Appetite 105 (2016) 164–171

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Dietary intake variations from pre-conception to gestational period according to the degree of industrial processing: A Brazilian cohort

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ARTICLE INFO

Article history:
Received 1 February 2016
Received in revised form
19 May 2016
Accepted 20 May 2016
Available online 24 May 2016

Keywords:
Pregnant women
Food intake
Food processing
Ultra-processed food
Cohort

ABSTRACT

Objective: To estimate food intake changes from pre-conception to gestational period according to the degree of food processing.
Methods: Prospective cohort conducted in a public health care center in Rio de Janeiro with Brazilian pregnant women (n = 189). A food frequency questionnaire was applied at the first (5^{th}–13^{th}) and third (30^{th}–36^{th}) gestational trimesters. The food items were classified according to characteristics of food processing in four groups: unprocessed/minimally processed foods; sugar/fat; processed foods and ultra-processed foods. The variation of food intake according to the degree of processing between the pre-conception and gestational period was compared using paired Student's *t*-test. Linear regression models were performed to estimate the association of mother's characteristics on the variation of food group contribution to the total energy intake between periods.
Results: Total energy intake was 2415 (SD = 813) in the pre-conception and 2379 (750) kcal in the gestational period. We excluded women who had implausible total energy intake (<600 and >6000 kcal/day). The contribution of unprocessed/minimally processed food group to total energy intake during pregnancy when compared to the pre-conception period was higher [50.5 (14.1) *vs*. 48.8 (12.4), p-value = 0.048], while the caloric share of ultra-processed food group was lower [41.3 (14.6) *vs*. 43.1 (12.5), *p*-value = 0.032]. We observed a negative association of age (*p*-value = 0.009) and a positive association of pre-pregnancy BMI (*p*-value = 0.060) with the variation of ultra-processed food intake.
Conclusions: Ultra-processed food intake decreased, while minimally/unprocessed food intake slightly increased from the pre-conception to gestational period. These results indicate potential for a larger improvement in the women's diet quality and that nutritional counseling interventions in pregnant women are still needed.

1. Introduction

Nutritional demands increase during pregnancy due to metabolic and physiological changes. These adjustments occur to provide an environment with adequate conditions for foetal development and also to prepare the maternal body for the post-partum period; these adjustments are particularly pronounced from the second trimester onward (Picciano, 2003).

Thus, pregnant women have an increased energy and nutrient demands that should be provided by food intake in appropriate

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http://dx.doi.org/10.1016/j.appet.2016.05.027
0195-6663/

amounts and quality (Newbern & Freemark, 2011). Studies have highlighted the importance of an adequate caloric supply throughout pregnancy for an adequate gestational weight gain (Campbell & MacGillivray, 1975; Kramer & Kakuma, 2003; Margerison Zilko, Rehkopf, & Abrams, 2010). However, some authors have demonstrated the relevance of the quality of diet during pregnancy and not only caloric intake (Lucan & DiNicolantonio, 2015; Monteiro, Levy, de Claro, Castro, & Cannon, 2011).

One approach to assess the quality of the diet is to analyze the intake of specific food groups. Food and food products may be grouped according to several characteristics, including the level of industrial processing. Food processing can be defined as any method or technique used by the industry to transform whole fresh food into food products (Monteiro, Levy, Claro, de Castro, & Cannon, 2010). The industrial processing of food items may culminate in loss of nutrients such as vitamins and minerals and increase of fat, sugar and sodium content, which are components harmful to health (Canella et al., 2014; Moreira et al., 2015).

One of the characteristics of the nutritional transition that is experienced worldwide is the increase in ultra-processed food intake (Martins, Levy, Claro, Moubarac, & Monteiro, 2013). The association between the degree of industrial processing undergone by food and health outcomes including implications on nutritional status was already reported (Canella et al., 2014). Nevertheless the scientific literature is scarce and data on pregnant women is still lacking. Data from nationally representative surveys indicate that there was an increase of ultra-processed food intake from 2002-2003 to 2008–2009 and that the increased intake of this food group was associated with obesity in the Brazilian population (Bielemann, Santos Motta, Minten, Horta, & Gigante, 2015).

Although there is a trend of high intake of ultra-processed food products in all life cycle stages (Martins et al., 2013), pregnancy is a period in which women are more likely to change their pattern of food intake due to the concern with the child's health (IOM, 2009). Additionally, in prenatal care women usually are advised about the importance of healthy dietary practices (Brazil, 2013).

The aim of the current study is to describe changes in the profile of food intake according to characteristics of food processing from pre-conception to the gestational period among Brazilian pregnant women and to identify maternal characteristics related to this change. Our hypothesis is that pregnant women change their profile of food intake, decreasing the intake of ultra-processed food products and increasing the intake of unprocessed/minimally processed foods.

2. Methods

2.1. Study design/population/sample

A prospective cohort study of pregnant women followed at the 5^{th}–13^{th}, 20th –26^{th}, and 30^{th}–36^{th} gestational weeks was conducted at a public health care center located in Rio de Janeiro, Brazil between November 2009 and October 2011. A total of 299 women were recruited, according to the following eligibility criteria: between 5 and 13 weeks of gestation at baseline, aged between 20 and 40 years and free from infectious and chronic diseases (except obesity). Criteria for exclusions after the baseline clinical evaluation consisted of the following: confirmed diagnosis of infectious or chronic non-communicable disease (except obesity) (n = 22), gestational week higher than 13 at first visit (n = 15), twin pregnancies (n = 4), miscarriage after screening (n = 25) and missing data in the general questionnaire at baseline (n = 5). Furthermore, because the current analysis aimed to estimate the dietary intake variation between these two time points, we excluded women without data on pre-conception or gestational dietary intake (n = 37). We also excluded women who had an implausible total energy intake (Oken, Kleinman, Olsen, Rich-Edwards, & Gillman, 2004) i.e. energy intake <600 kcal/day (n = 0) and >6000 kcal/day (n = 2). After exclusions, the final sample consisted of 189 pregnant women.

We further performed a sensitivity analysis comparing the results based on the criteria described above and the one that considers outliers women with caloric intake <1000 kcal/day (n = 3) and >4000 kcal/day (n = 14). The aim was to evaluate if the inclusion of these potential outliers produced biased results.

2.2. Dietary intake

A semi-quantitative food frequency questionnaire (FFQ) was applied twice during pregnancy; at the first trimester (covering 6 months before pregnancy herein called the pre-conception) and at the third trimester (covering the last 6 months of pregnancy, herein called the gestational period).

This questionnaire refers to an updated version of a previously FFQ developed for the Rio de Janeiro adult population (Sichieri & Everhart, 1998), composed of 82 food items, including non-alcoholic and alcoholic beverages. The updated version of the questionnaire kept the frequency options and portion sizes, so we understand it didn't impact on the validity (Lopes, Ferrioli, Hoffman, Sichieri, & Pereira, 2009; Sichieri & Everhart, 1998). The food intake frequency was summarized according to individual consumption frequency and transformed into daily frequency, as follows: >3 times/day = 4; 2–3 times/day = 2.5; 1 time/day = 1; 5–6 times/week = 0.79; 2–4 times/week = 0.43; 1 time/week = 0.14; 1–3 times/month = 0.07; and never or almost never = 0. Portions of food items listed in FFQ as household measures were standardized according to Pinheiro et al. (2004) (Pinheiro, Lacerda, Benzecry, Gomes, & Costa, 2004). The daily portion (grams) of each food item was calculated by multiplying the portion per daily frequency. Moreover, all food items were converted into their dietary energy content. The Brazilian Table of Food Composition (TACO, 2011) was used as the main database, and food items not found in TACO were added from the United States Department of Agriculture National Nutrient Database for Standard Reference (USDA, 2011).

2.3. Classification of food intake items

Food items were classified according to the nature, extent and purpose of industrial processing used in their manufacture as described by the Brazilian Food Guideline. The nature refers to the addition or not of oils, fats, sugar, salt or other substances to the original food, while the extent refers to the degree of processing. The purpose refers to durability, convenience, and palatability such as ready-to-eat or to-heat food products. If a food item receives the addition of any type of substance it is classified as either processed or ultra-processed. The addition of up to two substances extracted from foods or synthesized in laboratories from food substrates or other organic sources (flavor enhancers, colors, and several food additives) classifies the food as processed, and the addition of more than two substances classifies the food item as ultra-processed (Brazil, 2014).

Thus, the food items were classified in four groups as follows: Group 1 (unprocessed or minimally processed food): Unprocessed food of vegetable or animal origin and food without addition of substances such as artificial food dyes and preservatives or food without significant change in its nature; Group 2 (fat/sugar): Food industry ingredients and/or substances extracted and purified from food without any degree of processing or with minimal processing, which can be used in the preparation of dishes; Group 3 (processed