The Effects of the UK Pregnancies Better Eating and Activity Trial Intervention on Dietary Patterns in Obese Pregnant Women Participating in a Pilot Randomized Controlled Trial

Supplementary Issue: Parental Nutritional Metabolism and Health and Disease of Offspring

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ABSTRACT

OBJECTIVE: The objective of this study is to investigate the effects of the UK Pregnancies Better Eating and Activity Trial (UPBEAT) behavioral intervention on dietary patterns in obese pregnant women.

METHODS: Dietary patterns were derived from Food Frequency Questionnaires using principal component analysis in 183 UPBEAT pilot study participants.

RESULTS: Two unhealthy dietary patterns, *processed* and *traditional*, predominantly characterized by foods high in sugar and fat, improved [processed −0.54 (−0.92 to −0.16), $P = 0.006$ and traditional −0.83 (−1.20 to −0.45), $P < 0.001$] following the intervention, while a *cultural* pattern that was found to be associated with the Black African/Caribbean participants did not change [−0.10 (−0.46 to 0.26), $P = 0.589$].

CONCLUSION: Unhealthy dietary patterns are evident in obese pregnant women. The UPBEAT intervention was effective in improving maternal dietary patterns; however, obese pregnant women from minority ethnic groups may be less receptive to intervention.

KEYWORDS: diet, pregnancy, obesity, lifestyle, glycemic index, saturated fat

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Introduction

Obesity is a major public health concern, currently affecting over 600 million individuals worldwide.[1] In 2013, an estimated 25.4% of women in the UK were obese.[2] Maternal obesity, in particular, has far-reaching consequences since it is associated with major adverse maternal and fetal outcomes, notably gestational diabetes.[3,4] In the UK, it is estimated that 15% of women are obese when they become pregnant,[5] although these rates are higher in women of low socioeconomic status and from minority ethnic backgrounds.[6,7] The effects of maternal obesity may extend beyond health in pregnancy with several studies, suggesting that antenatal exposure to adverse metabolic influence in utero may be associated with a greater risk of obesity in the offspring.[8,9]

In the UK, there is no specific weight management guidance for obese pregnant women to improve diet or pregnancy outcomes. The dietary advice is in line with dietary recommendations for the general population.[10] These recommendations emphasize the importance of a healthy and varied diet consisting of wholegrain complex carbohydrates, fruit and vegetables, lean protein sources, and low fat dairy consumption alongside limited intakes of foods high in sugar and fat such as fried food, fizzy drinks, and confectionary.[10] In the USA, advice focuses on limiting gestational weight gain to within limits prespecified by the Institute of Medicine,[11] and the majority of lifestyle intervention studies worldwide have targeted gestational weight gain in obese pregnant women.[12] The UK Pregnancies Better Eating and Activity Trial (UPBEAT) was an antenatal lifestyle intervention in a large and diverse cohort of obese pregnant women, which primarily focused on preventing gestational diabetes and reducing the incidence of associated large-for-gestational age infants.[13] The intervention focused on reducing dietary glycemic load (GL) and saturated fat (SFA) intake while increasing physical activity was delivered throughout the second trimester of pregnancy.

We have recently reported that the intervention in the UPBEAT pilot study led to a reduction in dietary GL and SFA intake.[14] Since integrative assessments of dietary patterns have been utilized to describe diet, rather than isolated components of the diet,[15] the aim of the present analysis was to assess dietary patterns, through principal component analysis (PCA), in obese pregnant women who participated in the pilot study and to determine the effects of the UPBEAT intervention on dietary patterns.

Methods

Data collected from women participating in the UPBEAT pilot study were used for the present analysis. A detailed description of the UPBEAT pilot study has been published previously.[14] Research ethics committee approval was obtained in all participating centers, UK Integrated Research System; reference 09/H0802/5 (South East London Research Ethics Committee). The research was conducted in accordance with the Declaration of Helsinki.

Participants. Women attending for general antenatal care at four UK study centers with a body mass index (BMI) $\geq$30 kg/m^2, singleton pregnancy, and gestational age $>15^{+0}$ and $<17^{+6}$ weeks were invited to participate in the study. Women were ineligible if they had preexisting diabetes, hypertension, renal disease, systemic lupus erythematosus, antiphospholipid syndrome, sickle cell disease, thalassemia, celiac disease, currently prescribed metformin, thyroid disease, or current psychosis. The study centers, all in urban settings, were (1) The Southern General Hospital and Princess Royal Maternity Hospital (Glasgow), (2) The Royal Victoria Infirmary (Newcastle), (3) Guy's and St Thomas' NHS Foundation Trust (London), and (4) King's College Hospital NHS Foundation Trust (London).

Methods and procedures. Eligible, consented participants were randomized, balanced by minimization for maternal age, center, ethnicity, parity, and BMI, to either the control or the intervention arm. Participants in the control arm received standard care and returned for data collection with the study midwife at 27^{+0}–28^{+6} and 34^{+0}–36^{+6} weeks of gestation. Participants in the intervention arm attended a one-to-one appointment with a study health trainer (HT) and were invited to weekly group sessions for eight consecutive weeks from approximately 19 weeks of gestation. All women attended routine antenatal care appointments, which may have included general lifestyle advice in accordance with local policies, which draw on UK National Institute Health and Care Excellence (NICE) guidance.[10]

The intervention. The aim of the intervention was to reduce dietary GL and SFA intake and to increase physical activity. The dietary advice focused on increasing the consumption of low glycemic index (GI) foods in exchange for high GI foods, including sugar-sweetened beverages. Reduction of SFA in exchange for mono- and polyunsaturated fats was also encouraged. The focus of the dietary intervention was on exchange of foods rather than limiting energy intake. The physical activity advice aimed to increase daily activity through the use of a pedometer and step counting, with recommendations to walk at a moderate intensity level. The intervention was informed by psychological models of health behavior, including control theory and social cognitive theory. Participants were provided with a log book and encouraged to set themselves Specific, Measurable, Achievable, Relevant, and Time Specific (*SMART*) goals regarding lifestyle change. The intervention was delivered by HT; after the initial one-to-one session, the remainder of the intervention was delivered in groups. The majority of centers conducted the sessions in a hospital setting, although in one, a community center was used.

Dietary assessment. In both the control and intervention arms, a semiquantitative Food Frequency Questionnaire (FFQ) adapted from the UK arm of the European Prospective Investigation into Cancer Study (EPIC)[16] was administered by research midwives at study entry (randomization) and postintervention (28 weeks of gestation). The FFQ was a shortened version (26 items) of the EPIC questionnaire and principally focused on assessing the intake of food groups relevant to the intervention, over the preceding month. Sections of the questionnaire pertaining to sources of carbohydrate were detailed to distinguish low GI sources (eg, porridge, pasta, basmati rice, and new potatoes) from high GI sources (eg, refined breakfast cereals, easy cook rice, old potatoes, sugar-sweetened beverages, and white bread), and questions relating to dietary fat intake distinguished SFA sources (eg, full fat dairy products, cakes, and pastries) from low fat varieties (eg, low fat dairy products, white meat, and fish). Alcoholic beverages were not included in the FFQ; alcohol consumption was recorded separately with 94% of participants reporting alcohol abstinence. The adapted FFQ was compared to 24-hour recalls collected from the pilot participants and showed good agreement ($P < 0.05$) for fat, SFA, protein, and sugar (unpublished data). In addition, basic sociodemographic information, including age, ethnicity, educational attainment, partner status, living area, and household income, was collected by questionnaire. All data were entered onto a password-protected secure database (MedSciNet Ltd).

Data and statistical analyses. Sample size: this was a pilot study of predefined duration (March 2010 to May 2011). A sample size of 183 was recruited in this time frame. The FFQ included the following categories to indicate how often the participants were consuming each food or beverage item: (i) never or less than once a month, (ii) 1–3 days per month, (iii) once a week, (iv) 2–4 days per week, (v) 5–6 days per week, (vi) once a day, (vii) 2–3 per day, (viii) 4–5 per day, and (ix) 6+ per day. These categories were recoded into times consumed per week to create a continuous scale (0.25, 0.5, 1, 3, 5.5, 7, 17.5, 31.5, and 42). In addition, milk consumption was recoded in pints per week and added sugar to cereal in teaspoons per week, cheese in matchbox-sized pieces per week, and bread in slices per week. Detailed information was collected for milk, cereal, bread, butter, and cheese consumption, and in order to aid in the interpretation of the analysis, food groups were created for these items only. For example, skimmed and semi-skimmed milks were combined in one *reduced-fat milk* group, and all *low fat* spreading fats were combined in one *reduced-fat butter/spread* group.

PCA creates new variables that are uncorrelated linear combinations of the dietary variables, which explain as much as possible the total variation of the original dietary variables.[17] In the present study, PCA with orthogonal rotation was applied to FFQs to derive dietary patterns. The number of components retained was determined on the basis of an eigenvalue ≥2. To characterize the components, food and beverage items with a coefficient above 0.15 were chosen. To examine the changes in dietary patterns following the intervention, applied dietary pattern scores were calculated. To calculate applied scores, the frequencies of consumption at the 28-week time point were standardized to the mean and standard deviation observed at the baseline time point. The coefficients from the PCA at baseline were then multiplied by the standardized reported frequencies of consumption at 28 weeks. The data were analyzed using the statistical software package Stata version 13, StataCorp. Normality was investigated using distributional plots. To investigate the influence of the UPBEAT intervention on identified dietary patterns, analysis of covariance (ANCOVA)[18] was used to test for differences between the groups at 28 weeks, adjusting for baseline diet. Univariate linear regression was performed to explore the association between dietary patterns and age, BMI, ethnicity, education, and smoking status. 95% confidence interval and a P value of <0.05 were used to indicate a significant result.

Results

A total of 183 women were recruited, of which 89 were randomized to the control arm and 94 to the intervention.[14] End point data (28 weeks of gestation) were available for 75 control and 79 intervention participants (84% for both). The mean age of the participants was 30.5 [standard deviation (SD) 5.4] years, the mean BMI was 35.7 (SD 5.0) kg/m^2, and 44% of participants were nulliparous. Participants of White-European ethnicity comprised 56%, and the second most common ethnic group was Black African/Caribbean (38%; Table 1).

Dietary patterns. Three distinct dietary patterns were identified; two of which predominantly comprised of food groups high in sugar and fat and a third comprising of starchy carbohydrate and protein food groups, which was subsequently found to be associated with Black African and Caribbean participants and therefore may represent a cultural dietary pattern (Table 2).

Table 1. Baseline anthropometric, sociodemographic, and lifestyle characteristics of UPBEAT pilot study participants by treatment group.

	WHOLE GROUP (n = 183)	CONTROL (n = 89)	INTERVENTION (n = 94)
Age (years)	30.5 (5.4)	30.7 (4.9)	30.4 (5.7)
Age categories			
18–25	38 (21%)	21 (24%)	17 (18%)
26–30	52 (28%)	27 (30%)	25 (27%)
31–40	88 (48%)	39 (44%)	49 (52%)
41 plus	5 (3%)	2 (2%)	3 (3%)
Ethnicity			
White-European	103 (56%)	51 (57%)	52 (55%)
Black African/ Caribbean	70 (38%)	32 (36%)	38 (40%)
Asian	3 (2%)	1 (1%)	2 (2%)
Other	7 (4%)	5 (6%)	2 (2%)
BMI (kg/m^2)	35.7 (5.0)	35.7 (5.6)	35.6 (4.5)
BMI categories			
30–34.9	93 (51%)	50 (56%)	43 (46%)
35–39.9	53 (29%)	26 (29%)	27 (29%)
≥40	37 (20%)	13 (15%)	24 (26%)
Parity			
0	80 (44%)	40 (45%)	40 (43%)
1	65 (36%)	34 (38%)	31 (33%)
2+	38 (21%)	15 (17%)	23 (25%)
Cigarette smoking			
Never	124 (68%)	61 (69%)	63 (67%)
Ex-smoker	35 (19%)	20 (23%)	15 (16%)
Stopped during pregnancy	12 (7%)	2 (2%)	10 (11%)
Current smoker	12 (7%)	6 (7%)	6 (6%)
Household income per annum			
Not disclosed	21 (15%)	3 (4%)	18 (25%)
<£12,688	0 (%)	0 (0%)	0 (0%)
£12,689–17,628	17 (12%)	8 (12%)	9 (13%)
£17,629–23,452	16 (11%)	10 (15%)	12 (17%)
£23,453–32,500	21 (15%)	37 (54%)	27 (38%)
>£32,500	64 (46%)	10 (15%)	6 (8%)
Living area			
Inner city	136 (74%)	68 (76%)	68 (72%)
Suburban/town	42 (23%)	17 (19%)	25 (27%)
Rural	5 (3%)	4 (5%)	1 (1%)
Highest educational attainment			
None	8 (4%)	5 (6%)	3 (3%)
GCSE/O-level	36 (20%)	11 (12%)	25 (27%)
A-level	22 (12%)	11 (12%)	11 (12%)
Degree	54 (30%)	32 (36%)	22 (23%)
Higher degree	22 (12%)	8 (9%)	14 (15%)
Vocational qualification	41 (22%)	22 (25%)	19 (20%)

Note: Results shown are mean (SD) or n (%).

Table 2. Principal component analysis coefficients for dietary patterns 1, 2, and 3 for the Food Frequency Questionnaire data.

FOOD OR FOOD GROUP	PATTERN 1 'PROCESSED'	PATTERN 2 'MEAT & RICE'	PATTERN 3 'TRADITIONAL'
Fruit juices	0.012	0.165*	0.027
Fizzy drinks and squash	0.095	0.205*	0.144
Sugar-free drinks	0.187*	−0.063	0.113
Tea or coffee with sugar	0.132	−0.067	0.126
White or brown rice	−0.095	0.214*	0.021
Basmati rice	−0.139	0.257*	0.034
Pasta and noodles	0.327*	0.055	−0.054
New potatoes	0.332*	0.037	0.044
Old potatoes	0.337*	0.059	0.120
Chocolate	0.302*	−0.018	−0.035
Cereal bars	0.163*	−0.073	−0.184*
Biscuits and cookies	0.300*	−0.058	−0.114
Cakes and pastries	0.289*	0.124	−0.036
Sweets	0.241*	−0.012	0.089
Fresh fruit	0.039	−0.140	−0.205*
Red meat	0.004	0.476*	−0.051
Poultry	−0.021	0.464*	−0.045
Processed meat	0.138	0.408*	−0.033
Meat products	0.129	0.031	0.130
Fish	0.014	0.123	0.053
Battered fish	0.219*	0.074	0.006
Sugar added to cereals	−0.000	−0.023	0.041
White bread	0.095	−0.084	0.405*
Wholegrain bread	0.057	0.085	−0.403*
Full-fat milk	−0.045	0.158*	0.211*
Reduced-fat milk	0.130	−0.210*	−0.198*
Full-fat cheese	0.300*	−0.070	−0.023
Reduced-fat cheese	−0.095	−0.055	−0.046
Refined breakfast cereals	0.011	−0.177*	0.283*
Wholegrain breakfast cereals	0.078	0.020	−0.330*
Butter/spread	0.089	−0.034	0.294*
Reduced-fat butter/spread	0.017	0.071	−0.337*
Variation explained (%)	**10.3**	**9.0**	**8.4**

Note: *Coefficients of 0.15 or greater in absolute value.

The first component explained 10.3% of the variation and was characterized by large positive coefficients for pasta and noodles, old and new potatoes, chocolate, cereal bars, sugar-free drinks, biscuits, cakes and pastries, sweets, battered fish, and full-fat cheese. No large negative coefficients were observed. This diet was classified as the *processed* dietary pattern.

The second component explained 9.0% of the variation. This diet was classified as the *meat and rice* dietary pattern since predominant foods with high coefficients were meat and rice food groups including large positive coefficients for red meat, processed meat, poultry, basmati rice, and white or brown rice. In addition, high coefficients were found for drinks containing high amounts of sugar (fizzy drinks, squash, and fruit juice) and full-fat milk. Large negative coefficients were found for reduced-fat milk and refined breakfast cereals.

The third component, explaining 8.4% of the variation was characterized by large positive coefficients for white bread, full-fat milk, full-fat spread/butter, and refined breakfast cereals and negative coefficients for fruit, wholemeal bread, reduced-fat milk, reduced-fat spread/butter, wholegrain breakfast cereals, and cereal bars. This dietary pattern

Table 3. Dietary scores at baseline (15^{+0}–18^{+6} weeks' gestation) and end point (27^{+0}–28^{+6} weeks' gestation) for intervention and control groups.

DIET PATTERN	CONTROL n = 89, 75	INTERVENTION n = 94, 79	DIFFERENCE (95% CI)	*P*
'Processed'				
Baseline	0.11 ± 1.96	−0.11 ± 1.63	−0.54 (−0.92 to −0.16)	0.006
28 weeks	0.33 ± 1.48	−0.41 ± 1.30		
'Meat and Rice'				
Baseline	0.05 ± 2.05	−0.05 ± 1.31	−0.10 (−0.46 to 0.26)	0.589
28 weeks	−0.05 ± 1.15	−0.20 ± 1.34		
'Traditional'				
Baseline	−0.06 ± 1.59	0.06 ± 1.69	−0.83 (−1.20 to −0.45)	<0.001
28 weeks	−0.20 ± 1.54	−1.11 ± 1.52		

Notes: Results are shown as mean ± SD. **P**: differences between treatment groups at endpoint, assessed using ANCOVA, adjusting for baseline scores.

was characteristic of the traditional post-Second World War British low-income diet and therefore was classified as the *traditional* pattern.

Effects of the UPBEAT intervention on dietary patterns. Table 3 outlines the mean difference in dietary pattern scores between baseline and postintervention. Following the intervention, there was a significant change in scores between the groups for the processed and traditional dietary patterns. Participants in the intervention group demonstrated significantly reduced scores for these two unhealthy patterns of consumption. There was no change for the meat and rice score.

Social and demographic determinants of diet. Dietary patterns varied with age, BMI, ethnicity, education, and smoking status (Table 4). Black participants had higher scores for the meat and rice dietary pattern and lower scores for the processed dietary pattern compared with White participants. Older participants and those who received more years of education were less likely to adhere to the traditional diet pattern. Ex-smokers had higher scores for the processed pattern and lower scores for the traditional and meat and rice patterns.

Discussion

In the present study, three dietary patterns among a multiethnic group of obese pregnant women were identified using PCA, and the efficacy of the UPBEAT intervention to improve dietary patterns was demonstrated. Furthermore, differences in dietary patterns were explained by ethnic origin. Dietary patterns have been identified in several pregnancy populations;[19–28] however, to our knowledge, this is the first study to describe dietary patterns focusing solely on an obese pregnant population and to examine how a healthful intervention impacts on food intake. Maternal obesity is currently a major public health focus, and understanding dietary patterns enables unhealthful dietary habits to be identified, providing a target for intervention to improve the maternal diet of these high-risk groups.

Our processed pattern was characterized by the predominant consumption of foods with a high sugar and fat content and is consistent with the *Western* pattern described in the Southampton Women's Survey[23] and the Norwegian Mother and Child cohort;[21] our processed pattern was also consistent with the *confectionary* pattern described in the Avon Longitudinal Study of Pregnancy and Childhood cohort[22] and in the Generation R study.[24]

The ethnic diversity of the UPBEAT cohort, in which 38% of participants were of Black African or Caribbean ethnicity, was evident in the second dietary pattern, the meat and rice pattern. To our knowledge, the meat and rice dietary pattern has not been previously described in pregnant women. The meat and rice pattern was characterized by consumption of meat and rice food groups in addition to drinks with a high

Table 4. Social and demographic determinants of diet; regression parameters (95% confidence interval) of univariate linear regression analyses.

SOCIAL AND DEMOGRAPHIC FACTOR	'PROCESSED'	'MEAT AND RICE'	'TRADITIONAL'
Age	−0.03 (−0.08, 0.01)	−0.00 (−0.05, 0.04)	**−0.09 (−0.14, −0.05)**
BMI	−0.03 (−0.08, 0.03)	0.01 (−0.04, 0.06)	0.05 (0.00, 0.09)
Ethnicity (Black vs White)	**−1.62 (−2.12, −1.12)**	**1.02 (0.52, 1.52)**	0.43 (−0.07, 0.94)
Education	−0.03 (−0.12, 0.06)	−0.04 (−0.12, 0.05)	**−0.18 (−0.26, −0.10)**
Smoking (Ex-smoker vs never)	**0.86 (0.26, 1.46)**	**−0.73 (−1.30, −0.16)**	**−0.62 (−1.18, −0.08)**

Note: Regression coefficients with a *P* value <0.05 are shown in bold.

sugar content. A recent observational assessment of the dietary intake of Black British adults demonstrated that, in both the Caribbean and West African diets, rice dishes were the main source of energy. In addition, *one-pot* soups and stews based on meat were important contributors to the West African diet. In both diets, sugar-sweetened beverages and fruit juice were significant contributors to sugar and energy intakes, particularly for the Caribbean adults.[29] The identification of a cultural pattern is supported by the association with ethnic origin, as Black participants had higher scores on the meat and rice pattern and lower scores on the processed pattern. The majority of studies that have characterized dietary patterns in pregnant women have consisted predominantly of one ethnic group and, therefore, have been unable to address ethnic variation in dietary habits. Sommer et al explored ethnic differences in dietary patterns in pregnant women derived using cluster analysis and found that dietary patterns were strongly associated with ethnic origin.[30]

Our traditional pattern was characterized by high intakes of refined carbohydrates and high fat dairy foods and an absence of fruit, wholegrain bread, and breakfast cereals. Several studies have described a traditional dietary pattern in pregnant women.[21,22,24,25] In the UK, Northstone et al described a traditional pattern in line with a *meat and two veg* diet with high loadings for various types of vegetables and red meat and poultry.[22] However, our traditional pattern is not comparable to these patterns; our pattern was characteristic of British low-income diets[31] and may reflect the relatively high proportion of participants from inner city deprived areas that participated in UPBEAT.[32] Older and more educated participants did not follow this traditional, low-income pattern. Similar associations between these sociodemographic variables and traditional patterns have been identified in previous studies.[21,24]

The three dietary patterns recognized in our PCA are predominantly characterized by foods and beverages high in sugar and/or fat. The detrimental effects of foods and beverages with a high sugar and fat content are well reported, particularly in relation to the development of obesity and diabetes[33–35] and are therefore often targeted in health promotion interventions.[36] Unlike the pregnancy cohort studies, we did not identify a healthy dietary pattern similar to the *prudent* or *health conscious* pattern, which has been described in several studies.[20–23,25,27,28] Healthy dietary patterns have been associated with less disease in nonpregnant populations,[37] and therefore targeting obese pregnant women who are likely to be consuming diabetogenic diets for nutrition counseling is a priority.

Previous studies have examined changes in dietary patterns in preconception and throughout pregnancy suggesting little change,[19,38] but to our knowledge, no study has investigated the effect of an antenatal lifestyle intervention on dietary patterns. Reduced scores for the processed and traditional patterns indicate that the intervention group women modified their dietary intake following the intervention. The results support our trial findings, which demonstrated the efficacy of the UPBEAT intervention to achieve dietary change in the intervention group who significantly reduced dietary GL and SFA intake.[14,32] It is therefore promising that obese pregnant women are receptive to improving their diet in response to dietary advice delivered as part of an antenatal intervention.

However, the intervention had no effect on the meat and rice pattern associated with ethnic minority women. The prevalence of obesity is highest among ethnic minority women, particularly those of Black African and Caribbean ethnicity,[39] and obesity contributes significantly to the high rates diabetes in these women[6] thus, they are a priority for intervention. Our meat and rice pattern was associated with a high consumption of sugar-containing beverages, and recent evidence has demonstrated the detrimental impact of sugar-sweetened beverages on weight gain.[40] The lack of change in the meat and rice score allows us to speculate that the ethnic minority women were less receptive to the intervention and it may be that a culturally adapted intervention is needed that is sensitive to the cultural beliefs and practices of these women. To date, only one antenatal intervention in obese women has used a culturally tailored approach. The lifestyle intervention used in Hawkins et al was culturally and linguistically modified and aimed to prevent gestational diabetes risk factors in overweight and obese Hispanic pregnant women.[41] The study demonstrated that the intervention may help attenuate pregnancy-related decreases in physical activity.[41] Alternatively, the lack of change in this cultural dietary pattern may reflect a more healthful diet that needed less intervention.

The strengths and limitations of the study warrant consideration. The present study is the first to perform PCA in a group of obese pregnant women, an important target group in light of the current obesity epidemic. Furthermore, the UPBEAT cohort is ethnically and socially diverse, predominantly recruited from deprived inner city regions, and thus our work provides novel insights into the dietary patterns of such a population. The ethnic diversity of the UPBEAT pilot participants creates the opportunity to examine the relationship between ethnicity and dietary patterns. In addition, this study is the first to investigate the effects of an antenatal lifestyle intervention on dietary patterns in comparison to previous studies. The use of PCA allows for a comprehensive evaluation of dietary intake and is important in capturing some of the complexity of the diet while overcoming the limitations associated with focusing on single nutrient analysis.[15] The dietary patterns derived from PCA may be useful in informing health professionals of the dietary practices of a high-risk group such as obese pregnant women and may translate to public health messages. In addition, the ethnic diversity of the UPBEAT pilot participants was recognized in the results of the PCA, enabling dietary advice to be more culturally tailored and individualized.

Although dietary patterns are useful in describing food intakes in a given population, it is difficult to compare results of PCA across studies due to variations in dietary habits across different populations and settings. In addition, subjective decisions in aggregating food and beverage items into groups, extracting and naming components and determining cutoffs for food group loadings have been previously recognized as criticisms of this method.[42] Every dietary assessment method has its limitations, and in the present study, PCA was applied to dietary data collected by FFQs, which may be subject to bias.[43] Furthermore, the association between dietary patterns and maternal and fetal outcomes was not investigated as the pilot study was not powered for such outcomes. Having established dietary patterns in women from the pilot trial and determined an effect of the intervention, repetition of the same analytical method in the UPBEAT trial sample of 1555 women will enable examination of the relationship between the maternal diet and pregnancy outcomes in obese pregnant women.

Conclusion

The maternal diet may have significant short- and long-term consequences for both the mother and the child. PCA applied to FFQ data from the UPBEAT pilot study revealed two predominantly unhealthy and one cultural dietary pattern, which are likely to predispose to poor glycemic control. Our results demonstrate the efficacy of the UPBEAT intervention in improving dietary patterns of obese pregnant women; however, it is of concern that there was no change in the cultural pattern. Future studies that focus on a multiethnic group of obese pregnant women should ensure that the intervention is sensitive to the participants' cultural practices. PCA provides a valuable tool for characterizing the dietary intakes of obese pregnant women and should be complementary to the analysis of individual nutrients to provide a comprehensive assessment of the maternal diet.

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Author Contributions

Initial conception and design of the study: AF, CS, SB, and LP. Led on analysis and interpretation: CS and PS. Drafting the initial manuscript: AF and LG. All authors critically reviewed and approved the final version of the manuscript.

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