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Early Pregnancy Cravings, Dietary Intake, and Development of Abnormal Glucose Tolerance

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Abstract

Background—Little is known about the relationships between pregnancy cravings, maternal diet, and development of abnormal glucose tolerance.

Objectives—We examined relationships of pregnancy cravings with dietary intake and risk of developing isolated hyperglycemia (IH), impaired glucose tolerance (IGT), or gestational diabetes (GDM) later in pregnancy.

Design/Setting—Among 2,022 mothers in Project Viva, a prospective birth cohort recruited from medical practices in Eastern Massachusetts between 1999 and 2002, we assessed type of pregnancy craving based on self-report at mean 10.9 weeks gestation.

Main Outcome Measures—The outcomes were cross-sectional dietary intake from a food frequency questionnaire and incident IH, IGT, or GDM determined by glucose tolerance screening at 26–28 weeks.

Statistical Analyses Performed—We used linear regression to analyze the cross-sectional relationships between pregnancy cravings and dietary intake and multinomial logistic regression to analyze the prospective relationships between pregnancy cravings and development of IH, IGT, or GDM.

Results—During the first trimester, 443 (22%) women craved sweets, 225 (11%) craved salty foods, 261 (13%) craved savory foods, and 100 (4.9%) craved starchy foods. Sweet cravings were associated with increased intake of sucrose (1.9 gm/day 95% CI:0.1, 3.7), total fat (1.5 gm/day 95% CI:0.1, 2.9), and saturated fat (0.8 gm/day 95% CI:0.2, 1.4); salty cravings with increased

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Conflict of Interest:

Farland and Rifas-Shiman have no conflicts of interest to report.

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fiber (0.7 95% CI: −0.1, 1.6); savory cravings with increased N-3 fatty acids (0.10 gm/day 95% CI:0.02, 0.17); and starchy cravings with increased carbohydrates (8.0 gm/day 95% CI:0.3, 15.7) and decreased total fat (−2.6 gm/day 95% CI: −5.2, −0.1). Salty cravings were associated with lower risk of GDM (adjusted OR:0.34 95% CI:0.12, 0.97).

Conclusion—New cravings in the first trimester of pregnancy were associated with dietary intake. Craving salty foods may predict reduced risk of developing GDM, while craving sweet food does not appear to alter ones risk.

Keywords

diet; maternal diet; gestational diabetes; pregnancy cravings; abnormal glucose tolerance

Introduction/Background

Experiencing cravings for specific foods or types of food is common during pregnancy. Approximately 45–90% of women in the United States report experiencing new cravings sometime during pregnancy.[1–3] While there are different regional and cultural theories about pregnancy cravings and their relationship to gestational outcomes, there is little understanding of the correlates and outcomes related to such cravings.

Gestational diabetes (GDM) affects approximately 4–7% of pregnant women in the United States.[4,5] GDM can have harmful effects for both the mother and fetus, including increasing the risk of pregnancy complications, preeclampsia, emergency cesarean section, macrosomia, and asphyxia.[6–8] Even milder forms of abnormal glucose tolerance such as impaired glucose tolerance (IGT), are associated with increased health risks of macrosomia, toxemia, and emergency cesarean section.[9–11] The causes for GDM are multifaceted; the most important is higher weight status, but dietary intake of saturated fat or dietary fiber, limited physical activity, smoking during pregnancy, and family history may also increase risk.[12–14]

In studies from one group of authors, GDM was associated with subsequent decreased taste perception of sweet foods and increased craving for sweet food.[4,5] Tepper[4] found an exaggerated preference for sweetened dairy drinks in women with GDM compared to healthy women. This preference seemed to emerge during the third trimester of pregnancy (weeks 34–38).[4] Later research found women with GDM were twice as likely as normal glucose tolerant women to crave sweet food at 34–38 weeks gestation.[5] While these studies suggest a relationship between sweet cravings and GDM, the diagnosis of GDM preceded the measurement of the craving in most of them, whereas it is equally interesting to ask whether preexisting cravings reflect a biologic-state of increased risk to develop abnormal glucose tolerance. In one study, Belzer et al. did measure cravings prospectively starting at 16–20 weeks' gestation, but found little evidence of cravings related to GDM until the 3rd trimester, after the GDM diagnosis.[5]

One possible mechanism by which cravings could influence GDM risk is through changes in diet. However, clear nutrient or diet patterns predicting GDM diagnosis have not been consistently replicated across studies. In the Project Viva cohort, Radesky et al. found a

relationship between increased N-3 fatty acid intake in early pregnancy but no associations between many other foods or nutrients, with subsequent GDM diagnosis.[15] In contrast in a case-control study, Bo et al., found higher early pregnancy saturated fat intake to be associated with risk of GDM/IGT.[12] Moses et al. and Zhang et al. found prospective and cross-sectional correlations between increased dietary fiber intake and reduced risk of GDM.[14,16]

The objectives of this paper were to assess associations of new cravings during pregnancy with contemporaneous food and nutrient intakes, and with subsequent development of abnormal glucose tolerance. We hypothesized that cravings for sweet foods in early pregnancy would be associated with increased intake of sweet foods and with risk for abnormal glucose tolerance.

Materials and Methods

We based our analysis on participating mothers in the Project Viva pre-birth cohort. Other publications have described the recruitment and retention procedures.[17–19] In summary, Project Viva recruited pregnant women during their initial obstetric care visit between 1999 and 2002 at one of eight obstetrical offices of Harvard Vanguard Medical Associations, a multispecialty group practice located in eastern Massachusetts.

Women were eligible for participation if they could complete the study forms in English, had a singleton pregnancy, had no plans to move before delivery, and presented for their initial care visit before 22 weeks' gestation. We collected data through interviews, self-administered questionnaires, examinations, and electronic medical records. The authors have obtained both informed consent and ethics committee approval for studies on patients. This analysis was approved by the institutional review board at Harvard Pilgrim Health Care.

There were 2,128 live singleton births within the Project Viva cohort. For this analysis, we excluded women who denied permission to use medical records (n=25), with deliveries with no information on the glucose tolerance (n=36) and no information on cravings during early pregnancy (n=45), leaving 2,022 women for analysis.

Pregnancy Cravings Assessment

Mothers in the Project Viva cohort completed first trimester interviews at mean +/− SD 10.9 +/− 2.3 weeks gestation. Interviewers asked participants whether or not they had any new cravings for a particular food or beverage during this pregnancy. If participants answered yes, we asked them to list what new cravings they had experienced in an open-ended question. We created six categories for cravings: sweet, salty, savory, starchy, non-sweet dairy and other based on prior literature on the topic.[5] We put each food craving into one or more of the six categories. We assigned craving categories for each food: 'primary' for the category that is the primary or majority taste component of the food; 'secondary' for any other category that is not the main taste component of the food; and 'none' for craving categories not associated with the food. The lead author created these categories; for the ~25% of foods with ambiguous categorizations, all 3 authors discussed them to arrive at consensus. Table 1 shows all six categories of cravings, with examples of food with

'primary' status in each category. Table 2 shows examples of how we categorized cravings for specific foods into 'primary' (1), 'secondary' (2) and 'none' (0). For analysis, we collapsed 'secondary' and 'none,' and thus compared primary v. secondary/none in relation to the outcomes.

Dietary Assessment

After the early pregnancy interview we sent each woman home with questionnaires to complete. At mean 11.8 weeks gestation mothers in Project Viva completed a self-administered food frequency questionnaire (FFQ), which was modified for use during pregnancy from the FFQ used in the Nurses' Health Study, and validated within this study population for several nutrients.[20] We asked women to report frequency of consumption of over 140 specific food and beverages during this pregnancy, defined as "since your last menstrual period until now." To determine nutrient intake, we multiplied a weight assigned to the frequency of use by nutrient composition for the portion size pre-specified for each food. To estimate nutrient content, we used the Harvard nutrient composition database.[21]

Glucose tolerance outcomes

Mothers in Project Viva were screened by their prenatal providers for gestational diabetes between 26–28 weeks gestation, initially with a non-fasting oral glucose challenge. Participants were given 50 grams of oral glucose and venous blood was sampled one hour afterwards. A blood glucose level of ≥ 140 mg/dL prompted a referral for a 3-hour fasting 100-g oral glucose tolerance test. The participant's blood glucose was measured at baseline and once an hour for 3 hours after the glucose load. Normal blood glucose levels were <95 mg/dL at baseline, <180 mg/dL after 1 hour, <155 mg/dL after 2 hours and <140 mg/dL after three hours. We defined participants as normal if they were <140 mg/dL on the non-fasting oral glucose challenge, and having isolated hyperglycemia (IH) if they had a blood glucose level ≥140 on the non-fasting oral glucose challenge, but had no abnormal results on the glucose tolerance test. We defined participants as having impaired glucose tolerance (IGT) if they had one abnormal result on the glucose tolerance test, and gestational diabetes (GDM) if they had two or more abnormal results.

Statistical Analysis

We used linear regression to analyze the cross-sectional relationships between pregnancy cravings and dietary intake. Pre-specified nutrient outcomes included total energy, carbohydrates, sucrose, glucose, fructose, lactose, glycemic load, total fat, saturated fat, monounsaturated fat, trans fat, polyunsaturated fat, N-3 fatty acids, N-6 fatty acids protein, calcium and dietary fiber. Foods included cereals/breads and starches, and vegetables. The one dietary pattern we analyzed was fried food eaten away from home.

In multivariable adjusted models we included covariates we considered *a priori* to potentially be related to cravings and dietary intake, including maternal pre-pregnancy body mass index (BMI), age, race/ethnicity (white/black/Hispanic/other), education (college graduate yes/no), smoking during pregnancy and GDM in a previous pregnancy. We did not include the following potential confounders because adding them to the model did not change effect estimates by > 10%: parity, physical activity and TV watching during

pregnancy, and presence of nausea and/or vomiting. We energy-adjusted all nutrients via the residuals method.[22]

We used multinomial logistic regression to analyze the prospective relationships between pregnancy cravings and development of abnormal glucose tolerance diagnosis, with normal glucose tolerance as the referent. We included the same covariates as in the analysis of cravings and dietary intake.

Results

Among the 2,022 participants, mean +/− SD age was 31.8 +/− 5.2 years and mean pre-pregnancy BMI was 24.9 +/− 5.5 kg/m^2. A minority of participants 662 (33%) women identified as non-white. In the 1st trimester, 907 (45%) women reported cravings; 443 (22%) craved sweets, 225 (11%) craved salty foods, 261 (13%) craved savory foods, and 100 (5%) craved starchy foods (Table 3). 117 (5.8%) women developed GDM, 63 (3.1%) developed IGT, and 179 (8.9%) developed IH (Table 3).

Mean +/− SD total energy intake was 2061 +/− 674 kilocalories. Mean +/−SD intake (g/day) of carbohydrates was 277 +/−36, sucrose 49.5 +/−15.5, total fat 62.8 +/−12.1, saturated fat 23.4 +/−5.5, and N-3 fatty acids 1.13 +/−0.52; and glycemic load was 14759 +/−2274 (Supplemental Table 1).

In crude analysis, sweet cravings were associated with increased intake of sucrose (1.9 gm/day 95% CI 0.1, 3.7), total fat (1.5 gm/day 95% CI 0.1, 2.9), and saturated fat (0.8 gm/day 95% CI 0.2, 1.4); salty cravings were borderline associated with increased fiber (0.7 95% CI −0.1, 1.6) and decreased saturated fat (−0.6 95% CI−1.4, 0.2); savory cravings with increased N-3 fatty acids (0.10 gm/day 95% CI: 0.02, 0.17); and starchy cravings with increased carbohydrates (8.0 gm/day 95% CI 0.3, 15.7) and decreased total fat (−2.6 gm/day 95% CI −5.2, −0.1). In adjusted analysis, sweet cravings remained associated with increased saturated fat (0.7 gm/day 95% CI 0.1, 1.3), savory cravings with increased N-3 fatty acids (0.08 95% CI 0.01, 0.16), and starchy cravings with carbohydrates (7.6 95% CI 0.0, 15.2) and decreased total fat (−2.5 95% CI −5.1, 0.0) (Table 4).

Craving salty food was associated with lower risk of GDM (adjusted OR 0.34 95% CI 0.12, 0.97). Craving sweet, savory, or salty foods was not associated with abnormal glucose tolerance (Table 5).

Discussion

Approximately 45% of the Project Viva participants in this analysis reported having new cravings for specific foods that started during pregnancy. This estimate is consistent with the other published studies on the prevalence of cravings in early pregnancy.[1–3] Women tend to experience the largest number of new cravings during their third trimester, thus our study may underestimate of the total percentage of women experiencing cravings during the whole of pregnancy.[5] Approximately 5.8% of women in this analysis developed GDM, with a total of 17.8% developing some kind of abnormal glucose tolerance (GDM, IGT, or IH).

In this study, new dietary cravings in early pregnancy were associated with higher intakes of several nutrients including sucrose, total fat, saturated fat, N-3 fatty acids, carbohydrate intake, and glycemic load. However, while statistically significant, these changes are of modest magnitude. We hypothesized some of these associations. For example, sweet cravings were associated with both increased sucrose and total fat intake. This result implies that those who have sweet cravings may indulge their cravings by eating foods high in fat and sucrose, which are traditional components of dessert foods in the Western diet. Starchy cravings were associated with increased carbohydrate intake and increased glycemic load, implying that women who have strong cravings for starchy foods eat increased amounts of carbohydrates, which typically have a high glycemic load. Other relationships are more challenging to explain, for example associations between savory cravings and N-3 fatty acids intake.

Craving type also predicted abnormal glucose tolerance outcomes. In the adjusted analysis, salty cravings predicted lower risk GDM. We had originally hypothesized that sweet cravings would predict later GDM diagnosis. However, we found no evidence that sweet, savory, or starchy cravings were associated with abnormal glucose tolerance. This finding is consistent with Belzer et al. which found that women who developed gestational diabetes did not experience more sweet and savory cravings early in pregnancy compared to women with normal glucose tolerance.[5]

Our data raise the possibility of a possible mechanism in which cravings predict dietary intake and dietary intake contributes to abnormal glucose tolerance. Bo et al. found that increased saturated fat intake in the first trimester was associated with risk of GDM later in pregnancy (OR: 2, 95% CI: 1.2–3.2).[12] In this analysis we found salty cravings were associated with both decreased saturated fat intake and decreased odds of GDM, although in previous work we did not find that saturated fat intake predicted GDM in Project Viva.[15]

In another example, Zhang et al. and Moses et al. found dietary fiber intake to be associated with lower risk of GDM.[14,16] Every additional 10 gm/day in total dietary fiber was associated with a 26% (95% CI: 9–49) reduction in risk of GDM.[16] In our analysis salty foods were associated with both increased dietary fiber intake and reduced risk of GDM. As with saturated fat, however, in our previous work we did not find that dietary fiber intake during pregnancy was associated with GDM in Project Viva.[15]

Strengths and Limitations

Strengths of this analysis include its relatively large sample size, validated dietary assessment, and the prospective nature of the glucose tolerance outcome assessment. However, even with large overall sample size, low numbers of individuals in specific combinations of cravings and outcomes yielded wide confidence intervals.

Since Project Viva recruited women with health insurance, these results may not be generalizable to populations of lower socioeconomic status. Additionally, cravings for specific foods vary from culture to culture so the types and proportion of craving types may not be the same in other populations.

A challenge in this study was categorizing cravings for complex or mixed dishes, such as Mexican food (table 2). The complexity of categorizing complicated and mixed dishes may have led to non-differential misclassification and bias toward the null.

Conclusions

The main findings from our study are that cravings for salty food during pregnancy may be protective against later risk for abnormal glucose tolerance. Additionally, craving sweet food does not appear to alter ones risk. Further research is needed to confirm these findings and should investigate possible mechanisms between cravings during pregnancy with health outcomes, as well as implications for dietary clinical practice among pregnant women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Categorization of new cravings during early pregnancy in Project Viva

Sweet	Candy, cakes, cookies, fruit, fruit juice, pastries, sweetened cereal, sweetened milk, ice cream, frozen yogurt, pie, pudding, smoothies
Salty	Chips, crackers, pretzels, soup, pickles, French fries, fried food, popcorn, macaroni and cheese, peanut butter
Savory	Eggs, meat, mixed dishes, seafood
Starchy	Bread, non-fried potatoes, rice, pasta
Non-sweet dairy	Milk, cheese, plain yogurt
Other	Vegetables, water, ice

Table 2

Examples of cravings categorization (1: primary, 2: secondary, 0: none) used to classify pregnancy cravings in Project Viva

	Sweet	Salty	Savory	Starchy	Non-sweet Dairy	Other
Candy bar	1	0	0	0	0	0
French fries	0	1	0	1	0	0
Broccoli	0	0	0	0	0	1
Chicken Soup	0	1	2	0	0	0
Cake	1	0	0	2	0	0
Mexican Food	0	2	2	2	2	0

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Table 3

Covariates according to early pregnancy craving type among 2,022 participants in Project Viva

		Any Cravings		Sweet		Salty		Savory		Starchy	
	Total n=2022	No n=1115	Yes n=907	None/ Secondary n=1579	Primary n=443	None/ Secondary n=1797	Primary n=225	None/ Secondary n=1761	Primary n=261	None/ Secondary n=1922	Primary n=100
						N (%)					
Race/ethnicity											
Black	329 (16.3)	158 (14.2)	171 (18.9)	244 (15.5)	85 (19.2)	285 (15.9)	44 (19.6)	272 (15.4)	57 (21.8)	316 (16.4)	13 (13.0)
Hispanic	147 (7.3)	76 (6.8)	71 (7.8)	111 (7.0)	36 (8.1)	135 (7.5)	12 (5.3)	119 (6.8)	28 (10.7)	138 (7.2)	9 (9.0)
Asian	110 (5.4)	74 (6.6)	36 (4.0)	97 (6.1)	13 (2.9)	99 (5.5)	11 (4.9)	102 (5.8)	8 (3.1)	106 (5.5)	4 (4.0)
White	1360 (67.3)	780 (70.0)	580 (63.9)	1081 (68.5)	279 (63.0)	1212 (67.4)	148 (65.8)	1206 (68.5)	154 (59.0)	1290 (67.1)	70 (70.0)
Other	76 (3.8)	27 (2.4)	49 (5.4)	46 (2.9)	30 (6.8)	66 (3.7)	10 (4.4)	62 (3.5)	14 (5.4)	72 (3.7)	4 (4.0)
College graduate											
No	707 (35.0)	365 (32.7)	342 (37.7)	533 (33.8)	174 (39.3)	633 (35.2)	74 (32.9)	591 (33.6)	116 (44.4)	676 (35.2)	31 (31.0)
Yes	1315 (65.0)	750 (67.3)	565 (62.3)	1046 (66.2)	269 (60.7)	1164 (64.8)	151 (67.1)	1170 (66.4)	145 (55.6)	1246 (64.8)	69 (69.0)
Married or cohabitating											
No	170 (8.4)	75 (6.7)	95 (10.5)	118 (7.5)	52 (11.7)	149 (8.3)	21 (9.3)	135 (7.7)	35 (13.4)	161 (8.4)	9 (9.0)
Yes	1851 (91.6)	1039 (93.3)	812 (89.5)	1460 (92.5)	391 (88.3)	1647 (91.7)	204 (90.7)	1625 (92.3)	226 (86.6)	1760 (91.6)	91 (91.0)
Smoking during pregnancy											
No	1758 (87.5)	982 (88.9)	776 (85.8)	1386 (88.4)	372 (84.2)	1566 (87.8)	192 (85.3)	1531 (87.5)	227 (87.3)	1666 (87.3)	92 (92.0)
Yes	251 (12.5)	123 (11.1)	128 (14.2)	181 (11.6)	70 (15.8)	218 (12.2)	33 (14.7)	218 (12.5)	33 (12.7)	243 (12.7)	8 (8.0)
Nausea for > 7 days											
No	972 (48.2)	576 (51.8)	396 (43.7)	785 (49.8)	187 (42.2)	885 (49.4)	87 (38.7)	856 (48.7)	116 (44.4)	942 (49.1)	30 (30.3)
Yes	1046 (51.8)	536 (48.2)	510 (56.3)	790 (50.2)	256 (57.8)	908 (50.6)	138 (61.3)	901 (51.3)	145 (55.6)	977 (50.9)	69 (69.7)
Parity											
0	972 (48.1)	555 (49.8)	417 (46.0)	773 (49.0)	199 (44.9)	859 (47.8)	113 (50.2)	858 (48.7)	114 (43.7)	920 (47.9)	52 (52.0)
1–2	959 (47.4)	512 (45.9)	447 (49.3)	734 (46.5)	225 (50.8)	853 (47.5)	106 (47.1)	826 (46.9)	133 (51.0)	914 (47.6)	45 (45.0)
3+	91 (4.5)	48 (4.3)	43 (4.7)	72 (4.6)	19 (4.3)	85 (4.7)	6 (2.7)	77 (4.4)	14 (5.4)	88 (4.6)	3 (3.0)
Previous GDM											
No	1979 (97.9)	1091 (97.8)	888 (98.0)	1541 (97.7)	438 (98.9)	1755 (97.7)	224 (99.6)	1726 (98.1)	253 (96.9)	1880 (97.9)	99 (99.0)
Yes	42 (2.1)	24 (2.2)	18 (2.0)	37 (2.3)	5 (1.1)	41 (2.3)	1 (0.4)	34 (1.9)	8 (3.1)	41 (2.1)	1 (1.0)

		Any Cravings		Sweet		Salty		Savory		Starchy	
	Total n=2022	**No n=1115**	**Yes n=907**	**None/ Secondary n=1579**	**Primary n=443**	**None/ Secondary n=1797**	**Primary n=225**	**None/ Secondary n=1761**	**Primary n=261**	**None/ Secondary n=1922**	**Primary n=100**
Glucose category*											
Normal	1663 (82.2)	912 (81.8)	751 (82.8)	1308 (82.8)	355 (80.1)	1464 (81.5)	199 (88.4)	1442 (81.9)	221 (84.7)	1575 (81.9)	88 (88.0)
IH	179 (8.9)	98 (8.8)	81 (8.9)	135 (8.5)	44 (9.9)	162 (9.0)	17 (7.6)	160 (9.1)	19 (7.3)	173 (9.0)	6 (6.0)
IGT	63 (3.1)	35 (3.1)	28 (3.1)	46 (2.9)	17 (3.8)	58 (3.2)	5 (2.2)	56 (3.2)	7 (2.7)	60 (3.1)	3 (3.0)
GDM	117 (5.8)	70 (6.3)	47 (5.2)	90 (5.7)	27 (6.1)	113 (6.3)	4 (1.8)	103 (5.8)	14 (5.4)	114 (5.9)	3 (3.0)
						Mean +/− SD					
Age, years	31.8 +/− 5.2	32.1 +/− 4.9	31.5 +/− 5.6	31.9 +/− 5.1	31.5 +/− 5.6	31.9 +/− 5.1	30.9 +/− 6.1	31.9 +/− 5.1	31.1 +/− 5.8	31.9 +/− 5.2	31.3 +/− 5.7
BMI, kg/m^2	24.9 +/− 5.5	24.9 +/− 5.5	24.9 +/− 5.5	24.8 +/− 5.4	25.2 +/− 5.8	24.9 +/− 5.5	24.2 +/− 5.5	24.9 +/− 5.5	24.9 +/− 5.4	24.9 +/− 5.5	23.6 +/− 4.6

*IH- Isolated Hyperglycemia; IGT- Impaired glucose tolerance; GDM- gestational diabetes

Table 4

Associations of type of early pregnancy craving with contemporaneous nutrient intakes, data from 2,022 participants participating in Project Viva

	Sweet		Salty		Savory		Starchy	
Nutrient	**Crude**	**Adjusted***	**Crude**	**Adjusted***	**Crude**	**Adjusted***	**Crude**	**Adjusted***
	Linear regression estimate (95% CI)							
Carbohydrates(g/d)	−2.8 (−6.9, 1.4)	−2.4 (−6.5, 1.7)	4.9 (−0.5, 10.2)	3.8 (−1.4, 9.1)	−1.0 (−6.2, 4.3)	−1.0 (−6.2, 4.1)	8.0 (0.3, 15.7)	7.6 (0.0, 15.2)
Sucrose (g/d)	1.9 (0.1, 3.7)	1.5 (−0.2, 3.2)	0.9 (−1.4, 3.2)	0.7 (−1.5, 2.9)	0.7 (−1.6, 3.0)	0.1 (−2.1, 2.3)	2.0 (−1.4, 5.3)	2.4 (−0.8, 5.6)
Glycemic Load	−115 (−378,147)	−99 (−357,159)	178 (−160,517)	103 (−229,435)	−67 (−398,264)	−101 (−425,224)	466 (−22,954)	458 (−20,936)
Total Fat (g/d)	1.5 (0.1, 2.9)	1.2 (−0.2, 2.6)	−1.5 (−3.3, 0.3)	−1.2 (−3.0, 0.6)	0.7 (−1.1, 2.5)	0.5 (−1.2, 2.2)	−2.6 (−5.2, −0.1)	−2.5 (−5.1, 0.0)
Saturated Fat (g/d)	0.8 (0.2, 1.4)	0.7 (0.1, 1.3)	−0.6 (−1.4, 0.2)	−0.4 (−1.2, 0.4)	0.3 (−0.5, 1.1)	0.3 (−0.5, 1.0)	−0.9 (−2.1, 0.2)	−0.9 (−2.0, 0.3)
N-3 Fatty Acids (g/d)	0.03 (−0.03, 0.09)	0.02 (−0.04, 0.08)	−0.07 (−0.15, 0.01)	−0.06 (−0.14, 0.02)	0.10 (0.02, 0.17)	0.08 (0.01, 0.16)	0.01 (−0.11, 0.12)	0.01 (−0.10, 0.13)
Dietary Fiber (serv/d)	−0.5 (−1.1, 0.2)	−0.3 (−0.9, 0.4)	0.7 (−0.1, 1.6)	0.8 (−0.1, 1.6)	0.2 (−0.7, 1.0)	0.4 (−0.4, 1.2)	0.3 (−0.9, 1.5)	0.1 (−1.1, 1.3)

*Adjusted for age, race/ethnicity, education, smoking, pre-pregnancy BMI, and GDM in a previous pregnancy

Table 5

Associations of type of early pregnancy craving with the odds of developing abnormal glucose tolerance in mid-pregnancy, data from 2,022 participants participating in Project Viva

	Sweet		Salty		Savory		Starchy	
Glucose Tolerance Outcome	**Crude**	**Adjusted***	**Crude**	**Adjusted***	**Crude**	**Adjusted***	**Crude**	**Adjusted***
	Odds ratio (95% CI)							
Normal	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Isolated hyperglycemia	1.20 (0.84, 1.72)	1.26 (0.87, 1.82)	0.77 (0.46, 1.30)	0.85 (0.50, 1.44)	0.77 (0.47, 1.27)	0.81 (0.49, 1.34)	0.62 (0.27, 1.44)	0.65 (0.28, 1.53)
IGT	1.36 (0.77, 2.40)	1.41 (0.79, 2.50)	0.63 (0.25, 1.60)	0.67 (0.27, 1.71)	0.82 (0.37, 1.81)	0.82 (0.36, 1.83)	0.89 (0.28, 2.91)	1.03 (0.31, 3.37)
GDM	1.11 (0.71, 1.73)	1.37 (0.84, 2.23)	0.26 (0.10, 0.71)	0.34 (0.12, 0.97)	0.89 (0.50, 1.58)	0.76 (0.39, 1.49)	0.47 (0.15, 1.51)	0.62 (0.18, 2.14)

*Adjusted for age, race/ethnicity, education, smoking, pre-pregnancy BMI, and GDM in previous pregnancy