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RESEARCH ARTICLE

Impact of Obstetric Nutritional Risk on Perinatal Morbidity: A Case-Control Study

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ABSTRACT

Objective. Malnutrition is among the most relevant problems in pregnant women, which affects nutritional status of the fetus and newborn outcome. The impact of obstetric nutritional risk (ONR) on neonatal morbidity has not been investigated. The purpose of this work was to identify a possible association between ONR, on high-risk pregnancy (HRP) patients and perinatal morbidity.

Methods. This Case Control study included 118 neonates of HRP patients who were either (Cases, n =66) or not (Controls, n =52) with ONR. Groups were then compared to identify associated Neonatal Morbidity. Study variables included: neonatal morbidity, one and five-minute APGAR scores, birth weight, gestation weeks, preterm births, newborn gender and neonatal complications.

Results. Morbidity and preterm births were identified in 40 (60.6%) and 11 (21.1%) neonates (p <0.001); and 40 (60.6%) and 14 (26.9%) neonates (p <0.001), for cases and controls, respectively. Average one-minute and five-minute APGAR scores was 6 ± 1 and 8 ± 1 (p <0.05); and 8 ± 1 and 9 ± 1 (p >0.05) for cases and controls, respectively. Average birth weight and gestation weeks was 2,272.5 and 2,548.5 grams (p <0.05); and 34 ± 3.7 and 37 ± 3 weeks (p <0.05) for cases and controls, respectively. There were 34 (51.51%) and 24 (46.15%) female neonates (p < 0.05); and 32 (48.48%) and 28 (53.85%) male neonates (p >0.05) for cases and control, respectively.

Conclusion. Morbidity was significantly higher in neonates of HRP patients with ONR. Therefore, Obstetric Nutritional Risk had a negative impact on perinatal morbidity and newborn outcome.

Introduction

The importance of an adequate nutritional status of the hospitalized patient has been recognized and studied since the end of the last century. Currently, it is well known that malnutrition increases morbidity, mortality and health care costs.[1] Actually, it has been demonstrated that a significant number of patients admitted to hospitals are malnourished. McWhirter and Pennington showed that 40% of patients admitted to hospitals had some degree of malnutrition.[2]

The nutrition of pregnant women is currently a controversial issue. Among the most relevant problems are malnutrition and the severity of disease; which have a direct impact on the nutritional condition of the fetus and; therefore, on the newborn.[3-5] Recent studies have demonstrated that maternal nutrition status influence neonatal outcome. And, birth weight has been shown to be one of the most relevant affected parameters. A study performed by Ara D.K.S. et al., shows that pregnant women with both low body mass index (BMI) and hemoglobin are associated with an increased risk of low-birthweight (LBW), as compared to mothers with an adequate nutritional status and a normal-evolving pregnancy.[6] Maternal protein energy malnutrition is one of the main causes of intrauterine growth retardation.[7] A systematic review of the literature revealed that, neonates born in times of food insufficiency along with high levels of maternal malnutrition are associated with reduced thymic size and function.[8] Actually, Dutch famine and the 1918 influenza pandemic provided organic data on the epigenetic changes that can result from famine, infection and stress.[9] This opens a wider view on how pregravid and childhood exposure to and special events can affect all: the cardiovascular, endocrine and metabolic regulation systems. The resulting consequences can become transgenerational; due to larger possibilities to die from any of the pathologies that affect the aforementioned systems.

Pregnancy nutritional status and its impact on perinatal morbidity and mortality has become a controversial issue that has received little attention worldwide.[10] Currently, a specific screening methodology to assess the impact of Obstetric Nutritional Risk (ONR) on perinatal morbidity and mortality has not been described yet. Therefore, identifying the correlation between ONR and neonatal morbidity would help to improve all: pre, trans and postnatal management strategies; thus, significantly reducing neonatal complications and health care costs. The purpose of this work was to identify a possible association between ONR, on high-risk pregnancy (HRP) patients and perinatal morbidity.

Material and Methods

This ***Case-Control study*** included 118 neonates of High-Risk Pregnancy (HRP) patients admitted for Delivery to Hospital of Obstetrics and Gynaecology at Western National Medical Centre, Mexican Institute of Social Security (IMSS). Medical records of newborn babies from HRP patients were allocated in two groups by means of the Obstetric Nutritional Risk (ONR) Screening criteria reported by *Anaya-Prado R et al.*: "Obstetric Nutritional Risk" group (Cases, n = 66 neonates) and "No Obstetric Nutritional Risk" group (Controls, n = 52 neonates).[11,12] Groups were then compared to identify associated Neonatal Morbidity on either group. Study variables included: neonatal morbidity, one and five-minute APGAR scores, birth weight, gestation weeks, preterm births, newborn gender and neonatal complications.

Study Design

The group of investigators performed a "retrospective chart review" of High-Risk Pregnancy (HRP) patients admitted for delivery and who were assessed about their Obstetric nutritional risk status in accordance with ONR screening criteria. Obstetric nutritional risk diagnosis methodology has previously been described.[11,12] Although researchers did not assess for ONR status because of the study design; methodology follows in brief. An ONR score of 0 - 6 was obtained by adding *nutritional status score* (0 - 3) and *disease severity score* (0 - 3). A total score > 3 was considered a diagnosis of ONR. Nutritional status was scored as *absent*, *mild*, *moderate* and *severe* (0 - 3) based on three different variables: a) changes in estimated food intake, measured in quartiles; b) changes in body weight within the last 1 - 3 months, measured in percentage of body weight loss, and; c) changes in BMI, measured in kg/m^2. Gestational weight gain (GWG) by trimester and pregravid BMI status according to the World Health Organization (WHO) categories: Underweight < 18.5 kg/m^2; Normal weight 18.5 - 24.9 kg/m^2; Overweight 25.0 - 29.9 kg/m^2; Obese $\geq$ 30 kg/m^2, were considered for BMI range in different scores. Thus, BMI was categorized in accordance with gestational age, GWG by trimester and pregravid BMI. The disease severity score was categorized as *absent*, *mild*, *moderate* and *severe* (0 - 3) based on admission diagnosis.

As a result, two groups of newborns were integrated (*inclusion criteria*): a) newborn babies delivered of HRP patients who were classified with Obstetric Nutritional Risk (**Cases**, ONR > 3) and; b) newborn babies of HRP patients who were classified without Obstetric Nutritional Risk (**Controls**, ONR < 3). Thereafter, information concerning neonates on either group was collected from the medical records and compared accordingly. Neonate morbidity was the main outcome variable (Figure 1). Newborn babies of HRP patients who were not assessed about their Obstetric nutritional risk status in accordance with ONR screening criteria, were not included.

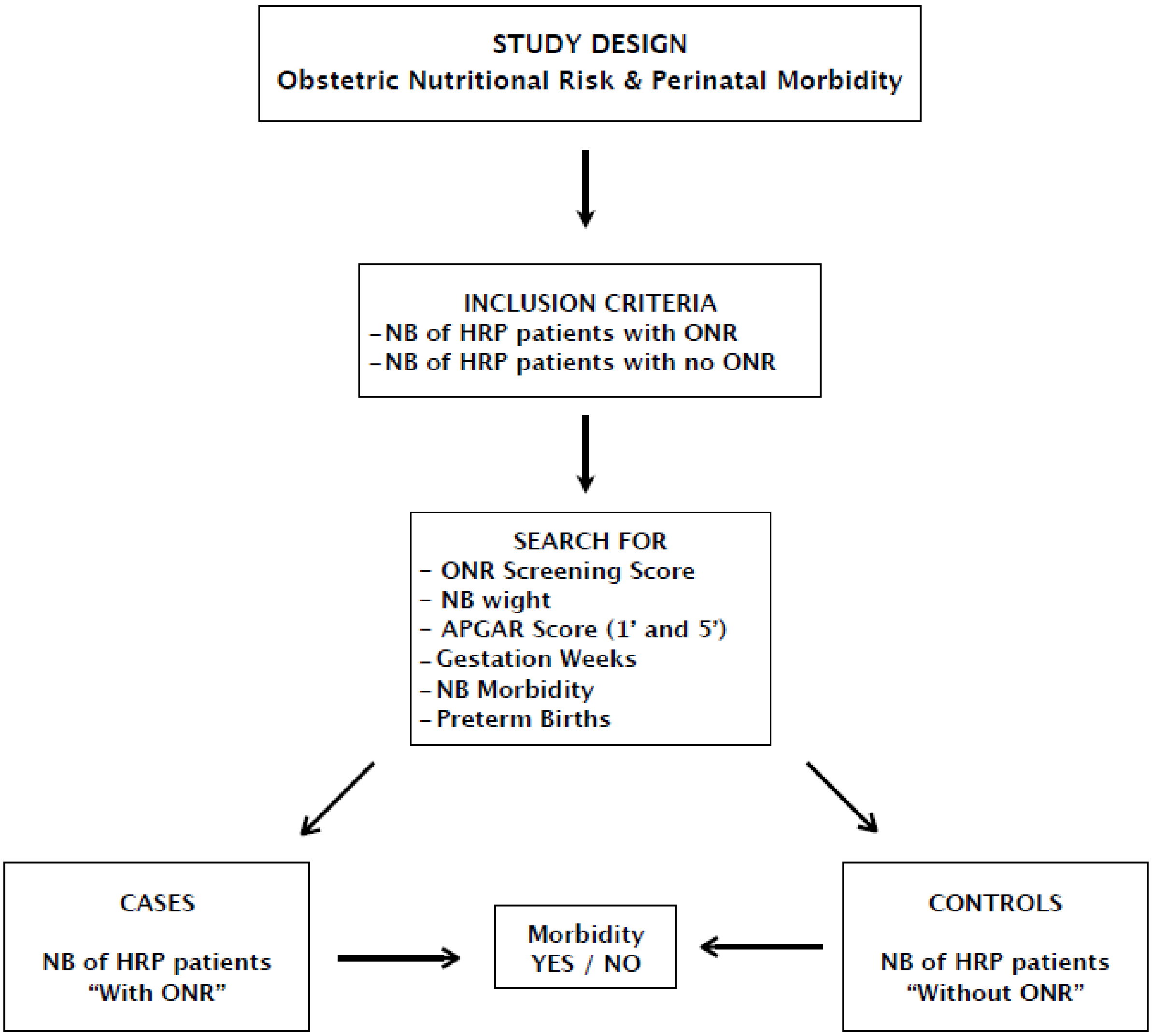

Figure 1. Retrospective chart review integrated two groups of Neonates for comparison in this case-control study. Newborns (NB) of high-risk pregnancy (HRP) patients with (cases) and with no (controls) obstetric nutritional risk (ONR). Main outcome variable was perinatal morbidity. APGAR, appearance, pulse, grimace, activity, respiration.

Ethics

The study was submitted and approved by the Hospital Ethics and Research Committee. Since the study design was retrospective, neither verbal nor written informed consent was obtained from participants. Nevertheless, this investigation adhered to principles of good clinical practice and in accordance with the Declaration of Helsinki. Hence, all information and patient data were handled and processed by the investigators, always ensuring confidentiality.

Statistical Analysis

Descriptive statistic was utilized for categorical data. The Pearson´s correlation and Chi^2 test, with Yates correction, or Fisher exact test were applied. Quantitative variables are expressed as mean ± standard deviation of the mean (SDM) and were compared by Student's *t* test for independent samples. Results are reported on averages. When normality test failed, the Mann-Whitney U test was employed. To determine the difference between individual means, data were analyzed by one-way analysis of variance (ANOVA), followed by the Student-Newman-Keuls' test. The analysis was performed using SigmaStat® (release 4.0), SPSS (release 21). A *P* value equal to or less than 0.05 was considered statistically significant.

Results

The study showed that 34 (51.51%) and 24 (46.15%) of neonates were females for cases and controls, respectively. The difference was statistically significant ($p < 0.05$). While 32 (48.48%) and 28 (53.85%) of neonates were males for cases and controls, respectively ($p > 0.05$). The difference between female and male newborns, on either group, was not significant ($p > 0.05$) (Table 1).

Obstetric Nutritional Risk and Neonate Parameters

Average one-minute and five-minute APGAR scores was 6 ± 1 and 8 ± 1 ($p < 0.05$); and 8 ± 1 and 9 ± 1 ($p > 0.05$) for cases and controls, respectively. The difference between the two groups was statistically significant, except for the five-minute APGAR score. There was also a statistically significant difference when one-minute versus five-minute APGAR scores were compared in cases group and cases versus controls (Table 1, Figure 2). Average birth weight was 2,272.5 and 2,548.5 grams for cases and controls, respectively ($p < 0.05$). The difference was statistically significant. Average birth weight of "term" and "preterm" pregnancy neonates was 2,975.2 and 2,892.6 grams ($p > 0.05$); and 1,844.14 and 1,774.3 grams ($p > 0.05$) for cases and controls, respectively (Table 1, Figure 3).

Table 1:

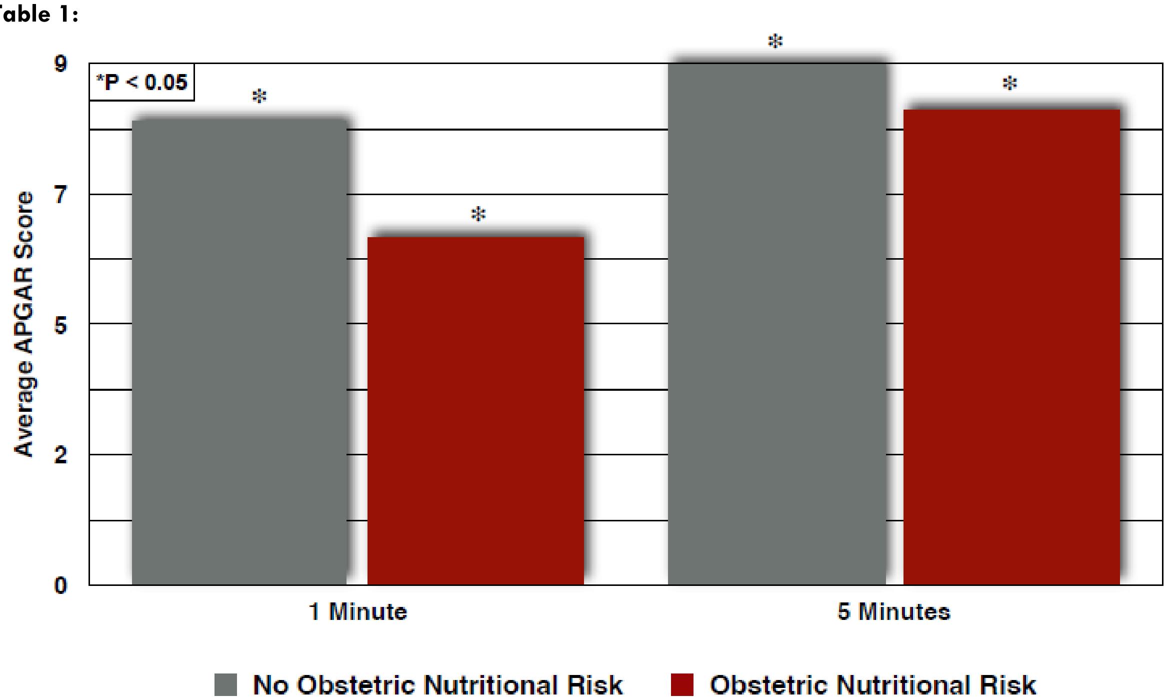

Figure 2. Average one-minute and five-minute APGAR scores. One-minute APGAR scores were significantly lower when neonates of high-risk pregnancy (HRP) patients, with obstetric nutritional risk (cases), were compared to controls *($p < 0.05$).

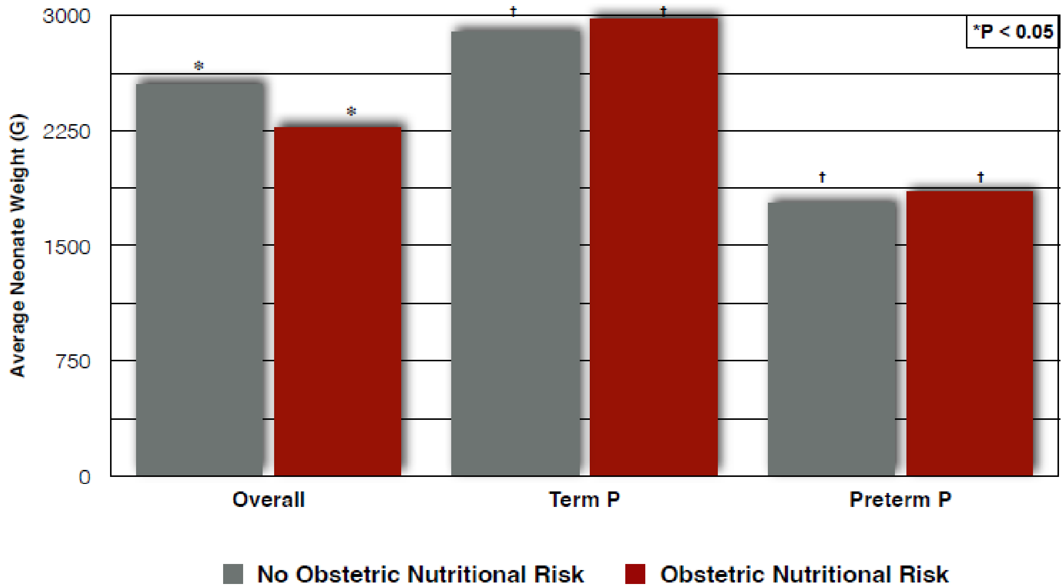

Figure 3. Average birthweight. *P <0.05, pair-wise comparisons: cases versus controls. †P >0.05, cases vs controls.

Obstetric Nutritional Risk and Neonatal Morbidity
Average "gestation weeks" was 34 ± 3.7 and 37 ± 3 weeks (p <0.05) for cases and controls, respectively. The difference was statistically significant. Average gestation weeks of "preterm births" was 32 ± 2.8 and 32 ± 2.5 weeks (p >0.05) for cases and controls, respectively (Table 1, Figure 4). The difference was not significant. The analysis demonstrated a total of 40 (60.6%) and 14 (26.9%) "preterm births" (p <0.001) for cases and controls, respectively (Figure 5). The difference was statistically significant. And morbidity was identified in 40 (60.6%) and 11 (21.1%) neonates (p <0.001) for cases and controls, respectively (Table 1, Figure 6). The difference between the two groups was statistically significant. Complications observed in neonates of HRP patients, with and without ONR, are depicted on Table 2. However, intra-uterine growth restriction was 25.76% (n = 17) and 11.54% (n = 6) for cases and controls (n = 6, 11.54%), respectively (Table 2).

Table 2:

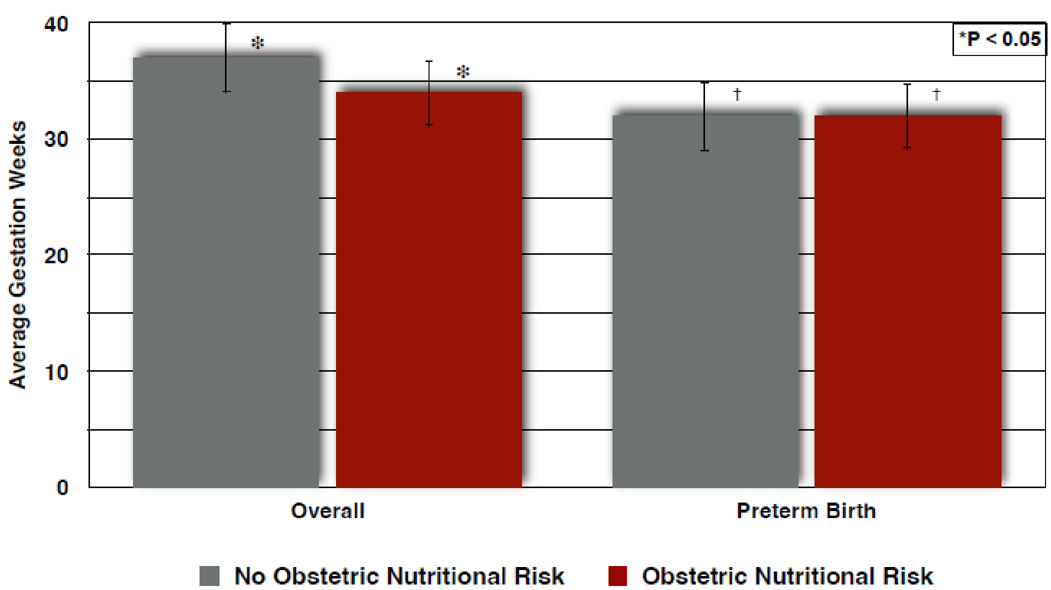

Figure 4. Average Gestation Weeks. *P <0.05 when comparing cases versus controls. †P >0.05, cases versus controls, only preterm birth stratus.

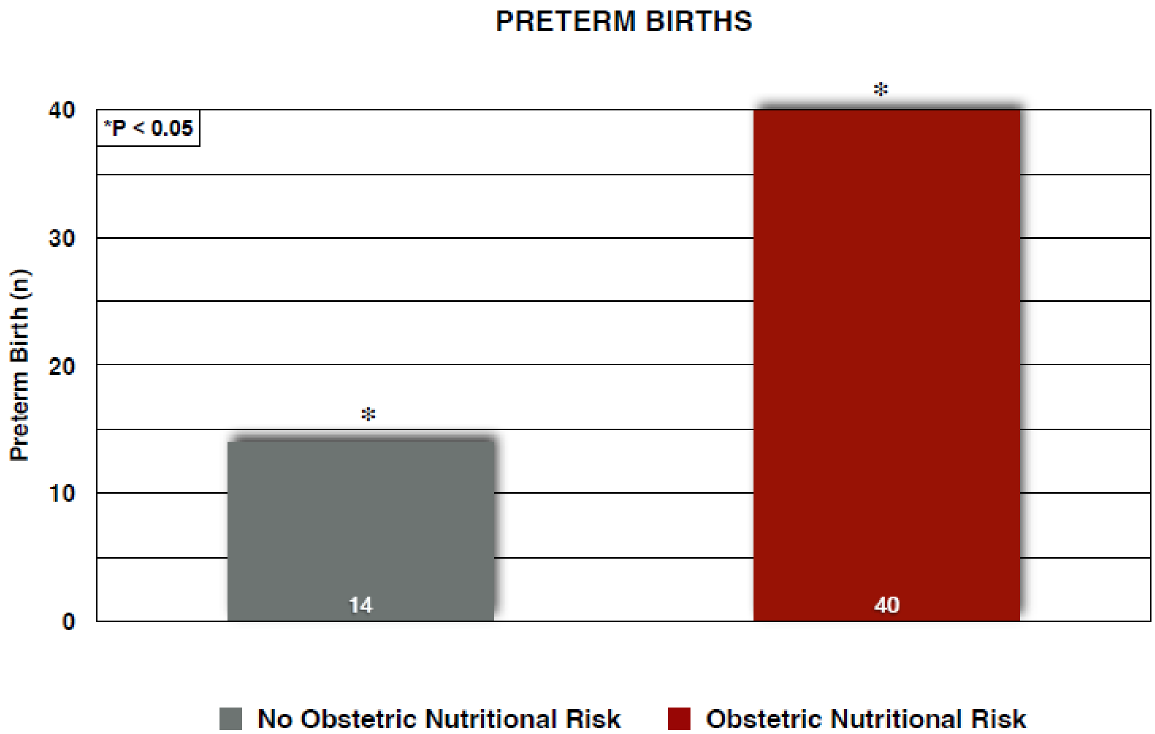

Figure 5. This figure shows number of "preterm births" observed in this study. *P <0.05, neonates of HRP patients with obstetric nutritional risk (cases) vs neonates of HRP patients with no ONR (controls).

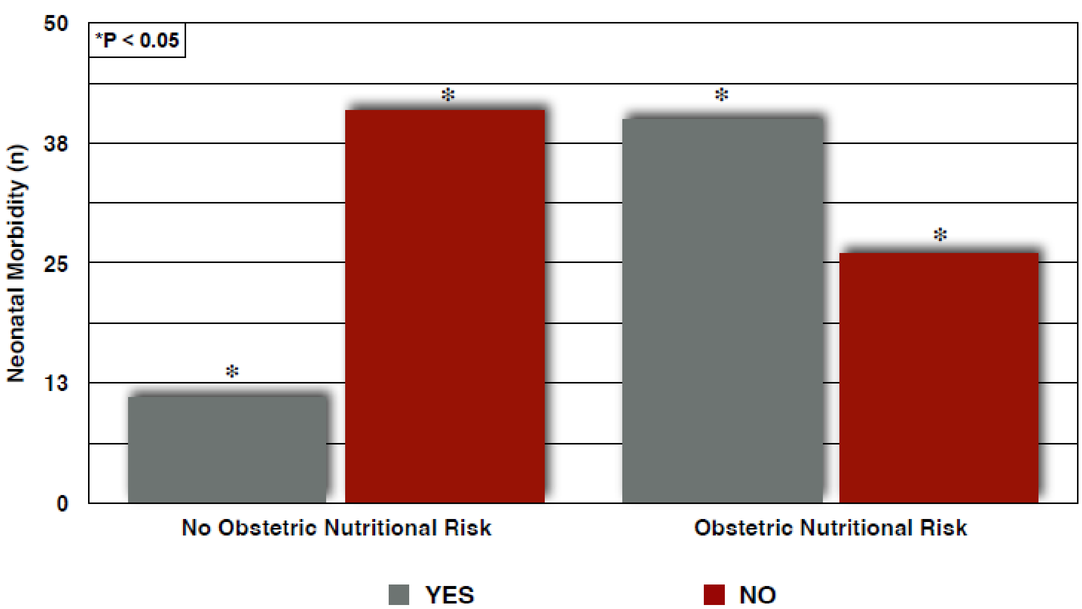

Figure 6. Neonatal Morbidity. *P <0.05, a statistically significant impact is clearly observed in neonates of HRP patients with obstetric nutritional risk (cases) when compared to those who were not nutritionally at-risk (controls).

Discussion

In this case-control study we were able to identify that Newborns of HRP patients who were Nutritionally-at Risk (ONR >3) showed a statistically significant higher morbidity, lower one-minute APGAR Scores and lower average birth weight. Additionally, the number of complication and preterm births were significantly higher in these group of patients.

The birth of a premature newborn is a frequent event and whose care represents a permanent challenge in current neonatology. Prematurity is one of the main causes of neonatal morbidity and mortality. It is responsible for 75% of perinatal deaths.[13,14] And, different risk factors have been demonstrated to significantly increase newborn morbidity.[13-15] Mother age is one of those frisk factors. Women 35 years-old or older have 2.3 more chances of giving birth to a malformed live newborn. Teenage mothers and those with associated comorbidities such as diabetes mellitus, hypertension and renal failure are also more likely to develop newborn morbidity. A greater number of congenital cardiac malformations, cleft lip and palate and bacterial infections have been described in this group of patients.[16] Our results are consistent with this information, since prematurity was significantly higher on newborn babies of HRP patients diagnosed with obstetric nutritional risk. Additionally, malformations, fetal death and infections were amongst the complications observed on these newborn babies. Consequently, this investigation shows that maternal nutritional status had a significant impact on neonatal morbidity.

Maternal malnutrition remains a critical public health care problem with direct consequences to newborn health.[17] In fact, there are great regional and inter-country disparities in the burden of individuals who are underweight, or those who suffer from anemia and micronutrient deficiencies around the world. These disparities are driven by complex and multifactorial causes, including lack of access to health care services, water and sanitation; as well as other social, economic and political elements.[18] While global prevalence of underweight among women, standardized by age, has decreased from 14.6% to 9.7% between 1975 and 2014; prevalence of obesity increased from 6.4% to 14.9% in the same period.[19] In any case, maternal undernutrition, overweight and obesity (malnutrition as a whole) have demonstrated short and long-term consequences in low-income and middle-income countries. Actually, maternal malnutrition has been shown to have an impact on newborn outcome.[17,20-23]

A high-risk pregnancy is one with either an abnormal or pathologic condition, concomitant to gestation or delivery, that threaten the life or health of the mother or fetus. Scientific information estimates a prevalence between 12% and 60%, depending on the country. Important risk factors for HRP are nutritional status (diet), woman´s age, hypertension, diabetes, autoimmune disorders, infectious diseases, history of chronic disease, complications in previous pregnancy, multifetal pregnancies and less than 1-year gestational interval.[12] The fact of the matter is that poor maternal nutritional status has been linked to different adverse birth outcomes, including intrauterine growth restriction (IUGR) and low birth weight. These, in turn, can impact the development of the newborn.[4,24] Interestingly enough, in this study we were able to demonstrate those two complications. And, to the best of our knowledge, this is the first report that finds a link between Obstetric Nutritional Risk and IUGR and low birth weight (Table 1, 2). Furthermore, IUGR has been reported to increase the risk of neonatal death and; for survivors, growth retardation at two years of age.[17] Furthermore, suboptimal breastfeeding has been shown to increase the risk of mortality in the first two years of life.[17,23]

As indicated earlier, newborns of HRP patients who were nutritionally at-risk (ONR > 3) showed a significantly lower birth weight and higher morbidity rates. These results are consistent with other reports in the literature.[25] A recent study by Woldeamanuel GG., et al., found that maternal anthropometry, including pregravid body mass index (BMI) and pregnancy total body weight increase, was directly associated with newborn birth weight.[24] However, this study used routine nutrition assessment tools. On a previous study we compared the Obstetric Nutritional Risk (ONR) Screening criteria with pregravid and on admission nutritional status and found a positive correlation with maternal morbidity.[12] That is, ONR screening methodology was able to anticipate maternal in-hospital complications.[11,12] Our next challenge was to identify whether the mother's nutritional risk condition, on hospital admission, had an impact on perinatal morbidity. And, with this study we found that ONR has a direct impact on neonatal outcome. Unfortunately, obstetric nutritional risk methodology has not been generalized yet. That's why we picked those patients (their records) who had been assessed about their Obstetric nutritional risk status in accordance with ONR screening criteria. This nutritional screening tool considers (ponders) the patient's nutritional status and severity of disease. Nutritional status score is based on three main categories: changes in estimated food intake, changes in body weight loss and changes in body mass index (BMI) by trimester and pregravid BMI status according to the World Health Organization (WHO). That is, obstetric nutritional risk screening approach considers underweight, normal weight, overweight and obesity in accordance with gestational age, gestational weight gain by trimester and pregravid BMI.[11,12]

Complication rates in our study were significantly higher for cases as compared to controls. These complications included intra-uterine growth restriction, sepsis and respiratory distress syndrome, among others (Table 2). A study performed by Yu Wang et al., concluded that mothers who scored higher on Health Eating Index (HEI) were 67% less likely to deliver newborns with fetal growth restrictions; as compared to those with lower HEI scores. That is, mothers with HEI had high-quality diets.[26] This idea is supported by other studies reporting that a good prenatal care is associated with decreased maternal mortality, preterm birth, neonatal death and stillbirth.[27] The number of pregnancy complications can significantly be reduced should proper weight control be instituted early in pregnancy. Therefore, every effort should be aimed at counselling women prior to or early in pregnancy to avoid underweight, overweight or obesity. A good prenatal weight control that improves maternal nutritional status should improve neonatal outcome.

Conclusion

In this study, we found that morbidity, preterm births, and complication rates were significantly higher in newborns of HRP patients with obstetric nutritional risk. While one-minute APGAR scores, birth weight and gestation weeks were significantly lower in these group of patients. Therefore, ONR had a negative impact on perinatal morbidity. We recommend that pre, trans and postnatal management strategies should be implemented to reduce perinatal morbidity.

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