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Patterns of energy balance-related behaviors and food insecurity in pregnant women

Padrões de comportamentos relacionados ao balanço de energia corporal e insegurança alimentar em gestantes

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Abstract *The behaviors related to caloric balance during pregnancy can lead to short- and long-term repercussion over the life course. This study aimed to identify patterns of energy balance-related behavior (EBRB) and its association with food insecurity (FI) in pregnant women. Cross-sectional, with pregnant women undergoing prenatal care in public health units in Colombo, Brazil, in 2018/2019. EBRB patterns were identified by factor analysis, and the scores were compared according to FI levels (mild and moderate/severe (M/S) through quantile regression. Four EBRB patterns were identified among 535 pregnant women: Factor 1- household/caregiving activities, exercise/sport, and physical inactivity; Factor 2 - fruits and vegetables; Factor 3 - paid work and commuting; Factor 4 - soda and sweetened beverage, sweets, and goodies. After adjusted analyses, women with mild FI presented higher scores for Factor 1 and lower scores for Factor 3. Higher scores for Factor 4 (p25) were observed among women with mild FI in simultaneous quantile regression. M/S FI was associated with lower scores for Factor 3 (p75). Mixed patterns with factors negatively and positively associated with energy balance were identified among pregnant women with FI.*

Key words *Social Inequality, Food Security, Energy, Cross-Sectional Studies*

Resumo *Os comportamentos relacionados ao balanço de energia corporal (CRBEC) durante a gestação podem estar associados às repercussões de curto e longo prazo. Este estudo objetivou identificar os padrões de CRBEC e sua associação com a insegurança alimentar (IA) em gestantes. Estudo transversal com mulheres em acompanhamento pré-natal em unidades públicas de saúde de Colombo (PR), Brasil em 2018/2019. Padrões de CRBEC foram identificados por análise fatorial e os escores foram comparados de acordo com os níveis de IA (IA leve, IA moderada/grave (M/G) por meio de regressão quantílica. Quatro padrões de CRBEC foram identificados entre 535 gestantes: Fator 1- atividades domésticas/cuidados, exercícios/esporte e inatividade física; Fator 2- frutas e vegetais; Fator 3 - trabalho remunerado e deslocamento; Fator 4 - refrigerantes e bebidas açucaradas, doces e guloseimas. Após análise ajustada as mulheres com IA leve apresentaram maiores escores para o Fator 1 e menores escores para o Fator 3. Maiores escores foram observados entre as mulheres com IA leve no Fator 4 (p25) na regressão quantílica simultânea. IA M/G foi associada a escores mais baixos para o Fator 3 (p75). Padrões mistos com fatores negativa e positivamente associados ao balanço de energia foram identificados entre as gestantes com IA.*

Palavras-chave *Desigualdade Social, Segurança Alimentar, Energia, Estudos Transversais*

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Introduction

Overweight and obesity have multicausal etiology and are related to genetic, metabolic, environmental and behavioral factors[1]. In Brazil, from 1974 to 2009, women had a 2.5% increase in annual rate of obesity[2], mainly those with lower schooling whose had higher cumulative prevalence of obesity[3].

Changes in patterns of food consumption and physical activity are among the factors most consistently associated with the increased prevalence of overweight and obesity worldwide[4], leading to a positive energy imbalance[5]. The positive energy imbalance happens when the value of energy intake is greater than the energy for body demands and results in weight gain[5]. The increased consumption of foods rich in energy, fats and added sugar, jointly with the decreased levels of physical activity and increased frequency of sedentary lifestyles corroborate to the energy imbalance[5].

Pregnancy is a critic and sensitive periods in which different expositions may exert short and long-lasting developmental outcomes[6]. A negative energy balance may lead to an insufficient weight gain, increasing the risk of restriction of the intrauterine growth. On the other hand, a positive energy balance may lead to an excessive weight gain, which increases the risk of diabetes, pre-eclampsia, eclampsia, need of more invasive labor care, including induced labor and cesarean sections. Furthermore, adverse pregnancy outcome is associated with obesity as preterm delivery, fetal mortality and macrosomia and low Apgar scores, beyond that are risk factors for the perpetuation of the intergenerational obesity cycle[7].

Lower socioeconomic status and food insecurity (FI) may be associated with lower energy expenditure due to metabolic adjustments, related to situations of deprivation or even the perception of lake of access to food, which can lead to reduced energy expenditure[8]. FI is related to limited or uncertain access to food – mild FI, progressively until the hunger experience characterizing severe FI[9]. Households headed by women with children are the most affected by FI[10]. Socioeconomic conditions and FI may be associated with changes in eating habits, quality, and access to food, leading to a higher energy consumption than body requirements, which chronically may cause excessive weight gain[11].

FI is a condition related to social vulnerability, and a predictor of malnutrition and overweight, which highlights the importance of reducing FI and the various forms of malnutrition[12]. The prevalence of FI in pregnancy ranged from 9.0% to 87.9%, with highest prevalence in low-income countries. In pregnancy FI increases the risk of opposite nutritional status, related to excessive and insufficient weight gain[13,14]. Other adverse outcomes relate to FI in pregnancy includes: anemia, maternal depression/anxiety disorders, gestational complications (diabetes, hypertension, obesity), low birth weight, postpartum depression, suicide[14], birth defects, neonatal mortality and early introduction of animal milk to infant's diet[15].

A systematic review found that households with FI were overexposed to the risk of obesity (OR=1.15 95%CI=1.06; 1.23), and women were more likely to be obese than men (OR=1.26 95%CI=1.05; 1.46). Subgroup analysis revealed that severe FI was related to higher risk of underweight (OR=1.49 95%CI=1.12; 1.85) than overweight (OR=1.37 95%CI=1.12; 1.61) or obesity (OR=1.29 95%CI=1.02; 1.57) among adults[16].

Furthermore, studies indicate a higher prevalence of physical inactivity at leisure among adults with worse socioeconomic conditions, and women are less likely to be physically active at leisure. During pregnancy 75% of daily physical activity, it is related to the care of children and adults, and more than ¾ of the women performed light physical activities. In addition, many of them may not feel safe[17] or comfortable about physical activity practices during pregnancy[18].

Thus, a context with unfavorable patterns of physical activity and food consumption among the most vulnerable population groups emerges, with potential negative effects on the energy balance, and risk factors for women and children survival, cumulative intergenerational background, and long-lasting outcomes, as non-communicable diseases. The World Health Organization suggests that interventions for the prevention of obesity and non-communicable diseases are designed for multiple risk factors[5], due to the coexisting behaviors and their deleterious concurrency[19].

The analysis of the patterns of energy balance-related behaviors (EBRB) has been applied to evaluate jointly food intake, and physical activity in different population, mainly in adolescents[20-23]. This approach allows to investigate the complexity of these behaviors, their synergistic and potentially deleterious effects[19]. Studies aiming identify patterns of behaviors in pregnant women focused exclusively on dietary patterns, while some of them have included physical activity as an exposure variable and not combined

with food consumption to identified EBRB[24,25]. While few studies evaluated data driven food patterns in relation to FI[26,27], from our knowledge, there are no studies focused on EBRB and FI in pregnant women.

Considering that women in reproductive age are a special group of concern considering obesity[28], and pregnancy may be a window of opportunity for evaluate EBRB, due to the relation of these behaviors with maternal and fetal outcomes[6,7], and the increasing vulnerability related to FI in that group[13-15,29], the aim of the study was to identify patterns of energy balance-related behavior (EBRB) and its association with food insecurity (FI) in pregnant women.

Methods

This is a cross-sectional study part of a prospective cohort called "Study of Living and Health Conditions of Pregnant and Puerperal Women" with data collection from February 2018 to June 2019 in Colombo, Paraná, Brazil.

The city of Colombo in 2018 had an estimated population of 240,840 inhabitants, a maternal mortality rate of 27.05 per 100,000 live births (2017), and in 2010. The FI prevalence in pregnancy woman in 2016-2017 was 45.1%[30], per capita income estimated at R$ 682.85 (U$ 210.10)[31]. In February 2021, there were 8,488 families benefiting from *Bolsa Família* – the main Brazilian income transfer program – totaling 26,018 people directly benefited by the Program, approximately 10% of the municipality's population, 87.7% of those responsible for receiving the benefit being female[32].

According to estimates by the Municipal Health Bureau of Colombo, in 2016, 3,807 citizens performed prenatal care in the Unified Health System (SUS) in the 24 health units.

Participants

We considered as eligible those pregnant women who underwent prenatal care at SUS and were residents of Colombo. The sample was proportionally distributed in relation to the number of pregnant women registered in each health unit and all pregnant women were consecutively invited from the prenatal consultation agenda. The inclusion criteria adopted were being pregnant and performing prenatal care in SUS in the city.

The interviews were carried out in the waiting room of the prenatal consultation. We conducted this research within the required ethical standards and after the approval of the project by the Human Being Research Ethics Committee at the University Federal of Paraná, with number 2405347. Only pregnant women aged over 18 years who read and signed the Informed Consent Form (ICF) and that underage who read and signed the Informed Assent Form (IAF) and whose guardians signed the ICF participated in the research.

Sample procedures

The sample estimate considering an unknown prevalence of the outcome of 50% (to maximize sample size of the study), margin of error of five percentage points, and confidence level of 95%, resulting in a minimum sample of 520 pregnant women. However, a percentage of 30% was added to compensate for refusals and losses in longitudinal studies, thus the desired final sample was 676 pregnant women, distributed proportionally to the number of women under prenatal care at the health units. During the consolidation of the fieldwork, incomplete questionnaires were observed for some variables, and, for increase the power of the study, other 59 (11.3%) pregnant women were selected to participate in the study (n=735). The sample size calculations were performed in the OpenEpi version 3.01 online application.

To maintain the constant number of observations between the different analysis models in multivariate analyses we used the listwise deletion strategy, excluding the questionnaires with missing answers in variables selected for the study, resulting in an analytical sample of 535 participants. Considering the number of pregnant women with food security (n=498) and with moderate/severe FI (n=38) it would be possible to detect a minimum difference of 0.15 in the comparison of means between the two groups, with power of 80% and 95% confidence level.

Variables and data measurement

The outcome was the EBRB comprising food consumption and physical activity domains. EBRB practices were investigated using two validated instruments: 1) Frequency of weekly food consumption (VIGITEL)[33], which investigates the consumption of FV, soda and sweetened beverages, with response option from 0 to 7 days a week; 2) Physical activity questionnaire for pregnant women (PPAQ)[34], which investigates the

level of daily physical activity in five dimensions of daily life: household/caregiving activities; paid work, sports/exercise, commuting, and physical inactivity[34]. To determine energy expenditure, the Metabolic Equivalent Task (MET) spent on the activity was multiplied by the duration of the activity per day to arrive at an average measurement of energy spent. Each activity was classified by its intensity: sedentary (<1.5 METs), light (1.5 - <3.0 METs), moderate (3.0-6.0 METs) and vigorous (>6.0 METs).

The main exposure variable FI was measured through the Brazilian Food Insecurity Scale (EBIA)[35,36]. The EBIA is an instrument with high internal consistency and with external validity to predict FI. Its use as a nationwide household food security measure is strongly recommended[35]. EBIA allows the classification with and without FI and for those who are classified as FI, the instrument allows stratification into three levels of FI. For each question answered "yes", a point is added to the total sum of the scale. For households without residents under 18 - a) Food Security - 0 points; b) Mild FI - 1 to 3 points; c) Moderate FI - 4 to 5 points; d) Severe FI - 6 to 8 points. In households under 18 - a) Food Security - 0 points; Mild FI - 1 to 5 points; b) Moderate FI - 6 to 9 points; c) Severe FI - 10 to 14 points. Due to the relatively small number of women in moderate (n=23) and severe (n=14) FI, those were grouped and called moderate/severe FI for analysis.

Age and schooling were considered as exposure variables: age in complete years; and schooling (in years of study).

Study Procedures

Interviewers received training on the stages of the research and applied the questionnaires. Quality control was performed in 11.6% (n=70) of the questionnaires, through telephone contact with the participants, using a reduced version of the questionnaire. intraclass correlation coefficient obtained for the variable was 0.99 (95%CI=0.98; 1.00). The other items reported in the interview coincided in both moments.

Statistical analyses

Data were double entered to check on typos in spreadsheets with controls for field input. Comparisons between the records with complete and incomplete information were performed using the Mann-Whitney nonparametric test or Pearson's chi-square test according to the characteristics of the variables under study.

The factor analysis, with the main factor extraction method was the technique applied for extract the EBRB which allows identifying factors or patterns of behaviors according to the degree of correlation between components of the group in the data set[37].

To evaluate the adequacy of the sample for factor analysis, the Kaiser-Meyer-Olkin (KMO) Coefficient was estimated, which verifies the existence and weight of partial correlations[38]. The KMO value obtained was 0.6, considered adequate. Bartlett's sphericity test was applied to measure the quality of correlations between variables and the p-value obtained was ≤0.001, which rejects the hypothesis that the data are not inter-correlated. Subsequently, orthogonal rotation (Varimax) was performed to examine the standard structure of EBRB.

The interpretation of each factor was performed based on the variables that obtained the highest factor loads. The number of factors to be retained was based on the presence of eigenvalues greater than 1, and on the percentage of variance explained by the factors. From the factor analysis, linear combinations of EBRB were generated, through the scores of the different factors, which were considered the dependent variables for the analyses. The correlation between the EBRB scores generated and the independent variables was tested using Spearman's correlation.

The association of the EBRB factors generated with the FI levels was tested, and adjusted for age, and schooling, through quantile regression. The use of quantile regression was defined from the distribution of the factors generated, which was not considered normal.

The quantile regression estimates the median of the dependent variable, conditioned to the values of the independent variable. Operationally, it finds the regression plan that minimizes the sum of absolute residuals instead of the sums of square residuals, used in linear regression[39]. The standard errors were estimated by Bootstrap analysis[39]. Regression results were expressed using coefficients (beta) and 95% confidence intervals. The coefficients in quantile regression have the same interpretation of a traditional regression, for each median (instead of mean) change in the response variable for one unit of change in the predictor variable while holding other predictors in the model constant[39].

Additionally, comparisons of EBRB in the quantiles 25 and 75 were tested by simultaneous

quantile regressions, with 100 bootstrap replications, as a result, associations in a specific quantile may not be significant in other because the regression coefficients were estimated in different levels of the distribution. The analyses were performed in the Stata 14 software (Stata Corp, Texas).

Results

The number of women considered eligible was 735, of whom 605 (82.3%) answered the questionnaire. For this study, we considered a sample of 535 participants who had complete information about the investigated variables. The mean age of the women who participated in the study was 26.0 years (95%CI=25.5; 26.5) and did not differ from those who refused to participate (26.6 years 95%CI=25.7; 27.5).

The age ranges from 13 to 43 years, 16.4% were adolescents. The median schooling was 9.5 years and ranged from 0 to 17 years, and 43.9% had at least complete secondary education. The mean consumption of fruits was 4.7 times per week, vegetable 4.3, and soda and sweets around three times. Pregnant women expend more energy in caring of other activities, follow by physical inactivity, paid work, commuting, and exercise/sport. The prevalence of food security was 52.5%, mild FI 40.6%, 6.9% moderate/severe FI (Table 1).

Four EBRB patterns were identified through factor analysis. The first factor explained 56.7% of the variance of the variables applied on multivariable approach, the second 43.9%, the third 41.8, and Factor 4 34.4%.

The pattern Factor 1 presented higher loads for the domains: household/caregiving activities (0.54), sports/exercise (0.33), and physical inactivity (0.49). The pattern Factor 2 presented high loads for consumption of fruits (0.50) and vegetables (0.47). Factor 3 presented high factor loading for energy expend in paid work (0.46) and commuting (0.48), while the last pattern identified as Factor 4 presented high loads for consumption of soft drinks, sweetened beverage (0.44) and sweets and goodies (0.44) (Figure 1).

Women with mild FI had higher scores for Factor 1, indicating that in the presence of mild FI women spent more energy on domestic activities/care, sports/exercises, and physical inactivity. This association remained after adjustments for age and education. Factor 2 scores increased with schooling, suggesting that women with higher schooling had higher FV consumption (Table 2).

Table 1. Distribution of demographic, socioeconomic, and obstetric history variables of pregnant at public health units. Colombo, Paraná, Brazil, 2018-2019 (n=535).

Variables	n	%
Age Group (years)		
0-19	88	16.4
20-29	399	74.6
≥30	48	9.0
Schooling (years)		
0-7	109	18.1
8-10	229	38.0
≥11	264	43.9
Food Insecurity		
Food security	281	52.5
Mild	217	40.6
Moderate	23	4.3
Severe	14	2.6
	Mean	**Std. Dev**
Energy balance-related behaviors		
Food frequency		
Vegetables (times per week)	4.3	2.1
Fruits (times per week)	4.7	2.1
Sweets and goodies (times per week)	3.4	2.4
Soda/sweet drinks (times per week)	3.3	2.6
Physical activity domains		
Household caregiving activities (mets)	17.1	9.1
Paid work (mets)	3.5	5.3
Sports/Exercise (mets)	2.4	3.8
Commuting (mets)	2.7	2.1
Physical inactivity (mets)	6.9	3.3

Note: Met=Metabolic equivalent task; Std. Dev=Standard Deviation.

Source: Authors.

For Factor 3, the scores were lower for moderate/severe FI and increased according to age and education. After adjustments, women with mild FI started to present higher scores for Factor 3, while for moderate/severe FI the association remained negative. The results revealed that women with moderate/severe FI had lower energy expenditure with paid work and commuting. On the other hand, women with mild FI had higher scores for Factor 3, indicating that women spent more energy on paid work and commuting. Factor 4 characterized by consumption of sweetened drinks and sweets adherence scores increased with age (Table 2).

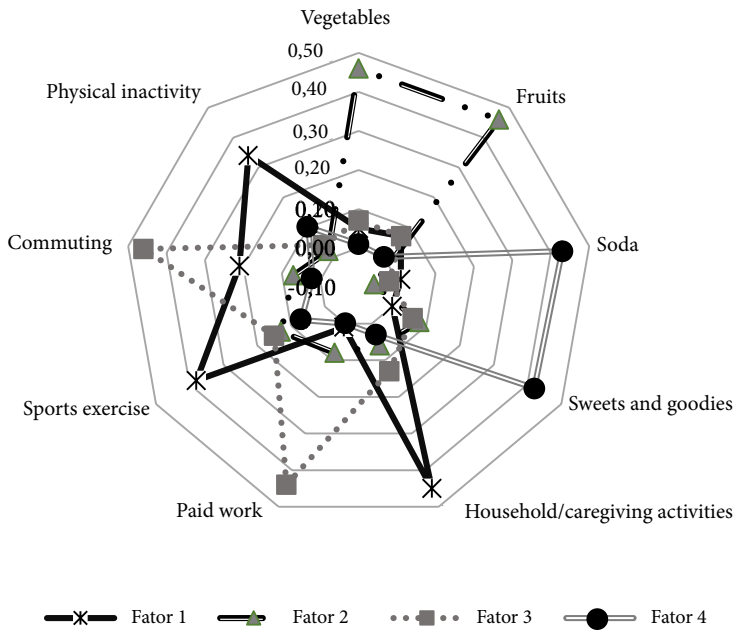

Figure 1. Factor loads of patterns of energy balance-related behaviors of pregnant women in prenatal care. Colombo, Paraná, Brazil, 2018-2019 (n=535).

Note: Factor loads after varimax rotation on the patterns of energy balance-related behaviors investigated. Factor 1: Household/caregiving activities, exercise/sports, and physical inactivity; Factor 2: Fruits and vegetables; Factor 3: Paid work and commuting Factor 4: Soda and sweetened drink, sweets, and goodies.

Source: Authors.

When investigating the EBRB distribution of scores through simultaneous quantile regressions for the 25th and 75th percentile, age (percentile 25), and schooling (percentile 25 and 75) were associated to higher scores on Factor 2 (Table 3). For Factor 3 the scores increased with schooling (percentile 25) and age (percentile 75), while lower scores were observed for women with M/S FI (percentile 75) while increased with age. For Factor 4, the scores were higher for mild FI (percentile 25) and decreased with age (percentile 25 e 75).

Discussion

Our study investigated the EBRB patterns and their association with the different degrees of FI, age, and schooling in a representative sample of pregnant women under prenatal care in the Unified Health System of the city of Colombo. As a result, four different patterns of EBRB distribution were identified among pregnant women. The patterns were divided in relation to foods considered protective (Factor 2) and risk (Factor 4) for energy balance, and two related to the different domains of physical activity (Factor 1 and 3). Education and age were associated with increasing in most of patterns of EBRB, mainly those considered protective.

The participants with higher schooling presented consistently higher scores for Factor 2, characterized by higher consumption of FV. The VIGITEL data from 2017 found that regular consumption of FV, that is, in five or more days per week, increased 17.1% according to schooling levels[33]. Schooling can influence the choice of healthy foods due to access to better employment opportunities, income and information[40]. Furthermore, higher income neighborhood has better access to higher quality FV environment[41]. The consumption of FV is essential at all stages of life. A prospective cohort of 1,036 pregnant women in eastern Spain found that daily con-

Table 2. Coefficients of quantile regression of patterns of energy balance-related behavior, for food insecurity and independent variables in pregnant women undergoing prenatal care. Colombo, Paraná, Brazil, 2018-2019 (n=535).

Variables	Factor 1 - Household/caregiving activities, sports/exercise, and physical inactivity						Factor 2 - Fruits and vegetables					
	Non-Adjusted			Adjusted			Non-Adjusted			Adjusted		
	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value
Food Insecurity												
Food Security	Ref			Ref			Ref			Ref		
Mild FI	0.183	0.083; 0.282	<0.001	0.192	0.058; 0.326	0.005	0.084	0.016; 0.184	0.100	0.119	-0.022; 0.261	0.100
Moderate/ Severe FI	-0.002	-0.277; 0.273	0.986	0.038	-0.180; 0.255	0.736	-0.216	-0.524; 0.091	0.168	-0.060	-0.269. 0.148	0.570
Age (years)	0.009	-0.002; 0.021	0.120	0.007	-0.005; 0.020	0.266	0.004	-0.008; 0.018	0.464	0.003	-0.006; 0.012	0.566
Education (years)	0.016	-0.003; 0.036	0.101	0.013	0.009; 0.036	0.242	0.044	0.029; 0.061	<0.001	0.051	0.034; 0.067	<0.001
Constant				-0.046	-0.861; -0.685	0.022				-0.681	-0.974; -0.389	<0.001

Variables	Factor 3 - Paid work and commuting						Factor 4 - Soda and sweetened drink, sweets, and goodies					
	Non-Adjusted			Adjusted			Non-Adjusted			Adjusted		
	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value
Food Insecurity												
Food Security	Ref			Ref			Ref			Ref		
Mild FI	0.003	-0.135; 0.141	0.966	0.011	0.001; 0.220	0.047	0.124	-0.490; 0.297	0.160	0.0.83	-0.059; 0.226	0.253
Moderate/ Severe FI	-0.037	-0.589; -0.159	0.001	-0.238	-0.360; - 0.117	<0.001	-0.177	-0.454; 0.101	0.212	-0.180	-0.409; 0.048	0.123
Age (years)	0.017	0.006; 0.028	0.002	0.013	0.007; 0.019	<0.001	-0.247	-0.033; -0.016	<0.001	-0.023	-0.033; -0.014	<0.001
Education (years)	0.035	0.007; 0.064	0.012	0.028	0.017; 0.039	<0.001	-0.013	0.120; 0.730	0.132	0.019	-0.005; 0.016	0.288
Constant				-0.630	-0.807; -0.454	<0.001				-0.765	-0.464; 1.00	<0.001

Note: Ref=reference category. Coef=Coefficient, beta generated by quantile regression. FI=Food insecurity. 95%CI=95% Confidence Interval.

Source: Authors.

sumption of 420 g or more of fruits showed an inverse association of higher fruit consumption with children born with low weight[42].

The consumption of soft drinks, sweetened beverages, sweets, and goodies (Factor 4). decreased as age increased among the participating pregnant women. The data are similar to those observed for Brazil in 2017, because the regular consumption of soda and sweetened beverages decreased with age[33]. This inverse association between age and consumption of soft drinks, sugars, sweets, and treats may be due to a generational effect, once older individuals formed their eating habits during a period with less consumption of processed foods, rich in fats, sugars and salt[43].

In the present study, women with mild FI had higher scores for consumption of sweet foods and soda in the lowest adherence quartile (25th percentile) similarly to other studies[44,45]. Among pregnant women those with mild FI presented higher scores of sweet foods and soda in the lowest quartile adherence, indicating higher scores for these behaviors that characterized the Factor. Sweetened beverages are easily found and affordable in places with few financial resources, thus

Table 3. Coefficients of simultaneous quantile regression of patterns of energy balance-related behavior, for food insecurity and independent variables in pregnant women undergoing prenatal care. Colombo, Paraná, Brazil, 2018-2019 (n=535).

Variables	Factor 1 - Household/caregiving activities, sports/ exercise, and physical inactivity						Factor 2 - Fruits and vegetables					
	Quantile 25			Quantile 75			Quantile 25			Quantile 75		
	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value
Food Insecurity												
Food Security	Ref			Ref			Ref			Ref		
Mild FI	0.18	-0.01; 0.37	0.007	0.02	-0.14; 0.19	0.753	0.017	-0.11; 0.14	0.797	0.10	-0.03; 0.23	0.137
Moderate/ Severe FI	-0.01	-0.20; 0.20	0.996	-0.16	-0.75; 0.43	0.596	-0.10	-0.26; 0.06	0.236	0.09	-0.59; 0.78	0.789
Age (years)	0.01	- 0.01; 0.01	0.886	0.00	-0.01; 0.02	0.493	0.003	-0.01; 0.01	0.624	0.01	0.03; 0.02	0.045
Education (years)	0.01	-0.01; 0.03	0.457	0.01	-0.01; 0.04	0.279	0.020	-0.05; 0.04	0.015	0.06	0.03; 0.09	<0.001
Constant	-0.67	-1.05; -0.29	0.001	0.13	-0.28; 0.54	0.546	-0.70	-1.05; -0.36	<0.001	-0.63	-1.02; -0.24	0.001

Variables	Factor 3 - Paid work and commuting						Factor 4 - Soda and sweetened drink, sweets, and goodies					
	Quantile 25			Quantile 75			Quantile 25			Quantile 75		
	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value	Coef	95%CI	P value
Food Insecurity												
Food Security	Ref			Ref			Ref			Ref		
Mild FI	0.014	-0.13; 0.16	0.854	-0.14	-0.32; 0.04	0.135	0.17	0.03; 0.31	0.013	0.06	-0.09; 0.21	0.462
Moderate/ Severe FI	-0.20	- 0.59; 0.20	0.338	-0.56	-1.02; -0.94	0.018	0.03	-0.26; 0.31	0.860	-0.30	-0.61; 0.01	0.060
Age (years)	0.008	-0.03; 0.02	0.170	0.02	0.001; 0.03	0.032	-0.03	-0.03; -0.01	0.001	-0.03	-0.03; -0.13	<0.001
Education (years)	0.05	0.01; 0.08	0.009	0.02	-0.01; 0.04	0.194	0.02	-0.01; 0.04	0.182	-0.03	-0.64; 0.03	0.078
Constant	-1.05	1.53; -0.57	0.001	-0.07	-0.52; 0.40	0.781	0.01	-0.39; 0.40	0.971	1.33	0.82; 1.83	0.001

Legend: Ref=reference category. Coef=Coefficient, beta generated by quantile regression. FI=Food insecurity. 95%CI=95% Confidence Interval.

Source: Authors.

becoming a regular consumption option. These findings about higher intakes of soda in pregnant women with mild FI are worrisome considering its association with hypertension[46], and diabetes incidence in pregnancy[47].

Among the participants, those with mild FI presented higher scores for Factor 1 indicating higher energy spent on household/caregiving activities, sports and exercise and physical inactivity. That EBRB pattern included a mixed profile of activities with higher and lower energy expenditure. There are some theories to explain adaptative modifications to reduce energy expenditure in low socioeconomic status group[8]. Women in poor neighborhood can face difficulties to engage and keep physically actives[48]. The domestic tasks and care for the other residents of the household are mainly performed by women in Brazil[49]. On average, the Brazilian woman spent 36.1 hours per week with household/caregiving activities. Poorer women have less help from others, and less availability of household equipment that decreases the time and energy spent to perform household activities.

In fact, the energy expenditure of caring of others was twice than others physical activity domains among the pregnant women investigated in our study. During pregnancy, time spent on

active leisure activities reduces. Women in the second and third trimester of pregnancy have lower levels of leisure-time physical activity, worse perception of health status[50] , and a sedentary lifestyle is associated with a worse quality of life[51].

The Factor 3 scores represented by paid work and commuting increased with the participants' age and education. This may indicate the predominance of occupations that require greater energy expenditure, as well as the greater time spent on commuting home – work among pregnant women of this study. On the other hand, the scores were lower for women in moderate/severe FI, suggesting that women in FI have less energy expenditure with paid work and commuting. In Brazil, there was an increase in woman insertion in the labor market, from 2004 to 2014[52], and the probability of women having paid work increases with schooling[53], which reduces the risks of reaching the degree most severe of FI, which can be accompanied by hunger.

Since the population evaluated was composed of women mostly in exclusive prenatal care in the UHS, for this group, higher education may likely mean greater access to employment, however, still in activities that require greater physical exhaustion. Colombo's characteristic of dormitory city[54] can also explain the time spent on commuting by these women, who can perform work activities in cities other than that of their residence.

This is the first study that investigated the patterns of EBRB and association with FI among pregnant women undergoing prenatal care. The broader concept of physical activity involves any activity that spends more energy than rest, such as day-to-day activities[55]. Women perform paid and unpaid activities like household chores and related to the care with others. Thus, investigating the levels of physical activity with domains of women's daily lives ensures more realistic measurement of physical activity levels in this group[56].

The use validated instruments, statistical techniques that allowed considering the non-linear distribution of associations between factors and exposure variables are positive aspects. Unlike traditional linear models, such as linear regression, that assume that estimates have a constant effect, simultaneous quantile regression can illustrate if independent variables have non-constant or variable effects across the full distribution of the dependent variable[39]. That explain partially the not always consistent associations between the EBRB patterns and FI levels, but in no case the associations change the direction, instead differences were observed according FI degrees, were reinforced in other quantiles than median, or significant only in a specific quantile.

The results should be interpreted in the context of some limitations. The cross-sectional design of this study does not allow cause-effect inferences. Other limitations include self-report, memory bias and socially accepted/desired responses, particularly in the health unit environment. The food consumption frequency tool has limitations, as it does not allow you to measure portion sizes for energy consumption calculations. It only indicates the regularity or not of the consumption of certain foods or food groups.

During data gathering, the research team repeatedly visited the same health units, which may have allowed different pregnant women the opportunity to participate. The rate of absence in prenatal care is low, and in many units, there is an active search for absent pregnant women by the health team, which increases the possibility of internal inference of the data.

Furthermore, there are no indications of age selection bias due to the similarity of age between participants and those who refused. Nevertheless, due to the questionnaire size, many pregnant women left incomplete questions. This reduced the sample available to perform some analyses and may not have conferred sufficient power to the study to identify associations between FI, especially moderate and severe, and the outcomes investigated. Despite this, differences in EBRB were identified according to FI degree: pregnant women with mild FI had higher energy expenditure with housework, physical exercises, and sedentary activities and higher scores on soda and sweets consumption, while those with moderate/severe FI had lower Factor 3 scores indicating low scores of paid works and commuting activities.

Future studies should use more detailed instruments to identify other aspects of food consumption. We suggest using such as 24-hour food recall, food registration or direct weighing of food among pregnant women. Qualitative studies should seek to identify the strategies employed by the families of pregnant women in FI, particularly severe FI, to deal with the adaptations imposed in the diet and daily life of FI.

The patterns investigated here are useful to suggest broader public health strategies to improve better EBRB patterns in pregnant women, mainly those with FI, younger and with lower schooling. Those initiatives include opportunities to engagement on sports/exercise, reducing

the time spent on inactive leisure activities; and to decrease the consumption of sugar-rich products, and to increase the consumption of FV. Furthermore, intersectoral strategies for improve access to timely schooling and job opportunities may reduce drivers for FI in women and contributes to promote healthier EBRB.

Collaborations

RC Fernandes and DA Höfelmann participated in the conceptualization, methodology and data curation. RC Fernandes participated in data gathering. DA Höfelmann performed the statistical analysis. Both authors drafted the article or critically reviewed the article and approved the final version of the manuscript to be published. The authors are responsible for all aspects of the work, ensuring that issues related to the accuracy or integrity of any part of the work are properly investigated and resolved.

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