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Relationship between Nutritional and Psychological Status of Pregnant Adolescents and Non-adolescents in Brazil

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ABSTRACT

This study compared the nutritional and psychological status of 855 pregnant adolescents and non-adolescents and assessed their relationships at three interviews (gestational age ≤16 weeks, 20-26 weeks, and 30-36 weeks). The instruments used were: anthropometry, state-trait anxiety inventories (STAI), general health questionnaire (GHQ), and perceived stress scale (PSS). More adolescents were thinner, had higher scores of the trait anxiety inventory (TAI), wished to abort their children, and were worried about changes in their bodies than non-adolescents. Multiple linear regression analyses (controlling for toxic exposure, socioeconomic, demographic and obstetric factors) detected negative associations between weight gain in the first interview and distress (GHQ) for both the groups of women and weight gain in the second interview and the variable "worry about body's change" for the non-adolescent group. The negative associations between body mass index and chronic anxiety (TAI) were present in the three interviews for non-adolescents. This study detected a relationship between the nutritional and the psychological status of pregnant women, although there were more associations for non-adolescents.

Key words: Pregnancy; Stress; Distress; Anthropometry; Body mass index; Weight gain; Adolescence; Brazil

INTRODUCTION

A rise in the number of pregnant adolescents in the last century is a cause of concern in public health (1), considering that lower maternal age has been associated with a higher prevalence of low birth-weight (LBW), maternal and neonatal morbidity and mortality. However, maternal age is not an independent determinant of intrauterine growth or gestational duration, but may indirectly influence nutrition and other important risk markers of LBW (2).

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Pregnancy in adolescence means an increase in nutritional requirements for the growth of the foetus and for the mother herself and is a potential determinant of lower weight gain (3). However, the biological mechanism that underlies the relationship between women's nutritional status and reproductive outcomes is not fully understood, except in extreme situations (e.g. famine) (4).

In developing countries, many children with mild-to-moderate malnutrition survive to reach adolescence, when malnutrition tends to remain mild but chronic, being detectable only by anthropometric measurements. On the other hand, relatively well-nourished children may develop malnutrition in adolescence as a result of acquired

dietary habits, influenced by obsession with thinness (5-9). Several studies, mainly from developed countries, have demonstrated that, despite the increasing trends in the prevalence of overweight and obesity, fatness phobia is common during female adolescence (10-14).

Brazil has been passing through a nutritional transition, with a dramatic shift towards obesity (15,16). Studies have shown a coexistence of malnutrition and obesity in low-income Brazilian communities (17), sometimes with these two conditions existing in the same household (18).

To examine only the nutritional aspects of pregnancy in adolescence is to take a limited approach, considering that the psychological consequences are of equal importance and may have an impact on the nutritional status of this population and on their babies (19). Adolescents are prepared neither physically nor emotionally for pregnancy. The World Health Organization considers adolescence to be the period between 10 and 20 years during which individuals undergo significant psychosexual and psychosocial development (5).

The relationship between the nutritional and the psychological status of pregnant adolescents also includes the possibility that it can be confounded by socioeconomic, demographic and obstetric factors. Stress/distress is likely to occur among adolescents who expect serious social disapproval when their condition becomes known. In this case, pregnancy is usually kept secret as long as possible, and antenatal care delayed. Even when these adolescents attend antenatal care services, a sense of shame, guilt, or inadequacy may grow, and further damage them, if they are not married. Usually, younger and poorer adolescents are the ones who are more in need of proper nutrition and psychological assistance (5). In addition, the relationship between their nutritional and psychological status may be influenced by unhealthy habits, such as smoking, alcohol or coffee consumption.

The objectives of this study were (1) to compare the toxic exposure and nutritional, psychological, socioeconomic, obstetric and demographic aspects of pregnant adolescents and non-adolescents and (2) to examine the association between the nutritional and the psychological status of pregnant adolescents and non-adolescents at the three interviews (gestational age ≤16 weeks, 20-26 weeks, and 30-36 weeks).

MATERIALS AND METHODS

This study is part of a large cohort study on risk factors for low birth-weight, prematurity, and intrauterine growth retardation (19). It initially involved 1,182 pregnant women who attended for antenatal care during September 1997–August 2000 at 12 health centres and 5 hospitals in Jundiaí, Southeast Brazil. The participants were insured by the "Sistema Único de Saúde"–SUS (the national health service that assists low-income families) and were interviewed at three different periods of pregnancy—at gestational age ≤16 weeks, 20-26 weeks, and 30-36 weeks. Women with chronic infectious diseases, metabolic diseases, cardiopathy, mental diseases, hypertension/pre-eclampsia/eclampsia, and multiple deliveries were not included in the study. Losses were due to multiple reasons, such as failure to attend one of the scheduled appointments at the prenatal services [85], migration to another geographical area [29], miscarriage [57], gestational age higher than 16 weeks at the first interview [28], refusal to answer one of three questionnaires [28], lack of reliable data on gestational age [71], lack of data on pre-pregnancy weight [10], and multiple pregnancies and negative pregnancy tests [19]. Therefore, data for 855 women were analyzed.

The nutritional status of each woman was assessed at the three interviews (at gestational age ≤16 weeks, 20-26 weeks, and 30-36 weeks) by anthropometric measurements (weight, height, body mass index [BMI], and mid-upper arm circumference [MUAC], which were determined according to the recommendations of Cameron and Jelliffe & Jelliffe (20,21). The anthropometric measurements were defined as being low, if they were below or equal to the following cut-off points: 54 kg for pre-pregnancy weight, 1.58 m for height, 7 kg for weight gain in pregnancy (2,4), 20 for BMI (22), and 23.5 cm for MUAC (23) in the three interviews. Weight gain at the three different periods of pregnancy was calculated by subtracting the actual weight of the woman from weight measured at the time of the previous interview or from pre-pregnancy weight, in the case of the first interview. Seven kg, 20, and 23.5 cm were used as cut-off points for low total weight gain in pregnancy, low BMI, and low MUAC respectively at each of the three periods of pregnancy, considering that there is no clear cut-off point for these anthropometric measurements per trimester of pregnancy. A standardized questionnaire was used for assessing information on characteristics of the women and their pre-pregnancy weight. If the mother had her body weight measured no more than two months

before conception or up to 11 weeks of gestation, her weight was considered as being a pre-pregnancy weight (4). Women's race was not considered for analysis, because the majority of the Brazilian population has a mixed racial background. Data obtained by the interviewers were checked against medical records and antenatal care cards.

The psychological status (stress and distress) of pregnant women was assessed by four psychologists who interviewed them three times during pregnancy by perceived stress scale (PSS), general health questionnaire (GHQ), and state anxiety inventory (STAI). These questionnaires and inventories have been used in other studies for assessing the psychological status of pregnant women (24).

Stress describes the perception or recognition that an insult has occurred (25). The 14-item PSS has been proven to possess substantial reliability and validity, thereby providing a potential tool for examining issues about the role of appraised stress levels in the aetiology of disease and behavioural disorders. PSS assesses the degree to which situations during the last month of the interview were appraised as stressful. The items are rated on a 5-point scale ranging from 'never' to 'very often' (26). The PSS scores were divided in quartiles, considering that there is no specific cut-off point for this scale to predict stress. Women with PSS scores in the highest quartile were considered as being stressed. The PSS questionnaire presents adequate reliability.

Distress describes negative emotional states (anxiety, depression, etc.) that may result from the perception of stress (25). Maternal psychological distress was assessed by the 12-item version of GHQ (27). This psychiatric screening instrument was found to be acceptably valid, and the content and concurrent validity of the questionnaire have been tested in a Brazilian population (28). According to this questionnaire, women with a GHQ score higher than 3 were classified as having distress.

Anxiety, in particular, was assessed by STAI, the most widely-used scale for measuring anxiety. STAI was developed to provide reliable, relatively brief, self-report scales for assessing the temporary condition of 'state anxiety' and the more general and long-standing quality of 'trait anxiety'. It is a well-standardized, 40-item, self-report instrument with a well-defined cut-off point of 40 for both SAI and TAI (29).

Gestational age was determined by a combination of ultrasonography performed up to the 20th week of gestation, the Capurro method (determined between 12 and 48 hours of birth) (30), and information on the date of the last menstrual period. Details about the GA determination have been reported elsewhere (19).

Smoking was estimated by the mean number of cigarettes smoked per day by pregnant women at the three interviews. Consumption of alcohol was assessed by the mean number of drinks of alcoholic beverages ingested per week by pregnant women at the three interviews [a drink is 12 ounces of beer, 4 ounces of wine, or $1^{1/2}$ ounces of liquor or 'pinga' (typical Brazilian spirit)]. Consumption of coffee was assessed by the mean number of cups of coffee ingested per day by pregnant women at the three interviews.

The mean (±SD) BMI, weight gain, MUAC, psychological scores, and per-capita income of mothers excluded and included in the study were similar. Education, parity, number of persons/house's room, marital status, and tobacco, alcohol and coffee consumption were also similar for both the groups of women.

On-site supervision of GA evaluation, anthropometric and interviewing procedures, including assessment of psychological status, took place throughout the study. To test for reliability, four psychologists interviewed 20 pregnant women four times at one-week intervals. There was an inter-observer coefficient of variation of 5% comparing the assessments of the psychologists.

Statistics were calculated with Epi-Info and STATA (STATA Corporation 702, University Drive East, College Station, TX 77840, USA). To compare the toxic exposure and socioeconomic, demographic, obstetric, nutritional and psychological aspects of pregnant adolescents and non-adolescents, we used χ^2 analysis. Multiple linear regression analyses were carried out using 12 different models, taking into account the variables, weight gain, and BMI, in the three different interviews as outcomes, and considering as predictors the following variables: age, education, per-capita income, persons per room, marital status, parity, pre-pregnancy BMI (only when outcome was weight gain), SAI, TAI, GHQ, PSS, wish to abort, worried about body's change, cigarette smoking, coffee and alcohol consumption. The variables were introduced as continuous variables (except for marital status), therefore avoiding any bias that may have been introduced by the use of specific cut-off values. To identify the best fitting models, we used the 'best subsets' method (31). We had six models for adolescents and six models for

non-adolescents. The six models for each group of women consisted of three models selecting BMI in the three different interviews as outcome, and three models selecting weight gain in the three interviews as outcome. In the multiple linear regression analyses carried out in this study, we included pre-pregnancy BMI instead of pre-pregnancy weight because a large number of pregnant women were adolescents and because they can grow during pregnancy (4,32). R^2 was used as an indicator of the goodness of fit of the models. It gives the percentage of variation explained by the variables left in the model. To indicate the importance of the association between the nutritional and the psychological status of adolescent and non-adolescent pregnant women, we used p values. A probability value of <0.05 was considered significant.

The university's institutional review board approved the study protocol. The participating women signed informed consents at the first interview.

RESULTS

Table 1-4 show the comparison of tobacco, alcohol and coffee consumption and socioeconomic, demographic, obstetric, nutritional and psychological aspects of pregnant adolescents and non-adolescents in the study. Adolescents had a lower socioeconomic status than non-adolescents: they lived in houses with a higher number of persons per room (p=0.03) and had a lower per-capita income (p<0.001). The majority of adolescents were single and primiparous, had a lower pre-pregnancy weight, MUAC, and BMI (p<0.001), and gained less weight up to the 16th week of pregnancy (p=0.04) compared to non-adolescents. More adolescents than non-adolescents had higher scores of TAI in the first (p=0.01), second (p=0.006), and third (p=0.03) interviews, and higher scores of PSS in the first (p=0.001), but not in the second (p=0.057) and third (p=0.09) interviews. A larger percentage of adolescents wished to abort the child (p=0.03) and were worried about changes in their bodies (p=0.006) compared to non-adolescents. A similar percentage of both the groups of women consumed tobacco, alcohol, and coffee during pregnancy, with the exception of coffee consumption in the first interview (p=0.03), which was higher for non-adolescents.

Tables 5 and 6 show the statistically significant associations between the nutritional status (assessed by

Table 1. Socioeconomic, demographic and obstetric characteristics of pregnant adolescents (n=214) and non-adolescents (n=641). Values are given as %, χ^2, and p value

Characteristics	Adolescent	Non-adolescent	χ^2	p value
Age (years)				
13-16	26.6	-		
17-19	73.4			
20-29	-	72.3		
30-42	-	27.7		
Education (years)				
≤4	14.5	19.3	3.7	0.1
5-8	52.8	46.2		
>8	32.7	34.5		
Per-capita income (mw*)				
0-1	33.2	21.5	27.4	<0.001
1.1-3	55.6	53.7		
>3	11.2	24.8		
Persons/house's room				
<1	44	53.5	6.9	0.03
1-2	52.3	44.5		
>2	3.7	2		
Marital status				
Married	24.3	60.8	107.9	<0.001
Single (with partner)	37.4	23.3		
Single (without partner)	36.9	13.1		
Other	1.4	2.8		
Parity				
0	81.8	41	107.1	<0.001
1-4	18.2	57.1		
>5	0	1.9		

* mw=Minimum wage (US$ 65)

Table 2. Nutritional characteristics of pregnant adolescents (n=214) and non-adolescents (n=641) at three interviews*. Values are given as %, χ^2, and p value

Characteristics	Adolescent	Non-adolescent	χ^2	p value
Pre-pregnancy weight (kg)				
<54	57.5	37	27.6	<0.001
≥54	42.5	63		
Height (cm)				
<158	42.1	46.5	1.2	0.1
≥158	57.9	53.5		
Pre-pregnancy BMI				
<20.0	31.4	16.3	35.9	<0.001
21.0-24.9	56.5	55.2		
25.0-29.9	9.8	22.9		
≥30.0	2.3	5.6		
BMI (1st interview)				
<20.0	23.8	10.8	36.6	<0.001
21.0-24.9	58.9	54.4		
25.0-29.9	14.5	27.3		
≥30.0	2.8	7.5		
BMI (2nd interview)				
<20.0	6.5	1.4	47.6	<0.001
21.0-24.9	58	40.4		
25.0-29.9	31.3	43.1		
≥30.0	4.2	15.1		
BMI (3rd interview)				
<20.0	1.4	0.3	27.2	<0.001
21.0-24.9	38.3	24.5		
25.0-29.9	50	51.0		
≥30.0	10.3	24.2		
MUAC (cm) (1st interview)				
≤23.5	21	8.4	24.8	<0.001
>23.5	79	91.6		
MUAC (cm) (2nd interview)				
≤23.5	14	5.5	16.7	<0.001
>23.5	86	94.5		
MUAC (cm) (3rd interview)				
≤23.5	12.1	3.4	22.9	<0.001
>23.5	87.9	96.6		
Weight gain (kg) (1st interview)				
<7.0	94.5	91.1	3.5	0.04
≥7.0	5.5	8.9		
Weight gain (kg) (2nd interview)				
<7.0	53.7	52.6	0.08	0.41
≥7.0	46.3	47.4		
Weight gain (kg) (3rd interview)				
<7.0	24.8	20.1	2.06	0.09
≥7.0	75.2	79.9		

* 1st interview: ≤16 weeks of gestation; 2nd interview: 20-26 weeks; 3rd interview: 30-36 weeks
BMI=Body mass index
MUAC=Mid-upper arm circumference

Table 3. Psychological characteristics of pregnant adolescents (n=214) and non-adolescents (n=641) at three interviews*. Values are given as %, χ^2, and p value

Characteristics	Adolescent	Non-adolescent	χ^2	p value
SAI (1st interview)				
≤40	65.4	69.4	1.19	0.27
>40	34.6	30.6		
TAI (1st interview)				
≤40	39.7	49.5	6.10	0.01
>40	60.3	50.5		
GHQ (1st interview)				
≤3	64	69.6	2.28	0.13
>3	36	30.4		
PSS (1st interview)**				
≤27	38.8	59.9	28.8	0.001
>27	61.2	40.1		
SAI (2nd interview)				
≥40	73.8	73.5	0.01	0.92
>40	26.2	26.5		
TAI (2nd interview)				
≤40	46.3	57.1	7.59	0.006
>40	53.7	42.9		
GHQ (2nd interview)				
≤3	74.3	74.6	0.01	0.93
>3	25.7	25.4		
PSS (2nd interview)				
≤27	71	76.7	2.83	0.057
>27	29	23.3		
SAI (3rd interview)				
≤40	69.2	71.1	0.30	0.58
>40	30.8	28.9		
TAI (3rd interview)				
≤40	50	57.4	3.56	0.03
>40	50	42.6		
GHQ (3rd interview)				
≤3	75.7	72.2	0.98	0.32
>3	24.3	27.8		
PSS (3rd interview)				
≤27	74.8	79.4	2.03	0.09
>27	25.2	20.6		
Wish to abort child				
Yes	22.4	15.9	4.7	0.03
No	77.6	84.1		
Worry about body's change				
Yes	53.3	42.6	7.4	0.006
No	46.7	57.4		

* n=560

** 1st interview: ≤16 weeks of gestation; 2nd interview: 20-26 weeks; 3rd interview: 30-36 weeks

GHQ=General health questionnaire

PSS=Perceived stress scale

SAI=State anxiety inventory

TAI=Trait anxiety inventory

weight gain and BMI) of pregnant adolescents and non-adolescents respectively and the following predictors: age, education, per-capita income, persons per room, marital status, parity, pre-pregnancy BMI (only when outcome was weight gain), SAI, TAI, GHQ, PSS, wish to abort, worried about body's change, cigarette smoking, coffee and alcohol consumption.

(p≤0.035). Gestational age was a predictor of BMI at the second interview (p=0.030), and GHQ was a predictor of weight gain at the first interview (p=0.008). Pre-pregnancy BMI was a predictor of weight gain at the three interviews (p≤0.006), and parity showed an association with weight gain at the second and third interviews (p≤0.015). The variables "worry about body's change" and education

Table 4. Tobacco, alcohol and coffee consumption of pregnant adolescents (n=214) and non-adolescents (n=641) at three interviews*. Values are given as %, χ^2, and p value

Characteristics	Adolescent	Non-adolescent	χ^2	p value
Cigarette smoking (1st interview)				
Yes	15	13.7	0.2	0.65
No	85	86.3		
Cigarette smoking (2nd interview)				
Yes	10.3	11.2	0.1	0.70
No	89.7	88.8		
Cigarette smoking (3rd interview)				
Yes	9.8	10.8	0.1	0.69
No	90.2	89.2		
Alcohol consumption (1st interview)				
Yes	25.2	21.1	1.6	0.20
No	74.8	78.9		
Alcohol consumption (2nd interview)				
Yes	18.2	18.4	0.00	0.95
No	81.8	81.6		
Alcohol consumption (3rd interview)				
Yes	12.6	12.3	0.01	0.91
No	87.4	87.7		
Coffee consumption (1st interview)				
Yes	66.8	74.3	4.4	0.03
No	33.2	25.7		
Coffee consumption (2nd interview)				
Yes	72	75	0.79	0.37
No	28	25		
Coffee consumption (3rd interview)				
Yes	68.7	71.9	0.81	0.36
No	31.3	28.1		

* 1st interview: ≤16 weeks of gestation; 2nd interview: 20-26 weeks; 3rd interview: 30-36 weeks

Table 5 shows that the psychological status of pregnant adolescents was not an important predictor of weight gain and BMI, except for GHQ and weight gain at the first interview (p=0.03). Age was the best predictor of BMI in the three interviews; younger adolescents had lower BMI (p≤0.036). At the second interview, gestational age was also a good predictor of BMI (p=0.036). The predictors of weight gain at the second interview were pre-pregnancy BMI and alcohol intake. The predictor of weight gain at the third interview was gestational age.

Table 6 shows that the psychological status of pregnant non-adolescents (assessed by TAI scores) was an important predictor of BMI at the three interviews, together with age and worry about body's change

were predictors of weight gain at the second and third interviews respectively.

DISCUSSION

The objectives of this study were to compare the consumption of tobacco, alcohol and coffee and demographic, obstetric, socioeconomic, nutritional and psychological aspects of pregnant adolescents and non-adolescents and to examine the association between the nutritional and the psychological status of these women at three interviews (gestational age ≤16 weeks, 20-26 weeks, and 30-36 weeks).

Tobacco, alcohol and coffee consumption was similar for adolescents and non-adolescents. Fewer adolescents (24.3%) were officially married compared to non-

adolescents (60.8%). A higher percentage (81.8%) of adolescents than non-adolescents (41%) was pregnant for the first time and was from lower socioeconomic classes, although both the groups of women had a very low per-capita income.

transformations that happened to their bodies during pregnancy (5). Depressive symptoms are common among adolescents, not only during pregnancy but also in the postpartum period (34). Our results confirm these data, showing that a larger number of adolescents were worried

Table 5. Predictors of weight gain and BMI of adolescents (n=214) at three interviews

1st interview*					
Outcome	Weight gain			BMI	
	Predictor=	Coefficient	p value	Predictor=	Coefficient	p value
	GHQ	-0.215	0.032	Age	0.344	0.033
	R^2=0.02			R^2=0.03	
2nd interview**					
Outcome	Weight gain			BMI	
	Predictor=	Coefficient	p value	Predictor=	Coefficient	p value
	Pre-pregnancy BMI	-0.189	0.001	Age	0.327	0.036
	Alcohol consumption	0.09	0.027	GA	0.163	0.036
	R^2=0.07			R^2=0.04	
3rd interview***					
Outcome	Weight gain			BMI	
	Predictor=	Coefficient	p value	Predictor=	Coefficient	p value
	GA	-0.301	0.006	Age	0.394	0.015
	R^2=0.03			R^2=0.02	

* 1st interview=All variables were investigated at a gestational age of ≤16 weeks
† Variables included in multiple linear regression models were: age, education, per-capita income, persons/house's room, marital status, parity, pre-pregnancy BMI (only when outcome was weight gain), SAI, TAI, GHQ, PSS, wish to abort, worry about body's change, cigarette smoking, coffee and alcohol consumption
**2nd interview=All variables were investigated from 20 to 26 weeks of gestation
***3rd interview=All variables were investigated from 30 to 36 weeks of gestation
BMI=Body mass index
GA=Gestational age
GHQ=General health questionnaire
PSS=Perceived stress scale
SAI=State anxiety inventory
TAI=Trait anxiety inventory

As pregnant adolescents are still growing and are usually thinner than non-adolescents, a greater weight gain was expected in this group of women, considering the associations between low weight gain in pregnancy and poor outcomes (33). In this study, the mean weight gain among adolescents and non-adolescents at the three interviews was similar. Almost one-third (31.4%) of adolescents had lower pre-pregnancy BMI compared to 16.3% of non-adolescents. The adolescents presented lower BMI and MUAC than non-adolescents at all the three interviews.

Adolescents are probably more vulnerable to special stresses, arising from rapid changes that accompany their transition from childhood to adulthood and additional

about changes in their bodies and had higher scores of TAI at all the three interviews compared to non-adolescents.

In the last 10 years, several studies have assessed the impact of the psychological status of pregnant women on birth-weight and gestational age of their newborn babies (19,35-40), but few studies have examined the association between the psychological and the nutritional status of adolescent and non-adolescent pregnant women. Casanueva *et al*. reported a positive impact of psychosocial support given during pregnancy to a group of adolescents on maternal weight gain and infant's birth-weight (41). As stated by the author, in favourable socioeconomic conditions, psychological

support given to pregnant adolescents can promote an adequate weight gain, probably by diminishing their anxiety level. Picone *et al*. investigated the effects of diet, smoking, and psychological stress on maternal weight gain and concluded that smoking and stress might cause low weight gain by reducing the use of calories for weight gain (42). Hickey *et al*. observed an important role for psychosocial factors in the aetiology of low prenatal weight gain among white women in the USA, but showed no such role for black women (43).

In this study, we observed an association between the nutritional and the psychological status of pregnant women, controlling for toxic exposure, socioeconomic, demographic and obstetric factors. Nevertheless, the associations between BMI and scores of TAI (which assess chronic anxiety) and the variable "worry about body's change" were present at the three interviews only for pregnant non-adolescents. Both the groups of women showed negative associations between weight gain at the first interview and the GHQ scores (which assess distress in general). The variable "worry about body's change" was also one of the predictors of weight gain, at the second interview, for non-adolescents. Apart from the psychological factors, there were associations

Table 6. Predictors of weight gain and BMI of non-adolescents (n=641) at three interviews

1st interview*						
Outcome	Weight gain			BMI		
	Predictor=	Coefficient	p value	Predictor=	Coefficient	p value
	Pre-pregnancy BMI	-0.093	0.004	Age	0.159	0.000
	GHQ	-0.128	0.008	TAI	-0.041	0.006
				Worry about body's change	-1.230	0.000
	R^2=0.02			R^2=0.06		
2nd interview**						
Outcome	Weight gain			BMI		
	Predictor=	Coefficient	p value	Predictor=	Coefficient	p value
	Pre-pregnancy BMI	-0.139	0.000	Age	0.169	0.000
	Parity	-0.203	0.012	TAI	-0.0317	0.035
	Worry about body's change	-0.506	0.017	Worry about body's change	-0.987	0.001
				GA	0.115	0.030
	R^2=0.06			R^2=0.06		
3rd interview***						
Outcome	Weight gain			BMI		
	Predictor=	Coefficient	p value	Predictor=	Coefficient	p value
	Pre-pregnancy BMI	-0.064	0.006	Age	0.152	0.000
	Education	-0.379	0.004	TAI	-0.051	0.001
	Parity	-0.240	0.015	Worry about body's change	-1.077	0.000
	R^2=0.03			R^2=0.06		

* 1st interview=All variables were investigated at a gestational age of ≤16 weeks

† Variables included in multiple linear regression models were: age, education, per-capita income, persons/house's room, marital status, parity, pre-pregnancy BMI (only when outcome was weight gain), SAI, TAI, GHQ, PSS, wish to abort, worry about body's change, cigarette smoking, coffee and alcohol consumption

**2nd interview=All variables were investigated from 20 to 26 weeks of gestation

***3rd interview=All variables were investigated from 30 to 36 weeks of gestation

BMI=Body mass index

GA=Gestational age

GHQ=General health questionnaire

PSS=Perceived stress scale

SAI=State anxiety inventory

TAI=Trait anxiety inventory

between the nutritional status of pregnant women and the demographic and obstetric factors and tobacco, alcohol and coffee consumption.

The results of this study suggest that psychological distress in pregnancy can influence weight gain up to the 16th week of gestation for both adolescents and non-adolescents and from the 20th to the 26th week of gestation for non-adolescents. Through catecholamine-mediated alterations, maternal psychological stress/distress may affect basal and resting metabolism and/or the ability with which energy is used for synthesizing new tissue, impairing weight gain in maternal and foetal tissue. The poor psychological status may also interfere with the achievement of a positive energy balance through stress/distress-related changes in physical activity, appetite, etc. (43-45). Chronic anxiety, in non-adolescents, was negatively associated with BMI from the beginning to the end of pregnancy.

Despite the fact that there were statistically significant associations between the nutritional and the psychological status of pregnant adolescents and non-adolescents, it is important to observe the low values of R^2 in the multiple linear regression models. There are two explanations for the low R^2: (1) other variables, not investigated in this study, may explain better the dispersion of outcomes—weight gain and BMI, and (2) the natural variation of outcomes are high. Maternal weight is influenced by the weight of the foetus, placenta, amniotic fluid, extracellular fluid, other tissue (fat), uterus + breast and blood (4). Therefore, it is difficult to measure all the components of maternal weight.

The influence of the psychological, demographic and obstetric factors and toxic exposure on the nutritional status of pregnant women (adolescents and non-adolescents) should be contemplated in future studies, trying to assess the impact of stress/distress in different components of maternal weight.

Another reason to evaluate the psychological status of pregnant women is that one of the risk factors for postpartum depression, a relevant problem in developing and developed countries (46,47), is prenatal distress, particularly anxiety or depression (48).

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