
Urban	reference			
Region of the country		.14	0 [0 – 90]	.38
Center/South	0.78 [0.56-1.09]			
North	reference			
Economic well-being level		.76	39 [-]	.2
The poorest	1.12 [0.52-2.42]			
Second/medium/ fourth/the richest	reference			

Temporal trend of predominant breastfeeding during the first 6 months. The prevalence of predominant breastfeeding during the first 6 months decreases significantly ($P < 10^{-3}$) from 2000 (50.5%) to 2018 (30.4%; Figure 14).

Temporal trend of continued breastfeeding up to the age of 2 years

Months. There was no significant decrease ($P = .09$) of the prevalence of continued breastfeeding up to the age of 2 years from 2000 to 2018 (Figure 15).

Discussion

We summarized evidence of breastfeeding practice from results of four published Tunisian MICS surveys reports from 2000 to 2018.

Never breastfeeding prevalence, early breastfeeding initiation, exclusive breastfeeding, predominant breastfeeding and continued breastfeeding up to the age of 2 years were 4% (95% CI [3%-7%]); 56% (95% CI

[20%-87%]); 15% (95% CI [5%-35%]), 41% (95% CI [31%-51%]) and 19% (95% CI [16%-22%]), respectively.

Breastfeeding practice in Tunisia was globally low compared to other countries of the Middle east and North Africa (MENA) region, especially concerning exclusive breastfeeding, and continued breastfeeding until 2 years.

The results of the latest MICS studies conducted in countries of the MENA region are summarized in the Table 11.¹⁴ Never breastfeeding ranged from 4.1% in Palestine to 12.9% in Algeria. Early breastfeeding initiation ranged from 32.4% in Iraq to 68.7% in Sudan. Exclusive breastfeeding ranged from 2.2% in Yemen to 55.4% in Sudan. Predominant breastfeeding ranged from 5.6% in Yemen to 80.8% in Sudan. And continued breastfeeding until 2 years ranged from 11.3% in Palestine to 48.8% in Sudan. We have acceptable prevalence of never breastfeeding and early breastfeeding initiation comparing to these rates. But our rates of exclusive, predominant and continued breastfeeding were among the lowest in the region (Table 11).

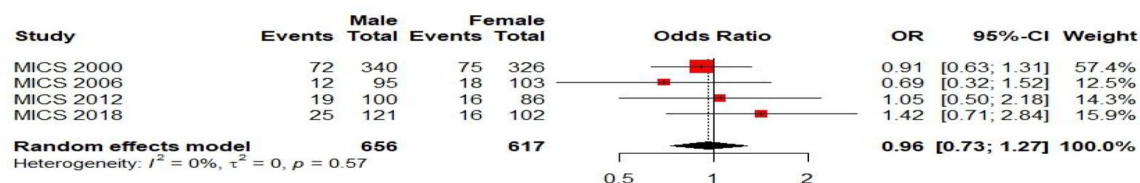
The prevalence of exclusive breastfeeding practice in the Eastern Mediterranean Region, varies across countries. In the Eastern Mediterranean Region, the regional average for exclusive breastfeeding was estimated at 30.9%, with the lowest rates observed in Yemen (9.7%) and Djibouti (12.4%), while the highest rates were reported in Afghanistan (57.5%), Sudan (55.6%), Iran (46%), Palestine (43.8%), Morocco (42.4%), and Libya (41.3%). While the regional average prevalence of never breastfeeding, mixed milk feeding and continued breastfeeding, was estimated at 15.7%, 42.9% and 41.5% respectively.^{18,19}

All our estimated breastfeeding indicators falls below the recommendations and are far from the target rates set by the WHO which aims to at least 70% for initiation in the first hour, 70% for exclusive breastfeeding, and 60% at 2 years by the year of 2030.²⁰

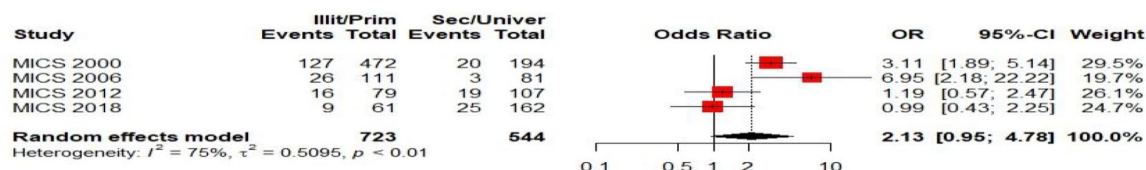
The prevalence of breastfeeding practices can vary significantly across different regions and countries due to a multitude of socio-cultural, economic, and health-care factors. Several factors contribute to these relatively lower prevalence observed in Tunisia compared to some neighboring countries^{4,21}:

- ✓ **Socio-cultural factors:** Tunisia, like many countries, has experienced shifts in societal norms and lifestyles. Urbanization and modernization often bring changes in family structures and practices. With more women entering the workforce and adopting Westernized lifestyles, there might be a decreased emphasis on breastfeeding due to

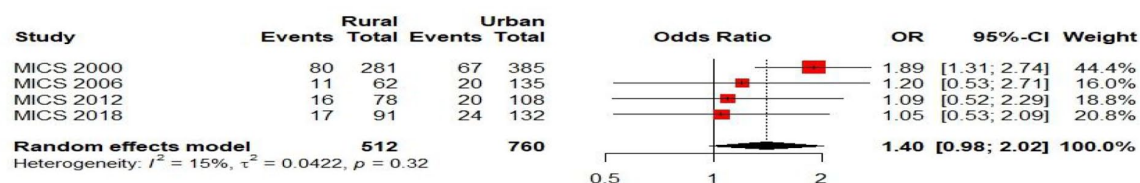
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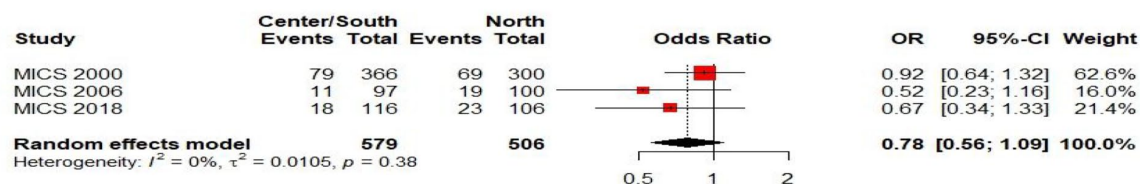
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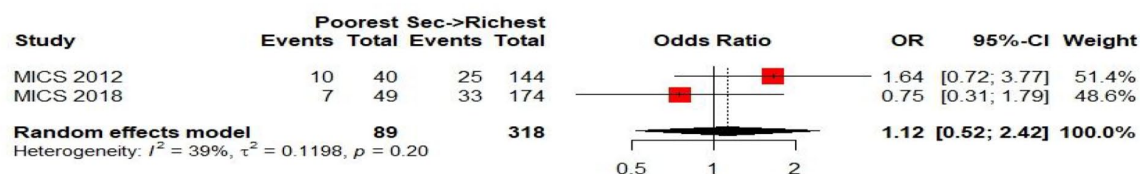


Figure 10. Forest plots of the pooled OR estimating the association between continued breastfeeding up to the age of 2 years and: (A) Infant sex; (B) Mother Educational level; (C) Environment of residence; (D) Region of the country; (E) economic well-being level.

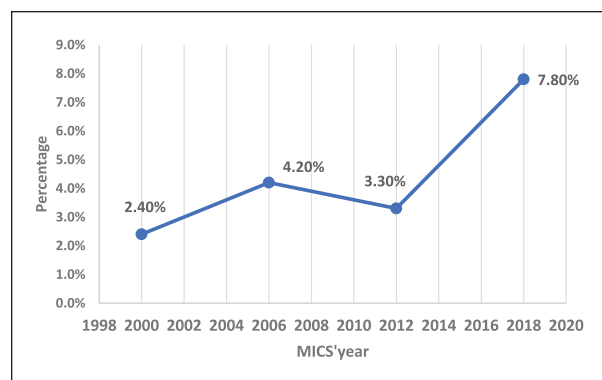


Figure 11. Trend of prevalence of children who were never breastfed according to the MICS Tunisian surveys (2000-2006-2012-2018).

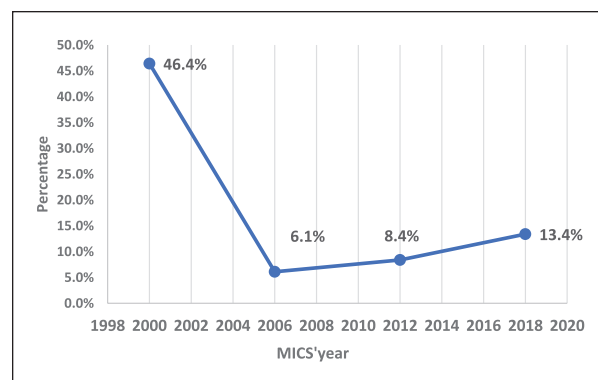


Figure 13. Trend of the prevalence of exclusive breastfeeding during the first 6 months according to the MICS Tunisian surveys (2000-2006-2012-2018).

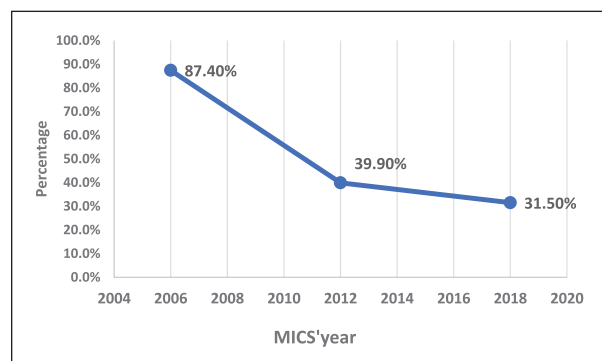


Figure 12. Trend of early initiation of breastfeeding according to the MICS Tunisian surveys (2006-2012-2018).

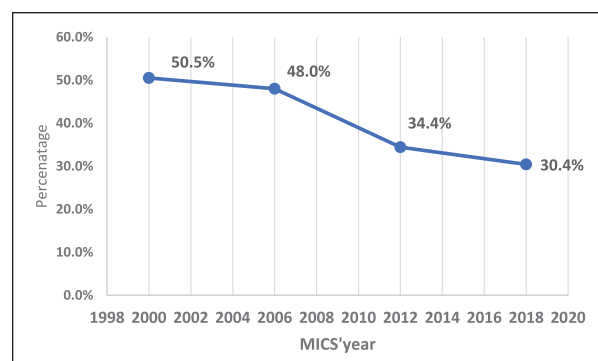


Figure 14. Trend of the prevalence of predominant breastfeeding during the first 6 months according to the MICS Tunisian surveys (2000-2006-2012-2018).

perceived inconveniences or pressures to return to work early.

- ✓ **Education and awareness:** There may still be gaps in education and awareness about breastfeeding benefits. Cultural beliefs or misconceptions about formula feeding being more convenient or equally beneficial could deter some mothers from breastfeeding exclusively.
- ✓ **Lack of information and support:** Insufficient information and support from healthcare providers and caregivers can hinder early breastfeeding initiation and continuation in Tunisia. This includes inadequate breastfeeding counseling and care following childbirth, especially for mothers who deliver via cesarian section.^{22,23}
- ✓ **Marketing and influence of formula companies:** Aggressive marketing strategies by formula milk companies can influence perceptions and practices related to infant feeding. Despite regulations, these companies may still find ways

to promote formula feeding as a viable alternative to breastfeeding, impacting the cultural norms surrounding infant feeding practices.

- ✓ **Workplace policies:** Balancing work and breastfeeding can be challenging for many mothers, especially in environments lacking supportive policies such as paid maternity leave, flexible work hours, and designated breastfeeding areas. Without adequate support from employers and policymakers, mothers may face barriers to breastfeeding continuation upon returning to work.

The mother educational level was significantly associated with early breastfeeding initiation, exclusive and predominant breastfeeding with higher rates among mothers who are illiterate or having a primary educational level. This result was comparable to some other studies conducted in the MENA region like Saudi Arabia

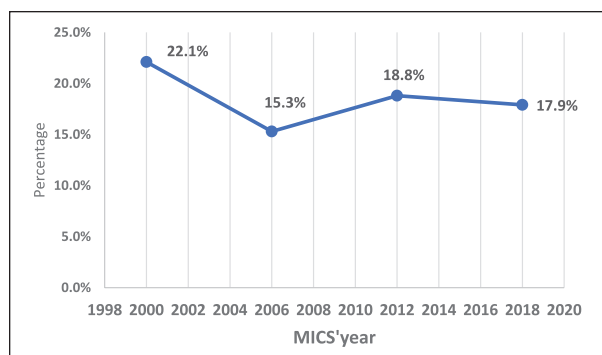


Figure 15. Trend of the prevalence of continued breastfeeding up to the age of 2 years according to the MICS Tunisian surveys (2000-2006-2012-2018).

and United Arab Emirates.²⁴⁻²⁶ Our finding can be explained by several factors:

- ✓ **Cultural norms and traditional practices:** In Tunisia, like many low- and middle-income countries, there are cultural norms and traditional practices that prioritize breastfeeding practice in general. These traditions may dictate that newborns should be breastfed immediately after birth or within the first hour. In addition, these cultural beliefs often emphasize the importance of breastfeeding exclusively for the first 6 months and continuing breastfeeding alongside complementary foods thereafter. Mothers with lower levels of education may be more likely to adhere to these traditional practices due to their strong cultural influence and lack of exposure to alternative beliefs or practices.
- ✓ **Limited exposure to formula milk marketing:** Mothers with lower levels of education may have limited exposure to marketing campaigns promoting formula milk substitutes especially in rural area. As a result, mothers in these communities may be less influenced by formula milk marketing and more likely to adhere to breastfeeding practice.²⁷
- ✓ **Access to multiple sources of information:** Mothers with higher levels of education may encounter conflicting information from internet resources or social media leading to a lower prevalence of breastfeeding practice.
- ✓ **Socioeconomic status and employment:** Educational attainment is closely linked to socioeconomic status and women's empowerment. Mothers with higher levels of education tend to have greater autonomy and decision-making power without being influenced by

traditional practices. Moreover, mothers with higher levels of education are more likely to be employed. Maternal employment is known to be a significant determinant and barrier to breastfeeding practices. Higher-educated mothers are more likely to hold jobs that demand their presence and commitment, leaving them with limited time for breastfeeding.²⁸ Lack of workplace support, such as adequate break times and designated lactation spaces, may make it difficult for employed mothers to continue exclusive breastfeeding.²⁹ Balancing work and childcare responsibilities can lead to increased stress and fatigue, which may impact a mother's ability to maintain exclusive breastfeeding.³⁰ Due to these factors, mothers with higher educational levels may be more likely to use formula milk substitutes and introduce complementary foods earlier.

The environment of residence was significantly associated with exclusive breastfeeding, with a higher prevalence among mothers from rural areas. The economic well-being level was also significantly associated with exclusive and predominant breastfeeding with higher prevalence among mothers having the poorest economic level. Living in rural area is often associated with lower socioeconomic status, including higher levels of poverty. Rural communities often have strong cultural norms and traditional practices that prioritize breastfeeding as the primary mode of infant feeding. These cultural beliefs may emphasize the nutritional and immunological benefits of breast milk and discourage the use of formula milk or other substitutes. As a result, mothers living in rural areas may be more likely to exclusively breastfeed their infants due to adherence to these cultural norms and traditions. Moreover, rural areas often have lower socioeconomic status compared to urban areas, with higher rates of poverty and unemployment. Mothers living in rural areas may face fewer barriers to exclusive breastfeeding due to the availability of social support networks, less pressure to return to work, and lower exposure to formula milk marketing compared to their urban counterparts.^{31,32}

In the other hand, there were disparities in breastfeeding practice between regions of the country which can arise due to a variety of factors. Regions within a country may vary widely in terms of socioeconomic status, with some areas experiencing higher levels of poverty, unemployment, and income inequality than others. Socioeconomic disparities can influence breastfeeding practices through factors such as access to healthcare services, availability of breastfeeding support programs, and employment opportunities that may affect mothers'

Table 11. Breastfeeding Practice Among Countries of Middle East and North Africa According to the Latest MICS Surveys.

	Never BF	Early BF initiation	Exclusive BF	Predominant BF	Continued BF until 2 years
Iraq (2018)	6.7	32.4	25.8	41.5	26.7
Palestine (2020)	4.1	40.6	43.3	47.4	11.3
Qatar (2012)	5.4	33.5	29.3	38.1	31.9
Yemen (2023)	6.0	38.0	2.2	5.6	38.4
Algeria (2019)	12.9	32.9	28.7	48.4	26.4
Sudan (2014)	4.4	68.7	55.4	80.8	48.8

Abbreviation: BF, breastfeeding.

ability to breastfeed. Moreover, different regions within a country may have distinct cultural norms, beliefs, and traditions regarding infant feeding practices. Cultural factors, including attitudes toward breastfeeding, family support for breastfeeding, and perceptions of formula feeding, can vary significantly between regions and influence breastfeeding behaviors among mothers. Also, geographic, and environmental characteristics, such as urbanization and rural isolation can affect breastfeeding practices. Urban areas may have higher rates of maternal employment and formula feeding due to factors such as workplace demands and access to formula milk marketing.^{33,34}

Otherwise, we observed a general decline in the practice of breastfeeding between 2000 and 2018. Never breastfeeding prevalence significantly increased ($P < 10^{-3}$) from 2000 (2.4%) to 2018 (7.8%). Early breastfeeding initiation significantly decreased ($P < 10^{-3}$) from 2006 (87.4%) to 2018 (31.5%). Exclusive breastfeeding during the first 6 months significantly decreased ($P < 10^{-3}$) from 2000 (46.4%) to 2018 (13.4%). And the predominant breastfeeding during the first 6 months significantly decreased ($P < 10^{-3}$) from 2000 (50.5%) to 2018 (30.4%).

This decline indicates a concerning trend in breastfeeding practices over the years, highlighting potential challenges or shifts in societal norms and healthcare policies that may have impacted breastfeeding initiation and continuation rates in Tunisia.

The decrease in breastfeeding practice in Tunisia between 2000 and 2018 can be attributed to several factors:

- ✓ **Changing of societal norms:** Shifts in societal attitudes toward breastfeeding may have contributed to a decline in its practice. Increased urbanization and exposure to Western influences could lead to a decrease in traditional breastfeeding practices. This shift may be driven by factors such as the perception of formula feeding as

more convenient or socially acceptable, especially in urban areas where women may be exposed to different cultural influences.³⁵ In fact, this was approved by our results finding a significant higher prevalence of never breastfeeding in urban environment.

- ✓ **Marketing of Breast Milk Substitutes:** Aggressive marketing of breast milk substitutes by formula milk companies has been identified as a significant barrier to breastfeeding initiation and duration. Studies have shown that exposure to formula milk advertising and promotional activities can undermine breastfeeding intentions and practices, leading some mothers to choose formula feeding over breastfeeding from birth.¹⁸
- ✓ **Workforce participation:** As more women entered the workforce, the pressure to return to work shortly after childbirth could have hindered exclusive breastfeeding practices.³⁶
- ✓ **Perceived barriers and misconceptions:** Women may perceive various barriers to breastfeeding, including concerns about milk insufficiency, discomfort associated with breastfeeding, and misconceptions about the benefits of formula feeding. Lack of accurate information and support from healthcare providers and family members can exacerbate these concerns, and could discourage women from exclusively breastfeeding their infants and opt for formula feeding instead of breastfeeding.³⁷

Policies and Measures Adopted in Tunisia to Support and Promote Breastfeeding

Breastfeeding practices in Tunisia have faced some challenges in recent decades, but there have also been efforts to promote and improve breastfeeding rates. Tunisia has implemented the International Code of Marketing of Breast-milk Substitutes since 1983,^{38,39}

which was established by the World Health Organization (WHO) to regulate the marketing of breast milk substitutes. The Code aims to protect and promote breastfeeding by ensuring that breast milk substitutes, such as infant formula, are not marketed in ways that undermine breastfeeding practices.

These regulations include restrictions on advertising, promotion, and sponsorship of breast milk substitutes, as well as measures to ensure that information provided to families about infant feeding is accurate and unbiased.

While Tunisia has taken steps to implement the Code, challenges such as monitoring and enforcement of regulations may still exist. Tunisia has legal measures that contain a few provisions with lower coverage of the Code articles in legislation. Only 3 articles of the code were respected. Continuous efforts are needed to ensure compliance with the Code and to address any gaps or issues that may arise in its implementation. Tunisia has also implemented the Baby-friendly Hospital Initiative (BFHI) in 93 hospitals,⁴⁰ which promotes best practices in maternity services to support breastfeeding initiation and duration.

Recommendations to Promote Breastfeeding Practice in Tunisia^{41,42}

- ✓ **Implement comprehensive breastfeeding policies:** Enact and enforce policies that support breastfeeding, including maternity leave, workplace accommodations, and regulations on marketing of breast-milk substitutes. Strengthen the implementation of the Baby Friendly Hospital Initiative nationwide to ensure all birthing facilities provide optimal support for breastfeeding.
- ✓ **Healthcare system support:** Strengthen healthcare systems to provide prenatal and postnatal breastfeeding counseling, lactation support services, and education for mothers and healthcare professionals. Invest in training and capacity building for healthcare providers to improve their skills in breastfeeding counseling and support.
- ✓ **Community and workplace support:** Develop community-based programs that encourage breastfeeding, such as peer support groups, breastfeeding-friendly workplace policies, and childcare facilities for working mothers. Implement workplace policies that support breastfeeding, such as paid maternity leave and designated spaces for expressing and storing breastmilk.
- ✓ **Public awareness campaigns:** Launch public awareness campaigns to promote the benefits of breastfeeding and dispel myths and misconceptions surrounding breastfeeding. A national

multi-media campaign is needed to raise awareness on the benefits of breastfeeding and address common myths and barriers, with a focus on urban and migrant populations.

- ✓ **Focus breastfeeding promotion efforts on urban areas** which are associated with lower breastfeeding practice shorter breastfeeding durations in Tunisia.

Strengths and Limitations of the Study

MICS surveys typically involve large sample sizes, providing robust and representative data on breastfeeding practices at national level. The large sample size enhances the statistical power of analyses and increases the generalizability of findings to the broader population. These studies follow standardized methodologies endorsed by UNICEF, ensuring consistency in data collection methods across surveys. This consistency enhances the reliability and comparability of results over time, enabling meaningful comparisons between different survey periods. Combining results from multiple MICS studies conducted in Tunisia between 2000 and 2018 can offer a comprehensive understanding of breastfeeding practices across different regions and demographic groups. The aggregated findings serve as valuable research evidence for advocacy efforts aimed at promoting breastfeeding. It provides a benchmark for monitoring progress in breastfeeding indicators and valuable insights into trends and patterns regarding breastfeeding practices in the country over time. It enables the assessment of the effectiveness of past interventions and guides future strategies to achieve breastfeeding-related targets. In fact, the aggregated data can inform policymakers about the prevalence of breastfeeding and its determinants and guide policy formulation. It enables the development of targeted interventions to promote breastfeeding and improve maternal and child health outcomes.

However, there are some limitations of the study. The latest MICS study was conducted in 2018 and the data is somewhat outdated which may not capture recent developments or changes in breastfeeding practices. Moreover, in many large-scale surveys like MICS studies, there are commonly limitations in the scope of factors studied. In the case of breastfeeding practices in Tunisia, the omission of certain determinants, such as maternal employment, and the delivery mode could indeed limit the comprehensiveness of the analysis. In fact, maternal employment is known as a significant determinant of breastfeeding practices, as it can influence factors such as the duration of maternity leave, access to breastfeeding breaks at work, availability of

breastfeeding support in the workplace. Likewise, the mode of delivery, whether vaginal or cesarean section, can influence breastfeeding initiation and duration. Research suggests that cesarean section births may be associated with delayed initiation of breastfeeding and reduced likelihood of exclusive breastfeeding in the early postpartum period. Understanding the impact of delivery mode on breastfeeding practices is essential for tailoring interventions and support strategies for mothers, particularly those who undergo cesarean sections. In addition to these unstudied factors, there may be other important determinants of breastfeeding practices that were not adequately captured in the MICS reports. These could include cultural norms and beliefs surrounding breastfeeding, access to healthcare services and lactation support and availability of formula milk marketing.

Without a comprehensive understanding of the factors influencing breastfeeding practices, the MICS studies may provide an incomplete picture of the challenges and barriers faced by mothers in maintaining breastfeeding. And efforts to promote and protect breastfeeding may not be effective.

Perspectives

Recognizing the importance of these determinants, future iterations of the MICS study in Tunisia could consider including questions related to maternal employment status and delivery mode in the survey questionnaire. By capturing these additional variables, more robust data could be generated to inform evidence-based interventions and policies aimed at promoting optimal breastfeeding practices.

Recognizing the limitations of the existing data, there is a clear need for further research to fill the gaps in knowledge regarding breastfeeding practices in Tunisia. Future studies could explore the association between maternal employment and breastfeeding outcomes in more detail, as well as investigate other relevant determinants identified in the literature. In addition to quantitative surveys like MICS, qualitative research methods can provide valuable insights into the socio-cultural context and individual experiences related to breastfeeding practices. Combining quantitative data with qualitative findings can offer a more comprehensive understanding of the complex factors influencing breastfeeding behavior.

Acknowledging these limitations and advocating for more comprehensive data collection methods, could lead to a better understanding of breastfeeding practices in Tunisia and to the development of effective strategies to support breastfeeding mothers.

Conclusions

In conclusion, Tunisia has been experiencing low rates of breastfeeding practice, with a concerning decline observed over the years. Addressing this issue effectively necessitates a comprehensive, multi-faceted approach that encompasses various aspects of policy-making, healthcare, and society.

There is a crucial need for policy changes accompanied by an increase in political commitment to promoting breastfeeding. This entails enacting and enforcing legislation that supports breastfeeding-friendly environments, such as laws regulating the marketing of breast milk substitutes and providing incentives for workplaces to support breastfeeding mothers. Also, the effective implementation of BFHI is essential in improving breastfeeding rates in Tunisia. Furthermore, comprehensive training for healthcare providers is essential to equip them with the knowledge and skills to support breastfeeding mothers effectively. Community-based interventions also play a pivotal role in fostering societal support for breastfeeding.

Author Contributions

Mariam Nouira: Conceptualization; Data curation; Formal analysis; Methodology; Validation; Writing—original draft; Writing—review & editing.

Nesrine Souayah: Data curation; Methodology; Writing—original draft.

Mohamed Maatouk: Conceptualization; Data curation; Formal analysis.

Hajer Nouira: Conceptualization; Data curation; Writing—review & editing.

Anis Hasnaoui: Supervision; Validation; Visualization; Writing—review & editing.

Sondess Arfa: Conceptualization; Supervision; Validation; Visualization; Writing—review & editing.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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