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Evaluation of efficacy and effectiveness of prenatal nutritional care on perinatal outcome of pregnant women; Rio de Janeiro, Brazil

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Abstract

Aim: **to evaluate the impact of a prenatal nutritional assistance proposal (PNA) for adult pregnant women.**

Methods: **a study of the impact of an applied nutritional intervention throughout the prenatal on perinatal outcomes - adequacy of total gestational weight gain, gestational anemia frequency and pregnancy complications in a public maternity hospital in Rio de Janeiro. The data represent three groups of adult pregnant women, during 10 years: GI (1999-2001, n = 225), GII (2005-2006, n = 208) and GIII (2007-2008, n = 394).**

Results: **in GII (reference group) it was included a detailed nutritional assessment, an individualized eating plan and an attendance of at least four scheduled appointments with a nutritionist. PNA coverage occurred in only 20.4% of GI, 100% of GII and 42.1% in GIII (p < 0.001). Women in GI had a higher proportion of inadequate total weight gain (OR 1.82, 95% CI: 1.20 -2.75), anemia (OR 2.18, 95% CI: 1.35 - 3.55) and pregnancy complications (OR 1.57, 95% CI: 1.04 - 2.36), as well as those who joined GIII, - OR 1.68 (95% CI: 1.16 - 2.44), OR 2.45 (95% CI: 1.56 - 3.84), OR 2.07 (95% CI: 1.42 - 3.00) - when compared to women in GII.**

Conclusions: **the model tested in GII PNA demonstrated to be effective in the outcomes studied.**

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Key words: *Maternal nutrition. Prenatal. Nutritional assistance.*

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EVALUACIÓN DE LA EFICACIA Y EFECTIVIDAD DE LA ATENCIÓN NUTRICIONAL PRENATAL SOBRE EL RESULTADO PERINATAL DE LAS MUJERES EMBARAZADAS; RÍO DE JANEIRO, BRASIL

Resumen

Objetivo: **evaluar el impacto de una propuesta de asistencia nutricional prenatal (ANP) para las mujeres embarazadas adultas.**

Métodos: **estudio del impacto de una intervención nutricional prenatal en los resultados perinatales, adecuación de la ganancia total de peso durante la gestación, frecuencia de anemia gestacional y complicaciones en el embarazo en una maternidad pública de Río de Janeiro. Los datos representan tres grupos de mujeres embarazadas adultas, durante 10 años: GI (1999-2001, n = 225), GII (2005-2006, n = 208) y GIII (2007-2008, n = 394).**

Resultados: **en el GII (grupo de referencia) se incluyó una evaluación nutricional detallada, un plan de alimentación individualizado y una asistencia de por lo menos cuatro citas programadas con un nutricionista. La cobertura PNA se produjo en solo el 20,4% en el GI, el 100% en el GII y el 42,1% en el GIII (p < 0,001). Las mujeres del GI tenían una mayor proporción de ganancia total de peso insuficiente (OR 1,82; IC 95%: 1,20 -2,75), anemia (OR 2,18; IC 95%: 1,35-3,55) y complicaciones del embarazo (OR 1.57, IC 95%: 1,04 - 2,36), así como aquellas que se unieron al GIII, - OR 1,68 (IC 95%: 1.16 - 2.44), OR 2,45 (IC 95%: 1,56-3,84), OR 2,07 (IC 95%:1,42-3,00), en comparación con las mujeres del GII.**

Conclusiones: **el modelo probado en el GII PNA demostró ser eficaz según los resultados estudiados.**

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Palabras clave: *Nutrición materna. Prenatal. Asistencia nutricional.*

Introduction

Maternal and child health indicators show a series of harmful effects occasioned by preventable causes, reflecting mainly the precariousness of prenatal care. The occurrence of these adverse outcomes of pregnancy results from a complex web of factors, including, in addition to the health services offered, social, cultural, psychological and biological determining causes. Findings from the literature show that adequate prenatal care can contribute in avoiding such problems in both adolescent and adult women[1,2].

Data from the National Demographic and Health Survey (DHS) from 2006 indicates that the minimum of six prenatal visits, as established by the Ministry of Health, occurred in 80.9% of pregnancies in Brazil, with the best numbers recorded in the Southeast (88.2%)[3]. Although prenatal care is considered one of the four pillars of a safe motherhood, few systematic evaluations have been conducted on the effectiveness of these programs in order to determine which interventions would lead to better results[4,5].

More recently, several authors have discussed the importance of prenatal care, their criteria and the scientific basis for interventions that are performed and the effects on maternal and perinatal health[1,2].

Among the health care measurements of the pregnant woman, nutritional care is one that must be highlighted, since there is a close association between maternal nutritional status (pre-and gestational) and women and newborn outcomes[6-9]. Thus, health professionals, working in the context of prenatal care, must assume their important role in guiding and supporting pregnant women in aspects of healthy nutritional and living habits, as well as in identifying pregnant women at nutritional risk[10,11].

The evaluation of the nutritional quality of prenatal care is necessary. Therefore there is a need for adaptation which is reinforced by some studies in prenatal services of the Health System[10,12,13,14]. When referring to nutritional assistance during prenatal care, it is apparent the scarcity of data. This finding indicates the need for an assessment of the nutritional care quality provided at this stage of the life cycle.

Rouse[15] emphasizes that nutritional intervention during antenatal care in developing countries have not gone through a formal evaluation, while the efficiency of a prenatal care model has been questioned. Data from some studies emphasizes the contribution of nutritional interventions to prevent mortality of both mother and fetus, as well as informal analyzes suggest that the cost-benefit of this intervention can be comparable and, in some cases, superior to standard practices of prenatal care[15,16]. The design of new programs should consider not only efficacy - power to produce the desired effects under controlled conditions - but also the effectiveness of proposed interventions, for instance, the ability to produce the desired effects under conditions of expected use, or when it arises from operational programs[17].

Thus this study aims to assess the impact of a proposed prenatal nutritional assistance (PNA), compared to routine conventional prenatal nutritional care, evaluating the feasibility of this intervention and contribution to the outcome.

Materials and Methods

The study was conducted in a public maternity hospital in Rio de Janeiro, which receives, annually, around 1500-2000 pregnant women from different parts of the city of Rio de Janeiro, at delivery and postpartum. This study gathered data from a ten year sequenced period derived from three previous researches in the same Health Unit. There was a similarity between the characteristics of the clientele at this maternity unit, and the ones verified for the group of mothers treated at the health sector in the municipality of Rio de Janeiro, according to information provided by the National Information System on Live Births (SINASC - Ministry of Health)[18].

This is a study of the impact of an applied nutritional intervention throughout the prenatal on perinatal outcomes - adequacy of total gestational weight gain, gestational anemia frequency and pregnancy complications.

The study data are represented by Group I (GI), Group II (GII) and Group III (GIII). The criteria for inclusion of women in the studies were: being ≥ 20 years, receiving prenatal care, being pregnant of a single fetus, and not being a carrier of diseases with onset prior to pregnancy (Fig. 1).

From GI, it was drawn a profile of 225 postpartum women, evaluated from 1999 to 2001, in the immediate postpartum period (up to 6 hours after birth), and their newborns. After having the health and nutrition profile of this group, the intervention was constructed (PNA proposed), which was tested in a cohort of pregnant women. GI was considered the group that received no intervention, because only 22.9% of the screened pregnant women had an appointment with a nutritionist during the prenatal period. For this group the PNA coverage in the unit under study was limited and only occurred when obstetricians from the health unit referred these pregnant women to the nutritionist, which occurred only in cases of weight deviation and/or other nutritional complications, at any gestational age.

Group II consisted of a cohort of 227 pregnant women treated at the health unit during the period of 2005-2006. GII presented a follow up loss of 8.4% (n = 19), having a total of 208 postpartum women at the end. In the investigation of differences between women enrolled in the study and the ones defined as losses, it was found a similarity on maternal age ($p = 0.73$), per capita family income ($p = 0.62$), number of pregnancies ($p = 0.33$), number of abortions ($p = 0.83$), pre-pregnancy BMI ($p = 0.45$), marital status ($p = 0.95$), ethnicity ($p = 0.55$), sanitary conditions of housing ($p = 0.61$), and classification of pre-pregnancy

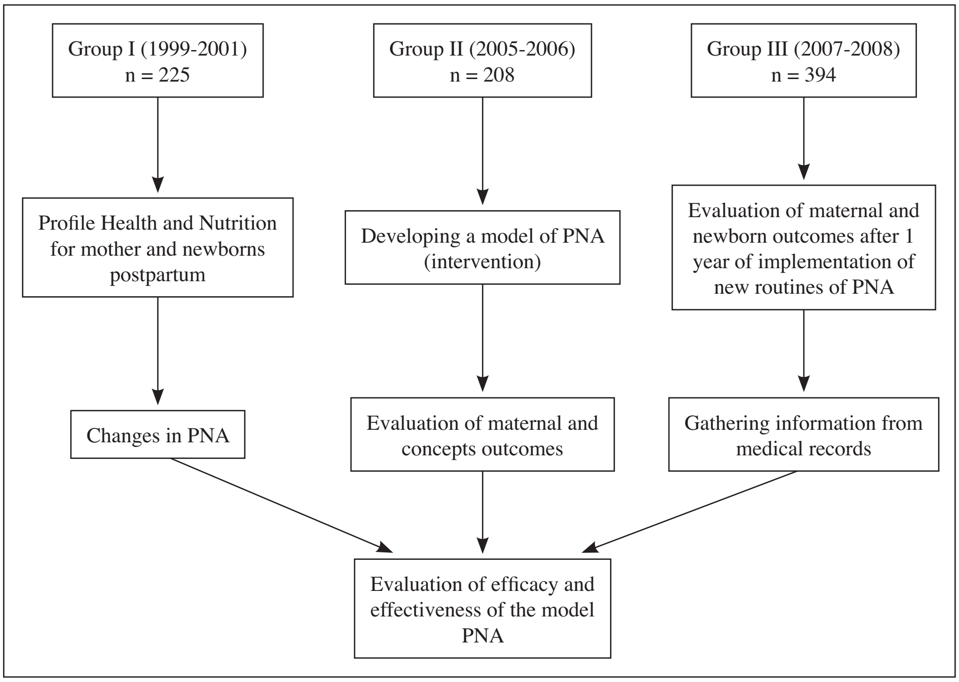

Fig. 1.—Representation of the process of study groups selection and data collection. PNA: prenatal nutritional assistance.

BMI (p = 0.24). We identified a higher proportion of women with better educational level in the group classified as losses (p = 0.02)[19].

Among the reasons for loss of follow-up are: spontaneous abortion (n = 7), moving to another state or health facility (n = 4), previous diabetes (n = 1), chronic hypertension (n = 1), withdrawal (n = 2), fetal death (n = 3) and diagnosis of HIV + (n = 1)[19].

These women joined the prenatal service of the unit before the 16th week of pregnancy and were followed up until postpartum, when the perinatal outcome was evaluated. This group received the intervention that was proposed by PNA.

The PNA proposal for GII included a review of the food service routine assistance with detailed elements of nutritional assessment - anthropometric program with recommended weekly and total gestational weight gain; development of individualized eating plan; adoption of the dietary counseling principles; and the necessity of at least four individual scheduled appointments with the nutritionist – since the beginning of prenatal care in the unit and throughout pregnancy. All pregnant women who met the inclusion criteria were incorporated into the study, under the responsibility of the research group.

The first appointment with a dietitian occurred before the 16th week of gestation, the second occurred after an interval of 15 to 30 days, the third during the second quarter of pregnancy (before the 28th week) and the fourth visit in the third trimester (between 28 weeks and birth).

The pregnant women also had to attend an average of three different educational activities with a multidisciplinary team of the unit.

GIII consisted of 394 mothers, who delivered in the unit studied, between 2007 and 2008, were followed throughout pregnancy by the Office of Pre-natal Health Unit, and which had its monitoring started before the 16th week of pregnancy. The study period was established, considering the period of one year after the implementation of the new PNA routines, with reviewed and updated care routines based on new scientific evidence.

In GIII, due to the daily routines of the unit, it was not possible to apply the mandatory minimum of 4 appointments or early onset of PNA concomitant to prenatal care, and universal referring was also not guaranteed. In this group, nutritional care was guaranteed by the local Nutrition Service. Pregnant women on care during this period went through at least one group consultation, and only those with risk factors were sent to individual consultations.

Information about GIII was collected through medical charts of the mothers who met the study inclusion criteria. These women were identified in the admission delivery book of the health unit.

The procedures for anthropometric assessment of pregnant / postpartum women and newborns, and identification of pregnancy complications and newborn were standardized for all study groups.

Anthropometric assessment evaluated the pre-pregnancy BMI according to the following cutoff points: underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5 to 24.9 kg/m^2) overweight (25, 0 kg/m^2 ≤ BMI <30 kg/m^2) and obesity (BMI ≥ 30.0 kg/m^2), according to WHO[22]. The adequacy of gestational weight gain was classified as adequate or inadequate (below and above), based on the Ministry of Health recommendation and validated by Padilha et al[7].

The anthropometric measurements of newborns were collected from medical records information about weight and gestational age at birth, considering preterm newborns with gestational age at birth less than 37 weeks of gestation. They were classified as low birth weight when birth weight was below 2500 g[20]. Information about neonatal and gestational complications was obtained by consulting medical staff opinion and laboratory tests evaluations included in the records, considering the recommendations of the Ministry of Health[21].

We considered cases of anemia, at any time during pregnancy, when the hemoglobin concentration was below 11.0 g/dL[21].

For all women in GII and those in GIII who had gone through four individual consultations, it was calculated, in the dietary planning, the total energy value (TEV) suitable for the recommended weight gain until term[22]. The plan was prepared taking into consideration the eating habits and sociodemographic conditions of the pregnant women. Specific guidelines regarding gastrointestinal symptoms and pregnancy complications were included in the plan, as well as guidelines to encourage and promote breastfeeding.

In the exploratory data analysis, measures of central tendency (mean and standard deviation) were calculated. Data analysis was performed in two steps: first the bivariate analysis was performed using the chi-square test, and next we performed a multivariate analysis using the logistic regression method.

We tested the homogeneity between the groups (GI, GII and GIII), comparing social and demographic characteristics (age, education and cigarette smoking), obstetric care (number of pregnancies, number of visits to prenatal care and PNA, and the frequency of anemia) and anthropometric measurements (BMI pre-pregnancy, gestational weight gain, total weight, and gestational age at birth).

We used the multiple logistic regression model with the variables, which in the bivariate analysis, showed significance inferior to 0.20, in order to find which factors were most strongly associated with the outcome. In this analysis, the study groups (GI and GIII) were simultaneously compared to GII, which was considered in the study as reference, because it received the intervention. Those variables associated with the dependent variable in a level below 0.05 continued in the final model. The observed differences were controlled in logistic regression models.

Odds ratio between exposure factors were estimated in the Logistic Regression, with a confidence interval (CI) of 95% for the outcomes studied. All analyzes were performed in SPSS version 17.0 for windows.

The research projects that generated the databases were reviewed and approved by the Ethics in Research of *Escola Nacional de Saúde Pública da Fundação Oswaldo Cruz*, *Maternidade Escola da Universidade Federal do Rio de Janeiro* and *Instituto de Puericultura e Pediatria Martagão Gesteira (IPPMG/UFRJ).*

Results

Characteristics of women and their fetuses from all three groups are shown in tables I and II. There was homogeneity between the groups according to maternal age and baby outcome - birth weight adequacy, complications of the newborn and gestational age at birth. It was also found that the highest frequency of the desirable outcomes according to the study interest was observed in GII - adequacy of gestational weight gain and total absence of anemia and pregnancy complications, supporting the choice of this group as the reference.

GIII presented a higher level of formal schooling education when compared to GI. In GIII the percentage of women who finished high school was of 48.8% and in GI this percentage was of 28.4% ($p<0.001$). There was less frequent use of cigarettes and alcohol among the members of GII.

There was a decrease in low prepregnancy weight among the members of the study because there was a lower proportion of women with low prepregnancy weight in GIII (4.5%) compared with the other groups (GI 19.3 %, $p <0.001$ and GII 13.1%, $p <0.001$). The prevalence of overweight was higher in GIII.

Data from prenatal care indicated an increase in the average number of consultations of 7.5 (± 2.7) in GI to 9.0 (± 1.7) in GII and 8.3 (± 2.2) in GIII. The PNA coverage was expanded among groups, because, it was found that in GI only 20.4% of pregnant women received this coverage; and in GIII a significant proportion of women received nutritional counseling (42.1%, $p <0.001$). The average number of consultations with the nutritionist was 0.55 (± 1.35), 4.12 (± 1.67) and 1.08 (± 1.62), respectively, in GI, GII and GIII.

Regarding the suitability of the total weight gain during pregnancy, it was found that there was a greater proportion of women with normal weight gain in GII (50.5%) when compared to the members of GI (34.3%, $p = 0.001$) and to members of GIII (34.6%, $p = 0.001$). It is also noteworthy, the frequency of weight gain above the recommended for members of GIII.

Regarding the frequency of low birth weight, it was found that it was similar among the groups, 5.8% in GI, 3.4% in GII and 4.5% in GIII ($p> 0.05$), being GII the group with the lowest percentage. As for prematurity, it was not observed variation in the frequency of this outcome between the study groups, being 6.3% in GI, 6.4% in GII and 6.3% in GIII ($p> 0.05$).

Considering the gestational complications, we observed a lower prevalence in GII (35.6%) when compared to GI, in which the prevalence was 43.6% ($p = 0.009$), while in GIII 51.3 % of women had some pregnancy complications ($p <0.001$). The frequency of gestational anemia was of 16.4% in GII, which was significantly lower when compared to GI (28.4%, $p = 0.004$) and GIII (26.4%, $p <0.001$). Other frequent complications were: pregnancy hypertensive disorders (6.2%, 5.8%, 3.6%) and gestational diabetes (1.8%, 1.9%, 4.3%) for GI, GII and GIII, respectively.

In table III, it can be verified that GI members had a greater inadequacy of total weight gain (OR 1.82, 95% CI: 1.20 - 2.75), as well as higher indexes of anemia (OR 2.18 95% CI: 1 0.35 - 3, 55) and complications of pregnancy (AB 1.57, 95% CI: 1.04 - 2.36) when compared to GII, which was considered the less risky in the study. Likewise, those who joined GIII also had a greater chance of inadequate total gestational weight gain (OR 1.68, 95% CI: 1.16 - 2.44), anemia (OR 2.45, 95% : 1.56 - 3.84) and pregnancy complications (OR 2.07, 95% CI: 1.42 - 3.00) when compared to GII.

Inadequate weight gain was also more frequent among female smokers (OR 2.29, 95% CI: 1.07 - 4.93); and women with pregnancy complications had higher number of prenatal visits (OR 1, 09, 95% CI: 1.02 - 1.16). The higher education level proved to be a

Table I

Maternal characteristics of pregnant women attended at a public maternity hospital of Rio de Janeiro in the different groups: GI (1999-2001), GII (2005-2006) and GIII (2007-2008). Rio de Janeiro, RJ, Brazil (2011)

Variables		*Groups*			*GI and GII (p)*	*GII and GIII (p)*	*GI and GIII (p)*
		GI %	*GII %*	*GIII %*			
Age (n = 825)	20 – 24 years 25 – 34 years > 35 years	37,3 51,1 11,6	31,7 58,7 9,6	31,4 54,8 13,8	0,289	0,323	0,297
Education (n = 808)	Incompleate basic education Complete basic aducation High school	36,9 34,7 28,4	29,3 31,7 38,9	24,0 27,2 48,8	0,580	0,071	<0,001
Smoking (n = 809)	Yes No	8,0 92,0	2,9 97,1	6,4 93,6	0,020	0,067	0,452
Drinking (n = 809)	Yes No	8,9 91,1	5,8 94,2	10,6 89,4	0,215	0,048	0,489
PPNS (n = 774)	Low weight Normal Overweight Obesity	19,3 61,3 10,4 9,0	13,1 68,4 10,7 7,8	4,5 62,6 24,4 8,4	0,321	<0,001	<0,001
Adequacy of weight gain (n = 779)	Low Adequate Over	33,8 34,3 31,9	19,7 50,5 29,8	26,1 34,6 39,3	0,001	0,001	0,095
PNA (n = 827)	Yes No	20,4 79,6	100,0 --	42,1 57,9	<0,001	<0,001	<0,001
Anaemia in pregnancy (n = 826)	Yes No	28,4 71,6	16,8 83,2	30,0 69,7	0,004	<0,001	0,631
Gestational Complication (n = 827)	Yes No	43,6 56,4	35,6 64,4	51,3 48,7	0,009	<0,001	0,065

PPNS: pre-pregnancy nutritional status; PNA: prenatal nutritional assistance.

Table II

Characteristics of the concepts of GI (1999-2001), GII (2005-2006) and GIII (2007-2008). Rio de Janeiro, RJ, Brazil (2011)

Variables		*Groups*			*GI e GII (p)*	*GII e GIII (p)*	*GI e GIII (p)*
		GI (%)	*GII (%)*	*GIII (%)*			
Adequacy of birth weight (n = 764)	Low birth weight Normal	5,8 94,2	3,4 96,6	4,6 95,5	0,237	0,549	0,469
Newborn complications (n = 559)	Yes No	16,0 84,0	15,5 84,5	13,4 86,6	0,877	0,603	0,51
Gestational age (n = 743)	Premature Term	6,3 93,7	6,4 93,6	6,3 93,7	0,968	0,964	0,981

Table III
Results of logistic regression related to the adequacy of the total gestational weight gain, anemia and pregnancy complications among followed pregnant women. Rio de Janeiro, RJ, Brazil (2011)

Variáveis	β	*Análise multivariada*		
		OR Ajustada	*IC 95%*	*p*
Inadequate gestational weight gain (n= 735)				
GI	0,60	1,82	1,20-2,75	0,005
GIII	0,52	1,68	1,16-2,44	0,006
Smoking in pregnancy	0,83	2,29	1,07-4,93	0,034
Gestational Anaemia (n= 741)				
GI	0,78	2,18	1,35-3,55	0,000
GIII	0,90	2,45	1,57-3,84	0,002
Gestational complications (n=743)				
GI	0,45	1,57	1,04-2,36	0,031
GIII	0,72	2,07	1,42-3,00	0,000
Education	-0,36	0,69	0,48-0,99	0,045
Prenatal number of appointment	0,08	1,09	1,02-1,16	0,015

OR: *Odds ratio,* 95% IC: 95% confidence interval
Controlled variables in the model: number of prenatal visits, education, smoking during pregnancy, Nutritional status before pregnancy and study groups (GI, GII (reference) and GIII).

protective effect for developing complications during pregnancy (OR 0.69, 95% CI: 0.48 -0.99).

Table III shows that dietary intervention applied in GI and GIII had similar effects on outcomes. The protective effect of the proposed nutritional assistance tested in GII was observed in maternal outcomes - inadequacy of the total gestational weight gain, anemia and pregnancy complications - because the frequencies of these outcomes were significantly lower in GII.

Discussion

The effectiveness of PNA in improving obstetric outcome of the women studied that was confirmed in this study corroborates with recent data from the literature. Scientific evidence shows the contribution of nutritional intervention during pregnancy, not only on the outcome of pregnancy, but also on the health of fetuses in early life and adulthood. According to the theory of metabolic programming, undernutrition in uterus, increases the likelihood of metabolic syndrome in young adults and adults[23-26].

The World Health Organization (WHO)[26] considers nutritional factors as good indicators of prenatal care quality among the other elements which also predict favorable perinatal and neonatal outcome. Therefore, it confirms the trend which points out that many complications during pregnancy are due to behaviors and life circumstances prior to the pregnancy period, especially the nutritional aspects[23,26].

Recently, Fraser et al.[27] investigated the association between gestational weight gain and pregnancy outcomes such as BMI, waist circumference and the occurrence of hypertension 16 years after pregnancy, and found that women with adequate weight gain during pregnancy had better results compared with those who had excessive weight gain.

The results are consistent with the findings that consider the effective implementation of PNA necessary, recognizing that anthropometric evaluation alone has its limitations when used to confirm the nutritional diagnosis of pregnant women, especially in identifying risky situations of specific nutritional deficiencies, such as anemia and vitamin A deficiency. The impact of these deficiencies in the short, medium and long term, are also related to the birth conditions and can negative effects during childhood and adult life, besides having great impact on maternal and infant morbidity and mortality rates[26].

Studies have described the association between maternal nutritional care and prematurity, low birth weight, and complications in the newborn[28,29]. These results were not found in this study, probably due to the low frequency of these outcomes.

Regarding pregnancy complications, the proposed intervention in GII was favorable compared to GI and GIII. WHO supports that each cause of maternal mortality is related to a specific nutritional care capable of preventing it[30]. The Pan American Health Organization (PAHO) emphasizes, among interventions to reduce maternal and infant mortality, those directed at optimizing maternal and newborn nutritional status[31].

The reduction of complications strengthens the importance of the nutritional care model with its minimum number of visits, early and individualized assistance, as verified in this study. The observed change in pre-pregnancy anthropometric measurements corroborates with the process of epidemiological and nutritional transition in Brazil, characterized by a shift between two opposite trends: the decline of undernutrition concomitant with the emergence of overweight and obesity[6,32].

The latest available data on the nutritional status of the population indicate that the prevalence of overweight and obesity in the female population is 48% and 16.9%, respectively[32]. Deviations from pre-pregnancy weight, especially overweight and obesity are associated with complications, such as gestational diabetes and hypertensive disorders[6,34].

Vitolo et al.[35] evaluated the impact of dietary guidelines on the control of weight gain among pregnant women attending a public health service. The intervention proved to be effective in decreasing the weight gain of pregnant women with excess weight and reducing clinical complications such as gestational diabetes, preeclampsia, low birth weight and prematurity in the group receiving the intervention.

The adequacy in total weight gain in GII demonstrates superior values to those found in a diversity of national and international casuistic studies[11,31,36]. Lowell and Miller[9] pointed out that a significant percentage of primiparous, young and poorly educated women, have excessive weight gain during pregnancy.

Rodrigues et al.[28] have identified various determinants of insufficient and excessive gestational weight gain, recognizing that these determinants can be identified early in pregnancy, having an interface with inadequate obstetric results, reinforcing the importance of early initiation of PNA. A systematic review of interventions during pregnancy in order to reduce excessive weight gain during pregnancy reported the insufficient quality of the studies, making it difficult to suggest recommendations based on evidences[14]. However Guelinckx et al.[37] conclude that a change of lifestyle improved the eating habits of obese women, although it did not influence the weight gain of pregnant women and physical activity level.

Padilha et al.[7] found that maternal weight gain in the first quarter of pregnancy is a significant predictor of birth weight, contrary to the assertion of some authors that the influence of maternal weight gain on birth weight occurs only in the second and third trimester[12], reinforcing the importance of early and appropriate prenatal care. The findings of Brown et al.[38] showed that weight gain in the first and second trimester was a predictor of birth weight, representing 31g and 26g, respectively. However, studies assessing the impact of maternal weight gain on the fetus weight index, found that the most expressive results were achieved in the first and third quarter of pregnancy.

According to results obtained in PNDS 2006, the prevalence of anemia among non-pregnant Brazilian women in reproductive age was of 29.4%, while among Southeast Region inhabitants the prevalence was of 28.5%[3].

Gargand and Kashyap[11] evaluated the effect of nutritional counseling during pregnancy, and concluded that the individualized weekly follow-ups contribute to proper nutritional status during pregnancy, improving anthropometric indexes and reducing the prevalence of anemia.

The reduction of anemia due to nutritional intervention was also described by Gadallah et al.[39]. According to this study the prevalence of anemia decreased from 55% to 32% in the group receiving the intervention, and it also suggests that anemia is very common among pregnant women and that intervention programs should include intervention programs before conception. Dickinson et al.[40] proposed the need for research models to investigate the barriers to improve micronutrient status during pregnancy, emphasizing the need for interdisciplinary work.

Recent studies found no association between anthropometric status before pregnancy and specific nutritional deficiencies such as anemia, reinforcing the rising concept that these deficiencies can occur even in women with appropriate anthropometric status, but with inadequate consumption of food source, which is the main cause of these deficiencies[6,41].

The findings suggest that cigarette smoking during pregnancy should be investigated among all women, and nutritional assistance was shown to be a protective effect against smoking in pregnancy[42]. Consequently, pregnant women should be informed about the deleterious effects of such substances, thereby contributing to better obstetric outcomes.

Prenatal care allows the development of a variety of educational activities, including the demotivation of the use of harmful substances to mother and child, such as cigarettes and alcohol. Considering that during the pregnancy period women are more responsive to guidelines aiming the improvement of mother and child health, professionals involved in prenatal care must be prepared to understand these practices and counsel pregnant women so that these women can be aware of all the harmful effects of the use of such substances both on their newborn as well as on their own health[42].

A study with the aim of identifying risk factors associated with weight gain during pregnancy reported that women classified as formal smokers were more likely to present excessive weight gain during pregnancy (OR 5.18, 95% CI: 1.62- 16:52)[32]. Recent publications discuss the effects of routine actions which focus on the promotion of preconception health on the improvement of pregnancy outcome, nevertheless there is insufficient evidence, showing the need for further studies to develop health promotion recommendations for women in reproductive age[43].

Women with pregnancy complications had a higher number of prenatal visits. This finding may be due to the need for more attention and treatment because of complications. The World's Children report acknowledges that basic interventions such as prenatal care, delivery assisted by specialized health workers and available emergency treatment for women and newborns can prevent approximately 75% of maternal deaths[44]. It is recognized that the prenatal care embodies quality health and nutritional services.

In this analysis, the highest level of schooling guaranteed protection against the development of pregnancy complications. Over the past few years, it has been estimated that the level of formal education of women is increasing and studies have shown a positive association between education and the quality of prenatal care[2,23,24].

A study with pregnant adolescents reveals that schooling conferred protection to fetal death (OR 0.97, 95% CI: 0.88 - 1.07) and post-neonatal mortality (OR 0.94, 95%: 0.84 - 1.05), as there was an increase in the numbers of years the mother had studied[45]. Data from the DHS 2006[3] shows that access to prenatal care increases with the progression of women's education.

This sample clearly showed the need to systematize PNA, thus contributing to the improvement of prenatal care quality. It is noteworthy reporting that when the pregnant woman is referred to a nutritionist, with a minimum of four visits, concomitant with the beginning of prenatal care as well as routine and updated appointments, the best perinatal outcome was found. On the other hand, when the nutritional assistance of this nature was not guaranteed, the perinatal outcome observed declined to the same level as ten years ago in the unit studied.

Niquini et al.[14] in a study evaluating the nutritional assistance provided to pregnant women treated in family health units in Rio de Janeiro reports that the nutritionist has the necessary competence in the context of prenatal care, to guarantee healthy food habits, food and nutritional security, prevention, diagnosis and treatment of pre-pregnancy and pregnancy nutritional disorders and deficiencies, as well as to provide continuous nutritional education for the members of a minimal family health team.

Although some studies show the impact of nutritional intervention in the improvement of perinatal outcome, PNA is considered important only for high-risk cases, and in Brazil it is still not present systematically in the prenatal manuals[21]. Thus, it is considered necessary the registration of the number and gap between the nutritionist appointments, the definition of gestational age for the beginning of the nutritional counseling, the criteria for referral to the dietitian, the definition of nutritional assessment based on several indicators, besides the anthropometric measurements, to classify pregnant women according to nutritional risk, and routine nutrition intervention for women at low and high risk.

In the logistic of prenatal care services, it should be discussed aspects related to multidisciplinary work, referrals to different health professionals and organization of the health team, which should have specific qualifications according to the complexity of the units. These units should allow an early and holistic care to pregnant women.

Given the expectations of health committees and the scientific community, efforts should be made in an attempt to make a planned nutritional assistance part of prenatal care. The focus of nutritional counseling should not only prioritize anthropometric measurements, but also the quantitative and qualitative aspects of a diet in the context of interdisciplinary prenatal care.

Author Contributions

Patricia de Carvalho Padilha and Cláudia Saunders participated in the design and planning of the study, in data collection, critical analysis of the results, in the preparation and review of the final manuscript. Larissa Mello de Oliveira, Elisabete Queiróz Caldeiras Neves, Anna Carolina Ghedini and Thaísa Costa participated in data collection, analysis of results and preparation of drafts the manuscript.

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Conflict of interest

The authors declare that they have no conflict of interests.

Ethical approval

The studies making up this case study were approved by the Research Ethics Committee of the Martagão Gesteira Institute of Pediatrics (IPPMG / UFRJ), and the Ethics Committee of the UFRJ Maternity School. All women who agreed to participate in the study signed a consent form.

References

1. Leal MC, Gama SGN, Ratto KMN, Cunha CB. Uso do índice de Kotelchuck modificado na avaliação da assistência pré-natal e sua relação com as características maternas e o peso do recém-nascido no Município do Rio de Janeiro. *Cad Saúde Pública* 2004; 20 (suppl 1): S63-S67.
2. Gonçalves CV, Cesar JA, Mendoza-Sassi RA. Qualidade e Equidade na assistência à gestante: um estudo de base populacional no Sul do Brasil. *Cad Saúde Pública* 2009; 25 (11): 2507-16.
3. Brasil. Ministério da Saúde (MS). PNDS 2006. Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher. Relatório. Brasília/DF, MS, 2008.
4. World Health Organization (WHO). Packages of interventions for family planning, safe abortion care, maternal, newborn and child Health. Disponível: http://www.who.int/making_pregnancy_safer/documents/fch_10_06/en/index.html. Disponível em: 27/08/2010.

5. Lu MC, Kotelchuck M, Culhane JF, Hobel CJ, Klerman LV, Thorp JM Jr. Preconception care between pregnancies: the content of internatal care. *Matern Child Health J* 2006; 10(5 Suppl):S107-22.
6. Padilha PC, Saunders C, Machado RCM, Silva CL, Bull A, Sally EOF et al. Associação entre o estado nutricional pré-gestacional e a predição do risco de intercorrências gestacionais. *Rev Bras Ginecol Obstet* 2007; 29(10): 511-8.
7. Padilha PC, Accioly E, Veiga GV, Bessa TCA, Libera BD, Nogueira JL, Alves PD, Souza Junior PR, Saunders C. The performance of various anthropometric assessment methods for predicting low birth weight in pregnant women. *Rev Bras Saude Matern Infantil* 2009; 9(2): 197-206.
8. Mitra AK, Rodriguez- Fernandes G. Latin America and the Caribbean: Assessment of the Advances in Public Health for the Achievement of the Millennium Development Goals. *Int J Environ Res Public Health* 2010; 7 (5): 2238-55.
9. Lowell H, Miller D. Weight gain during pregnancy: adherence to health Canada's guidelines. *Health Reports* 2010, 21 (2): catalogue no. 82-003-XPE.
10. Santos LA, Mamede FV, Clapis MJ, Bernardi JVB. Orientação nutricional no pré-natal em serviços públicos de saúde no município de ribeirão preto: o discurso e a prática assistencial. *Rev Latinoam Enferm* 2006; 14 (5): 41-7.
11. Garg A, Kashyap S. Effect of counseling on nutritional status during pregnancy. *Indian J Pediatr* 2006; 73 (8):687-92.
12. Andreto LM, De Souza AI, Figueiroa JN, Cabral-Filho JE. Fatores associados ao ganho ponderal excessivo em gestantes atendidas em um serviço público de pré-natal na cidade de Recife, Pernambuco, Brasil. *Cad Saúde Pública* 2006; 22(11):2401-9.
13. Melo ASO, Assunção PL, Gondim SSR, Carvalho DF, Amorim MMR, Benicio MHDA, Cardoso MAA. Estado nutricional materno, ganho de peso gestacional e peso ao nascer. *Rev Bras Epidemiol* 2007; 10(2): 249-57.
14. Niquini RP, Bittencourt SA, Aquino EM, Saunders C, Leal MC. Avaliação da estrutura de sete unidades de saúde da família para a oferta da assistência nutricional no pré-natal no município do Rio de Janeiro, Brasil. *Rev. Bras. Saude Mater Infant* 2010; 10(suppl.1): s61-s68.
15. Rouse DJ. Potential coast-effectiveness of nutrition interventions to prevent adverse pregnancy outcomes in the developing world. *J Nutr* 2003, 133 (5): 1640S-4S.
16. Agayo VM, Roley JA, Malanzele J, Meershoek SP. Oppotunities for improving the quality of nutritional services in the national health system in Mozambique: findings from Manica Province. *J Tropic Pediatr* 2004; 50 (5):314-318.
17. Davidsson L, Nestel P. Efficacy and effectiveness of interventions to control iron deficiency and iron deficiency anemia. INACG 2004. Disponível em: http://inacg.ilsi.org. Acesso em 15/12/2007.
18. Saunders C, Ramalho RA, Lima APPT, Gomes MM, Campos LFC, Silva BAS, Soares AG, Leal MC. Association between gestational night blindness and serum retinol in mother/newborn pairs in the city of Rio de Janeiro, Brazil. *Nutrition* 2005; 21(4): 456-61.
19. Saunders C, Padilha PC, Chagas CB, Silva CL, Accioly E, Ramalho, A. Consistência das informações de um estudo sobre o impacto da assistência nutricional no atendimento pré-natal. *Rev Paul Pediatr* 2009; 27(1):60-6.
20. WHO (World Health Organization). Physical status: the use and interpretation of report anthropometry: report of a WHO Expert Committee. Geneva: WHO; 1995.
21. Brasil. Ministério da Saúde (MS). Pré-natal e Puerpério: atenção qualificada e humanizada. Brasília, 2006.
22. FAO/WHO/UNU Expert Consultation. Food and nutrition technical report series. Human energy requirements. Report of a Joint FAO/WHO/UNU Expert Consultation. Rome, 17–24 October 2001. FAO/WHO/UNU; 2004.
23. Villar J, Bergsjo P. (2003). WHO Antenatal Care Randomized Trial: Manual for the Implementation of the New Model [homepage da Internet]. [Genebra: WHO Antenatal Care Trial Research Group. Disponível em: http://www. who.int/reproductive-health/publications/RHR_01_30/. Acesso em: 26/12/2006.
24. Gomez GR, Anzardo BRR. La nutrición: un aspecto importante en la calidad de vida de la mujer. *Rev Bras Saude Matern Infantil* 2003; 3 (2): 215-19.
25. Lima GS, Sampaio HAC. Influência de fatores obstétricos, socioeconômicos e nutricionais da gestante sobre o peso do recém-nascido: estudo realizado em uma maternidade em Teresina, Piauí. *Rev Bras Saude Matern Infantil* 2004; 4 (3): 256-61.
26. World Health Organization (WHO). Promoting Optimal Fetal Development-Report of a Technical Consultation. Geneva, 2006.
27. Fraser A, Tilling K, Macdonald-Wallis C, Hughes R, Sattar N, Nelson SM, Lawlor DA. Associations of gestational weight gain with maternal body mass index, waist circumference, and blood pressure measured 16 y after pregnancy: the Avon longitudinal Study of Parents and Children (ALSPAC). *Am J Clin Nutr* 2011; 93:1285–92.
28. Rodrigues PL, Lacerda EM, Schlüssel MM, Spyrides MH, Kac G. Determinants of weight gain in pregnant women attending a public prenatal care facility in Rio de Janeiro, Brazil: a prospective study, 2005-2007. *Cad Saúde Pública* 2008; 24(Suppl 2): S272-84.
29. Institute of Medicine and National Research Council. Weight Gain During Pregnancy: Reexamining the Guidelines. Washington, DC: The National Academies. Press; 2009.
30. Organización Mundial de la Salud (OMS), 1999. Reducción de la mortalidad materna. Declaración conjunta OMS/FNUAP/UNICEF/Banco Mundial. Classificación NLM: HB 1322.5. Ginebra: OMS.
31. Organización Panammericana de Salud Publica (OPAS). Intervenciones para mejorar los servicios de salud maternoinfantil y el estado nutricional de las madres y los niños: barreras y opciones. *Rev Panam Salud Publica* 2008; 24(2): 136-8.
32. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Indicadores de Vigilância Alimentar e Nutricional: Brasil 2006 / Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. – Brasília: Ministério da Saúde, 2009.
33. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa de Orçamentos Familiares 2008-2009: estado nutricional de crianças, adolescentes e adultos no Brasil. Rio de Janeiro, 2010.
34. Nucci LB, Schmidt MI, Duncan BB, Fuchs SC, Fleck ET, Britto MMS. Nutritional status of pregnant women: prevalence and associated pregnancy outcomes. *Rev Saúde Pública* 2001; 35 (6): 502-7.
35. Vitolo MR, Bueno MSF, Gama CM. Impacto de um programa de orientação dietética sobre a velocidade de ganho de peso de gestantes atendidas em unidades de saúde. *Rev Bras Ginecol Obstet* 2011; 33(1):13-9.
36. Streuling I, Beyerlein A, Kries RV. Can gestational weight gain be modified by increasing physical activity and diet counseling? A meta-analysis of interventional trials. *Am J Clin Nutr* 2010; 92 (4): 678-87.
37. Guelinckx I, Devlieger R, Mullie P, Vansant G. Effect of lifestyle intervention on dietary habits, physical activity, and gestational weight gain in obese pregnant women: a randomized controlled trial. *Am J Clin Nutr* 2010; 91(2):373-80.
38. Brown JE, Murtaugh AM, Jacobs RD, Margellos CH. Variation in newborn size according to pregnancy weight change by trimester. *Am J Clin Nutr* 2002, 76: 205S-9.
39. Gadallah M, Rady M, Salem B, Aly EM, Anwer W. The effect of nutritional intervention program on the prevalence of anemia among pregnant women in rural areas of Belbis district-Sharkia Governorate-Egypt. *J Egypt Public Health Assoc* 2002;77(3-4):261-73.
40. Dickinson N, Macpherson G, Hursthouse AS, Atkinson J. Micronutrient deficiencies in maternity and child health: a review of environmental and social context and implications for Malawi. *Environ Geochem Health* 2009; 31:253-72.
41. Chagas CB, Ramalho A, Padilha PC, Della Libera B, Saunders C. Reduction of vitamin A deficiency and anemia in pregnancy after implementing proposed prenatal nutritional assistance. *Nutr Hosp* 2011; 26(4):843-50.

42. Freire K, Padilha PC, Saunders. Fatores associados ao uso de álcool e cigarro na gestação. *Rev Bras Ginecol Obstet* 2009; 31(7): 335-41.
43. Witworth M, Dowswell T. Routine pre-pregnancy health promotion for improving pregnancy outcomes (Protocol for a Cochrane Review). In: The Cochrane Library, Issue 3, 2009.
44. United Nations Children's Fundation (UNICEF). Situação mundial da infância. Brasília: Unicef, 2009.
45. Oliveira EFV, Gama SGN, Silva CMFP. Gravidez na adolescência e outros fatores de risco para mortalidade fetal e infantil no Município do Rio de Janeiro, Brasil. *Cad. Saúde Pública* 2010; 26 (3): 567-78.