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Prevalence and Factors Associated with the Double and Triple Burden of Malnutrition in Mother-Child Pairs in Guinea

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Abstract: The double burden of malnutrition (DBM) and triple burden of malnutrition (TBM) remain a public health challenge in developing countries. This study examines the prevalence and factors associated with DBM and TBM in mother-child pairs in Guinea. A sample of 2605 mother-child pairs drawn from the fifth Guinea Demographic and Health Survey conducted in 2018 was selected for this study. Anthropometric measurements of children and their mothers and children's hemoglobin levels were collected. Univariate and multivariate regression analyses were performed to identify factors associated with DBM and TBM. The prevalence of DBM and TBM in mother-child pairs in households in Guinea were 9.6% (95% CI: 8.3-11.2) and 7.3% (95% CI: 6.1-8.6) respectively. Mothers who delivered by caesarean section (AOR = 2.63; 95% CI: 1.06-6.58), wealthy households (AOR = 2.17; 95% CI: 1.15-4.09) and mothers with 4 or more children (AOR = 2.18; 95% CI: 1.08-4.38) were factors significantly associated with the double burden of malnutrition. Wealthy households (AOR = 2.11; 95% CI: 1.04-4.29) and Caesarean delivery (AOR = 2.40; 95% CI: 1.06-5.42) were factors significantly associated with the triple burden of malnutrition. Multiparity was associated with DBM and wealthier households and caesarean section were positively associated with DBM and TBM. Public health actions focused on women of childbearing age should be undertaken to curb the development of this scourge.

Keywords: Double Burden, Triple Burden, Malnutrition, Associated Factors, Mother-Child Couple, Guinea

1. Introduction

In 2021, there were approximately 2.2 billion overweight adults in the world, of whom 40.8% were women, 49.2 million children were stunted, 45.5 million children were wasted [1] and 42% of children under five were anemic [2]. Undernourishment is rampant with high rates in the African region, which is going through a period characterized by high prevalence of undernutrition, overweight and diet-related non-communicable diseases (NCDs) [3].

According to the World Health Organization (WHO), the coexistence of undernutrition and overweight/obesity or diet-related NCDs is referred to as the "double burden of malnutrition" (DBM). The DBM can exist within individuals, households, populations or across the life course [4]. The coexistence of DBM with micronutrient deficiencies is referred to as the "triple burden of malnutrition" (TBM) [5].

Different forms of malnutrition are influenced by economic growth, urbanization, globalization and nutritional transition [4, 6-8]. The DBM has a negative economic impact on individuals and populations. It increases health expenditures, decreases productivity, slows economic growth,

which leads to poverty and poor health status of the population [4].

Several studies have been conducted on the double and triple burden of malnutrition around the world. The prevalence of DBM among mother-infant pairs was 6.6% in Nepal [5], 6.3% in Bangladesh [9] and that of TBM was 5.7% in India [10] and 7% in Nepal [5]. Recently, concerns have been raised about the double and triple burden of malnutrition in sub-Saharan Africa. They constitute a public health problem in the region with prevalence of 8% and 4.6% respectively [11].

The Guinea, like many countries on the African continent, is confronted with the problems of malnutrition. For children under five, the prevalence of wasting, underweight and stunting was 9%, 16% and 30% respectively. The prevalence of overweight among women aged 15-49 years was 27% [12]. The study by AK Christian et al. of 23 sub-Saharan African countries found that the prevalence of DBM and TBM among mother-child pairs in Guinea was 5.7% and 4.6% respectively [11]. To our knowledge, no study has yet explored the factors associated with DBM and TBM at the household level in Guinea. This study uses data from the fifth Demographic and Health Survey (DHS 2018). The objective is to determine the prevalence of DBM and TBM among mother-child pairs in Guinea and to identify associated factors.

2. Materials and Methods

2.1. Data And Population

This study used data extracted from the 2018 Guinean Demographic and Health Surveys (DHS 2018) to explore factors associated with DBM and TBM among mother-child pairs. The DHS are nationally representative demographic and household surveys that collect data on a wide range of reproductive, maternal, and child health topics, such as fertility, health-seeking behaviors. It was conducted by the National Institute of Statistics with technical support from the World Program on Demographic and Health Surveys. The population for this study was mother-child pairs (mothers aged 15-49 years and children aged 6-59 months).

2.2. Methods

A two-stage stratified cluster design was applied in survey sampling based on a list of enumeration areas (EAs) of the 2018 General Population Census of the Republic of Guinea. The survey covered the populations living in the strata of Guinea's eight administrative regions (Conakry, Boke, Faranah, Kankan, Kindia, Labe, Mamou, and NZerekore) in Guinea. In each region, apart from Conakry, two strata were formed: urban and rural [12]. In total, 15 sampling strata were formed and 401 enumeration areas were drawn in proportion to size, of which 138 were urban and 263 rural. In a selected household, all children aged 6-59 months and all women aged 15-49 years were eligible for anthropometric measurements and anemia testing. The number of households drawn was 8020 (2760 urban and 5260 rural).

2.3. Data Collection

We conducted data extraction from the DHS 2018 database. These extracted data were anthropometric (weight, height, age) and biochemical (hemoglobin level) for women aged 15-49 years and children aged 6-59 months. Stunted, wasted and underweight children were defined as those with Z-scores < -2 standard deviations for height-for-age, weight-for-height and weight-for-age respectively. Children with a hemoglobin level of < 11 g/dl [5, 10, 12, 13]. In addition, the body mass index (BMI) was used in non-pregnant women to assess their nutritional status. The classification was made according to the WHO cut-off values (undernutrition: < 18.5 kg/m2; normal BMI: 18.5 to 24.99 kg/m2 and overweight/obese: BMI >= 25.0 kg/m2) (6). Non-pregnant women who had a hemoglobin level < 12 g/dl were considered anemic [12, 13].

2.4. Dependent Variables

Four indicators of child malnutrition (stunting, wasting, underweight and anemia) and their respective mothers' body mass index (BMI) were used to define the outcome variables. The presence of anemia was coded as "1", and the absence of anemia as "normal" and coded as "0". Then, maternal stunting, wasting, underweight and BMI were dichotomized and coded 0 for "normal" and 1 for "stunting", "wasting", "underweight" and "obese/overweight", respectively. The different combinations of these variables were made: overweight/obese mother and anemic child, overweight/obese mother and stunted child, overweight/obese mother and wasted child and overweight/obese mother and underweight child [5, 10]. The binary variable DBM was measured using the response categories "normal" and "DBM". The latter included obese/overweight mothers with a malnourished child, i e. stunted/ wasted/underweight children. The binary variable TBM was measured using the response categories "normal" and "TBM". The latter includes DBM and anemic children as well [5].

2.5. Independent Variables

The independent variables included: i) maternal socio-demographics (age, marital status, education, occupation), antenatal visit, type of delivery and parity; ii) household characteristics (household economic index, residence and region) and iii) child characteristics (age, sex and birth weight). For the purpose of analysis, mothers' age was recoded into (15-24, 25-34 and 35 or more), marital status into married and unmarried (single, divorced and widowed), education level (none, primary and secondary or more), parity (1, 2-3, 4 or more), index of household economic well-being in tertile (poor, middle and rich), age of child in months (6-11, 12-23, 24-35, 36-47 and 48-59) and birth weight of child (< 2500 and 2500 or more).

2.6. Data Analysis

Statistical analyses were performed with Stata 14.2 software using the "svy" command to weight the samples.

Descriptive statistics (frequencies and percentages) were used to present the distribution of all variables of interest. The chi-square test of independence was then used to assess the associations between the independent variables, the DBM and the TBM. Independent variables that showed a p-value < 0.2 in the bivariate logistic regression were re-entered into the multivariate logistic regression to identify factors associated with DBM and TBM within households. Multicollinearity between the independent variables was checked before their introduction into the final model. Unadjusted odds ratio and adjusted odds ratios (AOR) with their 95% CI were reported. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Socio-Demographic Characteristics of Mother-Child Pairs

A total of 2605 mother-child pairs were selected for this study. The weighted average age of the mothers and children was 29.6 ± 0.2 years and 30.8 ± 0.3 months respectively. Almost half (48.3%) of the mothers were between 25 and 34 years old. The 71% of mothers resided in rural areas and 91.7% were married. About 77.2% had no education. Half of the mothers (50.1%) had more than 4 children, 97.4% had given birth by normal methods and 88.6% had had an antenatal consultation at the time of the survey. Approximately, 11.4% of the children were less than 12 months old and only 11.8% had a low birth weight (Table 1).

Table 1. *Sociodemographic profile of mother-child couples in Guinea, DHS 2018.*

Variables	Categories	Number	Weighted percentage
Characteristics of the mother			
Age (years)	15 – 24	648	24.8
	25 – 34	1260	48.3
	35 or more	697	26.9
Marital status	Not married	202	8.3
	Married	2403	91.7
Level of education	None	2026	77.2
	Primary	271	10.3
	Secondary or higher	308	12.5
Working status	Not working	892	32.6
	Working	1713	67.4
Prenatal consultation	No	202	11.4
	Yes	1535	88.6
Parity	1	298	11.9
	2-3	989	38.0
	4 or more	1318	50.1
Type of delivery	Vaginal delivery	2520	97.4
	Caesarean section	67	2.6
Wealth Index	Poor	870	32.6
	Middle	867	34.1
	Rich	868	33.3
Place of residence	Rural	1859	71.1
	Urban	746	28.9
Region	Conakry	241	12.0
	Boké	373	10.9
	Faranah	356	10.8
	Kankan	376	15.9
	Kindia	301	13.4
	Labé	343	12.5
	Mamou	290	8.8
	Nzérékoré	325	15.7
Characteristics of the child			
Age (months)	6 – 11	301	11.4
	12 – 23	658	25.1
	24 – 35	475	18.6
	36 – 47	597	23.0
	48 – 59	574	21.9
Gender	Male	1357	52.0
	Female	1248	48.0
Birth weight (grams)	2500 or more	1056	88.2
	< 2500	139	11.8

3.2. Prevalence of Different Forms of Malnutrition

The prevalence of the main forms of malnutrition were as follows: overweight/obese mother and stunted child 7.4% (CI: 6.4-8.7); overweight/obese mother and emaciated child 2.2% (CI: 1.5-3.3); DBM 9.6% (CI: 8.3-11.2) and TBM in mother-child pairs 7.3% (CI: 6.1-8.6) (Figure 1).

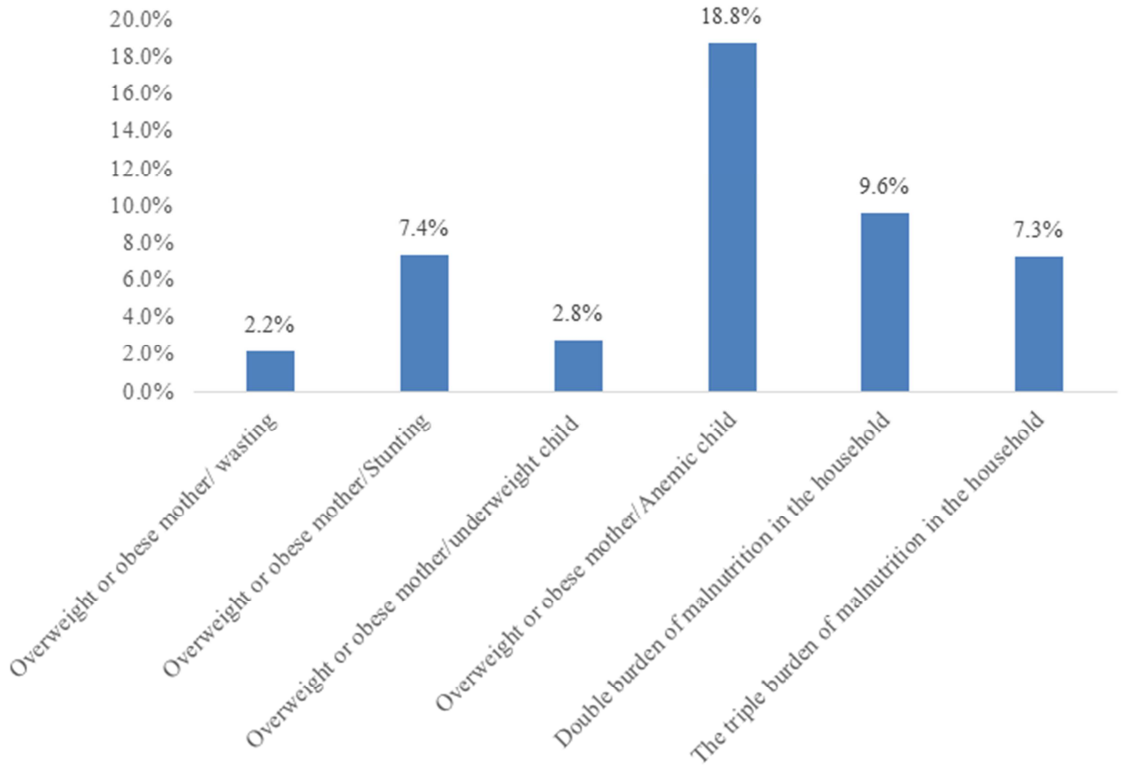

Figure 1. *Prevalence of different forms of malnutrition among mother-child pairs in Guinea, DHS 2018.*

The prevalence of DBM increased with parity, and large multiparous women had the highest prevalence (11.5%). The prevalence of DBM was higher in caesarean section (22.5%), in wealthy households (12.8%), in urban areas (13%) and in the Conakry region (16.5%) compared to the other modalities in their categories. By category, the prevalence of TBM was higher in cases of high multiparity (8.8%), in cases of caesarean section (19.1%), in wealthy households (10.2%), in urban areas (10.4%) and in Conakry (14.5%) (Table 2).

Table 2. *Prevalence of double and triple burden of malnutrition among mother-child pairs by category in Guinea, DHS 2018.*

Variables	**Categories**	**DBM [2]**		**TBM [3]**	
		(%) [1]	**p**	**(%)***	**p**
Characteristics of the mother					
Age (years)	15 – 24	6.97	0.063	6.92	0.876
	25 – 34	10.33		7.53	
	35 or more	10.85		7.54	
Marital status	Not married	11.5	0.421	8.86	0.426
	Married	9.47		7.14	
Level of education	None	9.49	0.295	6.98	0.170
	Primary	7.72		6.27	
	Secondary or higher	12.16		10.11	
Working status	Not working	8.17	0.128	5.84	0.082
	Working	10.34		7.96	
Prenatal consultation	No	8.96	0.897	5.74	0.395
	Yes	10.01		8.30	
Parity	1	6.34	0.012	5.75	0.023
	2-3	8.19		5.70	
	4 or more	11.49		8.82	
Type of delivery	Vaginal delivery	9.28	0.010	6.98	0.002
	Caesarean section	22.50		19.12	
Wealth Index	Poor	6.10	0.004	4.31	0.001
	Middle	10.01		7.39	
	Rich	12.78		10.2	
Place of residence	Rural	8.29	0.001	6.07	0.003
	Urban	13.02		10.44	

Variables	Categories	DBM [2]		TBM [3]	
		(%) [1]	p	(%)*	p
Region	Conakry	10.23	0.000	8.09	0.001
	Boké	16.48		14.50	
	Faranah	4.25		2.36	
	Kankan	9.62		6.78	
	Kindia	8.33		5.77	
	Labé	6.73		4.13	
	Mamou	4.33		3.0	
	Nzérékoré	14.40		11.88	
Characteristics of the child					
Age (months)	6 – 11	7.63	0.431	4.93	0.278
	12 – 23	9.15		7.48	
	24 – 35	12.0		9.11	
	36 – 47	9.55		7.92	
	48 – 59	9.32		6.04	
Gender	Male	10.41	0.212	7.86	0.285
	Female	8.79		6.66	
Birth weight (grams)	2500 or more	12.02	0.595	11.89	0.856
	< 2500	10.42		12.54	

[1]Weighted prevalence; [2]Double burden of malnutrition; [3]Triple burden of malnutrition

3.3. Factors Associated with the Dbm and TBM Among Mother-Child Pairs in Guinea

In multivariate logistic regression, multiparous women (4 or more) were 2.35 times (AOR = 2.35; 95% CI: 1.24-4.45) as likely as women with a single parity, women with caesarean section (AOR = 2.47; 95% CI: 1.04-5.85) compared to normal delivery, wealthy households (AOR = 1.93; 95% CI: 1.02-3.66) and households with a middle wealth index (AOR = 1.66; 95% CI: 1.05-2.64) compared to poor households were more susceptible to DBM. Mother-child pairs in the Faranah region were 60% (AOR = 0.4; 95% CI: 0.21-0.76) and those in Mamou were 59% (AOR = 0.41; 95% CI: 0.19-0.87) less likely to suffer from DBM (Table 3).

Table 3. *Factors associated with the double burden of malnutrition among mother-child pairs in Guinea, DHS 2018.*

Variables	Categories	Multivariate analysis	
		AOR [1] (95% CI [2])	p-value
Characteristics of the mother			
Age (years)	15 – 24	Ref. [3]	
	25 – 34	1.02 (0.63 – 1.66)	0.937
	35 or more	0.98 (0.55 – 1.75)	0.957
Working status	Not working	Ref.	
	Working	1.22 (0.86 – 1.73)	0.273
Parity	1	Ref.	
	2-3	1.52 (0.85 – 2.72)	0.155
	4 or more	2.35 (1.24 – 4.45)	0.009
Type of delivery	Vaginal delivery	Ref.	
	Caesarean section	2.47 (1.04 – 5.85)	0.040
Wealth Index	Poor	Ref.	
	Middle	1.66 (1.05 – 2.64)	0.031
	Rich	1.93 (1.02 – 3.66)	0.043
Place of residence	Rural	Ref.	
	Urban	1.10 (0.62 – 1.97)	0.740
Region	Conakry	Ref.	
	Boké	1.38 (0.71 – 2.73)	0.341
	Faranah	0.40 (0.21 – 0.76)	0.006
	Kankan	0.83 (0.44 – 1.55)	0.553
	Kindia	0.74 (0.40 – 1.39)	0.348
	Labé	0.72 (0.39 – 1.33)	0.294
	Mamou	0.41 (0.19 – 0.87)	0.021
	Nzérékoré	1.52 (0.81 – 2.87)	0.194

[1]Adjusted Odds Ratio; [2]Confidence Interval; [3]Reference categories

In multivariate logistic regression, multiparous women (4 or more) were 1.91 times (AOR = 1.91; 95% CI: 1.13-3.23) as likely as women with a single parity, women with caesarean section (AOR = 2.72; 95% CI: 1.17-6.32) compared to normal delivery, wealthy households (AOR = 2.03; 95% CI: 1.05-3.90) and households with a medium wealth index (AOR = 1.68; 95%

CI: 1.01-2.81) compared to poor households were more susceptible to TBM. Mother-child pairs in the Faranah region were 73% (AOR = 0.27; 95% CI: 0.12-0.59) and those in Mamou were 65% (AOR = 0.35; 95% CI: 0.19-0.87) less likely to suffer from TBM (Table 4).

Table 4. *Factors associated with the triple burden of malnutrition among mother-child pairs in Guinea, DHS 2018.*

Variables	Categories	Multivariate analysis	
		AOR [1] (95% CI [2])	**p-value**
Characteristics of the mother			
Age (years)	15 – 24	Ref. [3]	
	25 – 34	0.75 (0.43 – 1.30)	0.303
	35 or more	0.99 (0.57 – 1.71)	0.967
Working status	Not working	Ref.	
	Working	1.32 (0.87 – 1.99)	0.186
Parity	1	Ref.	
	2-3	1.15 (0.66 – 2.00)	0.628
	4 or more	1.91 (1.13 – 3.23)	0.015
Type of delivery	Vaginal delivery	Ref.	
	Caesarean section	2.72 (1.17 – 6.32)	0.020
Wealth Index	Poor	Ref.	
	Middle	1.68 (1.01 – 2.81)	0.046
	Rich	2.03 (1.05 – 3.90)	0.034
Place of residence	Rural	Ref.	
	Urban	1.13 (0.63 – 2.03)	0.685
Region	Conakry	Ref.	
	Boké	1.44 (0.68 – 3.06)	0.345
	Faranah	0.27 (0.12 –0.59)	0.001
	Kankan	0.68 (0.37 – 1.24)	0.209
	Kindia	0.61 (0.32 – 1.17)	0.135
	Labé	0.53 (0.25 – 1.12)	0.097
	Mamou	0.35 (0.16 – 0.77)	0.010
	Nzérékoré	1.51 (0.79 – 2.86)	0.209

[1]Adjusted Odds Ratio; [2]Confidence Interval; [3]Reference categories

4. Discussion

In 2012, the World Health Assembly developed six global nutrition targets by 2025 to combat malnutrition in all its forms. To do this, clear evidence is needed to guide policymakers to take action to improve maternal, infant and young child nutritional status. It is within this framework that this study explored the prevalence of and factors associated with DBM and TBM among mother-child pairs in households in Guinea. The prevalence of DBM and TBM among mother-infant pairs was 9.6% and 7.3% respectively. A previous study using DHS 2012 data found prevalence of 5.7% and 4.6% for DBM and TBM in Guinea, respectively [11]. The increase in the prevalence of overweight among women of childbearing age and the stagnation in the prevalence of various forms of undernutrition among children less than 5 years of age would explain this significant increase [12]. A diet high in fat, salt and sugar, urbanization and a sedentary lifestyle have contributed to the increase in overweight among women of childbearing age in sub-Saharan Africa [4, 6-8]. Low iron intake, poor hygiene and malaria are key factors in the development of anemia in children in sub-Saharan Africa [11, 14]. Lower prevalence of DBM and TBM were reported in Ethiopia with 1.8% and 1.2% respectively [15]. In Guinea, although the prevalence of DBM and TBM is low, actions need to be taken to curb their progression.

Multivariate logistic regression revealed that multiparity, caesarean section and household wealth index were positively associated with DBM and TBM among mother-child pairs within households.

Mothers with 4 or more children were more likely to suffer from DBM and TBM. This result corroborates those of other studies that have shown that multiparity increases the odds ratio of the double burden of malnutrition in the household. This association could be explained by weight gain during pregnancy [9, 16, 17]. Several studies have shown that a significant increase in weight during pregnancy may contribute to long-term maternal weight retention. This weight gain is thought to be related to physiological changes, eating behavior and physical inactivity during pregnancy [17-19].

A positive association between the household wealth index, the DBM and the TBM among mother-child pairs was found in our study. This result is supported by some studies [5, 10, 11] and contradicted by others [9, 15]. The results of a systematic review showed that the association between DBM and household income was mixed and would depend on the context and location of the study [20]. The direction of the association between DBM in mother-infant pairs and the economic level of the household would depend on the gross national income of the country. For low-income countries, richer mother-infant pairs were more likely to suffer from DBM than poorer ones. The direction of this association was reversed in high-income countries [21, 22].

Caesarean delivery increased the odds ratio of DBM and

TBM in the household in this study. This result is similar to that of the study in India, which indicated that delivery by caesarean section was a contributing factor to TBM [10]. Several studies have noted that children born by caesarean section were not introduced to breast milk early and weaned more quickly, which could have a negative impact on the child's growth [23, 24].

Faranah and Mamou regions had the lowest prevalence of overweight among women aged 15-49 compared to the other regions [12]. In addition, socio-cultural and genetic considerations of body image should be taken into account to explain differences in the regions of Guinea [25, 26].

This study has some limitations. It was not possible to establish a causal link between DBM, TBM and associated factors. The prevalence of different forms of malnutrition may be underestimated. Deficiencies of other micronutrients and diet-related NCDs were not taken into account. Determinants such as dietary intake, physical activity and socio-cultural influences were not assessed. Despite these limitations, the strengths of this study are the use of a representative sample of the population. In addition, it provides a contribution to the evolution of knowledge by being the first to study the factors associated with DBM and TBM in households in Guinea. Our results have implications for the fight against malnutrition in children under 5 years of age and in women of childbearing age, which remains a public health problem in our country.

5. Conclusion

The aim was to determine the prevalence of DBM and TBM among mother-infant pairs in Guinea and to identify associated factors. The study showed that the prevalence of DBM and TBM in Guinean households remains below 10% but is still an argument that the country has entered the nutritional transition. Multiparity, caesarean section and household wealth index are the factors associated with DBM and TBM in households. The overweight mother and undernourished child in a wealthy household constitute a paradox that needs to be explored through in-depth research in order to understand the determinants.

Several studies in the literature have shown the impact of maternal health and nutrition interventions in preventing child malnutrition [27-29]. Comprehensive preventive measures, such as educating the general public about healthy eating, promoting physical activity, breastfeeding and complementary food, are needed to curb the spread of this scourge. In addition, targeted actions such as family planning to space births and monitoring gestational weight gain would be a good strategy for curbing the progression of overweight among women of childbearing age.

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