REVISTA O MUNDO DA SAÚDE

# Pre-gestational anthropometric status and birth weight: NISAMI cohort



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**Abstract**

The aim of this study was to analyze the relationship between the pre-gestational Body Mass Index (BMIpg) and the newborn's weight in the municipality of Santo Antônio de Jesus, BA. This was a prospective cohort study, with 185 pregnant women and their respective newborns, attended at the Basic Health Units, from April 2012 to November 2013. The pre-gestational BMI was performed with data of their referred weight and height measured on the day of application of the questionnaire. The Kolmogorov – Smirnov test was performed to analyze the normality of the data. The association between pre-pregnancy nutritional status and perinatal outcomes was estimated through the Relative Risk and 95% confidence interval. Of the 185 women, 44.9% started the pregnancy with some weight deviation. Underweight (RR = 2.2; 95% CI = 0.5-9.5) and overweight (RR = 1, 1; 95% CI = 0.5-2.6) women showed a positive association with insufficient birth weight (<3000g), while obese women presented a negative association (RR = 0.8; 95% CI = 0.3-2.7). Only underweight women were at risk for low birth weight (RR = 3.1; 95% CI = 0.3-30.7). These data reveal that the pre-gestational anthropometric status influences the development of pregnancy and the nutritional inadequacies configured in periods prior to conception are considered determining factors for the child's weight. Pre-pregnancy weight deviations were positively associated with inadequate birth weight, which suggests the need for preconception nutritional care. Health care for women of childbearing age may assist in better pregnancy outcomes.

**Keywords:** Birth weight. Risk factors. Newborn. Pregnant women. Cohort study.

## INTRODUCTION

Anthropometric measurements are recommended for nutritional monitoring of pregnant women, due to their importance in preventing perinatal morbidity and mortality, prognosis of fetal development, and health promotion for women[1], in addition to practicality and low cost[2]. According to the Ministry of Health[3], the ideal context is that the Body Mass Index (BMI) considered in the initial diagnosis of the pregnant woman should be the pre-gestational BMI that indicates her previous nutritional status.

The pre-gestational nutritional status can influence both weight gain during pregnancy

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and postpartum weight loss[4]. Insufficient gestational weight gain is related to the occurrence of low birthweight newborns[4-6] and inadequate birth weight. Parallel to this, excessive weight gain in the gestational period is also associated with low birth weight (LBW), insomuch as this association may be related to the increase in pregnancy complications, which impact on the child's weight and are considered as one of the main risk factors for unfavorable gestational outcomes[7].

In Brazil, the prevalence of LBW is 9.2%, which may vary according to each region. However, the most serious situation is presented in the Northern (12.2%) and Northeastern (12%) states, caused by inadequate maternal nutrition and the difficulty in accessing health services. Regional estimates show a higher incidence of LBW in rural areas (11.2%) when compared to urban areas (8.6%)[8].

LBW is associated with inadequate fetal nutrition, which affects growth and increases the risk of neonatal morbidity or death[9]. It is considered an excellent indicator of maternal and child health and allows establishing the population's epidemiological profile[10]. According to a national study on neonatal mortality[11], deaths are concentrated in the Northeast (38.3%) and in low birthweight newborns (82%).

Therefore, given the relevance of this event for public health, particularly for the maternal and pediatric group, it is necessary to know the magnitude of the multiple risk factors that determine the prevalence of LBW in order to contribute to the prevention of diseases in this life cycle and promote adequate growth and development of the fetus. Thus, this study aimed to analyze the relationship between the pre-gestational body mass index (BMIpg) and the newborn's weight in the municipality of Santo Antônio de Jesus, BA.

## METHODOLOGY

This was a prospective cohort study involving 185 pregnant women, conducted by the Maternal and Child Health Research Center (NISAMI) at the Federal University of Recôncavo da Bahia (UFRB). It is part of a larger project entitled "Maternal risk factors for LBW, prematurity, and delayed intrauterine growth, in Recôncavo da Bahia".

This study included clinically healthy women, residents of and residing in the urban area, who were eighteen years of age or older, with a gestational age equal to or less than 15 weeks, enrolled in prenatal services of the Unified Health System (SUS), and who agreed to participate in the study. Twin pregnancy, anembryonic pregnancy, previous metabolic complications, HIV positive, abortions, and those without ultrasound confirmation of gestational age were excluded.

Data collection was carried out from April 2012 to November 2013 at Family Health Units in the municipality of Santo Antônio de Jesus. The pregnant woman was approached in the prenatal service center and at this moment the objectives of the study were presented, and those who agreed to participate signed the Informed Consent Form (ICF).

All those who agreed to participate had their data collected through a closed questionnaire containing questions about sociodemographic characteristics, nutritional information, gynecological and obstetric antecedents, laboratory tests, medication used, sun exposure, and anthropometric

values. For the present study, parameters related to sociodemographic characteristics were used, such as maternal age, maternal education, marital status, employment status, income, religion, and race, and anthropometric measurements were pre-gestational weight and measured height.

The anthropometric assessment of pregnant women was carried out in three moments: the first moment was in the family health unit, and the second and third moments were in the pregnant woman's home. These two home visits were made in the second and third gestational trimesters. To measure height, a Welmy stadiometer was used, with the capacity to measure up to 2 meters and an increment of 5 mm. It was performed with the pregnant woman standing, erect, barefoot, with her arms extended along her body, with her heels together and as close to the measuring stick as possible, head up, looking at a fixed point at eye level. The person in charge of carrying out the measurement slowly lowered the vertical nail, gently pressing the pregnant woman's hair until the nail touched the scalp.

To measure the weight, a portable Mars brand scale, model LC 200, was used, which is specific for weighing humans, with a capacity to weigh up to 150 kg and accuracy of 100 g, calibrated and certified by the National Institute of Metrology, Quality and Technology (INMETRO). The scale was supported on a flat, firm, smooth surface and away from the wall, with the pregnant woman in the center of the scale, with as little clothing as possible, barefoot, upright, with her feet together and her arms extended along her body, and she was kept in that position to read the weight on the display.

Anthropometric measurements were taken in duplicate, by the researchers and nutritionists responsible for the project and by the team of students of the UFRB Nutrition course, who were properly trained and following standardized norms[12]. The average of the values in the data analysis were used.

The main independent variable of this study is the BMIpg, used as a proxy for the pre-gestational nutritional status and was defined using the formula weight/height$^2$; where the weight was in kilograms and the height in meters, using the weight provided by the pregnant woman before becoming pregnant and the height measured by the researchers at the health unit. The cutoff points for adult women of the World Health Organization (WHO), in 1995[2], were classified as underweight (BMI<18.5 kg/m$^2$), eutrophic (18.5 kg/m$^2$≤BMI<25.0 kg/m$^2$), overweight (25.0 kg/m2≤BMI<30 kg/m$^2$) and obese (BMI≥30.0 kg / m$^2$).

The dependent variable in this study was birth weight. Newborns weighing less than 2,500 g were considered underweight, newborns weighing between 2,500 and 2,999 g were low weight, and those weighing more than 3,000 g were considered to be of adequate weight.

The database was entered twice and analyzed using SPSS® software, version 20.0. For the analysis of categorical variables (gestational age, number of pregnancies, family income, gestational weeks, and maternal education), absolute and relative frequency were used. The anthropometric variable (pre-gestational BMI) was described by means of mean and standard deviation. The Kolmogorov – Smirnov test was performed to assess the analysis of data normality. The Parametric Student's T Test for independent samples was used to assess the distribution of maternal characteristics, according to pre-gestational BMI and birth weight. P-values ≤0.05 were considered statistically significant. Relative Risk (RR) and its respective confidence intervals were also estimated to assess the relationship between LBW, according to the Pre-Gestational Body Mass Index.

The larger project in which this study is

inserted was previously approved by the Ethics Committee of the UFBA-CEPNUT School of Nutrition, under opinion number 16/12, on November 26, 2012. This study followed the ethical precepts of research involving human beings, according to Resolution 466 of December 12, 2012, from the Ministry of Health.

When nutritional risk factors were identified, the pregnant women were referred, if they expressed interest, to the Maternal and Child Nutrition Outpatient Clinic, which operated in a Basic Health Unit, located in the center of Santo Antônio de Jesus, and offers individualized nutritional assistance free of charge.

## RESULTS

Approximately 44.9% of women started their pregnancy with some weight deviation, according to the assessment of pre-gestational anthropometric status. Regarding the BMIpg classification, 4.9% were underweight and 13.5% were obese. The mean maternal age was 27 years old (±5.5) and the average pre-pregnancy weight was 63.0 kg (±14.1), with a minimum and maximum weight of 42 and 132 kg, respectively. Most women (86.0%) had an incomplete primary education and the average number of pregnancies among multiparous women was 2.3 (±1.5).

Table 01 shows the distribution of maternal characteristics. Of the studied pregnant women, most were aged between 23 and 31 years old (42.7%), most did not finish high school (85.95%), 70.27% had cesarean delivery, and more than half of the pregnant women (75.14%) claimed to have an income higher than one minimum wage.

As for maternal characteristics according to BMIpg, it was observed that 60.71% of eutrophic pregnant women were primiparous, and those with low BMIpg did not complete high school (5.03%). According to the minimum wage variable, 8.7% of pregnant women classified as underweight received less than one minimum wage. It was found, in relation to the number of gestational weeks, that 14.8% of pregnant women with 37 weeks of gestation or more were obese (Table 01).

Table 02 shows the gross relative risk for LBW, according to the BMIpg. It was observed that women with low gestational weight had 2.18 and 3.1 times more risk of having newborns with LBW (RR = 2.18; 95% CI = 0.50 - 9.53) and insufficient weight at birth (RR = 3.1; 95% CI = 0.3-30.7), respectively, but without statistical significance.

In Table 03, it is observed that there is a higher incidence of birth weight <3000 g in pregnant women who had low pre-gestational weight, which was 33.3 per 100 pregnant women/year. When calculating the Attributable Risk (AR) it was found that for LBW it is 14.7 for every 100 pregnant women with low pre-gestational weight. In relation to the Proportional Attributable Risk (RAP) of the population, it was shown that the reduction of the factor would prevent the appearance of 6% of the cases of LBW, while the RAP among pregnant women exposed to low pre-gestational weight will prevent 53.9% of low birthweight.

It can be seen, from table 04, that newborns of women who started their pregnancy at a normal weight had the highest average birthweight, while newborns of underweight pregnant women had the lowest average. Regarding the pre-gestational BMI, the statistically significant difference between the mean birthweight occurred among pregnant women who started their pregnancies underweight in relation to those with family

income >1 minimum wage. Such data reflect the same result for pregnant women who started with the appropriate weight. Pregnant women with less than 37 gestational weeks at delivery showed significant differences between the mean birthweight with pregnant women who started the pregnancy with adequate weight or as overweight/obese. In relation to normal birth, the significant difference between the mean birthweight occurred among pregnant women who started their pregnancy with an adequate weight.

**Table 1 –** Distribution of maternal characteristics, according to pre-gestational BMI in pregnant women residing in Santo Antônio de Jesus, Bahia, 2012-2013.

| | Total N (%) | Eutrophic N (%) | Low weight N (%) | Overweight N (%) | Obese N (%) |
|---|---|---|---|---|---|
| **Age** | | | | | |
| ≤ 23 years | 54(29.19) | 35 (64.81) | 6 (11.11) | 7 (12.96) | 6 (11.11) |
| 23 – 31 years | 79(42.70) | 45 (56.96) | 1 (1.27) | 21 (26.58) | 12 (15.19) |
| ≥ 31 years | 52 (28.11) | 22 (42.31) | 2 (3.85) | 21 (40.38) | 7 (13.46) |
| **Number of pregnancies** | | | | | |
| Primiparous | 140 (75.68) | 85 (60.71) | 7 (5.00) | 33 (23.57) | 15 (10.71) |
| Multiparous | 45 (24.32) | 17 (37.78) | 2 (4.44) | 16 (35.56) | 10 (22.22) |
| **Income** | | | | | |
| >1 MW* | 139 (75.14) | 81 (58.27) | 5 (3.60) | 35 (25.18) | 18 (12.95) |
| ≤ 1 MW | 46 (24.86) | 21 (45.65) | 4 (8.70) | 14 (30.43) | 7 (15.22) |
| **GW at delivery** | | | | | |
| ≥ 37 Weeks | 168 (90.81) | 91 (54.17) | 8 (4.76) | 44 (26.19) | 25 (14.8) |
| < 37 Weeks | 17 (9.19) | 11 (64.71) | 1 (5.88) | 5 (29.41) | 0 (0.00) |
| **Maternal Education** | | | | | |
| ≥ high school | 26 (14.05) | 11 (42.31) | 1 (3.85) | 8 (30.77) | 6 (23.08) |
| < high school | 159 (85.95) | 91 (57.23) | 8 (5.03) | 41 (25.79) | 19 (11.95) |
| **Type of delivery** | | | | | |
| Normal | 55 (29.73) | 31 (56.36) | 4 (7.27) | 11 (20.00) | 9 (16.36) |
| Cesarean | 130(70.27) | 71 (54.62) | 5 (3.85) | 38 (29.23) | 16 (12.31) |

GW = gestational week. MW = minimum wage *The minimum wage in 2013 was R$ 678.00.

**Table 2 –** Relative risk for low birthweight, according to the Pre-Gestational Body Mass Index, in pregnant women residing in Santo Antônio de Jesus, Bahia, 2012-2013.

| Pre-gestational BMI | Birthweight <2500 | | | Birthweight>3000 | | |
|---|---|---|---|---|---|---|
| | n (%) | RR | 95%CI | n (%) | RR | 95%CI |
| **Eutrophic** | 4 (3.9) | 1.0 | | 19 (18.6) | 1.0 | |
| **Low weight** | 1(11.1) | 3.1 | 0.30 – 30.75 | 3 (33.3) | 2.18 | 0.50 – 9.53 |
| **Overweight** | 2 (4.1) | 1.0 | 0.18 – 5.90 | 10 (20.4) | 1.12 | 0.48 – 2.63 |
| **Obese** | 0 | - | - | 4 (16.0) | 0.83 | 0.26 – 2.71 |
| **Total** | 7 (3.8) | | | 36 (19.5) | | |

BMI = body mass index. RR = relative risk. CI = Confidence interval. * N = 185 pregnant women

**Table 3 –** Incidence of Birth Weight (<3000g) according to Pre-Gestational Body Mass Index, in pregnant women residing in Santo Antônio de Jesus, Bahia, 2012-2013.

| Pre-gestational BMI | Birthweight < 3000g | Incidence per 100 pregnant women/ | Birthweight ≥ 3000g | Total |
|---|---|---|---|---|
| Low weight | 3 | 33.3 | 6 | 9 |
| Eutrophic | 19 | 18.6 | 83 | 102 |
| Total | 22 | | 89 | 111 |

BMI = body mass index.

**Table 4 –** Distribution of maternal characteristics, according to pre-gestational BMI and birthweight (M±SD), in pregnant women residing in Santo Antônio de Jesus, Bahia, 2012-2013.

| | Low weight M±DP | Eutrophic M±DP | Overweight and Obese M±DP |
|---|---|---|---|
| Birthweight | 3163.9±467.80 | 3354.2±498.3 | 3344.8±563.3 |
| **Gestational Age** | | | |
| <30 | 3242.8±491.7 | 3317.3±482.1 | 3339.0±493.0 |
| ≥ 30 | 2887.5±321.7 | 3488.5±543.9 | 3354.3±672.8 |
| **Number of pregnancies** | | | |
| Primiparous | 3242.8±491.7 | 3363.4±487.8 | 3338.7±509.2 |
| Multiparous | 2887.5±321.7 | 3307.9±561.9 | 3355.9±662.5 |
| **Income** | | | |
| >1 MW | 2906.0±382.9* | 3428.9±486.7* | 3328.2±531.2 |
| ≤1 MW | 3482.2±372.4 | 3066.2±443.8 | 3386.8±649.6 |
| **Gestational weeks in childbirth** | | | |
| ≥ 37 weeks | 3126.9±485.8 | 3406.5±475.0* | 3382.7±543.6* |
| <37 weeks | - | 2921.8±496.6 | 2821.0±632.9 |
| **Maternal education** | | | |
| ≥ high school | - | 3472.3±358.3 | 3262.6±725.1 |
| < high school | 3226.9±457.5 | 3333.9±512.3 | 3363.9±524.2 |
| **Type of delivery** | | | |
| Normal | 2853.3±443.4 | 3199.4±514.9* | 3156.7±304.2 |
| Cesarean | 3409.0±348.2 | 3421.8±479.0 | 3414.5±620.9 |

M = mean. SD = standard deviation. MW = minimum wage. *p <0.05, based on student's t test.

## DISCUSSION

The relationship between inadequacies in the pre-gestational anthropometric state and inadequate birthweight (low weight and insufficient weight) have been demonstrated in several studies in the scientific literature. Thus, in a study conducted with 228 pregnant women accredited to the health center, there was a statistically significant association between low pre-gestational maternal weight and LBW/insufficient weight of the children[13].

In agreement with this study, several others explain the inadequacy of the pre-gestational anthropometric status with the inadequate development of the fetus, manifesting as low weight and insufficient weight at birth[14-18]; thus, revealing that the pre-gestational anthropometric status as a strong predictor of child weight at birth.

This study revealed that most women were eutrophic, but those with low pre-pregnancy weight were predominantly younger (under 23 years old), favoring the risk of developing low weight or premature newborns. In this sense, it was observed that maternal age can be considered a risk factor for LBW[19]. The scientific literature reveals that mothers of children with LBW are significantly younger[5]. This relationship may be associated with inadequate nutritional reserves necessary for the proper development of pregnancy, since younger women are increasingly influenced by the media where they worship a lean body (BMI ≤18.5 kg/m$^2$) as a synonym for a perfect body and this can directly impact the pre-gestational nutritional reserves needed for proper pregnancy development.

It was also possible to observe in this study that obese and overweight pregnant woman had a higher percentage of cesarean deliveries. In a study carried out with Chinese women, it was observed that women that were overweight or obese before pregnancy had a higher risk of cesarean delivery compared to women who started pregnancy with a low weight[20-21]. This association can be justified by the greater likelihood of overweight women having a higher occurrence of complications during pregnancy, such as hypertensive syndromes and gestational diabetes mellitus, in addition to a higher probability of cephalopelvic disproportion which are indicative of a cesarean delivery[21].

With regards to maternal education, it was noted that women with higher education had a lower percentage of underweight individuals, while those who had not completed high school exhibited a higher percentage of overweight/obesity. As for birthweight, the children of pregnant women with less education and a BMI of low weight and normal weight had lower averages of birthweights. In agreement with a study carried out in Minas Gerais, which identified the prevalence and factors associated with LBW, the lower the maternal education, the more likely it is to have children with low weight[22]. Maternal schooling is an extremely sensitive variable to the socioeconomic conditions of families. In this perspective, low education can be associated with low-income conditions, which refers to the greatest food insecurity of families, impacting accessibility to food, which can lead to an inadequate nutritional status of these woman.

In this study, it was found that underweight primiparous and multiparous women were at risk of having newborns with LBW. In contrast, a study carried out in Porto Alegre with an analysis of 260 medical records of mothers, found, in relation to parity, that there is no significant difference between the number of children and birthweight[23]. A cross-sectional study in the Northeast region, on the other hand, evaluated the association between sociodemographic, prenatal and childbirth characteristics of adolescent mothers and young adults with LBW, in which 9.7% had low birthweight newborns and the first pregnancy demonstrated an association statistic with the low weight of the newborn[24].

Despite all the methodological care used in this study, there was a limiting factor that was in relation to the pre-gestational weight reported by the pregnant women, as the study began when women are already pregnant. One study showed that this weight may be underestimated, and to minimize bias, they used the referred weight and measured height

to calculate the BMI[25], similar to what was performed in this study.

Despite the limitations mentioned, in this study, a more robust method of analysis and design was used, which made it possible to monitor nutritional variables over time.



## CONCLUSION

Pre-pregnancy weight deviations were positively associated with inadequate birthweight, which suggests the need for preconception nutritional care. Quality health care for women of childbearing age can assist in better pregnancy outcomes.

Women who started pregnancy with a low BMI, and as long as they do not gain the weight recommended in 2009 by the Institute of Medicine, may have newborns with inadequate birthweight. This is an important finding, since it is possible to control weight gain with adequate prenatal care, involving a multidisciplinary team, including nutritionists.

The pre-gestational BMI is related to the nutritional development of the newborn, which reinforces the importance of adequate monitoring of the pregnant woman, individualized food assessment for the calculation of the weight-gain necessary for the healthy development of the mother and child, and the reduction of risks of complication in pregnancy outcomes.

It is recommended that studies be develop aimed at women of childbearing age, in order to promote a healthy life and adequate nutrition, providing favorable conditions for the gestational period, avoiding complications in the outcomes for newborns and a better quality of life for women.

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## REFERENCES

1. Silva SL, Bresani-Salvi CC, Caminha MFC, Figueiroa JN, Filho MB. Classificação antropométrica de gestantes: comparação entre cinco métodos diagnósticos utilizados na América Latina. Rev Panam Salud Publica. 2017; 41(85):1-9. DOI: 10.26633/RPSP.2017.85.
2. World Health Organization. Physical status: the use and interpretation of report anthropometry – report of a WHO Expert Committee. Geneva. WHO. 1995. Disponível em: https://www.who.int/childgrowth/publications/physical_status/en/
3. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento 12. de Ações Programáticas Estratégicas. Área Técnica de Saúde da Mulher. Pré-natal e puerpério: atenção qualificada e humanizada. Manual Técnico. Brasília: Ministério da Saúde. 2006. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/manual_pre_natal_puerperio_3ed.pdf
4. Santana JM, Assis AMO, Alves WPO, Santos DB. Associação entre ganho ponderal na gestação e peso ao nascer: Coorte NISAMI. Rev Bras Saúde Mater Infant. 2020; 20 (2). DOI: https://doi.org/10.1590/1806-93042020000200005 .
5. Moreira ALM, Sousa PRM, Sarno F. Baixo peso ao nascer e seus fatores associados. Einstein. 2018;16(4):1-6. DOI: https://doi.org/10.31744/einstein_journal/2018ao4251
6. Silva DG, Macedo NB. Associação entre ganho de peso gestacional e prognóstico da gestação. Sci Med. 2014;24(3):229-36. DOI: https://doi.org/10.1590/1806-93042019000100006.
7. Santos EMF, Amorim LP, Costa OLN, Oliveira N, Guimarães AC. Perfil de risco gestacional e metabólico no serviço de pré-natal de maternidade pública do Nordeste do Brasil. Rev Bras Ginecol Obstet. 2012; 34(3):102-6. DOI: https://doi.org/10.1590/S0100-72032012000300002.
8. Souto da Silva, S., Santos, F.D.D., & Coca Leventhal, L.. (2011). Nascimento de recém-nascidos de baixo peso em instituição filantrópica terciária do Município de Piracicaba. Enfermería Global, 10(23), 61-75. DOI: https://dx.doi.org/10.4321/S1695-61412011000300006

9. Shun YH, Choi SJ, Kim KW, Yu J, Ahn KM, Kim HY, et al. Association between Maternal Characteristics and NeonatalBirth Weight in a Korean Population Living in the Seoul Metropolitan Area, Korea: A Birth Cohort Study (COCOA). J Korean Med Sci. 2013 Apr;28(4):580-5. [English]. DOI: 10.3346/jkms.2013.28.4.580
10. Pedraza DF. Baixo peso ao nascer no brasil: revisão sistemática de estudos baseados no sistema de informações sobre nascidos vivos. Revista de Atenção à Saúde. 2014;12(41):37-50. DOI: https://doi.org/10.13037/rbcs.vol12n41.2237.
11. Lansky S, Friche AAL, Silva AAM, Campos D, Bittencourt DAS, Carvalho ML, et al. Pesquisa Nascer no Brasil: perfil da mortalidade neonatal e avaliação da assistência à gestante e ao recém-nascido. Cad Saúde Pública. Rio de Janeiro. 2014;30:192-207. DOI: https://doi.org/10.1590/0102-311X00133213.
12. Brasil. Ministério da Saúde. Caderno de Atenção Básica: Atenção ao pré-natal de baixo risco. Brasília. 2012. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/atencao_pre_natal_baixo_risco.pdf
13. Sato APS, Fujimori E. Estado Nutricional e ganho de peso de gestantes. Rev Latino-Am Enfermagem. 2012;20(3):1-7. DOI: https://doi.org/10.1590/S0104-11692012000300006.
14. Oliveira ACM, Pereira LA, Ferreira RC, Clemente APG. Estado nutricional materno e sua associação com o peso ao nascer em gestações de alto risco. Ciênc saúde coletiva. 2018; 23(7):2373-2382. DOI: https://doi.org/10.1590/1413-81232018237.12042016.
15. Santos MMAS, Baião MR, Barros DC, Pinto AA, Pedrosa PLM, Saunders C. Estado nutricional prégestacional, ganho de peso materno, condições da assistência pré-natal e desfechos perinatais adversos entre puérperas adolescentes. Rev Bras Epidemiol. 2012;15(1):143-54. DOI: http://dx.doi.org/10.1590/S1415-790X2012000100013.
16. Francisqueti FV, Rugolo LMSS, Silva EG, Peraçolli JC, Hirakawa HS. Estado nutricional materno na gravidez e sua influência no crescimento fetal. Rev Simbio-Logias. 2012;5(7):74-86. DOI: https://doi.org/10.1590/S0100-72032012000300003
17. Campos ABF, Pereira RA, Queiroz J, Saunders C. Ingestão de energia e de nutrientes e baixo peso ao nascer: estudo de coorte com gestantes adolescentes. Rev Nutr. 2013;26(5):551-61. DOI: http://dx.doi.org/10.1590/S1415-52732013000500006.
18. Ferreira HS, Moura, RMM, Assunção MP, Horta BL. Fatores associados à hipovitaminose A em crianças menores de cinco anos. Rev Bras Saúde Matern Infant. 2013;13 (3): 223-235. DOI: https://doi.org/10.1590/S1519-38292013000300004.
19. Capelli JCS, Pontes JS, Pereira SEA, Silva AAM, Carmo CN, Boccolini CS, et al. Peso ao nascer e fatores associados ao período pré-natal: um estudo transversal em hospital maternidade de referência. Ciênc Saúde Coletiva. 2014;19(7):2063-72. DOI: https://doi.org/10.1590/1413-81232014197.20692013.
20. Liu Y, Dai W, Dai X, Li Z. Prepregnancy body mass index and gestational weight gain with the outcome of pregnancy: a 13-year study of 292,568 cases in China. Arch Gynecol Obstet. 2012;286:905-11. [English]. DOI: 10.1007/s00404-012-2403-6.
21. Nogueira AI, Carreiro MP. Obesidade e gravidez. Rev Med Minas Gerais. 2013; 23(1): 88-98. DOI: http://www.dx.doi.org/10.5935/2238-3182.20130014.
22. Costa GM, Tiburcio JD, De Oliveira VC, Gontijo TL, Guimarães EAA. Determinantes do baixo peso ao nascer a partir das declarações de nascidos vivos. Cienc Enferm. 2014; 20(3):21-31. DOI: http://dx.doi.org/10.4067/S0717-95532014000300003.
23. Meller TC, Santos LC. A Influência do Estado Nutricional da Gestante na Saúde do Recém-Nascido. R Bras Ci Saúde. 2009;13(1):33-40. DOI: https://doi.org/10.25248/reas.e206.2019
24. Almeida AHV, Costa MCO, Gama SGN, Amaral MTR, Vieira GO. Baixo peso ao nascer em adolescentes e adultas jovens na Região Nordeste do Brasil. Rev Bras Saúde Matern Infant. 2014;14(3):279-86. DOI: http://dx.doi.org/10.1590/S1519-38292014000300009.
25. Mardones F, García-Huidobro T, Ralph C, Farías M, Domínguez A, Rojas IM, et al. Influencia combinada del índice de massa corporal pregestacional y de la ganancia de peso n el embarazo sobre el crecimiento fetal. Rev Med Chile. 2011;139:710-16. DOI: http://dx.doi.org/10.4067/S0034-98872011000600003.



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