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The impact of prenatal checkups and other factors on birth weight: A cross-sectional study for the Ecuadorian case

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Abstract:
Background*: Exploring the factors involved in birth weight is an important task for modern literature, since birth weight reflects gestational conditions and intrauterine development. Several studies provide empirical evidence suggesting that providing regular, quality prenatal care significantly reduces the incidence of birth of children weighing less than 2500 grams. Specifically, some studies have shown that mothers who had no prenatal care visits were five times more likely to have a low birth weight baby.*
Materials and Methods*: We used a representative sample of 3911 newborns from the 2018 National Health and Nutrition Survey (ENSANUT). We used a linear regression model and binary logistic regression where we estimated the Odds Ratio (OR) and marginal impacts with their 95% confidence intervals (95% CI) for each of the independent variables.*
Results*: Our results show that an increase in the number of prenatal check-ups performed during pregnancy also increases the average birth weight of the child, i.e. for each prenatal check-up the average birth weight of the child increases by 0.47 grams (CI= 0.25-0.58) (p<0.05). Also, a higher frequency of micronutrient intake is associated with a higher birth weight parameter. It was also shown that receiving counseling on micronutrient intake and pregnancy warning signs increased birth weight by 34.30 (CI= 28.041-53.649) and 80.27 (CI= 50.750-90.705) grams respectively. Also, preterm delivery decreases birth weight by 206.92 (-278.413 - -135.431) grams and postmature infants (born beyond 40 weeks gestation) have an average birth weight of 160.25 (CI= 99.955-220.560). Other protective factors are the mother's education, as the mother's level of schooling increases, with a mother with higher education (OR= 2.783, CI= 2.042-2.889) being the category with the highest magnitude.*
Conclusion: *on our findings, we recommend that health policy makers and medical professionals consider the promotion of prenatal care as an effective preventive method to detect perinatal diseases and thus reduce maternal and infant mortality in the Ecuadorian population.*
Key Word*:* ***Prenatal care; Birth weight; Cross-sectional studies; Maternal health; Ecuador****.*

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I. Introduction

Birth weight reflects the gestational conditions and the development of the product during the intrauterine period. 1. Low birth weight (LBW) is a global maternal and child health concern. The World Health Organization (WHO) defines this condition as a birth weight of less than 2500 g at birth, regardless of gestational age or any other ethology. A worldwide prevalence of approximately 15% and 20% has been estimated 2. In the case of Ecuador, in the year 20219 it was reported that 9.1% of all births nationwide had low birth weight. 3.

However, the WHO warns of a possible distortion and unreliability in the official figures due to the large number of neonates who are not weighed at birth, either because the birth took place at home or in health homes with limited conditions, so that the real prevalence of this condition can be minimized. 2.

LBW is generally recognized as a disadvantage for the infant, due to susceptibility to immediate complications at birth (asphyxia, meconium aspiration, hypothermia, hypoglycemia, hypocalcemia and polycythemia), as well as long-term consequences such as impaired cognitive development and increased risk of chronic diseases later in life 4. The main reason for LBW is preterm birth or intrauterine growth restriction (IUGR), but also multiple pregnancies, infections, poorly controlled chronic diseases such as diabetes and hypertension, genetic background, environmental factors and limited access to adequate preconception care can predispose to this condition. 5.

Faced with this serious problem, the WHO has set as a goal a 30% reduction in prevalence by the year 2025, through the implementation of public policies aimed at adequate health care in prenatal check-ups during pregnancy, accessible to all pregnant women, with adequate nutritional, neonatal and postnatal care, with a minimum of 5 check-ups by the doctor or midwife.6.

Theoretically, it is expected that effective prenatal screening can prevent low birth weight and thus reduce infant mortality in vulnerable populations. Several studies provide evidence that providing quality prenatal care significantly reduces the incidence of birth of children weighing less than 2500gr. For example, one study 7 found that children whose mothers did not receive five prenatal care visits had a higher risk of low birth weight compared to those whose mothers did not receive prenatal care (OR = 1.32, 95% CI). These results were also corroborated by 8, in her study of 9348 pregnant women who received prenatal care at Vanderbilt University Medical Center from January 2009 to June 2016, where she showed that those women with more than 5 prenatal care visits had a 68 % reduced risk of having preterm delivery and 66 % reduced risk of having low birth weight infants.

Poor utilization of antenatal care services by pregnant women has also been shown to be significantly related to low birth weight. For example, [9] determined that mothers who had not had any visits to the antenatal care unit were five times more likely to have a low birth weight baby, and those who attended, less than four times, were three times more likely (OR 3.4; 95% CI) to have a LBW baby than mothers who visited four or more times. In addition, not taking iron supplements also increased the risk (OR 3.0; 95 % CI (1.1-8.2)) of a low birth weight baby. Mothers who did not take deworming pills during pregnancy were three times more likely (OR 3.1; 95 % CI (1.0-13.8)) to have a low birth weight baby.

The multivariate analysis of a study carried out in Peru also corroborated that risk factors such as having 1 to 3 prenatal check-ups, multiple gestation, being an adolescent and a short inter-gestational interval are associated with low birth weight. The proposed model had an overall sensitivity of 66.3%. 10. Likewise, 5 determined a significant difference in the absence of prenatal care between low birth weight infants (3.68%) and normal birth weight infants (2.26%). On the characteristics of prenatal care: monitoring by a physician was more common for the normal birth weight group (93.74 %) compared to the LBW group, the quality of prenatal care was higher for the normal birth weight group (0.90 vs. 0.87), as was the number of prenatal care visits (6.12 vs. 6.79).

Due to the high incidence of newborns with low birth weight, despite the efforts made by the country and, specifically, by the Ministry of Public Health. In this context, the objective of this study is to estimate the association between the number of prenatal checkups performed during pregnancy and its influence on birth weight. For this purpose, we use different measures of both the variable of interest (prenatal control) and our dependent variable, which is birth weight.

Therefore, with our study we seek to deepen the study of the factors that influence low birth weight, especially the number of prenatal checkups performed during pregnancy for its prevention, through the implementation of public policies that will help reduce the impact of this neonatal condition. In summary, there is a need to evaluate the quality and frequency of prenatal care during pregnancy in Ecuador and to determine if improved prenatal care adequately mitigates the occurrence of LBW in newborns.

II. Material And Methods

Study Design and Population: A cross-sectional study was conducted using data from the 2018 National Health and Nutrition Survey of Ecuador (ENSANUT), whose data were obtained by the National Institute of Statistics and Census (INEC). After cleaning the database, a total of 3911 Ecuadorian neonates were obtained. Data from prenatal checkups carried out by women who reported a pregnancy in the last 5 years were included.

Sample size: 3911 Ecuadorian neonates.

Source of Information: ENSANUT 2018 is a survey included in the National Statistical Program that uses probability sampling applied every 5 years and whose target population is all household members in the 24 provinces of Ecuador. The ENSANUT 2018 includes the form referring to Women of Childbearing Age, Childhood Health and Breastfeeding, which aims to collect information on women aged 10 to 49 years, children under 5 years, men aged 12 years and older and children aged 5 to 17 years. by urban and rural area to make representative estimates at the national level, urban-rural, by geographic domain for the 24 provinces of the Country.

Study Variables: Our independent variable of interest is the number of prenatal checkups performed during the gestational period of each pregnancy. The information for this variable was obtained through the question In total, how many prenatal checkups did you have before delivery? In addition, the quality of prenatal checkups was considered, through the questions: Where did you have the most frequent checkup, During pregnancy did you consume iron, folic acid, Iron plus folic acid, How often did you take micronutrients, During pregnancy checkup did you receive counseling or advice on breastfeeding, use of micronutrients, warning signs during pregnancy?

Our dependent variable was infant birth weight (birth weight ≥ 2500 g = 1; birth weight < 2500 g = 0). Newborn birth weight reported in grams at birth regardless of gestational age or any other factor that might influence it. Information on birth weight was obtained from the records of the live birth card or the comprehensive care booklet, provided by the mother.

The control variables were divided into characteristics of the mother and characteristics of the child. The characteristics of the mothers evaluated were: region of origin of the mother, ethnicity, educational level, residential area, sex, type of delivery and weeks of gestation at birth.

Inclusion and Exclusion Criteria: All children of women who responded to the questions in section IV Childhood Health of the ENSANUT survey, referring to Prenatal Control and Newborn Care, were included. Missing values for birth weight data were excluded.

Statistical analysis

The ENSANUT 2018 survey database was analyzed with the statistical package Stata v15. A value of p<0.05 was considered to determine statistical significance between variables. The Chi-square test was used to determine the overall correlation between the variables of interest. The association was evaluated using prevalence ratios (OR) with their respective 95% confidence intervals with an analysis for each of the variables included in the study, with the independent variable of interest being NPC. To determine the model of risk factors for low birth weight, binary logistic regression was applied to calculate the OR with their 95% confidence intervals; in addition, the sociodemographic characteristics were reported as absolute frequencies, and the numerical variables were reported as means.

Finally, for the determination of the predictor variables, the ROC curve was applied with the probabilities estimated by applying logistic regression under the method of introducing their confidence intervals and their statistical significance p < 0.05.

Ethical considerations

The study was conducted using secondary sources. The present study did not require the approval of an institutional ethics committee for its execution, since it is an analysis of data freely available to the public and it was not necessary to use informed consent.

III. Result

Table 1 presents the descriptive statistics of the variables used in this study. Here we observe that the mean birth weight of the individuals is 3332.45 grams (with a CI= 3308.51-3356.39) In addition, 6.83% of all individuals in our sample presented low birth weight and it is observed that 51.1% of the newborns were male. Regarding our independent variable of interest, we observe that the number of prenatal controls reported by the mothers is 7.36 prenatal controls. Regarding the characteristics of the mother, we observed that 42.7% were women from the coastal region and 81.03% were mestizo women. It is also reported that 43.4% of the mothers have a high school education and 71.3% are women from the urban area. In addition, 70.4% of the mothers reported that they had prenatal checkups in the health facilities of the Ministry of Public Health (MSP). 88.5% of the mother's report that they consume micronutrients daily and 80.3% report that they consume micronutrients such as iron plus folic acid. Interestingly, 80.5% and 78.9% of mothers reported that they received micronutrient intake counseling and counseling on risk signs, respectively. Also, 53.1% of mothers reported that they had a normal delivery and 84.2% reported that the child was born on time. These descriptive statistics reveal important patterns of the individuals considered in this study.

Table N°1: Descriptive statistics of the variables used in this study.

Variable	N	Mean-Percent	Min	Max	95% CI
Weight (grams)	3911	3332.45	1000	8000	3308.51-3356.39
Weight (low weight=0)	267	6.83%	0	1	6.05-7,66
Weight (normal weight=1)	3644	93.17%	0	1	92.33-93.55
Number of prenatal checkups	3911	7.36	0	30	7.27 -7.45
Sex of newborn					
Woman	1880	48.2%	0	1	47.1-48.9
Man	2031	51.1%	0	1	50.2-52.1
Frequency of micronutrient consumption					

Frequency of micronutrient intake (daily=1)	3446	88.5%	0	1	88-89.3
Frequency of micronutrient consumption (passing a day=2)	289	7.6%	0	1	7.01-8.41
Frequency of micronutrient consumption (passing two days=3)	159	4.81%	0	1	3.98-5.10
Frequency of micronutrient consumption (more than two days=4)	17	0.42%	0	1	0.32-0.51
Micronutrient intake					
Consumed micronutrients (iron=1)	518	13.2%	0	1	13-13.5
Consumed micronutrients (Folic acid=1)	244	6.13%	0	1	5.15-6.29
Ingested micronutrients (iron plus folic acid=1)	3149	80.3%	0	1	79.2-80.5
Mother's region of origin					
Sierra	1502	38.5%	0	1	38-39
Costa	1658	42.7%	0	1	41.21-43.09
Amazon	661	16.3%	0	1	15.98-17.01
Galapagos	90	2%	0	1	1.96-2.51
Mother's ethnicity					
Indigenous	271	7.1%	0	1	6.6-7.28
Afro-Ecuadorian	201	5.3%	0	1	4.90-5.98
Mongrel	3196	81.03%	0	1	80.22-81.86
White	68	1.4%	0	1	1.2-1.9
Montubio or Others	175	4.6%	0	1	4-5.1
Mother's educational level					
None	31	0.7%	0	1	0.3-1.1
Basic Education	1082	27.3%	0	1	27.1-28.3
Middle/High School Education	1719	43.4%	0	1	43.41-44.12
Higher Education	1079	27.1%	0	1	26.87-27.98
Residential area					
Urban Area	2791	71.3%	0	1	70.3-72.1
Place where prenatal checkups were performed					
Place where prenatal checkups were performed (HPM)	2766	70.4%	0	1	69.76-71.92
Did you receive advice on micronutrients?					
Did you receive advice about micronutrients? (yes=1)	3160	80.5%	0	2	79.87-81.72
Did you receive advice on risk signs?					
Did you receive advice about micronutrients? (yes=1)	3082	78.9%	0	2	77.3-79.1
Week of the first prenatal checkup					
Weeks first control	3911	7.32	1	40	7.16 -7.48
Type of delivery					
Normal delivery	2105	53.1%	0	1	52.1-53.5
Type of birth					
Type of birth (on time=1)	3286	84.2%	0	1	83.5-85.33
Type of birth (preterm=1)	508	12.7%	0	1	11.01-13.12
Type of birth (postmature=1)	117	2.1%	0	1	1.78-2.65

Subsequently, **Figure 1** shows the distribution of birth weight and shows that about 20% of the sample of newborns had a birth weight of approximately 3000 grams. We observe that the distribution of this variable is close to a normal distribution. On the other hand, we observed that 20% of the mothers reported that they had 8 prenatal check-ups during pregnancy.

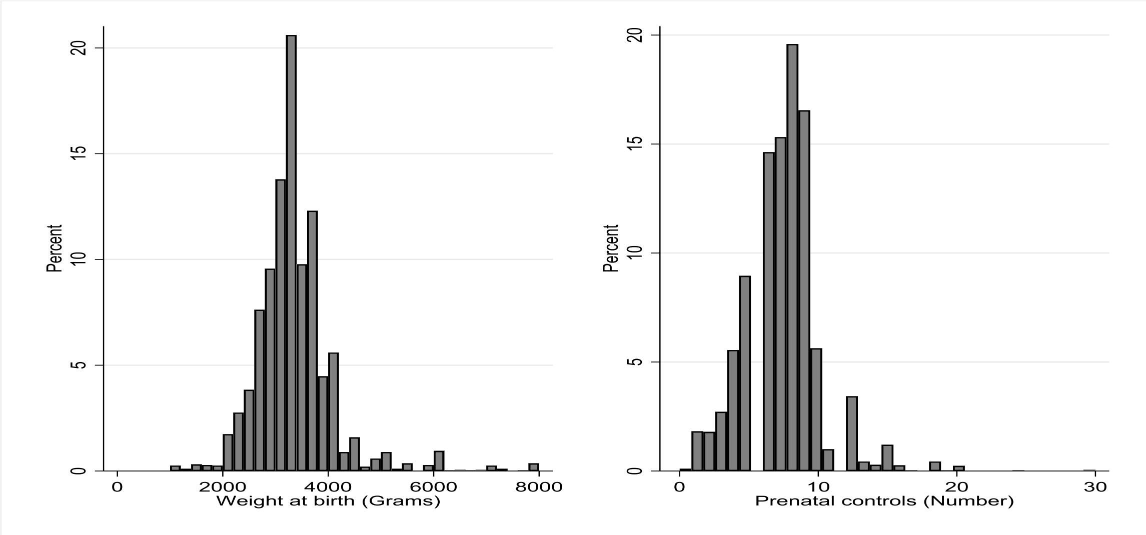

Figure 1. Distribution of birth weight and number of prenatal checkups.

Table 2. Average birth weight of low birth weight and normal birth weight infants.

Number of prenatal checkups	Average birth weight of low birth weight infants	N	Mean birth weight of normal birth weight infants	N
0	2297.95	1	3.025.84	3
1	2.076.32	6	3.514.25	65
2	1.927.99	6	3.460.67	64
3	2133	5	3.609.86	101
4	2.124.70	21	3.297.36	196
5	2.049.88	30	3.400.22	320
6	2069.42	37	3.385.33	535
7	2128.66	51	3.445.71	548
8	2145.37	45	3.439.78	721
9	2124.56	65	3.421.55	1091

On the other hand, observing a clear pattern of positive association between the number of prenatal controls and birth weight, we performed a multiple regression analysis using an Ordinary Least Squares (OLS) estimator presented in **Table 3.** In the table, the dependent variable is the continuous variable newborn weight (measured in grams). Our main findings show that there is a positive correlation between the number of prenatal controls and birth weight, this being a statistically significant parameter. Specifically, our multiple regression analysis reveals that an increase of one additional prenatal check-up increases the average birth weight of the child by 0.47 grams with a confidence interval between 0.25 to 0.58 grams. Many of our control variables have a correct sign and magnitude. For example, boys have a mean birth weight of 74.3 (CI= 26.749-121.913) grams compared to girls. Other parameters with a positive sign are micronutrient intake and frequency of consumption. Higher frequency of consumption is associated with a parameter of greater magnitude (higher birth weight). Receiving counseling on micronutrient intake and pregnancy warning signs increase birth weight 34.30 (CI= 28.041-53.649) and 80.27 (CI= 50.750-90.705) grams respectively. Also, preterm delivery decreases birth weight by 206.92(-278.413 - -135.431) grams and postmature infants (born beyond 40 weeks gestation) have a mean birth weight of 160.25 (CI= 99.955-220.560).

Table 3. Regression analysis (OLS) between the number of prenatal controls and birth weight (in grams).

	Parameter	P-value	95% CI
Dep. Var: Birth weight (grams)			
Number of prenatal checkups			
Prenatal checkups	0.417**	0.030	0.254-0.588
Sex of child born			
Woman	Ref.		
Man	74.331***	0.002	26.749-121.913
Mother's region of origin			
Sierra	Ref.	.	
Costa	55.143**	0.049	0.342-109.944

Amazon	110.108***	0.003	37.582-182.634
Galapagos	12.073	0.885	-151.730-175.876
Mother's ethnicity			
Indigenous	Ref.	.	
Afro-Ecuadorian	237.354***	0.001	92.271-382.438
Mongrel	73.312	0.153	-27.173-173.798
White	208.992**	0.046	3.867-414.116
Montubio or Others	287.004***	0.000	135.859-438.148
Mother's educational level			
None	Ref.	.	
Basic Education	114.356	0.184	87.413-456.126
Middle/High School Education	147.614	0.286	123.524-418.752
Higher Education	162.739	0.244	111.249-436.728
Residential area			
Rural	Ref.	.	
Urban	49.147*	0.096	8.745-107.039
Place where prenatal checkups were performed			
Other establishment	Ref.	.	
HPM health facilities	-15.143	0.612	-73.670--43.383
Consumed micronutrients during pregnancy			
iron?	Ref.	.	
Folic acid	1.429	0.820	1.011-1.552
iron plus Folic Acid?	2.472	0.946	1.852-2.081
Frequency of micronutrient intake			
daily	Ref.	.	
spending a day	-17.942	0.703	-74.196-110.079
spending two days	-7.995	0.897	-113.129-129.119
More than two days	-18.798	0.919	-380.697-343.101
Did you receive advice on micronutrients?			
No	Ref.	.	
Yes	34.304	0.359	28.041-53.649
Did you receive advice about alarming signs?			
No	Ref.	.	
Yes	80.227**	0.026	50.750-90.705
Week of the first prenatal checkup			
Weeks first control	-3.840	0.121	-8.694-1.015
Type of delivery			
Cesaria	Ref.	.	0.000-0.000
normal (vaginal)	42.134	0.101	22.518-56.251
Type of birth			
on time	Ref.	.	
premature	-206.922***	0.000	-278.413- -135.431
post-mature	160.257**	0.025	99.955-220.560
Constant	3084.449***	0.000	2780.158-3388.740
Observations	3911		
AIC	62975.03		
BIC	63138.09		
R^2	0.025		
F	3.956		
Log-likehood	-31461.514		

Notes: Asterisks mean: *p < 0.10,**p < 0.05, ***p < 0.01. In the table, the dependent variable is the continuous variable newborn weight (measured in grams).

Next, to further explore this proposed relationship, we dichotomized the dependent variable to expand our analysis using a logistic model as shown in **Table 4.** In the table, the dependent variable is the dichotomous variable newborn weight that takes a value of 1 if the newborn has a normal weight (weight >=2500gr) and takes a value of 0 if the newborn is underweight (weight<2500gr). Here we observe that, as expected, the odd ratio (OR) is positive (greater than 1) and significant, which shows us that an increase of an additional prenatal check-up increases by 2 times the risk of having a normal weight (CI= 1.981-2.055) compared to those women who did not have any prenatal check-up. Other factors are positive odds ratios are the mother's education, which increase as the mother's level of schooling increases, with a mother with higher education (OR= 2.783, CI= 2.042-2.889) being the category with the highest magnitude. Another factor with a positive odds ratio is micronutrient intake, which has an OR= 2.099 (CI= 1.055-2.155).

Table 4. Logistic regression analysis between the number of prenatal controls and birth weight (in grams).

	OR	P-value	95% CI
Var. dep.: Normal weight=1, 0 otherwise			
Number of times of prenatal checkups			
Prenatal checkups	2.005***	0.004	1.981-2.055
Sex of child born			
Woman	Ref.		
Man	1.522***	0.001	1.162-1.678
Mother's region of origin			
Sierra	Ref.		
Costa	1.083	0.590	1.010-1.369
Amazon	1.511**	0.049	1.002-1.824
Galapagos	2.402	0.152	2.322-2.575
Mother's ethnicity			
Indigenous	Ref.		
Afro-Ecuadorian	1.035	0.932	1.003-1.056
Mongrel	0.933	0.806	0.626-2.086
White	0.903	0.864	0.276-1.071
Montubio or Others	0.818	0.620	0.692-0.991
Mother's educational level			
None	Ref.		
Basic Education	2.262	0.125	2.221-2.860
Middle/High School Education	2.337	0.109	2.191-2.889
Higher Education	2.783*	0.060	2.042-2.889
Residential area			
Rural	Ref.		
Urban	1.078	0.635	1.035-1.086
Place where prenatal checkups are performed			
Other establishment	Ref.		
HPM health facilities	0.822	0.235	0.521-1.128
Consumed micronutrients during pregnancy			
iron?	Ref.		
Folic acid	1.496	0.188	1.197-1.903
iron plus Folic Acid?	2.099**	0.023	1.055-2.155
Frequency of micronutrient intake			
daily	Ref.		
spending a day	0.652*	0.050	0.058-1.001
spending two days	0.693	0.799	0.593-1.770
More than two days	0.976	0.981	0.083-2.034
Did you receive advice on micronutrients?			
No	Ref.		
Yes	1.099	0.634	1.0093-1.482
Did you receive advice about alarming signs?			
No	Ref.		
Yes	1.715*	0.092	1.027-1.955
Week of the first prenatal checkup			
Weeks first control	0.985	0.246	0.040-1.010
Type of delivery			
Cesaria	Ref.		
normal (vaginal)	1.233	0.125	1.058-1.478
Type of birth			
on time	Ref.		
premature	0.214***	0.000	1.021--1.664
post-mature	1.317*	0.096	1.213-1.611
Constant	5.790***	0.007	5.472-5.940
Observations	3911		
AIC	1848.35		
BIC	2011.41		
Chi^2	152.4		
Chi^2 *p-value*	0.000		
Log-likehood	-898.174		

Notes: Asterisks mean: *p < 0.10,**p < 0.05, ***p < 0.01. In the table, the dependent variable is the dichotomous variable newborn weight which takes a value of 1 if the newborn has a normal weight (weight >=2500gr) and takes a value of 0 if the newborn has a low weight (weight<2500gr).

After estimating the logit model, we can estimate the marginal impacts (MI) of the independent variable on the probability of a newborn having a normal birth weight. **Figure 2** shows that as the number of prenatal checkups increases, the probability of being born with a normal birth weight increases. For example, a pregnant woman with six prenatal checkups has a 0.18% higher probability of being born with a normal birth weight compared to those mothers who did not have any prenatal checkups. This probability increases significantly, since, for example, a mother who has 30 prenatal check-ups during pregnancy has a 0.83% chance of having a newborn with normal birth weight.

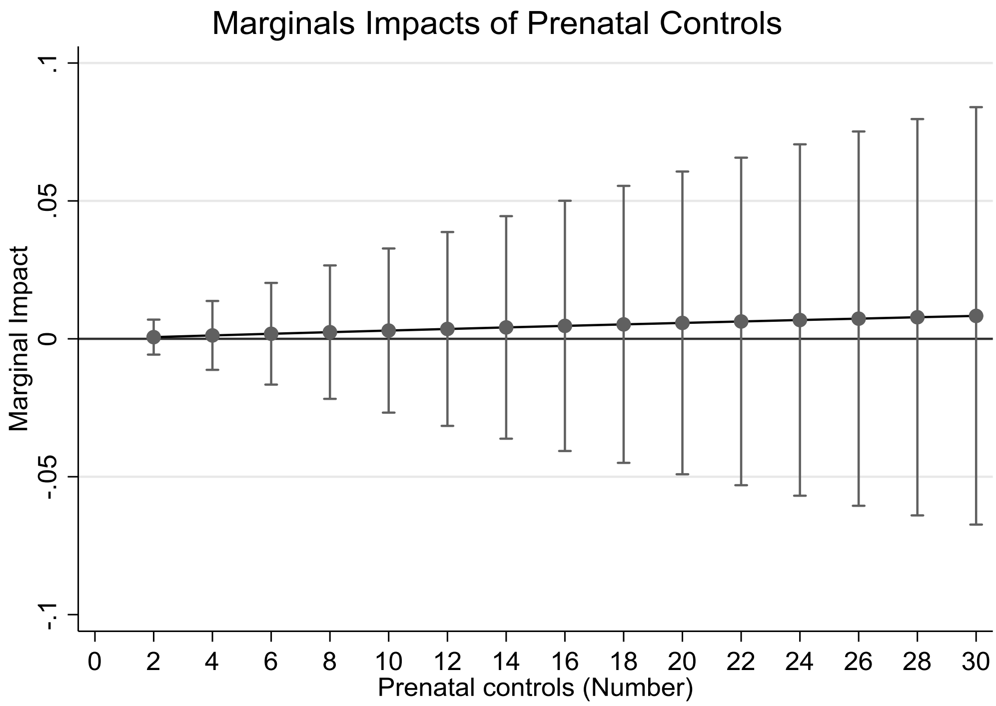

Figure 2. Marginal impacts of prenatal controls on the probability of normal birth weight and their respective 95% confidence intervals.

Finally, to determine the discriminatory power of the predictor variables, the ROC curve was applied with the probabilities estimated by applying logistic regression under the method of introducing their confidence intervals and their statistical significance $p < 0.05$. The ROC Curve coincides with the probability of correctly distinguishing a case of normal birth weight from one that is not, through the predictor variables, with the worst case scenario being when the area is equal to 0.50. In our case, having a greater number of prenatal controls, the mother having a higher educational level, consuming iron plus folic acid and with a daily frequency, in addition to receiving counseling on how they are consumed and counseling on risk signs during pregnancy, represented an area under the curve of 0.7053 (95% CI: 0.651-0.794), considering that they adequately predict normal birth weight cases ($p < 0.001$).

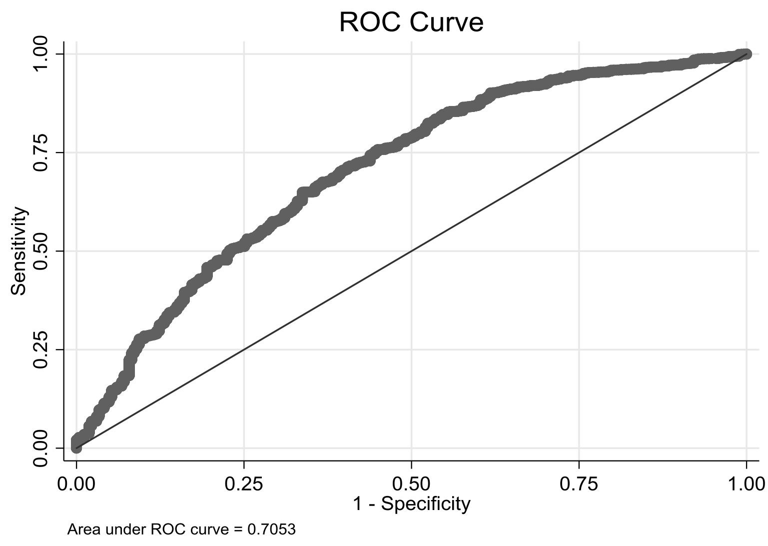

Figure 3. ROC curve for the determination of the sensitivity of the model of factors associated with normal birth weight.

IV. Discussion Of Results

In the present study, an association was found for normal birth weight with some factors: having a greater number of prenatal check-ups, the mother having a higher level of education, consuming iron and folic acid more frequently and on a daily basis, as well as receiving advice on how they are consumed and advice on signs of risk during pregnancy. We conclude that prenatal consultations are an essential means of bringing health professionals closer to mothers, and with properly trained health personnel, preventive activities can be promoted during pregnancy and healthy diets can be encouraged. [11]. One of the points that best exemplify the prevention schemes are prenatal controls, our study found 2 times the associated risk of having a normal birth weight for each additional control during pregnancy, another study in our same line found a relationship with almost 2 times the risk (OR: 1.9). [12]. In Argentina they also found an association, but when less than five prenatal checkups were performed. [13]. In Colombia, [14]argues that there are still barriers for pregnant women to attend prenatal checkups, it is assumed that the objective of the checkup is to prepare women for motherhood and parenthood, detecting risks in a timely manner, which is not being done due to multiple factors, among them the lack of adherence to prenatal checkups; The same report indicates that this adherence should be expressed not only in attendance, but also in compliance with the recommendations.

A study conducted in Cuba evaluated the quality of prenatal care of pregnant women with low birth weight newborns, and found that the level of knowledge about low birth weight among professionals attending prenatal visits was inadequate (60% when the standard was 90%), and compliance with the flow chart for insufficient weight gain was 20% when the standard was 90%. [15]. this is more difficult in those with few prenatal checkups, it would be necessary to study the reasons why pregnant women do not complete their prenatal checkups. A study conducted in Peru found that incomplete services, failure to offer follow-up appointments, lack of coordination between services, lack of knowledge about prenatal care and short time for prenatal visits were associated with a lower number of prenatal visits. [16].

In Brazil, a study found that the increase in low birth weight cases is due to an increase in the rate of multiple births and a reduction in the rate of fetal death (500 to 999 g). [17]. The study found a nearly 6-fold association for low birth weight (ORa: 5.7; 95% CI: 1.4-23.0). According to Gallardo et al. (2012) low birth weight is due to two fundamental causes: having occurred a birth before term or that the fetus presents insufficient weight in relation to gestational age, in multiple gestations both events occur, by the multiple gestation itself, fetuses rarely reach term and, therefore, the outcome of low weight is more likely; Another event that is leading to more multiple gestations is described by Kushner-Dávalos (2010), who argues that a large number of people delay pregnancy due to sociocultural factors, preferring personal and professional development rather than having children, and therefore resort to assisted fertilization, making multiple gestations more likely.

Latin America continues to be the region with the highest number of adolescent pregnancies, after sub-Saharan Africa. Among the countries with adolescent pregnancy above 13% are Argentina, Bolivia, Colombia, Ecuador, Guatemala and the Dominican Republic, which have increased in prevalence in recent years; in the group of countries that have decreased in prevalence are El Salvador, Honduras, Nicaragua, Panama and Venezuela. Among the countries with less than 13% of adolescent pregnancy and which have lowered their prevalence are Brazil, Costa Rica, Haiti, Jamaica, Peru and Uruguay; only Mexico, which belongs to the group with a prevalence of less than 13%, is the country in which it has registered an increase inprevalence. [18]. A systematic review found that age under 20 years was associated with low birth weight in Latin American countries; among the mechanisms that explain this event are young women with immaturity of the reproductive system and emotional immaturity. [19]. A case-control study in Argentina found in 380 adolescents a proportion of 8.8% of low birth weight newborns, compared to 8.4% of adult pregnant women. (Minuzzi et al., 2010). Regarding the adolescent factor, an association of 0.3 (ORa:0.3; 95% CI: 0.1-0.7) was found, which means that not being an adolescent would reduce the risk of low birth weight by 70%; other studies find this element as a risk factor. [21]. Castilla et al. (2014) argue that the worst outcomes with respect to underweight are more frequent in the children of adolescents than in adult women.

Morí Quispe et al, (2013) point out that mothers with underweight children are not prepared to handle situations that may threaten the life of their babies or situations in which there is a high risk of sequelae that invalidate the autonomy of the child, as these are more frequent in adolescent mothers, another event that would happen in the adolescent pregnant woman is her poor nutrition, Garcés and Gómez (2011) point out that in the malnourished pregnant woman, and fundamentally in the adolescent who has not completed her development, there is an inadequate maternal-fetal exchange, as well as an abnormal metabolism of proteins, lipids, carbohydrates and minerals in the mother, which leads to insufficient utilization of nutrients by the fetus and affects its development. In Argentina, Salcedo et al., (2012) found that more than 60% of mothers who presented insufficient weight gain during gestation, or poor pregestational BMI, had children with poor nutritional status. Ariza et al., (2014) in Colombia, identified that adolescent pregnancy occurred more frequently in less favored social sectors, and that pregnant girls and young women have inadequate nutritional status, which increases the risk of low birth weight among other pathologies, this group is also more prone to unwanted pregnancy, in Peru the figure of unwanted pregnancy in pregnant women with low birth weight newborns is 30.2%. [22]. Another factor found was that of having a short inter-gestational interval (ORa: 0.2; 95% CI: < 0.1-0.7), that is, having a period between pregnancies of more than two years would reduce the risk of low birth weight.

by 80%. Giving the uterus of a woman with a previous pregnancy little recovery time would be the underlying cause, since when the uterus is subjected to a subsequent pregnancy in less than two years, the environment for the new gestation is considered unfavorable. In a study carried out in Cuba, 3 times more probabilities of low birth weight were found with a short inter-gestational interval (OR: 3.09), although the data were not significant. [23]. In Spain, a study found that 64% of pregnancies with an inter-gestational interval of less than 24 months had preterm birth. [24].

We consider that these four factors: having a greater number of prenatal check-ups, that the mother has a higher educational level, consuming iron plus folic acid and with a daily frequency, in addition to receiving advice on how they are consumed and advice on risk signs during pregnancy, are predictors of normal birth weight and should form part, together, of the processes of training, prevention and follow-up of pregnant women; these four factors, which in the proposed model adequately predict the event, their probabilities are predictive as well. Therefore, the factors that can be managed by the health system would be those corresponding to: prenatal controls, they should have clear objectives in each control, especially in pregnant women with low birth weight; iron and folic acid consumption and adequate counseling, because this event is a function of the gestation planning of hospitals (or health centers) and also the factor of counseling on warning signs would be associated in the same sense.

V. Conclusion

This cross-sectional study u a representative sample of 3911 newborns from the 2018 National Health and Nutrition Survey (ENSANUT) of Ecuador. We used a linear regression model to estimate the associated parameters and a binary logistic regression to estimate the Odds Ratio (OR) and their 95% confidence intervals (95% CI) for each of the independent variables.

Our results show that the average birth weight of the individuals in our sample is 3332.45 grams (with a CI= 3308.51-3356.39). In addition, 6.83% of all individuals in our sample presented low birth weight. We also evidenced that the number of prenatal controls reported by the mothers is 7.36 prenatal controls. In addition, 70.4% of the mothers reported that prenatal controls were performed in the health facilities of the Ministry of Public Health (MOH). 88.5% of the mother's report that they consume micronutrients daily and 80.3% report that they consume micronutrients such as iron plus folic acid. Interestingly, 80.5% and 78.9% of mothers reported that they received micronutrient intake counseling and counseling on risk signs, respectively. Also, 53.1% of mothers reported that they had a normal delivery and 84.2% reported that the child was born on time. These descriptive statistics reveal important patterns of the individuals considered in this study. Our results also reveal that an increase in the number of prenatal checkups performed during pregnancy also increases the average birth weight of the child, i.e. for each prenatal checkup the average birth weight of the child increases by 0.47 grams (CI= 0.25-0.58) ($p<0.05$). Also, a higher frequency of micronutrient intake is associated with a higher birth weight parameter. It was also shown that receiving counseling on micronutrient intake and pregnancy warning signs increased birth weight by 34.30 (CI= 28.041-53.649) and 80.27 (CI= 50.750-90.705) grams respectively. Also, preterm delivery decreases birth weight by 206.92 (-278.413 - -135.431) grams and postmature infants (born beyond 40 weeks gestation) have an average birth weight of 160.25 (CI= 99.955-220.560). Other protective factors are the mother's education, as the mother's level of schooling increases, with a mother with higher education (OR= 2.783, CI= 2.042-2.889) being the category with the highest magnitude.

Based on our findings, we recommend that health policy makers and medical professionals consider the promotion of prenatal care as an effective preventive method to detect perinatal diseases and therefore reduce maternal and infant mortality in the Ecuadorian population.

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Gissele Verdezoto-Unaucho, et. al. "The impact of prenatal checkups and other factors on birth weight: A cross-sectional study for the Ecuadorian case." *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, 11(02), 2022, pp. 44-54.