Maternal Sugar Intake with Maternal Weight and Body Composition Changes During and After Pregnancy

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ABSTRCT

MATERNAL SUGAR INTAKE WITH MATERNAL WEIGHT AND BODY COMPOSITION CHANGES DURING AND AFTER PREGNANCY

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This study was the first to explore the impaction of maternal total sugar, added sugar, free sugar, fructose, and SSB intake on changes in maternal body weight and body composition during and after pregnancy. A total of 863 pregnant women' data from the APrON study were analyzed through 36 linear regression models. Maternal dietary intakes were measured through web-based 24-hr recall and a sugar database. Maternal dietary intake, weights and fatness were measured at each trimester and 3-month postpartum visit. Both total and free sugar intake was significantly associated with higher gestational weight and fatness gain between the second and third trimester. Maternal added sugar intake was significantly associated with maternal weight gain between the second and third trimester. Maternal calories intake was proposed as a mediator in this relationship. Future studies should further explore if a low sugar dietary intervention could help with maintaining GWG within a healthy range.

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GLOSSARY AND LIST OF ABBREVIATIONS

ADP = Air displacement plethysmograph

APrON = Alberta Pregnancy Outcomes and Nutrition

BC = Body composition

BIA = Bioelectrical impedance analysis

BMI = Body mass index

BW = Birth weight

CCHS = Canadian Community Health Survey

CDC = Center of Disease Control

CI = Confidential interval

CVD = Cardio-vascular disease

DRI = Dietary Reference Intake

DXA = Dual energy x-ray absorption

FM = Fat mass

FFM = Fat free mass

FFQ = Food frequency questionnaire

GDM = Gestational weight gain

GWG = Gestational weight gain

HFCS = High fructose corn syrup

IOM = Institute of Medicine

NHANES = National Health and Nutrition Examination Survey

PPWR = Postpartum weight retention

SFT = Skin fold technique

SSB = Sugar sweetened beverage

T1DM = Type 1 diabetes mellitus

T2DM = Type 2 diabetes mellitus

WHO = World Health Organization

USDA = United States Department of Agriculture

VIF = Variance inflation factor

Chapter 1 Literature Review

Excessive weight gain and weight retention are problematic for pregnant women, as they may lead to undesired health consequences. Identifying the factors causing weight and fat mass gain is critical for understanding how to help pregnant women to maintain weight and fat mass in a health range and how to improve overall health in this population.

Sugars have been attracting attention as a possible weight reduction target as excessive sugar intake has been linked with weight gain, particularly in non-pregnant population. While many studies have been done to examine the potential association between sugar intake and weight and fat mass gain in the general adult population; limited research has been completed to understand if sugar intake is related to weight and body composition changes during and after pregnancy for mothers.

This review will summarize the current knowledge about sugar intake in Canada and the health effects of sugar intake, focusing on weight gain, maternal weight and body composition measurements, and the effects of sugar intake during pregnancy.

1.1 Sugar intake in Canada

This section will present definitions of sugars and sugar groups, followed by current Canadian sugar intake data and recommendations.

1.1.1 Definitions of sugar groups

Monosaccharides and disaccharides are part of the carbohydrate family and are often referred to as "sugars" (Whitney & Rolfes, 2008). Monosaccharides include glucose, fructose, and galactose (Whitney & Rolfes, 2008). Disaccharides, including sucrose, lactose, and maltose, are sugars composed of pairs of monosaccharides (Whitney & Rolfes, 2008). Sucrose is also known as table sugar, and it contributes to the majority of the daily sugar intake. Sucrose consists of two monosaccharides, glycose and fructose joined by a glycosidic bond.

Sugars are often grouped based on their source because the origin of sugar is associated with different health effects. The most common sugar groups used in the scientific literature and dietary recommendations are total sugar, free sugar, and added sugar. Total sugar refers to all sugar (mono- and disaccharides) present in the food, derived from any sources (Mela & Woolner, 2018). Added sugar is defined as “mono- and disaccharides used as an ingredient in the processing and preparation of foods as well as sugars eaten separately”, whereas free sugar is defined as “mono- and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrup, fruit juices, and fruit juice concentrates” (Whitney & Rolfes, 2008; WHO, 2018). By this definition, added sugars are similar to free sugars, but the key distinction between added sugar and free sugar is that added sugar does not include naturally occurring sugar present in dairy foods and nonintact fruit and vegetables (juiced or pureed) (Mela & Woolner, 2018; WHO, 2018).

Sugars can have different effects on the human body depending on their source. Although both naturally present sugar and added sugar consist of the same sugar molecules which are indistinguishable chemically and biologically; natural sugars come from foods that contain various nutrients, such as fiber, essential vitamins and minerals, and phytochemicals (Whitney & Rolfes, 2008). In contrast, added sugar are present in foods, such as sugar-sweetened beverages (SSB), sweets, and baked goods, which are often low in nutrients but high in calories (Whitney & Rolfes, 2008). Therefore, one serving of fruit and one serving of SSB may contain the same amount of sugar, but the fruit contains more both essential and non-essential nutrients compared with SSB. In addition, these naturally present forms of sugar are also referred to as bound sugar, as they are bounded with food matrix and absorbed into the bloodstream more slowly than those who freely presented added sugar (Whitney & Rolfes, 2008). Thus, consuming food with added sugar may bring fewer benefits and more harms to people compared with food including natural sugar.

1.1.2 Recommendations for sugar intake

As free sugar or added sugar consumption has been associated with negative health effects, the Canadian government and several international organizations have released recommendations to limit sugar intake. Canada's Food Guide, as released in 2019, did not recommend a specific amount of daily sugar intake that is acceptable, but encouraged limiting the intake of "highly processed" food and beverages which contain excessive added sodium, sugar, and saturated fat (Government of Canada, 2019). The Food Guide also recommended drinking water rather than SSBs and fruit juices to avoid excessive sugar intake (Government of Canada, 2019). The Dietary Reference Intakes (DRI) suggested that added sugar should not account for more than 25 percent of daily total energy intake (IOM, 2005). The World Health Organization (WHO) provided a more stringent recommendation than DRIs, as they recommended restricting consumption of free sugars to less than ten percent of total energy intake, and advised that further reducing the intake to below five percent could have additional health benefits (WHO, 2018).

1.1.3 Current Canadian sugar intake

The sugar intake of Canadians is ranked in the tenth highest place worldwide (Statista, 2020). Based on the Canadian Community Health Survey (CCHS) data collected in 2015, Canadian non-pregnant women older than 19 years of age consume an average of 75 grams of sugar from both food and beverages (Langlois et al., 2019). Another analysis of this data revealed that

Canadian adults aged from 19 to 70 consume 18.8% – 22.9 % of their total daily energy intake from total sugars, and half of it came from added sugars (Brisbois et al., 2014). Added sugar contributed to 11% - 13% of total daily calories for Canadian adults depending on age category (Brisbois et al., 2014; Statistics Canada, 2019). The top source of added sugar intake for Canadians was SSBs, which contributed to about 8.9% of total sugar intake, whereas the second largest contributor is baked goods and products, contributing to approximately 8.8% of total sugar intake (Langlois et al., 2019).

The sugar intake of Canadians has decreased between 2004 and 2015, which corresponds with a decrease in the availability of products containing added sugar on markets; however, it is worth noting that although the amount of sugar intake has decreased, Canadian's percentage of energy intake from total sugar has increased; for Canadian non-pregnant women who aged 19 and older, their percentage of energy intake from added sugar has increased from 11.6% to 13.4% between 2004 and 2015 (Langlois et al., 2019; USDA, 2015). As Canadians are consuming more calories from sugar, the association between sugar intake and health continues to be a concern. The contribution of sugar to weight gain and obesity is the primary health consequence of concern. The next section will examine the evidence linking sugar to excessive weight gain and its possible mechanisms.

1.2 Health effects of sugar intake on body weight

Increased sugar intake is associated with various undesired health consequences, such as nutrient deficiency and tooth decay (Burt et al., 1988; Ruottinen et al., 2004; Vartanian et al., 2007). Researchers also have found that added sugar intake may lead to overweight, obesity, and relevant chronic complications, such as type 2 diabetes, and cardiovascular diseases (Mearns, 2014; J. M. Rippe & Angelopoulos, 2016; Welsh et al., 2011).

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health (Peirson et al., 2015). In 2018, 61.9% of Canadians aged 18 and older were classified as overweight and obese based on their reported BMI (Statistics Canada, 2019). In order to reduce the risk of overweight or obesity and promote population health, identifying the cause of weight gain and developing appropriate weight management strategies are important. Exploring the association between sugar intake and body weight has become a research interest in the field of nutrition, as we investigate ways in which we can to help people maintain a healthy weight.

1.2.1 Associations between sugar intake and body weight

Evidence from recent cohort studies has suggested that increased total sugar intake may be associated with weight gain. Two longitudinal studies, one which included 1236 Japanese men and one including 248 Canadian adults both found that intake of total sugar was a significant risk factor for weight gain after adjustment for total energy intake and lifestyle factors (Drapeau et al., 2004; Ibe et al., 2014). In an Canadian Study, participants who reported eating more sugar gained an average of 2 kg more weight, and had significantly higher skinfold thickness (20 cm) and waist circumference (2.5cm) than people who reported consuming less sugar over 6 years (Drapeau et al., 2004). While these studies suggest a potential association between total sugar intake and weight gain, some studies have found contrary results. A WHO-commissioned systematic review and meta-analysis including 38 prospective cohort studies did not find any association between total fructose-containing sugars and body weight changes (Morenga et al., 2013).

Controversial evidence was also presented when examining the association between free sugar intake and weight changes. In two longitudinal study including 7081 Australian adults and children in total, researchers showed that free sugar intake was not significantly associated with BMI changes (Ahmad et al., 2020; Hon et al., 2018). Whereas in a prospective cohort study including 14,941 Japanese adults showed that, after adjusting for total energy intake and other dietary and lifestyle factors, male participants with high free sugar intake, and fructose intake had increased weight gain of 0.20 kg and 0.12 kg respectively in ten years (Yamakawa et al., 2020). However, no similar association was identified among female participants (Yamakawa et al., 2020). Researchers suggested that stress and neighborhood socioeconomic positions may result in the sex-differentiated associations in Japanese participants (Yamakawa et al., 2020).

The strongest evidence connecting sugar intake with weight gain comes from research about SSBs. Although the previous mentioned WHO-commissioned systematic review and meta-analysis conducted by Morenga and colleagues (2013) did not find an association between total sugars and body weight, that study identified a significant positive association between SSBs intake and weight gain (Morenga et al., 2013). Similarly, Malik and colleagues (2013) conducted a systematic review including both cohort studies and RCTs to summarize evidence about SSBs intake and weight gain. In seven prospective cohort studies including totally 170,141 men and women, researchers found that each SSB serving per day was associated with an additional weight gain of 0.22kg over one year (Malik et al., 2013a). When the results of five RCTs including 2772 children and adolescents were examined, they showed that there were significant reductions in BMI when SSB intake was reduced (Malik et al., 2013a). Five additional RCTs conducted in adults showed that there were increases in body weight when SSBs were added to participants' daily intake (Malik et al., 2013a). Thus this systematic review provided strong evidence to suggest that SSBs consumption promoted weight gain in both children and adults (Malik et al., 2013a; Morenga et al., 2013).

These results suggest that sugars from SSB might be a special case compared with sugar coming from solid food sources. Compared to solid sugar, the liquid form of sugar only activates an incomplete energy compensation mechanism (Almiron-Roig et al., 2013). After critically examining 121 studies, researchers found that liquid calorie preloads were associated with 75% or less of normal energy compensation activated by solid food (Almiron-Roig et al., 2013). Because the liquid calories from SSBs only activate an incomplete energy compensation mechanism, the ingestion of liquid calories will not fully provoke the later energy intake adjustment; consequently, people will continue ingesting more calories afterward (Almiron-Roig et al., 2013). Thus, liquid calorie intake from SSBs consumption might better promote weight gain as they promote excess caloric consumption (Almiron-Roig et al., 2013).

1.2.2 Associations between added/free sugar intake and body composition

Studies investigating the impact of sugar intake on body composition have had mixed results. A cross-sectional study of secondary school students in Catania and a longitudinal study included 4000 older adults in Hong Kong both suggested that sugar intake was associated with increased body fat percentage (Liu et al., 2018; Marventano et al., 2017). Liu and colleagues (2018) found that with each 1% increase in added sugar intake, whole body fat, central fat, and body fat% increased by 0.043 kg, 0.029 kg, and 0.05%, respectively. On the contrary, no evidence was found to establish the association between sugar intake and fatness in a longitudinal study of children aged 5-9 years old in the UK or in a population-based prospective cohort study included 2361 Dutch children (Johnson et al., 2007; Leermakers et al., 2015). These mixed results about sugar intake and body composition might due to their different study designs, including populations, dietary data measuring method, and identified confounding variables. More research, especially RCTs, are needed to further explore the association between sugar intake and body composition.

1.2.3 Mechanisms

The mechanism explaining how sugars intake causes weight gain is still unclear. Two key theories have been proposed to explain this association. The first theory suggests that the unique metabolic response of fructose causes weight gain, and the second theory suggests that additional added sugar intake causes excessive calorie intake, which results in weight gain (Khan & Sievenpiper, 2016).

1.2.3.1 Theory 1: unique metabolic response of fructose

The distinct metabolic process of fructose may explain the association between weight gain and sugar intake. Both fructolysis and glycolysis are important sugar metabolic pathways that generate pyruvate and high-energy molecules ATP from fructose and glucose, but their metabolic pathways are distinct from each other (Figure 1). In the glycolysis, fructose-6-phosphate (F6P) is converted into fructose-1, 6-biphosphate (F2, 6BP), catalyzed by phosphofructokinase 1 (PKF1) (Boscá & Corredor, 1984). As PKF1 is a highly regulated enzyme, and it is controlled by various substrates such as F2, 6BP, AMP, ATP, Citrate, and H^+, the rate of hepatic glycolytic flux is limited (Boscá & Corredor, 1984). In contrast, fructolysis does not require the enzyme, PKF1; therefore, fructolysis bypasses this rate limiting restriction (Hannou et al., 2018). As fructolysis is unrestricted, more byproducts can be generated, and all these substrates are available for all central carbon metabolic pathways, such as glycogenesis, gluconeogenesis, lipogenesis, and oxidative phosphorylation, facilitating energy storage and weight gain (Hannou et al., 2018; Stanhope et al., 2009). Consequently, the excessive fructose intake can influence lipid metabolism. As discussed earlier, fructolysis can generate pyruvate and glycerol-3-phosphate (Glycerol-3-P), which enables the process of lipogenesis, contributing to both steatosis and to increased circulating triglyceride levels in the form of very low-density lipoprotein (VLDL) (Hannou et al., 2018).

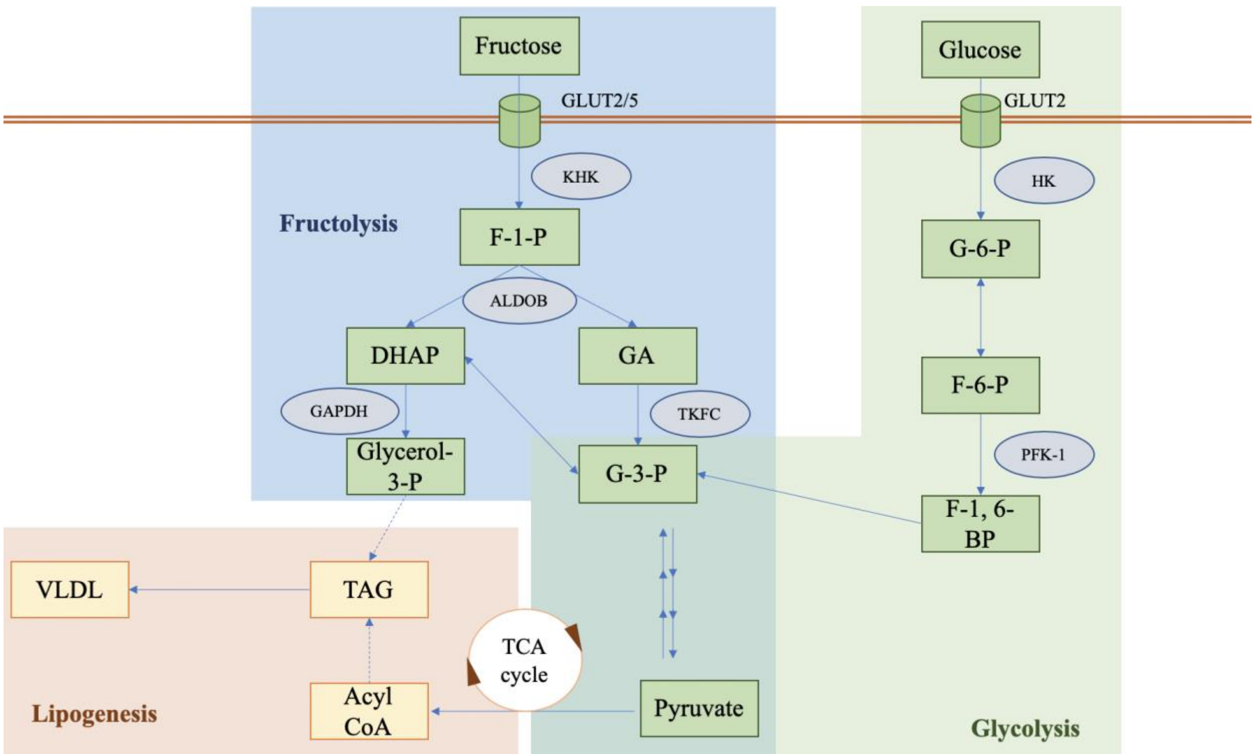

Figure 1. Sugar metabolism: Fructolytsis, glycolysis, lipogenesis. Acyl CoA, Acetyl CoA; ALDOB, aldolase B; DHAP, dihydroxyacetone phosphate; GA, glyceraldehyde; GAPDH, glyceraldehyde 3-phospate dehydrogenase; HK, hexokinase; KHK, ketohexokinase; PDK-1, pyruvate dehydrogenase kinase 1; TAG, triacylglyceral; TKFC, triokinase/FMN cyclase.

Excessive fructose intake would also influence insulin circulation. Insulin is secreted in response to the increased blood glucose concentration, and it controls the transport of glucose from the bloodstream into the muscle and fat cells (Basciano et al., 2005). Although fructose does not directly stimulate pancreatic β cell to secrete insulin, ingestion of large quantity of fructose would lead to rapid stimulation of lipogenesis and TG accumulation, which consequently would contribute to reduced insulin sensitivity and hepatic insulin resistance (Basciano et al., 2005; Ter Horst et al., 2016). When insulin resistance or hyperinsulinemia has developed, a normal amount of insulin will produce a subnormal effect, resulting in an elevated fasting glucose (Basciano et al., 2005). Both insulin resistance and hyperinsulinemia are strongly associated with overweight and obesity development (Crofts et al., 2016).

Although some evidence supports that the unique metabolic responses of fructose could cause weight gain, it is worth noting that much of this evidence was generated from animal studies, mostly with rodent models (Khan & Sievenpiper, 2016). The evidence generated from rodent models might not extrapolate to humans, as the key fructose metabolism mechanisms are different between rodents and humans (James M. Rippe, 2014). In rodents, as much as 60-70% of total fatty acids are synthesized from fructose, while in humans, only less than 5% of total TG is synthesized from fructose (Sievenpiper et al., 2011). In addition, many of these animal studies include the ingestion of a large amount of pure fructose in their study design; however, in a typical human diet, fructose is commonly ingested with glucose in a 1:1 ratio in sucrose form, or a slightly higher ratio in the form of HFCS (Khan & Sievenpiper, 2016). Thus, the evidence produced in the lab setting may not be applicable in real life situation.

1.2.3.2 Theory 2: excessive added sugar intake increases caloric intake

The second theory proposes that the excessive calorie intake, caused by high sugar intake, could contribute to weight gain. Sugar can promote excessive calorie intake in several ways. Firstly, the endocrine system responds to fructose in a different way than other sugars, which could promote eating behaviors, resulting in excessive calorie intake. Unlike the glucose, fructose does not stimulate the "satiety" hormone leptin or suppresses the "hunger hormone" ghrelin, which may lead to overall impaired satiety signaling and increased food intake and consequently weight gain (Starling et al., 2017a; Teff et al., 2004). Secondly, compared with glucose, fructose activates a greater number of brain regions involving attention and reward processing, including the visual cortex and left orbital frontal cortex (Luo et al., 2015). The brain stimulation could lead to greater hunger and desire for food, and cause a greater willingness to give up long-term monetary rewards to obtain immediate high-calorie foods, which would result in weight gain (Luo et al., 2015). Thirdly, as fructose is the sweetest sugar, and its sweetness could enhance food palatability; fructose intake could promote eating behaviour and encourage overeating (Hannou et al., 2018).

Several systematic reviews have presented evidence supporting the theory that additional caloric intake explains the association between sugar intake and weight gain. One systematic review consisting of 13 RCTs and another including 31 RCTs both showed that consuming fructose-containing sugar or other sources of carbohydrates under energy-matched conditions had no different effects on body weight, suggesting fructose containing sugars did not affect body weight differently when caloric intake is the same (Morenga et al., 2013; Sievenpiper et al., 2012). Similarly, when SSBs were replaced with milk in isocaloric condition, no differences were found in body weight and total body fat in a trial with children for 16 months (Albala et al., 2008). However, a meta-analysis revealed that supplementing the diet with excessive calories from SSB resulted in significant weight gain (0.28 kg) compared with individuals who had the same diets without supplementing with SSB (Kaiser et al., 2013). Based on this evidence, we may speculate that the weight gain associated with added/free sugar intake is likely due to excess calorie intake rather than the unique metabolic response of fructose.

1.3 Maternal weight and body composition changes during and after pregnancy

Gestational weight gain is an important indicator of both the mother's and the fetus' health status (Kominiarek & Peaceman, 2017). While gaining adequate amount of weight during pregnancy is critical for sporting fetal development, gaining excessive or insufficient weight during pregnancy have been associated with many adverse health outcomes, including macrosomia, cesarean delivery, gestational diabetes mellitus (GDM), preeclampsia, and offspring obesity (Goldstein et al., 2017; Hedderson et al., 2010; Hrolfsdottir et al., 2015; Nohr et al., 2008).

Weight status also plays an important role in the mother's health after giving birth. Excessive postpartum weight retention can cause undesired health consequences to women, including increased risk for obesity, cardiovascular disease, and potential undesired complications for future pregnancies (Endres et al., 2015; Wahabi et al., 2019). In this section, the definitions of, current trends of, and the recommendations for gestational weight gain and postpartum weight retention for pregnant women will be presented.

1.3.1 Gestational weight gain (GWG)

GWG is often measured in three different ways: total weight gained during pregnancy (kg), the average rate of weight gain in the second and/or third trimester (kg/week), and the adequacy ratio (Kominiarek & Peaceman, 2017). The adequacy ratio is calculated as a ratio of total observed GWG to the recommended value based on IOM guidelines (Kominiarek & Peaceman, 2017).

The Institute of Medicine (IOM) GWG recommendations provide guidance regarding weight gain for women during pregnancy (IOM, 2009). The newest IOM GWG recommendations were released in 2009, and they differed from the previous recommendations as they considered current sociodemographic trends such as increased racial/ethnic diversity, increased pre-pregnancy BMI, higher rates of overweight and obesity, and older average maternal age (IOM, 2009). The IOM's (2009) recommended rate and total weight gain for singleton pregnancies are summarized in Table 1.

Table 1. IOM Gestational weight gain Guidelines (Health Canada, 2010; IOM, 2009).

Pre-pregnancy BMI	Mean rate of weight gain in the 2nd and 3rd trimester[1] (kg/week)	Recommended total weight gain[2] (kg)
BMI <18.5	0.5	12.5-18
BMI 18.5 – 24.9	0.4	11.5-16
BMI 25.0 – 29.9	0.3	7-11.5
BMI > 30.0[3]	0.2	5-9

[1] Rounded values
[2] Calculations for the recommended weight gain ranges assume a gain of 0.5 – 2 kg in the first trimester
[3] A lower weight gain may be advised for women with a BMI of 35 or higher, based on clinical judgement and a thorough assessment of the risks and benefits to mother and child

Women whose GWG falls within the recommendation range have better pregnancy outcomes than others (IOM, 2009). In one study from Statistics Canada, researchers found that in

2010 as almost one-half (48.8%) of Canadian gain more weight than recommended during pregnancy (Lowell & Miller, 2010); similarly, after 10 years, in another study from the APrON team, researchers found that 49% women exceeded the GWG recommendations (Subhan, Shulman, Yuan, McCargar, Bell, & APrON Study Team and ENRICH, 2019). The excessive GWG may lead to higher risk of undesired health consequences for moms, which is concerning. Researchers from the APrON team have identified that women who gained excessive weight above the recommendations had higher chance to be overweight (OR5.5) or obese (OR 6.5) (Begum, Colman, & McCargar, 2012).

Pre-pregnancy weight status is the key factor associated with the GWG (Dudenhausen et al., 2015). A study of Canadian women showed that overweight women were significantly more likely to have excessive GWG compared with women whose pre-pregnancy weight was within normal BMI range (Lowell & Miller, 2010). Other key risk factors for weight gain that is in excess of the guidelines include excessive caloric intake and low physical activity levels (Shieh et al., 2018; Wang et al., 2019).

Several provincial educational resources are available in Canada for pregnant women to learn more about healthy pregnancy weight gain (Alberta Health Services, n.d.; Ontario Prenatal Education, n.d.; Perinatal Services BC, n.d.). In these resources, many evidences suggested that interventions, such as supervised light-to-moderate exercise, healthy eating with calorie and macronutrient goals, and regular monitoring of GWG, can help women achieve proper GWG within the guidelines (Ronnberg et al., 2015; Ruiz et al., 2013; Shieh et al., 2018).

1.3.2 Maternal body composition changes during pregnancy

Body composition refers to the distribution and size of all body components that comprise the total body weight (Widen & Gallagher, 2014). Various measurement techniques can be used to measure body composition, including skinfold thickness (SFT), bioelectrical impedance analysis (BIA), dual-energy x-ray absorption (DXA), and air displacement plethysmography (ADP) (Nelms et al., 2016). Body composition can also be described in different ways, including two-compartment model, three-compartment model, and four-compartment models (Widen & Gallagher, 2014). The two-compartment model divides the body into FM and FFM (Widen & Gallagher, 2014). The three-compartment model includes FM, water, and a combination of mineral and protein, whereas the four-compartment model divides the FMM into mineral, water, and protein (Widen & Gallagher, 2014). All these models can be used to describe pregnant women's body composition, but appropriate corrections need to be applied because changes in maternal body composition during pregnancy would violate some underlying assumptions for human body composition measurement (Widen & Gallagher, 2014).

Both FFM% and FM% are expected to change during pregnancy. Changes in FFM during pregnancy result from increased blood volume, extracellular fluid volume, and enlarged uterus and breast tissue (Pitkin, 1976). As part of the FFM, bone mass does not change significantly during pregnancy (Purdie et al., 1988). FM is the most variable component of maternal body composition during pregnancy, and changes can range from – 10 kg to +15 kg These body composition changes are positively correlated with GWG (Lederman et al., 1997; Most et al., 2018).

Predictors of changes in maternal body composition have not been fully studied. In a study including 1820 pregnant women, researchers found that GWG is associated with higher fat gain during pregnancy (Subhan, Shulman, Yuan, McCargar, Bell, & APrON Study Team and ENRICH, 2019). Besides, other known predictors of GWG, such as pre-pregnancy BMI, socio-economic status, are likely to be predictors of body composition change; however, the associations have not been thoroughly tested (Widen & Gallagher, 2014). More studies are needed to explore potential predictors of changes in body composition during pregnancy in the future.

Changes in body composition in the non-pregnant population are associated with several health consequences, including higher risk of developing CVD (Lee et al., 1999; Su et al., 2015), type 2 diabetes mellitus (Solanki et al., 2015), hypertension (Ye et al., 2018), and breast cancer (Iyengar et al., 2019). However, whether these undesired health consequences can be applied to pregnant women is still unknown. In pregnant women, it has been identified that increased maternal FM% is positively associated with infant BW, and increased incidence of macrosomia and neonatal adiposity (Connor et al., 2014; Forsum et al., 2006). The goal for pregnant mothers is to gain the appropriate amount of FM to support the pregnancy.

1.3.3 Postpartum weight change

Postpartum weight change refers to the weight changes after giving birth. Postpartum weight change is calculated by subtracting the pre-pregnancy weight from the current postpartum weight. Currently, no recommendations have been established for an appropriate timeline for postpartum weight loss. Common goals for returning pre-pregnancy weight are between 3 months to 2 years, and many of the studies that examined postpartum weight retention (PPWR) use times within this range (Endres et al., 2015; Hollis et al., 2017; Shao et al., 2018; Wahabi et al., 2019).

Many factors have been identified as predictors for excessive PPWR, including GWG, pre-pregnancy BMI, household income, dietary intake, smoking habits and choice of infant feeding method (Ip et al., 2007, Bergum, Colman, & McCargar, 2012). A systematic review and meta-analysis comprised of twelve studies revealed that increased higher GWG is strongly associated with higher PPWR (Mannan et al., 2013). Compared with women who had adequate GWG, women who had excessive GWG retained an additional 2.89 kg in 9 years after delivery (Mannan et al., 2013). Another study showed that women who gained more weight during pregnancy than the IOM recommendation range maintained the excessive weight up for 21 years after giving birth (Ashley-Martin & Woolcott, 2014; Nehring et al., 2011; Viswanathan et al., 2008). Choice of infant feeding method also significantly impact PPWR. It is suggested that breastfeeding and having a healthy lifestyle may help women gradually lose weight after giving birth (Health Canada, 2010). In a systematic review including 14 cohort studies, researchers identified that breastfeeding mothers had significantly lower PPWR of -0.38 kg compared with mothers who chose formula feeding (Jiang et al., 2018).

Studies about changes in postpartum body composition are limited. A longitudinal study followed 41 Korean pregnant women for 6 weeks postpartum recognized an 6.15 kg reduction in FFM which accounted for 12.80% of postpartum weight loss (Cho et al., 2011). Interestingly, the FM increased 9.66% at 6 months postpartum from pre-pregnancy (Cho et al., 2011). A potential explanation for that is although the amount of FM would decrease during pregnancy, as total body weight also deceases too, the FM% would increase. Another cohort study followed 15 Swedish pregnant women for 12 months after pregnancy, and researchers identified that women had an increased total adipose total volume (ATV) (2.86L) at 12 months postpartum than before pregnancy (Sohlstrom & Forsum, 1995). Subhan and colleagues suggested that excessive GWG is associated with higher postpartum fat mass retention (Subhan, Shulman, Yuan, McCargar, Bell, & APrON Study Team and ENRICH, 2019). In two cohort studies which included a combined total of 158 American pregnant women, researchers showed that women who breastfed more had less adipose tissue compared to women who did not breastfeed or breastfed less (Dewey et al., 1993; Hopkinson et al., 1997). Breastfeeding mothers had 2.8mm less in triceps-skin fold thickness than formula-feed mothers (Dewey et al., 1993). Breastfeeding appears to be one of the key factors affecting postpartum body composition changes.

1.4 Sugar intake during pregnancy

Pregnant women have been shown to consume more sugar sweetened food compared with non-pregnant women of the same age (Crozier et al., 2009). In a cohort study including 2649 pregnant women, researchers found that the intake of soft drinks, breakfast cereals, cakes and biscuits, noncitric fruit, sweet spreads, and hot chocolate drinks increased significantly compared with their pre-pregnancy diet (Crozier et al., 2009). The higher sugar intake during pregnancy may cause some undesired health consequences. Thus, understanding the reasons why moms consume more sugars during pregnancy becomes important. In this section, sugar intake during pregnancy, and its association with GWG and PPWR will be discussed.

In one study, pregnant women reported that they consumed more sugar because they had to make compromises to balance their physical symptoms, lifestyle changes, and perceived nutrition requirements (Graham et al., 2013). Women stated that high sugar food choices could help them relieve some common physical symptoms of pregnancy, such as cravings, increased appetite, nausea, and fatigue (Graham et al., 2013). Women also felt that they were encouraged by others to consume high-sugar food items as they were pregnant and would need to “eat for two” (Graham et al., 2013). Unfortunately, pregnant women reported that they did not receive any advice from health practitioners regarding sugar intake (Graham et al., 2013). Identifying the importance of having appropriate sugar intake during pregnancy is critical, as evidence generated from many studies suggested that maternal sugar intake during pregnancy may pose risk toward both maternal and infant health.

1.4.1 Sugar intake in relation to GWG and maternal body composition

The positive association between added sugar intake and GWG has been identified in many research, studies including prospective cohort studies and observational studies conducted in Iceland, Norway, Germany, and the US (Maslova et al., 2015a; Olafsdottir et al., 2006; Renault et al., 2015; Starling et al., 2017a). Olafsdottir and colleagues (2015) identified that women who consumed more sweets had a higher risk of gaining excessive weight (OR=2.52). Monosaccharides and sucrose were also identified to be strongly associated with GWG in a prospective birth cohort conducted including 200 German pregnant women (Diemert et al., 2016). An increase in 1 g per day of sugar intake was associated with an increase of 26g of GWG over the course of pregnancy (Diemert et al., 2016).

The association between maternal sugar intake and maternal body composition changes has not been examined in the literature to date. This gap in the literature may be due to the limitations in the feasibility and accuracy of maternal body composition measuring methods, as methods that rely on radiation, such as DXA, are not ethically possible in the pregnant population. Performing SFT measurements on pregnant women is also complicated for several reasons. Firstly, the compressibility of the subcutaneous adipose tissue layer changes during pregnancy, which affects the SFT measurement (Widen & Gallagher, 2014). Moreover, edema, which is commonly presented during pregnancy, can also affect the SFT measurement (Widen & Gallagher, 2014). Lastly, equations specific to pregnant women are needed to be developed and applied to estimate their fat mass (FM) and fat-free mass (FFM) based on the SFT readings (Widen & Gallagher, 2014). Due to these concerns related to performing SFT on pregnant women, less research about pregnancy body composition has been conducted. Thus, future research projects about association between added sugar intake and maternal body composition changes could add significantly to the current body of literature.

Chapter 2 Rationale, Research questions, and Research objectives

2.1 Rationale

Pregnant women tend to consume more sugar sweetened food comparing with non-pregnant women who at the same age (Crozier et al., 2009). Their higher sugar intake during pregnancy might cause undesired health consequences, potentially, including excessive weight and FM gain and retention.

Gaining an adequate amount of weight during pregnancy is critical for supporting fetal development, but gaining excessive weight during pregnancy has been associated with many adverse health outcomes such as macrosomia, GDM, preeclampsia, and offspring obesity (Goldstein et al., 2017; Hedderson et al., 2010; Hrolfsdottir et al., 2015; Nohr et al., 2008). Similarly, excessive postpartum weight retention can lead to higher risk of obesity and associated chronic diseases (Endres et al., 2015; Wahabi et al., 2019). Excessive maternal FM gained during pregnancy and retention after pregnancy have been also been associated with higher chronic disease risk, including increased risks for developing type 2 diabetes, hyperglycemia, cardiovascular diseases (CVD) (Connor et al., 2014; Forsum et al., 2006).

Many studies have explored the association between dietary sugar intake and weight changes in non-pregnant populations (Drapeau et al., 2004; Ibe et al., 2014; Malik et al., 2013a; Morenga et al., 2013) but limited research has explored the impact of sugar on pregnant women's body weights, post-partum weight retention and body composition during pregnancy and postpartum. Currently, there are no dietary recommendations developed for PPWR and maternal body composition changes management.

By completing this research, we expect to fill the gaps in literatures by exploring the impact of maternal sugar intake on changes in body weight and body composition during and after pregnancy. This study may help health practitioners give appropriate advice to pregnant women regarding sugar intake based on scientific evidence.

2.2 Research questions

1. What is the relationship between maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) and GWG during three trimesters?
2. What is the relationship between maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) and the PPWR women from birth to 3 months postpartum?
3. What is the relationship between maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) and body composition of pregnant women during second and third trimesters?
4. What is the relationship between maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) and body compositions of pregnant women at 3 months postpartum?

2.3 Research objectives

1. Determine if maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) is associated with GWG during three trimesters?
2. Determine if maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) is associated with PPWR up to 3 months postpartum.
3. Determine if maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) is associated body composition changes during pregnancy.
4. Determine if maternal sugar intake (total sugar, free sugar, added sugar, and sugar from SSBs) is associated with postpartum body composition changes up to 3 months postpartum.

Chapter 3 Methods

The present study is a secondary data analysis of data from the Alberta Pregnancy Outcomes and Nutrition (APrON) study. The APrON study is a longitudinal prospective pregnancy and birth cohort study of pregnant women and their children living in Alberta, Canada. The primary aims of the APrON study are to determine the relationships between maternal nutrient intake and maternal health status, during and after gestation. Details about the rationale and methods for the APrON study were discussed by Kaplan and colleagues (2014). The present study explored the association between maternal dietary sugar intake and changes in maternal body weight and body composition during and after pregnancy.

3.1 Study protocol

Participants were recruited using various strategies by the APrON team, including posting posters at locations that pregnant women frequently visit (i.e., grocery stores, community centers, and family physician's office), advertising on local news, radio shows, newspapers, and banners along roads, visiting prenatal education classes and pregnancy and baby fairs, and word by mouth. Two different primary recruitment methods were applied in Calgary and Edmonton, as the health practice settings are different in these two cities. In Calgary, on-site recruitment was done by research assistants in waiting rooms of high-volume maternity care and ultrasound clinics. In Edmonton, recruitment focused on distributing the information across Edmonton's many less centralized clinics as well as the public media campaigns described above.

At the time of recruitment, pregnant women who were 16-years-old or older, had a gestational age less than 27 weeks, and who were living in one of the two major cities, Calgary or Edmonton, were eligible for the APrON study. Women who did not speak English or planned to move out of these two cities were excluded.

After the women expressed interest in participating in the APrON study, a research assistant contacted the potential participant and scheduled an initial meeting. A package containing the first set of questionnaires was also mailed to the potential participants' address. Informed consent was acquired before the first meeting. The project was approved by the University of Calgary Health Research Ethics Board and the University of Alberta Health Research Ethics Biomedical Panel.

3.2 Data collection

During pregnancy, data were collected once per trimester via questionnaires and in-person assessments. Women who were less than 13 gestational weeks when recruited were assessed up to three times in in pregnancy (1^{st}, 2^{nd}, and 3^{rd} trimester). Women who were at 14-27 gestational weeks when recruited were assessed up to twice (2^{nd} and 3^{rd} trimester). After pregnancy, women were asked to complete questionnaires and attend an in-person assessment at 3 months post-partum.

3.2.1 Maternal questionnaires

Sociodemographic data were collected using a demographic questionnaire which included questions about the woman's education, family income, family constellation, marital status, occupation. Other information that was collected included, health history (including mental health and medications), obstetric history, medication use, street drug and alcohol use, smoking history, and food security (Appendix A). In the subsequent visits, information that could potentially change was checked (i.e., marital status, medication use). Pregnancy related data were assessed at each visit, including pregnancy complications (e.g., nausea and vomiting) during pregnancy, and maternal physical activy during and after pregnancy.

3.2.2 Maternal dietary intake

Maternal dietary intake data were collected through 24-hr recalls at each study visit. The 24-hr recall is a structured approach aimed at capturing detailed information regarding participant's food and beverage intake in the past 24 hours (Knüppel et al., 2019). The 24-hr recall data can be used to assess total dietary intake and particular macro/micro-nutrients intake as it provides detailed dietary information, however, it is prone to bias due to its reliance on participants' memory. A single 24-hr recall is not able to account for the day-to-day variation in individual dietary intakes. However, 24-hr recalls from a single has been validated to capture the dietary intake of populations (Knüppel et al., 2019). Details such as type and quantity of the food, diet supplements, and beverage intake were all included in dietary data collection.

Starting in August 2010, an online Food Behaviour Questionnaires were used to conduct the 24-hr recall. The Food Behaviour Questionnaire was developed at the University of Waterloo, and it has been validated in pre-school aged children, First Nations, and Athletes, to understand food-related issues (Hanning et al., 2007, 2009; McCargar et al., 2003; Minaker et al., 2006; Skinner et al., 2013). Using this online tool, participants could choose from more than 800 foods to record their meals and snacks on the previous day. Pictures of foods and serving sizes were presented during the 24-hr recall, helping participants describe their meal accurately. At the end of the survey, a summary of participants' food and nutrient consumption compared to Canada's Food Guide was provided to the participants.

3.2.3 Maternal sugar intake

Maternal sugar intakes were calculated based on the maternal dietary intake collected from the online Food Behaviour Questionnaire using a sugar database developed at the University of

Guelph. The sugar database includes 640 food items' sugar content, including total sugar, free sugar, added sugar, and natural sugar.

The total sugar and natural sugar content of the foods was determined using the Canadian Nutrient File, US Department of Agriculture food composition database, and National Cancer Institute food composition database (Health Canada, n.d.; National Cancer Institute, 2020; USDA, n.d.); if no information was available in these databases, an estimation made based on the sugar content of similar food products (e.g., sugar content of a red pepper was applied to an orange pepper). For mixed dishes without a full sugar breakdown, recipes in which sugar information was available for the individual ingredients were used for estimating the sugar content. Added sugar content of foods was determined qualitatively based on the food categorization. For example, all sugar presented in a chocolate bar would be classified as added sugar, and all of the sugar content in fresh fruits would be classified as natural sugar. For the free sugar content, after identifying the food items which contain juices, the estimated amount of sugar in the juice plus the added sugar content for the food would be identified as free sugar content.

3.2.4 Maternal weight and body composition measurements

Anthropometric data, including weight, height, and SFT, was collected at each visit during pregnancy and at 3 months postpartum. All the data were collected by trained research assistants. Height was measured at the first visit and body weight was measured at every visit. Women were instructed to wear light clothing when coming to the anthropometric measuring visits. For height measurements, a digital stadiometer (HM200P Portstad Portable Stadiometer, Charder, Seattle, WA, USA) was used, and the readings were rounded to the nearest 0.1 cm. Weights were measured using a digital scale (Healthometer Professional 752KL, Pelstar LLC, Bridgeview, IL, USA) and measurements were rounded to the nearest 0.01 kg. Pre-pregnancy weight was self-reported.

Skinfold thickness measurements were performed at tricep, bicep, subscapular, supriliac, and thigh using Lange calipers (Beta Technologies, Inc., Cambridge, MD, USA). All measures were taken in triplicate on the participant's right aide, and the mean value was used. One research assistant conducted measurements of 68% of participants. The inter-rater reliability was determined by repeating the SFT measurements on every 50th participant. The coefficient of variation, representing the inter-rater reliability, for all sites, was between 2.8% to 5.1%, which represented a low variation. The inter-rater reliabilities were at least 15%, and the intra-rater reliability were no less than 12% (Kaplan et al., 2014).

The GWG was calculated as the difference between pre-pregnancy body weight and the weight measured at the 3rd trimester visit, and the PPWR was calculated as the difference between postpartum weight (measured at 3 months postpartum) and the self-reported pre-pregnancy weight.

Maternal body fat mass was computed from SFT data through a series of calculations. First, the sum of biceps, triceps, subscapula, and supreiliac SFT was used to estimate the maternal body density (Durnin & Womersley, 1974). An equation developed specifically for pregnant women was used to calculate maternal fat mass % based on the predicted body density (Van Raaij et al., 1988). An equation for non-pregnant women was used to calculate the maternal body fat mass % after pregnancy (SIRI, 1956).

Total fat mass gained in pregnancy was calculated as the difference in FM between second trimester and third trimester, and fat mass retention was difference in FM between postpartum and third trimester.

3.2.5 Statistical analyses

Baseline characteristics of the participants were be summarized by calculating frequencies for categorical variables; means and standard deviation for continuous variables. Linear regression was performed to evaluate how much variance in weight and fatness change during and after pregnancy could be explained by dietary sugar intake. A Total of 36 models were built to explore the association between 4 types of dietary sugar intake (i.e., total sugar, added sugar, free sugar, and fructose) and maternal weight/fatness changes during and after pregnancy. An additional 4 models were built to understand if there is an association between SSB intake (total sugar and numbers of servings) and maternal weight and/or fatness change during and after pregnancy. R square, R square change, unstandardized coefficient (B), 95% confidential intervals (CI), and standardized coefficient (β), and variance inflation factor (VIF) was calculated and used to assess multicollinearity between independent factors and outcomes. The VIFs for all factors were all within acceptable range in all models.

A list of confounding variables, including maternal age, education, ethnic origin, marital status, income, pre-pregnancy BMI, number of live children, smoking during pregnancy, social support, exercise, breastfeeding status, were selected based on evidence from the literature. The associations between these potential confounding variables and outcomes were examined, and only significant predictors of sugar intakes for weight and/or fat gain were included in the corresponding regression models.

Chapter 4 Results

4.1 Demographics

Initially, data for 2190 participants were available from the APrON study. Participants who had GDM, T1DM, and T2DM (n=81) were excluded from the study because diabetes influences carbohydrate intake and metabolism, which may impact the outcomes of interest in this study. Because for the first 985 participants, the 24-hr recalls were conducted through in-person interviews, and the food codes used in these visits vary from those the food codes used in the sugar database, participant who did not complete the 24-hr recall using the online Food Behaviour Questionnaire (n=985) were also excluded. Participants who did not report all demographic variables that were included in the statistical analysis (n=241) were excluded from the study. Participants younger than 20 (n=20) were excluded from the study because the IOM weight gain guidelines only apply to adult pregnant women (20 or older) (IOM, 2009). A total of 863 participants were included in this study.

Table 1 shows the characteristics of the 863 participants who were included in the final analyses. It is important to note that not all regression models include all 863 participants as not all participants reported dietary intake or weight/fatness change at each time point. For example, only 149 participants were recruited early enough in their pregnancies to provide their dietary intake and weight/fatness data during their first trimester. The mean age of the participants was 31 years, ranging from 20 to 44 years old. Nearly three-quarters (71%) of the participants had completed a university degree or higher and 57% had a total income higher than $100,000. The leading ethnic origin group in the sample was Caucasian (78.6%), followed by the Asian group (13.3%). The majority of participants (63.7%) had a pre-pregnancy BMI within the healthy range and approximately one third of participants were identified as overweight or obese based on their pre-pregnancy BMI. More than half of the participants were in their first pregnancy (56.4%), and nearly all participants were non-smokers during pregnancy (98.4%). For mothers who had reported breastfeeding status, most all of them were engaging in fully breastfeeding practice.

Table 2. Characteristics of pregnant women in the APrON Study included in this analysis.

Characteristic	**Mean±SD (Range) or n(%) n=863**
Age (year)	31.27±4.19 (20-44)
Education	
Completed high school diploma or less	93 (10.8)
Completed trade, technical school	160 (18.5)
Completed university	415 (48.1)
Completed post-grad	195 (22.6)
Marital Status	
Married or common-law	837 (97.0)
Single (never married)	22 (2.5)
Separated or divorced	4 (0.4)
Widowed	0 (0)
Total income	
Less than $40.000	71 (8.2)
$40,000 - $69,999	116 (13.4)
$70,000 - $99,999	181 (21.0)
$100,000 or more	495 (57.4)
Ethnic origin	
Black	12 (1.4)
Caucasian/White	678 (78.6)
Asian	116 (13.3)
Latin American	29 (3.4)
Native/Aboriginal Peoples of North America	11 (1.3)
Other	17 (2.0)
Trimester when entered the study	
First Trimester	149 (17.3)
Second Trimester	714 (82.7)
Pre-pregnancy weight (kg)	66.37±14.34 (42-131.54)
Pre-pregnancy BMI classification	
Underweight	26 (3.0)
Normal Weight	550 (63.7)
Overweight	187 (21.7)
Obese	100 (11.6)
Number of live children	
0	487 (56.4)
1	296 (34.3)
2 or more	80 (9.3)
Smoking status during pregnancy	
Yes	14 (1.6)
No	849 (98.4)
Infant birth weight (g)	3342.9±544.1
Breastfeeding status at 3 months postpartum	
Fully breastfeeding	393 (49.5)

Not fully breastfeeding	49 (5.7)
Missing	421 (48.8)

4.2 Maternal dietary intake, weight changes, and fatness changes

Maternal dietary sugar intake seemed increased over the course of pregnancy and decreased after pregnancy, both in total intake and in % of energy coming from sugars (Table 2). Average maternal weight and fatness changes were also presented. (Table 3 and Table 4). Both body weight and body fatness increased during pregnancy and decreased at the 3 months post-partum visit.

Table 3. Maternal dietary sugar intake at different time points.

	First trimester (n=192)	**Second trimester (n=844)**	**Third trimester (n=781)**	**Across whole pregnancy (n=863)**	**3-months postpartum (n=773)**
Total sugar gram per day (% of total energy intake)	106.7±52.1 (19.5%)	117.3±51.4 (22.4%)	126.0±57.6 (25.0%)	119.7±44.1 (22.0%)	104.9±53.1 (18.6%)
Added sugar gram per day (% of total energy intake)	49.7±39.7 (9.2%)	57.8±40.6 (11.1%)	64.3±44.4 (12.7%)	59.6±34.2 (11.0%)	57.6±42.7 (10.3%)
Free sugar gram per day (% of total energy intake)	66.7±45.6 (12.3%)	75.0±46.0 (14.4%)	80.5±50.1 (16.0%)	76.1±39.0 (13.9%)	69.5±46.7 (12.6%)
Fructose gram per day (% of total energy intake)	25.4±15.2 (4.5%)	26.4±15.1 (5.1%)	27.2±16.0 (5.4%)	26.5±12.5 (4.9%)	22.2±15.2 (4.0%)

Table 4. Maternal weight changes across pregnancy and until 3 months postpartum.

	Pre-pregnancy to 1st trimester (n=187)	**1st to 2ndtrimester (n=171)**	**2nd to 3rd trimester (n=755)**	**pre-pregnancy to 3rd trimester pregnancy (n=764)**	**3rd trimester to 3 months postpartum (n=554)**
Weight change (grams/wk)	149.37±247.1	354.7±340.5	560.6±246.0	375.2±144.3	-663.6± -310.7

Table 5. Maternal fatness changes at different time points.

	1st to 2nd trimester (n=197)	**2nd to 3rd trimester (n=781)**	**3rd trimester to 3-month postpartum (n=773)**
Fatness change (gram/wk)	94.4±259.1	206.9±205.0	-180.3 ± 253.2

Among the 764 participants who have completed their third-trimester visits and reported their pre-pregnancy weight, 218 (28.6%) participants gained excessive weight based on the IOM guideline. Participants were categorized based on their pre-pregnancy BMI. Of the 499 participants who had a pre-pregnancy BMI within the normal weight range, 79 (15.8%) had gestation weight gain that exceeded the IOM recommendations. It is also important to note that almost half of these participants (47.5%) had their GWG below the recommendation, indicating inadequate GWG. For the overweight and obese group, 95 (58.2%) and 44 (55.6%) participants had excessive gestational weight gain, respectively.

Table 6. Maternal gestational weight gain in comparison to the IOM guideline.

Pre-pregnancy BMI	GWG less than recommendation	GWG within the recommendation	GWG above the recommendation
Underweight (n=23)	10 (43.5%)	13 (56.5%)	0 (0%)
Normal (n=499)	237 (47.5%)	183 (36.7%)	79 (15.8%)
Overweight (n=163)	15 (9.2%)	53 (32.5%)	95 (58.2%)
Obese (n=79)	15 (19.0%)	20 (25.3%)	44 (55.6%)
Total (n=761)	277 (36.4%)	269 (35.2%)	218 (28.6%)

4.3 Associations between dietary sugar intakes and weight/fat change

When examining the associations between maternal weight change and the four types of sugar intake, no significant associations were found in the weight change between pre-pregnancy and first trimester, between the first and second trimesters or during the whole pregnancy (pre-pregnancy to 3rd trimester). Total sugar was a significant predictor of maternal weight gain per week between the second and third trimesters (Table 5). Maternal weight would increase .46g per week for each gram of total sugar intake per day. After including maternal calorie intake into the model, the regression equation remained significant ($F(20,723) = 3.87$), $p<.001$), with an R^2 of .097; but total sugar was no longer a significant predictor of maternal weight gain in the third trimester.

Similar results were found for added sugar intake and free sugar intake in relation to maternal weight gain between the second and third trimesters (Table 6 & Table 7). For each gram of added sugar and free sugar intake per day, the weight would increase 0.52g and 0.51g, respectively. However, once maternal calorie intake was entered into the model, sugar intake became non-significant predictors for maternal weight change. No significant regression equation was found between maternal fructose intake and maternal weight change between the second and third trimesters.

Table 7. Regression results for maternal total sugar intake and maternal weight changes at between the second and third trimesters (n=744).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-5.08	2.36	-.09	-2.15	.03	-5.34	2.34	-.09	-2.28	.02
Education	-13.01	10.65	-.05	-1.22	.22	-15.05	10.57	-.06	-1.42	.16
Ethnic (Ref=white)										
Black	330.21	84.45	.15	3.91	<.001	312.44	83.80	.14	3.73	<.001
Asian	-25.25	29.18	-.04	-.87	.39	-27.41	28.91	-.04	-.95	.34
Latin	-50.71	49.96	-.04	-1.02	.31	-40.81	49.57	-.03	-.82	.41
Native	-27.57	92.90	-.01	-.26	.79	-21.80	92.06	-.01	-.24	.81
Arab	60.72	110.40	.02	.48	.63	47.41	109.44	.02	.43	.67
Other	-141.53	81.86	-.06	-1.73	.08	-128.33	81.18	-.06	-1.58	.11
Marital status (Ref=married)										
Single	33.56	62.91	.02	.53	.59	33.69	62.34	.02	.54	.59
divorced	94.36	241.881	.01	.39	.70	101.20	239.67	.02	.42	.67
Common law	16.84	28.85	.02	.58	.56	16.59	28.59	.02	.58	.56
Separated	89.63	140.83	.02	.64	.53	75.84	139.58	.02	.54	.59
Income	-13.90	10.09	-.06	-1.38	.17	-10.68	10.03	-.05	-1.07	.29
Pre-pregnancy BMI	.61	1.94	.01	.31	.75	.10	1.92	.01	.05	.96
Live children	-5.86	13.41	-.02	-.44	.66	-7.88	13.29	-.02	-.59	.55
Smoker during pregnancy	-21.34	77.57	-.01	-.28	.78	-16.25	76.87	-.01	-.21	.83
Social support	7.28	3.88	.07	1.89	.06	6.95	3.84	.07	1.81	.07
Exercise	-9.81	7.43	-.05	-1.32	.19	-6.66	7.41	-.03	-.90	.37
Total Sugar	**.46**	**.16**	**.11**	**2.88**	**.01**	**.06**	**.20**	**.02**	**.34**	**.74**
Total kcal intake						**.07**	**.02**	**.17**	**3.80**	**<.001**
R square	.08					.10				
R square change	.08					.02				
F	3.25**					3.87**				

Table 8. Regression results for maternal added sugar intake and maternal weight changes between the second and third trimesters (n=744).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-5.13	2.36	-.09	-2.17	.03	-5.30	2.34	-.09	-2.27	.02
Education	-11.51	10.64	-.04	-1.08	.28	-14.97	10.56	-.06	-1.42	.16
Ethnic (Ref=white)										
Black	336.33	84.77	.15	4.00	<.001	316.08	84.01	.14	3.76	<0.001
Asian	-27.44	29.23	-.04	-.94	.35	-25.48	28.92	-.04	-.88	.38
Latin	-46.81	50.04	-.03	-.94	.35	-39.91	49.54	-.03	-.81	.42
Native	-24.51	93.02	-.01	-.30	.77	-21.44	92.03	-.01	-.23	.82
Arab	53.02	110.41	.02	.55	.58	49.39	109.23	.02	.45	.65
Other	-141.83	81.97	-.06	-1.73	.08	-127.94	81.16	-.06	-1.58	.12
Marital status (Ref=married)										
Single	39.14	62.96	.02	.62	.53	34.47	62.30	.02	.55	.58
divorced	94.56	242.22	.01	.39	.70	102.92	239.64	.02	.43	.67
Common law	15.78	28.90	.02	.55	.59	16.18	28.59	.02	.57	.57
Separated	90.21	141.03	.02	.64	.53	77.34	139.56	.02	.55	.58
Income	-13.90	10.11	-.06	-1.38	.17	-10.48	10.04	-.04	-1.05	.30
Pre-pregnancy BMI	.50	1.94	.01	.26	.80	.06	1.92	.01	.03	.98
Lived children	-7.01	13.41	-.02	-.52	.60	-7.98	13.27	-.02	-.60	.55
Smoker during pregnancy	-28.21	77.62	-.01	-.36	.72	-.17.16	76.83	-.01	-.22	.82
Social support	7.30	3.89	.07	1.88	.06	6.85	3.84	.07	1.78	.08
Exercise	-8.67	7.50	-.04	-1.16	.25	-6.22	7.44	-.03	-.84	.40
Added Sugar	**.52**	**.21**	**.10**	**2.52**	**.01**	**.15**	**.23**	**.03**	**.66**	**.51**
Total kcal intake						**.06**	**.02**	**.16**	**4.09**	**<.001**
R square	.05					.08				
R square change	.08					.02				
F	3.14**					3.88**				

Table 9. Regression results for maternal free sugar intake and maternal weight changes between the second and third trimesters (n=744).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-5.05	2.36	-.09	-2.14	.03	-5.27	2.34	-.09	-2.25	.03
Education	-11.79	10.63	-.04	-1.08	.28	-15.01	10.55	-.06	-1.42	.16
Ethnic (Ref=white)										
Black	337.44	84.67	.15	4.00	<.001	316.97	83.99	.14	3.77	<0.001
Asian	-25.36	29.24	-.04	-.87	.39	-24.72	28.95	-.04	-.85	.39
Latin	-51.63	49.98	-.04	-.1.03	.30	-41.47	49.55	-.03	-.84	.40
Native	-22.02	92.94	-.01	-.24	.81	-20.73	92.02	-.01	-.23	.82
Arab	56.04	110.33	.02	.51	.61	50.60	109.25	.02	.46	.64
Other	-145.93	81.88	-.07	-1.78	.08	-129.40	81.17	-.06	-1.59	.11
Marital status (Ref=married)										
Single	34.15	62.94	.02	.54	.59	33.02	62.31	.02	.53	.60
divorced	94.80	242.00	.01	.39	.70	102.97	239.60	.02	.43	.67
Common law	15.48	28.87	.02	.55	.59	16.06	28.59	.02	.56	.57
Separated	89.91	140.89	.02	.64	.52	77.57	139.53	.02	.55	.58
Income	-14.18	10.09	-.06	-1.41	.16	-10.62	10.03	-.05	-1.06	.30
Pre-pregnancy BMI	.59	1.94	.01	.30	.76	.09	1.92	.01	.05	.96
Lived children	-6.31	13.41	-.02	-.52	.60	-7.74	13.28	-.02	-.60	.56
Smoker during pregnancy	-23.51	77.58	-.01	-.30	.76	-15.94	76.83	-.01	-.21	.84
Social support	7.50	3.87	.07	1.94	.05	6.92	3.84	.07	1.80	.07
Exercise	-8.58	7.48	-.04	-1.16	.25	-6.21	7.43	-.03	-.84	.40
Free Sugar	**.51**	**.18**	**.10**	**2.76**	**.01**	**.16**	**.20**	**.03**	**.77**	**.443**
Total kcal intake						**.06**	**.02**	**.16**	**4.00**	**<.001**
R square	.08					.10				
R square change	.08					.03				
F	3.21**					3.87**				

Table 10. Regression results for maternal total sugar intake and maternal fatness changes between the second third trimesters (n=629).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-2.63	2.13	-.05	-1.24	.22	-2.82	2.10	-.06	-1.42	.16
Education	-7.97	10.19	-.03	-.78	.43	-10.26	10.05	-.04	-.94	.35
Ethnic (Ref=white)										
Black	63.78	92.63	.03	.69	.49	12.87	92.05	.01	.30	.77
Asian	8.12	28.62	.01	.28	.78	11.88	28.23	.02	.38	.70
Latin	23.37	48.16	.02	.49	.63	33.80	47.53	.02	.50	.62
Native	121.80	92.62	.05	1.32	.19	129.38	91.30	.05	1.26	.21
Arab	106.50	104.51	.04	1.02	.31	75.26	103.27	.03	.79	.43
Other	-99.66	73.33	-.06	-1.36	.16	-91.45	72.30	-.05	-1.20	.23
Marital status (Ref=married)										
Single	-126.54	59.82	-.09	-2.12	.04	-121.06	.58.98	-.09	-2.00	.05
divorced	200.26	204.06	.04	.98	.33	207.26	201.14	.03	.86	.39
Common law	15.57	26.35	.02	.59	.56	11.12	26.00	.01	.31	.76
Separated	-44.12	119.23	-.02	-.45	.65	-59.48	117.58	-.03	-.62	.54
Income	-4.45	9.80	-.02	-.45	.65	-1.27	9.69	-.01	-.24	.81
Pre-pregnancy BMI	-3.60	1.78	-.08	-3.03	.04	-4.33	1.76	-.10	-2.30	.02
Lived children	1.18	12.33	.01	.10	.92	-.03	12.16	-.01	-.05	.96
Smoker during pregnancy	70.87	65.63	.04	1.08	.28	78.03	64.71	.05	1.23	.22
Social support	2.26	3.54	-.01	-.17	.87	1.50	3.50	.02	.34	.74
Exercise	.20	6.71	.01	.03	.98	3.56	6.66	.01	.29	.78
Total Sugar	**.52**	**.15**	**.15**	**3.55**	**<.001**	**.11**	**.17**	**.07**	**1.61**	**.11**
Total kcal intake						**.06**	**.02**	**.16**	**3.40**	**.001**
R square	.05					.08				
R square change	.05					.03				
F	1.85*					2.36**				

Table 11. Regression results for maternal free sugar intake and maternal fatness changes between the second and third trimester (n=629).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-2.68	2.14	-.06	-1.25	.21	-2.81	2.10	-.06	-1.44	.15
Education	-5.98	10.19	-.03	-.59	.56	-9.98	10.05	-.04	-.87	.39
Ethnic (Ref=white)										
Black	70.14	93.02	.03	.75	.45	13.32	92.15	.01	.30	.76
Asian	4.30	28.70	.01	.15	.88	11.85	28.24	.02	.34	.73
Latin	22.92	48.34	.02	.47	.64	33.74	47.55	.02	.49	.62
Native	124.65	92.93	.05	1.34	.18	130.21	91.30	.05	1.26	.21
Arab	100.61	104.86	.04	.96	.34	74.43	103.16	.03	.76	.45
Other	-105.12	73.56	-.06	-1.43	.15	-92.31	72.32	-.05	-1.22	.23
Marital status (Ref=married)										
Single	-122.93	60.00	-.09	-2.05	.04	-120.47	58.94	-.08	-1.96	.05
divorced	198.55	204.75	.04	.97	.33	207.61	201.16	.03	.85	.40
Common law	14.25	26.45	.02	.54	.59	10.70	26.00	.01	.26	.80
Separated	-45.79	119.63	-.02	-.38	.70	-59.74	117.57	-.03	-.64	.52
Income	-5.29	9.83	-.02	-.54	.59	-1.26	9.70	-.01	-.26	.80
Pre-pregnancy BMI	-3.62	1.78	-.09	-2.03	.04	-4.36	1.76	-.10	-2.33	.02
Lived children	.88	12.37	.01	.07	.94	-.10	12.16	-.01	-.07	.95
Smoker during pregnancy	67.68	65.83	.04	1.03	.30	77.84	64.71	.05	1.23	.22
Social support	2.79	3.54	.03	.79	.43	1.55	3.49	.02	.37	.71
Exercise	1.26	6.77	.01	.19	.85	3.93	6.68	.02	.39	.70
Free Sugar	**.49**	**.17**	**.12**	**2.92**	**.01**	**.11**	**.18**	**.06**	**1.38**	**.17**
Total kcal intake						**.07**	**.02**	**.17**	**3.86**	**<.001**
R square	.05					.07				
R square change	.05					.02				
F	1.62*					2.32**				

4.3.2 Maternal dietary sugar intake and fatness change

Eight models were built to explore the association between dietary sugar intake (total sugar intake, free sugar intake, added sugar intake, and fructose intake) and maternal fatness change per week between the first and second trimesters and between the second and third trimesters. No significant associations were found in the first four models regarding dietary sugar intake and fatness change between the first and second trimesters.

Total sugar was identified as significant predictor of maternal fat gain per week between the second and third trimesters. For each gram of total sugar intake per day, maternal fatness would increase .52g per week. Total sugar became a non-significant predictor of maternal fatness gain per week between the second and third trimesters when maternal calorie intake was added to the model. A similar relationship was found between maternal fatness gain and maternal dietary free sugar intake between the second and third trimesters. Free sugar was a significant predictor of maternal weight gain per week between the second and third trimesters. For each gram of free sugar intake per day, the fatness would increase .49g per week. After including the maternal calorie intake into the model, free sugar became a non-significant predictor of maternal weight gain per week in the third trimester. When examining maternal added sugar intake and fructose intake, no significant associations were found in relation to maternal fatness change between the second and third trimester.

4.3.3 Results at 3-month postpartum

Eight models were created to understand relationships between maternal sugar intake and maternal fatness/weight change per week between the third trimester and 3-months postpartum. No significant regression equations were identified for this interval.

4.3.4 Maternal SSB intake and maternal weight/fatness change

No significant associations were found when examining the relationship between maternal dietary SSB intake (total sugar contained in SSB and numbers of serving) with maternal weight and fatness change during pregnancy or at 3-month postpartum.

Chapter 5 Discussion

This study is the first to explore four different ways to describe of sugar intake, including total sugar, added sugar, free sugar, and fructose, in relation to both maternal weight and fatness changes during and after pregnancy. We showed that both total and free sugar intake was significantly associated with higher gestational weight and fatness gain between the second and third trimester. In addition, maternal added sugar intake was significantly associated with maternal weight gain between the second and third trimester. The effect remained significant after adjusting for multiple sociodemographic confounding variables, but disappeared when models were adjusted for caloric intake suggesting that maternal sugar intake promotes maternal weight/fatness gain by increasing energy intake.

5.1 Demographics

This sample population had higher socioeconomic status compared with the general Canadian population. According to Statistics Canada (2017), 40.7% of Canadian women aged

24-36 had bachelor's degrees or higher, whereas 70.7% of the participants in this study had a university degree or higher. In addition, in 2012, the same year our data was collected, two-parent families with children in Alberta had a median after-tax income of $84,600, (Statistics Canada, 2014); in contrast, 57.4% of participants in this study had an annual family income higher than $100,000. Therefore, compared with Canada's whole pregnant women population, the sample group is more highly educated and wealthier. Other than the higher socio-economic status, our participants had a lower dietary sugar intake than that seen in other populations of pregnant women. While the findings of this study can not necessarily be generalized to the broader population of Canadian women, a significant association between sugar and weight was seen in this very healthy population, suggesting that potentially, the effects may be more pronounced in a population with a higher sugar intake and more significant weight gain.

5.2 Maternal dietary sugar intake

Participants in this study had lower sugar intake compared with other populations. For example, based on the NHANES data from 2003-2012, on average, American pregnant women aged between 20-39 years old had 85.1g (14.8% of energy) added sugar intake (Cioffi et al., 2018); in contrast, participants in this study only had, on average, 58.62g (10.91% of energy) added sugar intake during pregnancy. Data from the 2015 CCHS shows that non-pregnant Canadian females consumed 75 g (15.2% of energy) total sugar and 47.6g (11.7% of energy intake) free sugar intake (Langlois et al., 2019; Rana et al., 2021). In comparison, pregnant women from this study consumed 119.7 g (22.0%) total sugar and 76.1 g (13.9%) free sugar during pregnancy, which slightly higher than the CCHS's non-pregnant Canadian females' intake. Our participants' low sugar intake potentially can be due to their high socio-economic status; evidence from other studies suggested a higher socio-economic status is significantly associated with less dietary sugar intake (Blumfield et al., 2016; KM & AL, 2009; Konttinen et al., 2013; Shupler & Raine, 2017). The sugar intake of women in our study may be higher than that found in the CCHS due to pregnancy, as some studies have shown that sugar intake increases during pregnancy. It could also reflect differences in the methods of calculating sugar intakes between the two studies (Rana et al., 2021). The CCHS study only used Canadian Nutrient File to calculate the total sugar intake, and the food items that were missing in the Canadian Nutrient File were set to have zero sugar value (Rana et al., 2021). In contrast, our sugar database included data from not only Canadian Nutrient File, but also US Department of Agriculture food composition database, and National Cancer Institute food composition database. No sugar values were missing for the food items included in this study.

When our participants' sugar intake was compared with the DRI recommendation (i.e., added sugar intake should be less than 25% of the total energy intake), most participants (97.6%) met this recommendation. However, when comparing intakes observed in this study with the WHO guidelines (i.e., free sugar intake should be less than 10% of the total energy intake), nearly three-quarters of participants (72.5%) exceeded the WHO recommendation; furthermore, only 113 participants (13.1%) had free sugar intake less than 5% of total energy intake which was proposed by WHO as a future consideration.

5.3 Maternal weight and fatness changes

Among the 764 participants who have completed their third-trimester visits and reported their pre-pregnancy weight, 218 (28.6%) participants gained excessive weight based on the IOM guideline. Excessive weight gain was more common in overweight and obese women, with 58.2% and 55.6% of these women gaining excessive weight, respectively. Similar results were found in a study which included 12,830 pregnant women from Nova Scotia (Ashley-Martin & Woolcott, 2014). Researchers found that women who were overweight and obese at pre-pregnancy had a significantly higher chance of gaining excessive weight during pregnancy (Ashley-Martin & Woolcott, 2014). Similar results were found in another APrON study. Bergum and colleagues (2012) identified that women whom GWG exceeded the IOM guideline were more like to be overweight (OR 5.5) or obese (OR 6.5).

In another APrON study, Jarman and colleagues (2016) identified that among 1541 participants they included in their study, 49.4% of participants exceeded the IOM guideline for total gestational weight gain, and most of the participants who gained excessive weight were either overweight or obese at pre-pregnancy. Despite the fact that our study also used the APrON data, of the 863 participants included in this study, only 28% of participants had excessive GWG. It is important to note that more than half of participants included in Jarman and colleagues' study had an overweight or obese pre-pregnancy BMI (27.1% and 34.5% respectively); whereas in our analysis, only 21.3% of participants were overweight and 10.3% were obese at pre-pregnancy. The difference between the results further supported the idea that women who were overweight or obese at pre-pregnancy have higher chance to gain excessive weight during pregnancy.

Few studies have examined changes in maternal fat mass during pregnancy. However, the results from this study are similar to those of a study included twenty women (or mothers) of twins from US (Gandhi et al., 2018). Participants from this study had 27.3±8.3 kg fat at the second trimester visit and 29.9±8.3 kg fat at the third trimester visit. Gandhi and colleagues (2018) measured moms' fat mass through air displacement plethysmography (ADP), and their participants had 27.8±6.3 kg fat at the second trimester and 29.0±6.2kg at the third trimester, which is similar to what has been measured in this study: 27.3 kg at the second trimester and 29.9kg at the third trimester.

5.4 Associations between sugar intake and weight/fatness gain

In our study, sugar intake was significantly related to weight gain and fatness gain between the second and third trimesters. Many previous studies have demonstrated an association between maternal sugar intake and GWG. In the Healthy Star prospective cohort study, researchers identified that participants whose dietary pattern included high consumption of added sugar had greater GWG (Starling et al., 2017b). In another study which focused on examining how protein/carbohydrate ratio and added sugar impact GWG, researchers found that added sugar intake was associated with GWG among 46,262 Danish pregnant women (Maslova et al., 2015b). In this study, it was identified that total, free, and added sugars were significantly associated with maternal weight gain and fatness gain during the third trimester. Our study also showed that maternal calorie intake played an essential role in the association between maternal sugar intake and maternal weight/fatness change. After including maternal calories intake into the regression model, all significant associations between sugar intakes and weight/fatness changes were no longer significant. Thus, maternal calorie intake was a mediator in the relationship between maternal sugar intake and maternal weight/fatness change with high maternal sugar intake increasing maternal calorie intake, which, consequently, is associated with increases in gestational weight and fatness gain. The link between increased sugar intake, increased caloric intake, and weight gain has been identified in many non-pregnancy related studies showing that this is a likely mechanism for the link between sugar intake and weight gain in non-pregnant populations (Drapeau et al., 2004; Malik et al., 2013b; Morenga et al., 2013). Our study demonstrates that this also appears to be the mechanism during pregnancy. Other possible mechanisms include the unique metabolic response of fructose, as fructose intake impacts both lipid metabolism and insulin circulation (Boscá & Corredor, 1984; Hannou et al., 2018). However, in this study, no significant association was found between maternal fructose intake and maternal weight/fatness change at any given time point. Therefore, based on the evidence presented in this study, it is proposed that the unique metabolism of fructose is not the reason that causes weight gain, at least in this pregnant population.

There was no association identified between dietary sugar intake and weight/fat gain between the first and second trimesters or from pre-pregnancy to the end of pregnancy. Similarly, Olafsdottir and colleagues (2006) found that maternal macronutrient intake was significantly associated with gestational weight change in later pregnancy but not in early pregnancy. The greater likelihood of finding significant associations in the third trimester can be due to various reasons. Firstly, because many participants did not participate in the APrON study until their second trimester, the sample size available when examining weight and body fatness changes between the second and third trimesters is much bigger than the samples with complete data between the first and second trimesters. Small sample sizes decrease the power of detecting a significant difference; thus, it is possible that the smaller sample size limited the ability to identify a significant result in the first and second trimester. However, it is important to note that no significant association was found during the whole pregnancy despite a larger sample size. Thus, the effect of sample size is only one of many factors potentially impacting the result. Secondly, only 5% of the total GWG is gained in the first trimester, and the remainder 95% will be gained during the last two trimesters (Institute of Medicine, 1947); thus, the small amount of weight change that occurred over the first trimester makes it difficult to identify a statistically significant differences at that time. Thirdly, the human placental growth hormone (PGH), is only secreted starting in mid-pregnancy, and this can potentially explain the significant association between dietary sugar intake and maternal weight gain in later pregnancy. The PGH is not regulated by the placenta but responds inversely to glucose and insulin levels in the maternal body, helping dispose of glucose to the fetus in later pregnancy (Velegrakis et al., 2017). Therefore, higher maternal sugar intake can promote PGH secretion, promoting fetal weight gain, which, consequently, appearing in increased GWG (Malamitsi-Puchner et al., 2005).

Gaining more than recommended weight during third trimester can be a significant problem among pregnant women in Canada as it is associated with many complications, including a higher risk of pregnancy-induced hypertension, LGA, macrosomia, higher risk of cesarean section, preterm birth (Drehmer et al., 2013; Gonzalez-Ballano et al., 2021; Sridhar et al., 2016). As higher sugar intake is associated with higher GWG in the third trimester, advising a lower sugar intake may help prevent excessive GWG in later pregnancy, consequently lowering the risk for these pregnancy-related complications. Excessive GWG is also associated with risk of increased postpartum BMI (Mannan et al., 2013). The PPWR which can increase risks for many other health complications related to overweight and obesity, including diabetes, hyperglycemia, postpartum depression, and hemorrhage (Brunk, 2009; Butwick et al., 2018; Fan et al., 2019). Currently, almost one-half (48.8%) of Canadian pregnant women gain more weight than recommended during pregnancy (Lowell & Miller, 2010); thus, identifying appropriate approach to help preventing excessive GWG would be important.

The findings of this study are also important because, currently, there is no recommendation to advise women regarding their dietary sugar intake during pregnancy. As we found in this study that current participants' dietary sugar intake was significantly associated with higher gestational weight gain and higher maternal fatness gain between the second and third trimesters and we found that most women's added sugar intakes were under the DRI sugar recommendation for added sugar, this study suggests that relying on the DRI dietary sugar intake recommendation may not be stringent enough to help pregnant women maintain their GWG within the healthy range. The WHO guidelines could be used as a goal for pregnant women in order to maintain their GWG and fatness gain within the healthy range; however, meeting the WHO guideline may be challenging for the Canadian pregnant women population, as even in this upper middle-class sample population, in which dietary sugar intake is much lower than the sugar intake of the US general population, most women still exceeded the WHO guideline. Future studies are required to determine an optimal sugar intake goal for reducing risk of excessive gestational weight gain.

5.5 SSB intake

No significant association was found between maternal SSB intake and maternal weight/fatness change in this study. This finding is in contrast ton a study which included 495 healthy pregnant Icelandic women, inwhich researchers identified that each serving of SSB intake per day was associated with 0.46 kg of weight gain in the third trimester and 0.52 kg of weight retention at 1-month postpartum (Mahabamunuge et al., 2020). Their participants, on average, had 0.9 and 0.7 servings of SSB intake per day in the 3rd trimester and at 1-month postpartum, respectively (Mahabamunuge et al., 2020); whereas our participants only had half of their intake: 0.36 (SD: 0.75) servings per day during pregnancy and 0.37 (SD:0.59) 3-month postpartum. The low SSB intake in our population may explain the dissimilar results.

5.6 Postpartum

No significant association between sugar intake and weight/fat retention was identified in this study at the three-month postpartum study visit. One previous study has identified and effect of sugar on postpartum weight retention. In a study of 99 Hispanic women from Southern California, Alderete and colleagues (2020) found that each 1 gram of added sugar intake per day was associated with 0.05 kg postpartum weight retention from 1 month to 6 months postpartum. In addition, one serving (236.6ml) of soft drink per day was associated with a 1.52 kg increase in the maternal postpartum weight. The average maternal total sugar intake was 87.7±31.9 gram (20.8% of energy), and the added sugar intake was 46.9±22.8 gram (10.9% of energy) (Alderete et al., 2020), which are similar to participants' dietary intake in the present study. The differences in the findings may be due to various reasons. Firstly, previous evidence has suggested that higher pre-pregnancy BMI and excess GWG are associated with higher PPWR (Ketterl et al., 2018; Rong et al., 2015). In our study, 63.7% of participants had a pre-pregnancy BMI within the normal weight range, and 77.2% of participants gained appropriate weight during pregnancy based on the IOM guideline. In contrast, in the study conducted by Alderete and colleagues (2020), 84.9% of participants were either overweight or obese based on their pre-pregnancy BMI (Alderete et al., 2020). Thus, the association between sugar intake and PPWR may only be present in the overweight and obese population. Secondly, only 99 participants were included in Alderete and colleagues' study (2020). The small sample size may increase the probability of having type 1 error, which would make their results prone to become false-positive. Lastly, Alderete and colleagues (2020) chose to measure weight at 6-months postpartum, whereas in our study, weight was measured at 3-months postpartum. The longer interval may increase the probability of detecting a significant difference.

Chapter 6 Strengths and limitations

One of the limitations of this study is the high probability of type 1 error which would increase the risks of having false positive results (Andrade, 2019). A total of 40 models were made to examine the associations between various sugar and maternal weight/fatness changes.

Because creating multiple comparisons can increase the probability of type 1 error (McKillup, 2005), potentially, our results could contain false positives. However, having the large sample size can potentially combat the effects of multiple comparisons (Columb & Atkinson, 2016). Increase the threshold for statistical significance than $P<0.05$ would help with avoiding type 1 error, but this strategy was not used as lowering the significance level may preventing the capturing the true deference of the test (Andrade, 2019).

The second limitation of this study was that the fat content of the body was calculated based on SFT measurements and a series of derived calculations. Several limitations are associated with the STF technique, such decreased accuracy with overweight or underweight subjects and inter-/intra-rater reliability issues. However, the measured inter and intra-rater reliability of measurements in the APrON study was low and considered acceptable and the use of pregnancy-specific calculations increases the validity of the measurements in this study.

The dietary data collection method, 24-hr recall, was both a strength and limitation to this study. Although it is a useful tool to collect dietary intake for a group of people, it is prone to bias due to its reliance on participants' memory. In addition, despite 640 food items were included in the program, the choices in the online Food Behaviour Questionnaire 24-hr food recall program were still limited, which could also create errors when estimating participants' dietary intake. Besides, the Online Food Questionnaire However, the 24-hr recall is considered one of the best methods to collect dietary intake, especially for a group of people, since it does not induce change in people's dietary habits and it is based on real dietary intake rather than participants' perceptions of their intake like in FFQs. The creation of the sugar database for this project was a strength of this study, as it enabled the researchers to explore if different types of sugar would impact maternal weight/fatness. This level of detail about sugar intake is not available from other Canadian databases such as the Canadian Nutrient File.

Fourthly, many participants did not join the study until their second trimester. The missing data limited our ability to explore the effect of sugar intake in the first and second trimesters. In addition, the total pregnancy GWG in this study was calculated by using self-reported pre-pregnancy weight, making the results prone to response bias. Evidence from other studies suggested that the self-reported gestational weight tended to be very similar to the measured early pregnancy weight, potentially due to memory bias (Carrilho et al., 2020; Natamba et al., 2016), which further limits our ability to detect a significant difference.

Chapter 7 Implications

To date, this study was the first to explore if both maternal weight changes and fatness change were associated with four types of sugar during and after pregnancy. This study identified that maternal total sugar and free sugar intake were significantly associated with higher maternal weight and fatness gain between the second and third trimesters, and added sugar intake was significantly associated with maternal weight gain between the second and third trimesters. Increased calorie intake associated with increased sugar intake explained the link between maternal weight and fatness gain and sugar intake. This study provides evidence to suggest that decreasing sugar intake could be an effective intervention to prevent excess weight gain.

Future research can continue exploring the association between maternal sugar intake and maternal weight/fatness change. For example, researchers can consider using the WHO recommendations for free sugar intake as a cut-off to explore the risk of having excess gestational weight gain and to determine if this guideline can be used for pregnant women to prevent excessive GWG. Randomized control trials can also be employed to explore if an intervention to lower sugar intake can help pregnant women maintain GWG within a healthy range.

Chapter 8 Conclusion

In summary, this study examined the association between four types of maternal dietary sugar intake (total sugar, free sugar, added sugar, and fructose) and maternal weight/fatness change during and after pregnancy. Maternal dietary sugar intake was identified to be associated with maternal weight and fatness change between the second and third trimesters, and maternal calorie intake was proposed as a mediator in this relationship between sugar intake and weight/fatness change. No significant association was found in the early pregnancy, 3-month postpartum, and with SSB intake.

The findings of this study can serve as a preliminary data to support the theory that decreasing sugar intake potentially can be an effective intervention to prevent excess gestational weight/fatness gain. To develop appropriate clinical intervention suggestions, RCTs were required to test and demonstrate the effectiveness of the approach. Previous study has tested and suggested different dietary approaches to help avoid gaining excessive weight during pregnancy.

(Bertz et al., 2012; Hill et al., 2013; Sagedal et al., 2017). To suggest a dietary sugar intake suggestion, future RCTs are needed to better understand the association between maternal dietary sugar intake and GWG in order to better formulate guidelines for health practitioners.

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Appendices A Demographic Questionnaire

CRU-010-APrON

Plate #016

Timepoint of Trial: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J

ID #: ☐☐☐☐☐☐☐☐ AB Your Initials: ☐☐☐ F M L Visit Date: ☐☐ dd ☐☐ mm ☐☐☐☐ yyyy

First Visit Questionnaire

Instructions: If you have not yet signed the consent form, your decision to answer these questions will be interpreted as your agreement to participate.

Please use a black or blue pen. If you're not sure about an answer, your best guess is okay. You can add comments at the end. A few of our questions may sound as if they overlap, but they are asked for slightly different reasons.

Your answers are confidential. We use this information to compare groups of people in this study, not specific individuals.

THANK YOU!

If you have any questions, please contact the following:

Calgary
APrON Calgary
Office (403) 955-2783
Email: infocalgary@apronstudy.ca

Edmonton
APrON Edmonton
Office (780) 492-4667
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version date 5 April 2011

CRU-010-APrON Plate #017

Timepoint of Trial: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J

ID #: ☐☐☐☐☐ ☐☐ ☐ AB

Section 1. Pregnancy and Medical Information

We begin with questions about current and past pregnancies and your medical information

A. Pregnancy Information

1. Have you ever been pregnant before? ☐ Yes ☐ No (**GO TO QUESTION 4**)

2. How many times have you been pregnant? (counting this pregnancy) ☐☐ Times.

3. How many live born children have you had? ☐☐

4. Approximately when is the expected due date to deliver your baby? ☐☐ dd ☐☐ mm ☐☐☐☐ yyyy ☐ Don't Know

5. How many weeks pregnant are you? ☐☐ Weeks. ☐ Don't Know

6. Was this a planned pregnancy? In other words, were you purposely trying to become pregnant? ☐ Yes ☐ No

7. Did you receive treatment to help you become pregnant?
This may include fertility-enhancing drugs or reproductive technology (Clomid, in vitro fertilization, partner or donor medically assisted sperm injection). ☐ Yes ☐ No
Please specify type: ______________________

B. Dental Care

1. Have you had your teeth cleaned by a dentist or dental hygienist *during this pregnancy*? ☐ Yes ☐ No

2. *Before this pregnancy*, when did you last have your teeth cleaned by a dentist or dental hygienist?
☐ 1-6 months before this pregnancy
☐ 7-12 months before this pregnancy
☐ More than one year before this pregnancy
☐ I've never had my teeth cleaned by a dentist or dental hygienist

C. Nausea and Vomiting

For the following 3 questions estimate your **average daily** experience so far in this pregnancy. Please **complete all months up to and including your current month** of pregnancy. < means "less than" and > means "more than".

1. On average, how much of the time did you feel nauseated or sick to your stomach?

Month 0-1 (0-4 weeks)	☐ None	☐ <1 hr/day	☐ 1 hr/day	☐ 2-3 hrs/day	☐ 4-6 hrs/day	☐ >6 hrs/day
--------Stop here if you are 4 weeks (1 month) pregnant or less--------						
Month 1-2 (5-8 weeks)	☐ None	☐ <1 hr/day	☐ 1 hr/day	☐ 2-3 hrs/day	☐ 4-6 hrs/day	☐ >6 hrs/day
--------Stop here if you are 8 weeks (2 months) pregnant or less--------						
Month 2-3 (9-12 weeks)	☐ None	☐ <1 hr/day	☐ 1 hr/day	☐ 2-3 hrs/day	☐ 4-6 hrs/day	☐ >6 hrs/day
--------Stop here if you are 12 weeks (3 months) pregnant or less--------						
Month 3-4 (13-16 weeks)	☐ None	☐ <1 hr/day	☐ 1 hr/day	☐ 2-3 hrs/day	☐ 4-6 hrs/day	☐ >6 hrs/day
--------Stop here if you are 16 weeks (4 months) pregnant or less--------						
Month 4-5 (17-20 weeks)	☐ None	☐ <1 hr/day	☐ 1 hr/day	☐ 2-3 hrs/day	☐ 4-6 hrs/day	☐ >6 hrs/day
--------Stop here if you are 20 weeks (5 months) pregnant or less--------						
Month 5-6 (21-24 weeks)	☐ None	☐ <1 hr/day	☐ 1 hr/day	☐ 2-3 hrs/day	☐ 4-6 hrs/day	☐ >6 hrs/day
--------Stop here if you are 24 weeks (6 months) pregnant or less--------						
Month 6-7 (25-28 weeks)	☐ None	☐ <1 hr/day	☐ 1 hr/day	☐ 2-3 hrs/day	☐ 4-6 hrs/day	☐ >6 hrs/day

CRU-010-APrON Plate #019

Timepoint of Trial: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J

ID #: ☐☐☐☐☐ ☐☐ ☐ AB

2. On average, how many times per DAY did you vomit or throw-up?

Month 0-1 (0-4 weeks) ☐ None ☐ 1-2 times ☐ 3-4 times ☐ 5-6 times ☐ >6 times

---Stop here if you are 4 weeks (1 month) pregnant or less-------------------------------

Month 1-2 (5-8 weeks) ☐ None ☐ 1-2 times ☐ 3-4 times ☐ 5-6 times ☐ >6 times

---Stop here if you are 8 weeks (2 months) pregnant or less-----------------------------

Month 2-3 (9-12 weeks) ☐ None ☐ 1-2 times ☐ 3-4 times ☐ 5-6 times ☐ >6 times

---Stop here if you are 12 weeks (3 months) pregnant or less----------------------------

Month 3-4 (13-16 weeks) ☐ None ☐ 1-2 times ☐ 3-4 times ☐ 5-6 times ☐ >6 times

---Stop here if you are 16 weeks (4 months) pregnant or less----------------------------

Month 4-5 (17-20 weeks) ☐ None ☐ 1-2 times ☐ 3-4 times ☐ 5-6 times ☐ >6 times

---Stop here if you are 20 weeks (5 months) pregnant or less----------------------------

Month 5-6 (21-24 weeks) ☐ None ☐ 1-2 times ☐ 3-4 times ☐ 5-6 times ☐ >6 times

---Stop here if you are 24 weeks (6 months) pregnant or less----------------------------

Month 6-7 (25-28 weeks) ☐ None ☐ 1-2 times ☐ 3-4 times ☐ 5-6 times ☐ >6 times

3. On average, how many times per DAY did you have retching or dry heaves (nothing brought up)?

Month 0-1 (0-4 weeks)	☐ None	☐ 1-2 times	☐ 3-4 times	☐ 5-6 times	☐ >6 times
---Stop here if you are 4 weeks (1 month) pregnant or less---					
Month 1-2 (5-8 weeks)	☐ None	☐ 1-2 times	☐ 3-4 times	☐ 5-6 times	☐ >6 times
---Stop here if you are 8 weeks (2 months) pregnant or less---					
Month 2-3 (9-12 weeks)	☐ None	☐ 1-2 times	☐ 3-4 times	☐ 5-6 times	☐ >6 times
---Stop here if you are 12 weeks (3 months) pregnant or less---					
Month 3-4 (13-16 weeks)	☐ None	☐ 1-2 times	☐ 3-4 times	☐ 5-6 times	☐ >6 times
---Stop here if you are 16 weeks (4 months) pregnant or less---					
Month 4-5 (17-20 weeks)	☐ None	☐ 1-2 times	☐ 3-4 times	☐ 5-6 times	☐ >6 times
---Stop here if you are 20 weeks (5 months) pregnant or less---					
Month 5-6 (21-24 weeks)	☐ None	☐ 1-2 times	☐ 3-4 times	☐ 5-6 times	☐ >6 times
---Stop here if you are 24 weeks (6 months) pregnant or less---					
Month 6-7 (25-28 weeks)	☐ None	☐ 1-2 times	☐ 3-4 times	☐ 5-6 times	☐ >6 times

CRU-010-APrON Plate #021

Timepoint of Trial: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J

ID #: ☐☐☐☐☐ ☐☐ ☐ AB

4. Have you taken medication for nausea or vomiting during this pregnancy?

☐ Yes ☐ No (**IF NO, SKIP TO QUESTION 6**)

5. If you have taken medication for nausea or vomiting during this pregnancy:

a. What type was it?: (**CHECK ALL THAT APPLY**):

☐ Prescription: Diclectin ☐ Prescription: Other ☐ Over-the-counter ☐ Alternative/herbal/ traditional

b. Which months during your pregnancy have you taken medication for nausea or vomiting? (**CHECK ALL THAT APPLY SO FAR**):

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

c. In general, how helpful was medication for nausea or vomiting in controlling your symptoms? (**CHECK ONE ANSWER**):

☐ No change (or worse) ☐ Mildly better ☐ Moderately better ☐ Much better ☐ Completely better

6. Have you been treated in the hospital for nausea and vomiting in this pregnancy?

☐ Yes ☐ No (**GO TO QUESTION 7**)

If yes, **CHECK ALL THAT APPLY**:

☐ Treated in an emergency room

☐ Admitted to hospital for at least one night

7. How much have you needed to change your diet due to nausea and vomiting in this pregnancy? (CHECK ONE):

☐ Not at all ☐ Mild change ☐ Moderate change ☐ Major change ☐ Completely different

D. YOUR Current Medical Conditions and Medications
In the following table, check "no" or "yes" to tell us if you currently have each medical condition. If you have a medical condition, please write any prescription medications you currently take for the condition, or prescription medications that you stopped taking for the condition because of pregnancy.

	Do you currently have this condition? NO	YES	If YES Medications you currently take for this condition	If YES Medications for this condition you stopped because of pregnancy
Anxiety	☐no	☐yes---->		
Asthma	☐no	☐yes---->		
Celiac	☐no	☐yes---->		
Depression	☐no	☐yes---->		
Diabetes: Type 1 (insulin dependent)	☐no	☐yes---->		
Diabetes: Type 2 (non insulin dependent)	☐no	☐yes---->		
Diabetes: Gestational	☐no	☐yes---->		
Epilepsy (seizures)	☐no	☐yes---->		
Heart disease	☐no	☐yes---->		
Primary (chronic) hypertension (you had high blood pressure be- fore pregnancy)	☐no	☐yes---->		
Gestational hypertension (high blood pressure that developed about half way through your pregnancy)	☐no	☐yes---->		

CRU-010-APrON

Plate #023

Timepoint of Trial: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J

ID #: ☐☐☐☐☐ ☐☐ ☐ AB

	Do you currently have this condition? NO	YES	**If YES** Medications you currently take for this condition	**If YES** Medications for this condition you stopped because of pregnancy
Pre-eclampsia (toxemia): high blood pressure caused by symptoms like protein in urine and possibly changes in blood and the liver.	☐ no	☐ yes---->		
Hypothyroidism (low functioning thyroid)	☐ no	☐ yes---->		
Hyperthyroidism (overactive thyroid)	☐ no	☐ yes---->		
Inflammatory bowel disease: ulcerative colitis	☐ no	☐ yes---->		
Inflammatory bowel disease: Crohn's disease	☐ no	☐ yes---->		
Irritable bowel syndrome	☐ no	☐ yes---->		
Polycystic Ovary Syndrome (PCOS)	☐ no	☐ yes---->		
Other current medical conditions ?	☐ no	☐ yes **(specify below)**		
1.				
2.				
3.				
4.				
5.				

version date: 5 April 2011

Section 2. Lifestyle Information

The next few sets of questions ask about your lifestyle, beginning with questions about physical activity.

A. Physical Activity

We are asking about your physical activity at work and outside of work. Most of the questions refer to your *"current physical activity," defined as the past month.* There are also 2 questions that ask about physical activity over the past year.

For some people your work will be a paid job; for others your work could be attending school and studying, or household activities. Consider your main daily activities to be your occupation.

1.a. What is your main occupation (i.e. your work)?______________________________

Please be specific. For example: student, homemaker, farmer, high school teacher, legal secretary, self-employed accountant.

→ Is this work: ☐ Full Time ☐ Part Time

Please read the following examples carefully:

Examples of light activity: Desk work, driving, teaching, studying, housework.

Examples of moderate activity: Occupations requiring moderate effort and considerable use of arms, legs or occasional total body movements including cleaning services, waiting tables or institutional dishwashing, carpentry, plumbing, electrical work, dry wall, farming, assembly line work (tasks requiring movement of the entire body, arms, or legs with moderate effort), mail carriers, patient care (bathing, dressing, moving patients, physical therapy).

Examples of vigorous activity: Occupations requiring strenuous effort and extensive total body movement including sports, teaching an aerobics or physical activity class requiring active and strenuous participation, fire fighting, masonry, heavy construction work, coal mining, manually shovelling or digging ditches, most forestry work, moving items professionally.

Use these examples to answer the next question:

1.b. Most of the time would you rate your physical activity level of this main occupation as: ☐ Light ☐ Moderate ☐ Vigorous

Please answer the following about your current activity (past month):

2. At “work” I sit...	☐ Never	☐ Seldom	☐ Sometimes	☐ Often	☐ Always
3. At “work” I stand...	☐ Never	☐ Seldom	☐ Sometimes	☐ Often	☐ Always
4. At “work” I walk...	☐ Never	☐ Seldom	☐ Sometimes	☐ Often	☐ Always
5. At “work” I lift heavy loads...	☐ Never	☐ Seldom	☐ Sometimes	☐ Often	☐ Very Often
6. After “work” I am tired...	☐ Never	☐ Seldom	☐ Sometimes	☐ Often	☐ Very Often
7. At “work” I sweat...	☐ Never	☐ Seldom	☐ Sometimes	☐ Often	☐ Very Often
8. In comparison to others my own age, I think my “work” is physically...	☐ Much lighter	☐ Lighter	☐ As heavy	☐ Heavier	☐ Much Heavier

The next questions refer to your leisure time activities (i.e.. physical activity outside of work):

9. Do you participate in regular physical activity? ☐ Yes ☐ No (go to question 11)

If yes, which activity do you do most frequently?____________________________________

How many hours a week?	☐ <1	☐ 1-2	☐ 2-3	☐ 3-4	☐ >4
How many months a year?	☐ <1	☐ 1-3	☐ 4-6	☐ 7-9	☐ >9

Based on the definitions below, how would you rate your first activity in terms of physical activity?

☐ Light ☐ Moderate ☐ Vigorous

Light Physical Activity: Considered to be physical movement that is easy to sustain over a prolonged period of time and requires minimal effort (e.g. light walking).

Moderate Physical Activity: Considered to be a somewhat harder activity that may have you breathing faster and, while not exhausting, can only be sustained for a shorter period of time (e.g. brisk walking).

Vigorous Physical Activity: Considered to be activity that is hard, has you breathing heavily and sweating, and could only be sustained for very short periods of time (e.g. running).

10. Do you participate in a second regular physical activity? ☐ Yes ☐ No (go to question 11)

If yes, which activity is it?____

How many hours a week?	☐ <1	☐ 1-2	☐ 2-3	☐ 3-4	☐ >4
How many months a year?	☐ <1	☐ 1-3	☐ 4-6	☐ 7-9	☐ >9

Based on the definitions of light, moderate, and vigorous physical activity above, how would you rate your second activity in terms of physical activity?

☐ Light ☐ Moderate ☐ Vigorous

CRU-010-APrON Plate #027

ID #: A

F G H I J

11. In comparison with others my own age, I think my physical activity during leisure time is...	Much less	Less	The same	More	Much more
12. During leisure time I sweat...	Never	Seldom	Sometimes	Often	Very Often
13. During leisure time I walk...	Never	Seldom	Sometimes	Often	Very Often
14. During leisure time I cycle...	Never	Seldom	Sometimes	Often	Very Often
15. During leisure time I do physical activities (other than walking or cycling)...	Never	Seldom	Sometimes	Often	Very Often
16. During leisure time I watch television...	Never	Seldom	Sometimes	Often	Very Often
17. How many minutes per day do you walk and/or cycle (rollerblade/run) to and from work, school and shopping?	<5	5-15	15-30	30-45	>45
18. During leisure time I do do-it-yourself activities...	Never	Seldom	Sometimes	Often	Very Often
19. During leisure time in the spring/summer I work in the garden...	Never	Seldom	Sometimes	Often	Very Often
20. How many hours per day do you sleep on average?	5 or less	6	7	8	9 or more

There are 3 final questions to summarize your physical activity outside of work. Please read the following definitions.

1. MILD PHYSICAL ACTIVITY: Considered to be physical movement that is easy to sustain over a prolonged period of time and requires minimal effort (e.g. light walking)

2. MODERATE PHYSICAL ACTIVITY: Considered to be a somewhat harder activity that may have you breathing faster and, while not exhausting, can only be sustained for a shorter period of time. (e.g. brisk walking)

3. STRENUOUS PHYSICAL ACTIVITY: Considered to be activity that is hard, has you breathing heavily and sweating, and could only be sustained for very short periods of time (e.g. running)

And then use the definitions to answer the following 3 questions about your leisure-time activity. **Answer all 3 questions, writing "0" if you did not engage in the type of activity.** *Please recall your **leisure-time** activity frequencies in the **past month** for all 3 questions.*

1. How often did you engage in physical activity of a **MILD** nature for at least 15 minutes in duration in your typical week in the past month? *times/week*

2. How often did you engage in physical activity of a **MODERATE** nature for at least 15 minutes in duration in your typical week in the past month? *times/week*

3. How often did you engage in physical activity of a **STRENUOUS** nature for at least 15 minutes in duration during your typical week in the past month? *times/week*

B. Smoking, Alcohol, and Recreational Street Drugs

Next we have some questions about cigarette smoking, alcohol, and recreational street drugs. Your answers are confidential and available only to the study team. The information is coded by number only, and used to compare groups, not specific individuals.

1. Please tell us about your cigarette smoking.

a) ☐ **I have never smoked** or smoked less than 100 cigarettes in my life (GO TO Question 2)

b) ☐ **I used to smoke daily or occasionally** for about:

☐☐ years ☐☐ months ☐☐ weeks ☐☐ days

Answer the following two questions:

On average I used to smoke:

______# cigarettes per ______day _____week _____month _____year

☐ I quit: ☐ Before I was pregnant

☐ When I found out I was pregnant

c) ☐ **I currently smoke**, on average:

______# cigarettes per ______day _____week _____month _____year

(Write “<1” if you smoke less than 1 cigarette)

Comments:____

2. Please tell us about your use of alcohol:

a) ☐ **I have never consumed alcohol** (GO TO Question 3)

b) ☐ **I used to drink occasionally or daily** for about:

☐☐ years ☐☐ months ☐☐ weeks ☐☐ days

Answer the following two questions:

On average I drank:

______# drinks* per ______day _____week _____month _____year

☐ I quit: ☐ Before I was pregnant

☐ When I found out I was pregnant

c) ☐ **I currently drink,** on average:

______# drinks* per ______day _____week _____month _____year

1 drink=a 5 ounce glass of wine, 12 ounces of beer, a mixed drink or cooler with 1.5 ounces of liquor

Comments:

____

3. Please tell us about your use of recreational street drugs

a) ☐ **I have never used recreational drugs** (GO TO Section 3 "Recent and Past Life Events")

b) ☐ **I used to use drugs occasionally or daily** for:

☐☐ years ☐☐ months ☐☐ weeks ☐☐ days

Answer the following two questions

On average I used street drugs:

______# times per ______day _____week _____month _____year

I quit:
☐ Before I was pregnant
☐ When I found out I was pregnant

c) ☐ **I currently use street drugs**, on average:

______# times per ______day _____week _____month _____year

4. If you are currently using recreational or street drugs, please indicate which ones you use:

☐ Marijuana or Hashish (hash, pot, hashish oil, hash putty)
☐ Cocaine or Crack (coke, rock)
☐ Heroin (smack, horse)
☐ Tranquilizers (downers, ludes)
☐ Stimulants: amphetamines (uppers, speed, crystal)
☐ Psychedelics/Hallucinogens: mushrooms, LSD/Acid PCP/Angel Dust, Ecstasy
☐ Inhalants: Glue, gas, toluene, hairspray, other aerosols

Section 3: Recent and Past Life Events

The next two sections are about events and feelings that women may experience

A. Recent Life Events During this Pregnancy

Listed below are a number of events that may have brought changes in your life. Please tell us if any of these events happened to you in this pregnancy. If yes, please assess how much effect it had on you. Your answers will be held in strict confidence. ***Check all that apply.***

	No this has never happened *during this pregnancy.*	**Yes this has happened *during this pregnancy***	**If yes, how much did this affect you?**		
			Not at all	**Somewhat**	**A lot**
1. A close friend/family member had a serious accident/illness	☐	☐ →	☐	☐	☐
2. You were separated/divorced	☐	☐ →	☐	☐	☐
3. A close friend or relative died	☐	☐ →	☐	☐	☐
4. You had a serious argument with your partner	☐	☐ →	☐	☐	☐
5. Your partner was emotionally cruel to you	☐	☐ →	☐	☐	☐
6. Your partner was physically cruel to you	☐	☐ →	☐	☐	☐
7. You were sexually abused	☐	☐ →	☐	☐	☐

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ID #: A

F G H I J

B. Life Events 12 months before this pregnancy

In the 12 months before this pregnancy, had any of these events happened to you? Many of the events listed are of a personal nature. Your answers will be held in strict confidence. **Check all that apply.**

	No this has never happened *in the 12 months before this pregnancy.*	Yes this has happened *in the 12 months before this pregnancy*	If yes, how much did this affect you?		
			Not at all	Somewhat	A lot
1. A close friend/family member had a serious accident/illness	☐	☐ →	☐	☐	☐
2. You were separated/divorced	☐	☐ →	☐	☐	☐
3. A close friend or relative died	☐	☐ →	☐	☐	☐
4. You had a serious argument with your partner	☐	☐ →	☐	☐	☐
5. Your partner was emotionally cruel to you	☐	☐ →	☐	☐	☐
6. Your partner was physically cruel to you	☐	☐ →	☐	☐	☐
7. You were sexually abused	☐	☐ →	☐	☐	☐

C. Past Life Events

Before the age of 17, have any of these events happened to you? Many of the events listed are of a personal nature. Your answers will be held in strict confidence. **Check all that apply.**

	No, this never happened before the age of 17	Yes, this happened before the age of 17	If yes, how much did this affect you?		
			Not at all	Somewhat	A lot
1.A close Friend/family member had a serious accident/illness	☐	☐ →	☐	☐	☐
2. A close friend or relative died	☐	☐ →	☐	☐	☐
3. You were sexually abused	☐	☐ →	☐	☐	☐

Section 4: Your Feelings

As you are pregnant, we would like to know how you are feeling. Please check the answer that comes closest to how you have felt **IN THE PAST 7 DAYS**, not just how you feel today.

In the past 7 days:

1. I have been able to laugh or see the funny side of things	☐ As much as I always could	☐ Not quite so much now
	☐ Definitely not so much now	☐ Not at all
2. I have looked forward with enjoyment to things	☐ As much as I ever did	☐ Rather less than I used to
	☐ Definitely less than I used to	☐ Hardly at all
3. I have blamed myself unnecessarily when things went wrong	☐ Yes, most of the time	☐ Yes, some of the time
	☐ Not very often	☐ No, never Not
4. I have been anxious or worried for no good reason	☐ at all	☐ Hardly ever
	☐ Yes, sometimes	☐ Yes, very often
5. I have felt scared or panicky for no very good reason	☐ Yes, quite a lot	☐ Yes, sometimes
	☐ No, not much	☐ No, not at all
6. Things have been getting on top of me (feeling overwhelmed)	☐ Yes, most of the time I haven't been able to cope at all	☐ Yes, sometimes I haven't been coping as well as usual
	☐ No, most of the time I have coped quite well	☐ No, I have been coping as well as ever
7. I have been so unhappy that I have had difficulty sleep-ing	☐ Yes, most of the time	☐ Yes, sometimes
	☐ No, not very often	☐ No, not at all
8. I have felt sad or miserable	☐ Yes, most of the time	☐ Yes quite often
	☐ No, not very often	☐ No, not at all
9. I have been so unhappy that I have been crying	☐ Yes, most of the time	☐ Yes quite often
	☐ No, only occasionally	☐ No, never
10. The thought of harming myself has occurred to me	☐ Yes, quite often	☐ Sometimes
	☐ Hardly ever	☐ Never

CRU-010-APrON Plate #033

Timepoint of Trial: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J

ID #: ☐☐☐☐☐ ☐☐ ☐ A

Section 5: Support

Now we would like to ask you a few questions about your support from family, friends, and the community.

1. Do you have someone you can confide in, or talk to, about your private feelings or concerns?	☐ none of the time	☐ a little of the time	☐ about half of the time	☐ most of the time	☐ all of the time
2. Do you have someone you can really count on to help you in a difficult situation?	☐ none of the time	☐ a little of the time	☐ about half of the time	☐ most of the time	☐ all of the time
3. Do you have someone you can really count on to give you good advice when you are making important personal decisions?	☐ none of the time	☐ a little of the time	☐ about half of the time	☐ most of the time	☐ all of the time
4. Do you have someone who makes you feel loved and cared for?	☐ none of the time	☐ a little of the time	☐ about half of the time	☐ most of the time	☐ all of the time

CRU-010-APrON Plate #034

ID #: ☐☐☐☐☐ ☐☐ ☐ A

Timepoint of Trial: ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I ☐ J

Section 6: General Background

Next, we have some general background questions about you and your residence. Your answers are confidential.

1. What is your marital status? At present are you:
   - ☐ Single (NEVER MARRIED)
   - ☐ Married
   - ☐ Divorced
   - ☐ Common-law/living with partner/ living as married
   - ☐ Widowed
   - ☐ Separated

2. What is the highest level of education that you have completed?
   - ☐ Less than high school diploma
   - ☐ Completed high school diploma
   - ☐ Completed trade, technical, or vocational school, or business/ community college (e.g., SAIT, NAIT, Devry)
   - ☐ Completed university undergraduate degree
   - ☐ Completed post-graduate degree

3. What is the total income, **before taxes and deductions,** of all the household members from all sources in the past 12 months? (**YOUR BEST GUESS IS OK**)?
   - ☐ Less than $20, 0000
   - ☐ $20,000-$39,999
   - ☐ $40,000-$69,999
   - ☐ $70,000-$99,999
   - ☐ $100,000 or more

4. What is your *partner's* occupation? (**PLEASE BE SPECIFIC**)
   - ☐ I do not have a partner

   ____

5. How many adults (over the age of 18) live in your household? ☐☐

6. How many children (under the age of 18) live in your household (**NOT INCLUDING THIS PREGNANCY**)? ☐☐

6. a. If children live in your household, what are their ages? (**START WITH THE FIRST BORN CHILD**)

1.	Years	Months	4.	Years	Months
2.	Years	Months	5.	Years	Months
3.	Years	Months	6.	Years	Months

If more than 6 children live in your household write their ages below:

____

7. How many people smoke **inside** your home? (**DO NOT INCLUDE THEM IF THEY SMOKE ONLY OUTSIDE**)

☐☐ number of people

8. Were you born in Canada?

☐ Yes ☐ No

(If no) how long have you lived in Canada?

☐ Less than 1 year ☐ 1 to 3 years

☐ 4 to 5 years ☐ >5 years

9. How would you **best** describe your ethnic origin (race)?

☐ Black (African, African North American)

☐ Caucasian/white (e.g. English, French, German, Greek, Irish, Polish, Russian, Scottish, Ukrainian)

☐ Chinese

☐ Filipino

☐ Japanese

☐ Korean

☐ Latin American

☐ Native/Aboriginal Peoples of North America (First Nations, North American Indian, Metis, Inuit)

☐ South Asian

☐ South East Asian

☐ Arab

☐ West Asian

Other, specify________________________________

10. Please enter today's date:

dd mm yyyy

Appendicies B Results of all regression analysis

Table 12. Regression results for maternal total sugar intake and maternal weight changes between pre-pregnancy and first trimesters (n=183).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	118.65	310.15	.05	.38	.70	2.14	5.75	.03	.37	.71
Education	-42.41	22.42	-.16	-1.89	.06	-39.68	22.53	-.15	-1.76	.08
Ethnic (Ref=white)										
Black	114.48	257.16	.03	.45	.66	77.19	258.99	.02	.30	.77
Asian	62.19	64.73	.10	.96	.34	68.49	64.91	.11	1.06	.29
Latin	59.43	134.73	.04	.44	.66	55.73	134.65	.03	.41	.68
Arab	151.07	261.91	.05	.58	.57	182.02	263.07	.05	.70	.49
Other	125.72	258.67	.04	.49	.63	138.12	258.66	.04	.53	.59
Marital status (Ref=married)										
Single	105.87	157.46	.05	.67	.50	72.91	159.94	.04	.46	.65
Common law	-47.02	62.49	-.06	-.75	.45	-46.56	62.44	-.06	-.75	.46
Income	9.50	23.61	.04	.40	.69	8.31	23.61	.03	.35	.73
Pre-pregnancy BMI	-2.62	3.54	-.06	-.74	.46	-2.90	3.55	-.07	-.82	.42
Lived children	-18.66	31.04	-.05	-.60	.55	-21.65	31.12	-.06	-.70	.49
Smoker during pregnancy	-14.14	186.37	-.01	-.08	.94	5.02	186.94	.01	.03	.98
Social support	-4.80	11.27	-.04	-.43	.67	-4.84	11.26	-.04	-.43	.67
Exercise	22.74	16.92	.11	1.34	.18	21.29	16.95	.11	1.26	.21
Total Sugar	.13	.39	.03	.34	.73	-.15	.46	-.03	-.33	.74
Total kcal intake						.04	.04	.11	1.14	.26
R square	.05					.58				
R square change	.05					.01				
F	.55					.59				

Table 13. Regression results for maternal added sugar intake and maternal weight changes between pre-pregnancy and first trimesters (n=183).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	2.99	5.63	.05	.53	.60	2.19	5.65	.03	.39	.70
Education	-40.73	22.33	-.16	-1.82	.07	-38.78	22.31	-.15	-1.74	.08
Ethnic (Ref=white)										
Black	102.38	256.82	.03	.40	.69	67.77	257.28	.02	.29	.79
Asian	53.29	65.25	.08	.82	.42	61.37	65.32	.09	.94	.35
Latin	57.88	135.02	.03	.43	.67	44.23	134.98	.03	.33	.74
Arab	127.53	260.30	.04	.49	.63	178.30	262.08	.05	.68	.50
Other	113.89	259.73	.03	.44	.66	120.82	259.04	.04	.47	.64
Marital status (Ref=married)										
Single	110.67	157.36	.06	.70	.48	70.40	159.53	.04	.44	.66
Common law	-47.04	62.50	-.06	-.75	.45	-44.51	62.34	-.06	-.71	.48
Income	9.77	23.59	.04	.41	.68	7.53	23.58	.03	.32	.75
Pre-pregnancy BMI	-2.37	3.55	-.05	-.67	.51	-2.75	3.55	-.06	-.78	.44
Lived children	-19.33	31.06	-.05	-.62	.54	-22.97	31.08	-.06	-.74	.46
Smoker during pregnancy	-23.67	186.76	-.01	-.13	.90	-2.78	186.8	-.01	-.02	.99
Social support	-4.54	11.27	-.03	-.40	.69	-4.71	11.24	-.04	-.42	.68
Exercise	22.11	17.00	.11	1.30	.20	19.7	17.0	.10	1.2	.25
Added Sugar	-.16	.50	-.03	-.31	.76	-.47	.55	-.08	-.86	.39
Total kcal intake						.05	.04	.13	1.4	.16
R square	.05					.61				
R square change	.05					.01				
F	.55					.63				

Table 14. Regression results for maternal free sugar intake and maternal weight changes between pre-pregnancy and first trimesters (n=183).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	3.20	5.66	.05	.57	.57	2.31	5.71	.04	.41	.69
Education	-42.25	22.37	-.16	-1.89	.06	-40.22	22.43	-.16	-1.79	.08
Ethnic (Ref=white)										
Black	110.04	256.44	.03	.43	.67	84.76	257.24	.03	.33	.74
Asian	62.59	64.99	.10	.96	.34	68.77	65.17	.11	1.06	.29
Latin	59.41	134.74	.04	.44	.66	55.65	134.68	.03	.41	.68
Arab	147.78	260.59	.04	.57	.57	185.90	262.62	.06	.71	.48
Other	128.09	259.07	.04	.49	.62	136.36	258.98	.04	.53	.60
Marital status (Ref=married)										
Single	110.04	256.44	.03	.43	.67	75.47	159.74	.04	.47	.64
Common law	62.59	64.99	.10	.96	.34	-45.81	62.47	-.06	-.73	.47
Income	59.41	134.74	.04	.44	.66	8.00	23.63	.03	.34	.74
Pre-pregnancy BMI	147.78	260.59	.04	.57	.57	-2.91	3.55	-.07	-.82	.41
Lived children	128.09	259.07	.04	.49	.62	-21.55	31.16	-.06	-.69	.49
Smoker during pregnancy	110.04	256.44	.03	.43	.67	3.92	187.08	.01	.02	.98
Social support	62.59	64.99	.10	.96	.34	-4.97	11.26	-.04	-.44	.66
Exercise	59.41	134.74	.04	.44	.66	21.20	17.02	.11	1.25	.22
Free Sugar	147.78	260.59	.04	.57	.57	-.12	.50	-.02	-.23	.82
Total kcal intake						.042	.037	.11	1.12	.27
R square	.05					.06				
R square change	.05					.01				
F	.55					.59				

Table 15. Regression results for maternal fructose intake and maternal weight changes between pre-pregnancy and first trimesters (n=183).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	4.06	5.66	.06	.72	.48	3.47	5.72	.05	.61	.55
Education	-42.78	22.15	-.17	-1.93	.06	-42.17	22.19	-.16	-1.90	.06
Ethnic (Ref=white)										
Black	130.64	255.73	.04	.51	.61	112.85	257.09	.03	.44	.66
Asian	66.93	63.61	.10	1.05	.30	74.44	64.41	.11	1.15	.25
Latin	44.11	134.65	.03	.33	.74	43.44	134.82	.03	.32	.75
Arab	174.94	259.03	.05	.68	.50	204.01	262.08	.06	.78	.43
Other	109.69	257.39	.03	.43	.67	124.40	258.41	.04	.48	.63
Marital status (Ref=married)										
Single	92.41	157.00	.05	.59	.56	72.34	159.34	.04	.45	.65
Common law	-46.08	62.19	-.06	-.74	.46	-45.49	62.27	-.06	-.73	.47
Income	7.384	23.549	.032	.31	.75	6.74	23.59	.03	.29	.78
Pre-pregnancy BMI	-2.505	3.507	-.057	-.71	.48	-2.83	3.54	-.06	-.80	.43
Lived children	-17.61	30.90	-.05	-.57	.57	-19.35	31.02	-.05	-.62	.53
Smoker during pregnancy	-28.78	185.26	-.01	-.16	.88	-9.89	187.10	-.01	-.05	.96
Social support	-4.15	11.22	-.03	-.37	.71	-4.47	11.24	-.03	-.40	.69
Exercise	22.24	16.84	.11	1.32	.19	21.61	16.88	.11	1.28	.20
Fructose	1.68	1.29	.10	1.30	.20	1.34	1.37	.08	.98	.33
Total kcal intake						.03	.04	.07	.77	.44
R square	.06					.06				
R square change	.06					.01				
F	.65					.65				

Table 16. Regression results for maternal total sugar intake and maternal weight changes between the first and second trimester (n=171).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	13.53	7.78	.15	1.74	.08	12.39	7.51	.13	1.65	.10
Education	-5.05	32.48	-.01	-.16	.88	9.94	31.65	.03	.31	.75
Ethnic (Ref=white)										
Black	575.72	334.17	.13	1.72	.09	515.16	323.06	.12	1.60	.11
Asian	56.52	89.57	.06	.63	.53	26.44	86.90	.03	.30	.76
Latin	-69.16	177.08	-.03	-.39	.70	-123.29	171.65	-.06	-.72	.47
Arab	70.78	337.72	.02	.21	.83	133.42	326.52	.03	.41	.68
Other	124.27	339.86	.03	.37	.72	134.84	328.11	.03	.41	.68
Marital status (Ref=married)										
Single	40.45	209.28	.02	.19	.85	-23.36	202.85	-.01	-.12	.91
divorced	-101.01	85.54	-.09	-1.18	.24	-77.05	82.86	-.07	-.93	.35
Common law	33.77	32.53	.10	1.04	.30	34.65	31.41	.11	1.10	.27
Separated	-14.26	4.81	-.24	-2.96	.004	-16.25	4.68	-.27	-3.47	<.001
Income	10.21	41.24	.02	.25	.805	5.25	39.83	.01	.13	.90
Pre-pregnancy BMI	229.42	243.95	.07	.94	.348	198.37	235.67	.06	.84	.40
Lived children	30.51	15.77	.16	1.94	.055	29.10	15.23	.15	1.91	.06
Smoker during pregnancy	10.55	23.50	.04	.45	.654	8.97	22.69	.03	.40	.69
Social support	.13	.54	.02	.23	.818	-.90	.60	-.14	-1.50	.14
Exercise	40.45	209.28	.02	.19	.847	.17	.05	.30	3.50	<.001
Total Sugar	-101.01	85.54	-.09	-1.18	.239	-23.36	202.82	-.01	-.12	.91
Total kcal intake						-77.05	82.86	-.07	-.93	.35
R square	.06					.21				
R square change	.15					.06				
F	.06					2.39^{*}				

Table 17. Regression results for maternal added sugar intake and maternal weight changes between the first and second trimester (n=171).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	13.33	7.78	.14	1.71	.09	12.89	7.54	.14	1.71	.09
Education	-4.04	32.54	-.01	-.12	.90	6.38	31.69	.02	.20	.84
Ethnic (Ref=white)										
Black	576.90	334.19	.13	1.73	.09	514.93	324.39	.12	1.59	.12
Asian	53.75	90.41	.057	.60	.55	31.43	87.88	.03	.36	.72
Latin	-67.24	177.32	-.030	-.38	.71	-137.58	173.14	-.06	-.80	.43
Arab	67.52	338.40	.015	.20	.84	123.00	328.36	.03	.36	.71
Other	115.49	338.24	.026	.34	.73	167.68	328.16	.04	.51	.61
Marital status (Ref=married)										
Single	47.61	207.46	.02	.23	.819	-43.64	202.92	-.02	-.22	.83
divorced	-101.01	85.59	-.09	-1.18	.240	-78.05	83.23	-.07	-.94	.35
Common law	34.14	32.52	.10	1.05	.295	31.48	31.52	.10	1.00	.32
Separated	-14.24	4.88	-.24	-2.92	.004	-15.41	4.74	-.25	-3.25	<.001
Income	9.66	41.18	.02	.23	.815	8.41	39.91	.02	.21	.83
Pre-pregnancy BMI	227.02	243.87	.07	.93	.353	209.88	236.38	.07	.89	.38
Lived children	30.95	15.67	.16	1.98	.050	27.31	15.22	.14	1.79	.08
Smoker during pregnancy	10.13	23.47	.04	.43	.667	10.32	22.75	.04	.45	.65
Social support	.02	.68	.01	.03	.974	-.71	.70	-.08	-1.01	.32
Exercise	47.61	207.46	.02	.23	.819	.15	.05	.26	3.32	<.001
Added Sugar	-101.01	85.59	-.09	-1.18	.240	-43.64	202.92	-.02	-.22	.83
Total kcal intake						-78.05	83.23	-.07	-.94	.35
R square	.15					.21				
R square change	.15					.06				
F	1.65					2.39^{*}				

Table 18. Regression results for maternal free sugar intake and maternal weight changes between the first and second trimester (n=171).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	13.54	7.80	.15	1.74	.09	12.66	7.56	.14	1.68	.10
Education	-5.14	32.68	-.01	-.16	.88	8.01	31.90	.02	.25	.80
Ethnic (Ref=white)										
Black	572.37	334.87	.13	1.71	.09	538.80	324.55	.12	1.66	.10
Asian	56.83	90.20	.06	.63	.53	30.42	87.74	.03	.35	.73
Latin	-67.77	176.96	-.03	-.38	.70	-127.13	172.34	-.06	-.74	.46
Arab	66.73	337.26	.02	.20	.84	153.42	327.74	.03	.47	.64
Other	120.71	338.62	.03	.36	.72	161.63	328.25	.03	.49	.62
Marital status (Ref=married)										
Single	42.94	208.16	.02	.21	.84	42.94	202.85	-.01	-.12	.91
divorced	-101.45	85.58	-.09	-1.19	.24	-101.45	82.86	-.07	-.93	.35
Common law	34.00	32.51	.10	1.05	.30	34.00	31.41	.11	1.10	.27
Separated	-14.34	4.84	-.24	-2.96	.01	-14.34	4.68	-.27	-3.47	.01
Income	10.03	41.21	.02	.24	.81	10.03	39.83	.01	.13	.90
Pre-pregnancy BMI	229.46	244.05	.07	.94	.35	229.46	235.67	.06	.84	.40
Lived children	30.69	15.71	.16	1.95	.05	30.69	15.23	.15	1.91	.06
Smoker during pregnancy	10.62	23.56	.04	.45	.65	10.62	22.69	.03	.40	.70
Social support	.12	.61	.02	.20	.84	.12	.60	-.14	-1.50	.14
Exercise	42.94	208.16	.02	.21	.84	42.94	.05	.30	3.50	<.001
Free Sugar	-101.45	85.58	-.09	-1.18	.24	-101.45	202.85	-.01	-.12	.91
Total kcal intake						.16	82.86	-.07	-.93	.35
R square	.15					.20				
R square change	.15					.06				
F	1.65					2.31*				

Table 19. Regression results for maternal fructose intake and maternal weight changes between the first and second trimester (n=171).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	13.54	7.80	.15	1.74	.09	12.66	7.56	.14	1.68	.10
Education	-5.14	32.68	-.01	-.16	.88	8.01	31.90	.02	.25	.80
Ethnic (Ref=white)										
Black	572.37	334.87	.13	1.71	.09	538.80	324.55	.12	1.66	.10
Asian	56.83	90.20	.06	.63	.53	30.42	87.74	.03	.35	.73
Latin	-67.77	176.96	-.03	-.38	.70	-127.13	172.34	-.06	-.74	.46
Arab	66.73	337.26	.02	.20	.84	153.42	327.74	.03	.47	.64
Other	120.71	338.62	.03	.36	.72	161.63	328.25	.04	.49	.62
Marital status (Ref=married)										
Single	42.94	208.16	.02	.21	.837	-37.59	203.09	-.02	-.19	.85
divorced	-101.45	85.58	-.09	-1.19	.238	-76.97	83.23	-.07	-.93	.36
Common law	34.00	32.51	.10	1.05	.297	32.99	31.49	.10	1.05	.30
Separated	-14.34	4.84	-.24	-2.96	.004	-15.64	4.71	-.26	-3.32	<.001
Income	10.03	41.21	.02	.24	.808	7.21	39.93	.01	.18	.86
Pre-pregnancy BMI	229.46	244.05	.07	.94	.349	203.35	236.54	.06	.86	.39
Lived children	30.69	15.71	.16	1.95	.053	27.83	15.24	.15	1.83	.07
Smoker during pregnancy	10.62	23.56	.04	.45	.653	9.13	22.83	.03	.40	.69
Social support	.12	.61	.02	.20	.839	-.69	.64	-.09	-1.09	.28
Exercise	42.94	208.16	.02	.21	.837	.16	.05	.27	3.33	<.001
Fructose	-101.45	85.58	-.09	-1.19	.238	-37.59	203.09	-.02	-.19	.85
Total kcal intake						-76.97	83.23	-.07	-.93	.36
R square	.15					.20				
R square change	.15					.06				
F	1.65					2.31^{*}				

Table 20. Regression results for maternal total sugar intake and maternal weight changes between second and the third trimester (n=753).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-5.36	2.37	-.09	-2.26	.02	-5.43	2.34	-.09	-2.32	.02
Education	-11.42	10.90	-.04	-1.07	.29	-14.634	10.58	-.06	-1.38	.17
Ethnic (Ref=white)										
Black	320.43	84.73	.14	3.78	<.001	309.46	83.62	.14	3.70	<.001
Asian	-37.38	28.98	-.05	-1.29	.20	-30.85	28.62	-.04	-1.08	.28
Latin	-51.28	50.19	-.04	-1.02	.31	-39.76	49.57	-.03	-.80	.42
Native	-21.39	93.33	-.01	-.23	.82	-21.95	92.07	-.01	-.24	.81
Arab	37.89	110.50	.01	.34	.73	42.25	109.02	.01	.39	.70
Other	-146.93	82.20	-.07	-1.79	.07	-127.60	81.20	-.06	-1.57	.12
Marital status (Ref=married)										
Single	35.53	63.22	.02	.56	.57	35.25	62.37	.02	.57	.572
divorced	85.01	242.91	.01	.35	.73	99.67	239.66	.02	.42	.678
Common law	15.29	29.03	.02	.53	.60	17.29	28.64	.02	.60	.546
Separated	78.31	141.42	.02	.55	.58	74.90	139.52	.02	.54	.592
Income	-15.35	10.12	-.07	-1.52	.13	-10.68	10.03	-.05	-1.06	.288
Pre-pregnancy BMI	.77	1.95	.02	.40	.69	.08	1.92	.01	.04	.966
Lived children	-6.75	13.46	-.02	-.50	.62	-8.32	13.28	-.02	-.63	.531
Smoker during pregnancy	-22.85	78.00	-.01	-.29	.77	-18.29	76.96	-.01	-.24	.812
Social support	8.09	3.88	.08	2.09	.04	7.03	3.83	.07	1.83	.067
Exercise	-11.03	7.45	-.06	-1.48	.14	-6.54	7.42	-.03	-.88	.378
Total Sugar	.80	.57	.05	1.39	.16	-.22	.61	-.01	-.36	.721
Total kcal intake						.07	.016	.18	4.57	.000
R square	.07					.10				
R square change	.07					.03				
F	2.89**					3.87**				

Table 21. Regression results for maternal total sugar intake and maternal weight changes during pregnancy (n=753).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	.53	1.39	.02	.38	.70	.37	1.38	.01	.27	.79
Education	-4.01	6.25	-.03	-.64	.52	-5.41	6.19	-.04	-.87	.38
Ethnic (Ref=white)										
Black	12.27	50.15	.01	.25	.81	.76	49.67	.01	.02	.99
Asian	.27	17.02	.01	.02	.99	-.03	16.83	.01	-.01	1.00
Latin	3.73	29.67	.01	.13	.90	10.32	29.38	.01	.35	.73
Native	44.03	55.19	.03	.80	.43	47.70	54.58	.03	.87	.38
Arab	55.98	65.57	.03	.85	.39	47.41	64.87	.03	.73	.47
Other	-58.29	48.63	-.04	-1.20	.23	-49.64	48.13	-.04	-1.03	.30
Marital status (Ref=married)										
Single	1.26	37.31	.01	.03	.97	1.31	36.89	.01	.04	.97
divorced	135.32	143.71	.03	.94	.35	139.97	142.11	.04	.99	.33
Common law	7.56	17.03	.02	.44	.66	7.19	16.84	.02	.43	.67
Separated	57.09	83.67	.03	.68	.50	48.07	82.76	.02	.58	.56
Income	-3.76	5.93	-.03	-.63	.53	-1.68	5.89	-.01	-.29	.78
Pre-pregnancy BMI	-3.16	1.14	-.11	-2.77	.01	-3.45	1.13	-.12	-3.06	.01
Lived children	-4.38	7.94	-.02	-.55	.58	-5.72	7.85	-.03	-.73	.47
Smoker during pregnancy	16.28	46.08	.01	.35	.72	19.55	45.57	.02	.43	.67
Social support	2.55	2.29	.04	1.12	.27	2.37	2.26	.04	1.05	.30
Exercise	-.20	4.39	-.01	-.05	.96	1.91	4.37	.02	.44	.66
Total Sugar	.40	.09	.16	4.21	<.001	.14	.11	.06	1.24	.21
Total kcal intake						.04	.01	.18	4.20	<.001
R square	.02					.04				
R square change	.05					.02				
F	1.82					2.65^{**}				

Table 22. Regression results for maternal added sugar intake and maternal weight changes during pregnancy (n=753).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	.42	1.40	.01	.30	.77	.30	1.38	.01	.22	.828
Education	-2.51	6.28	-.02	-.40	.69	-5.10	6.19	-.03	-.82	.411
Ethnic (Ref=white)										
Black	14.05	50.60	.01	.28	.78	-.78	49.84	-.01	-.02	.99
Asian	-5.11	17.13	-.01	-.30	.77	-2.25	16.85	-.01	-.13	.89
Latin	6.45	29.87	.01	.22	.83	11.67	29.39	.02	.40	.69
Native	46.68	55.54	.03	.84	.40	48.84	54.62	.03	.89	.37
Arab	45.20	65.91	.03	.69	.49	42.57	64.81	.02	.66	.51
Other	-59.48	48.94	-.05	-1.22	.23	-49.22	48.17	-.04	-1.02	.31
Marital status (Ref=married)										
Single	6.11	37.53	.01	.16	.87	2.68	36.91	.01	.07	.94
divorced	132.92	144.64	.03	.92	.36	139.26	142.24	.04	.98	.33
Common law	6.97	17.14	.02	.41	.68	7.06	16.86	.02	.42	.68
Separated	55.87	84.21	.02	.66	.51	46.36	82.83	.02	.56	.58
Income	-4.11	5.97	-.03	-.69	.49	-1.62	5.89	-.01	-.28	.78
Pre-pregnancy BMI	-3.21	1.15	-.11	-2.79	.01	-3.48	1.13	-.12	-3.08	.01
Lived children	-5.44	7.98	-.03	-.68	.50	-6.18	7.85	-.03	-.79	.43
Smoker during pregnancy	10.19	46.35	.01	.22	.83	18.17	45.60	.01	.40	.69
Social support	2.73	2.30	.05	1.18	.24	2.44	2.27	.04	1.08	.28
Exercise	.35	4.45	.01	.08	.94	2.20	4.39	.02	.50	.62
Added Sugar	.35	.12	.11	2.86	.01	.08	.13	.02	.58	.56
Total kcal intake						.05	.01	.21	5.10	<.001
R square	.03					.07				
R square change	.03					.03				
F	1.31					2.59**				

Table 23. Regression results for maternal free sugar intake and maternal weight changes during pregnancy (n=753).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	.45	1.40	.01	.32	.75	.30	1.38	.01	.21	.83
Education	-2.60	6.27	-.02	-.42	.68	-5.10	6.19	-.03	-.82	.41
Ethnic (Ref=white)										
Black	13.90	50.57	.01	.28	.78	-1.47	49.84	-.01	-.03	.98
Asian	-4.47	17.15	-.01	-.26	.80	-2.63	16.88	-.01	-.17	.88
Latin	3.24	29.85	.01	.11	.91	11.06	29.41	.01	.38	.71
Native	48.22	55.53	.03	.87	.39	49.11	54.62	.03	.90	.37
Arab	46.03	65.90	.03	.70	.49	42.03	64.83	.02	.65	.52
Other	-62.29	48.92	-.05	-1.27	.20	-49.77	48.18	-.04	-1.03	.30
Marital status (Ref=married)										
Single	2.97	37.54	.01	.08	.94	2.14	36.92	.01	.06	.95
divorced	132.44	144.60	.03	.92	.36	138.81	142.25	.04	.97	.33
Common law	6.90	17.14	.02	.40	.68	7.09	16.86	.02	.42	.67
Separated	55.25	84.18	.02	.66	.51	45.92	82.83	.02	.55	.58
Income	-4.39	5.96	-.03	-.74	.46	-1.71	5.89	-.01	-.29	.77
Pre-pregnancy BMI	-3.13	1.15	-.11	-2.73	.01	-3.47	1.13	-.12	-3.07	.01
Lived children	-5.02	7.98	-.02	-.63	.53	-6.12	7.85	-.03	-.78	.44
Smoker during pregnancy	12.98	46.35	.01	.28	.78	18.64	45.61	.02	.41	.68
Social support	2.90	2.30	.05	1.26	.21	2.49	2.26	.04	1.10	.27
Exercise	.28	4.45	.01	.06	.95	2.13	4.39	.02	.48	.63
Free Sugar	.32	.101	.11	2.93	.01	.05	.12	.02	.45	.65
Total kcal intake						.05	.01	.21	5.05	<.001
R square	.03					.06				
R square change	.03					.03				
F	1.33					2.58**				

Table 24. Regression results for maternal fructose intake and maternal weight changes during pregnancy (n=753).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	.34	1.40	.01	.25	.81	.30	1.38	.01	.22	.83
Education	-3.27	6.29	-.02	-.52	.60	-5.38	6.20	-.04	-.87	.39
Ethnic (Ref=white)										
Black	4.90	50.40	.01	.10	.92	-2.26	49.58	-.01	-.05	.96
Asian	-7.10	16.94	-.02	-.42	.68	-1.81	16.69	-.01	-.11	.91
Latin	2.96	29.85	.00	.10	.92	10.63	29.39	.01	.36	.72
Native	50.52	55.53	.03	.91	.36	50.09	54.61	.03	.92	.36
Arab	39.33	65.73	.02	.60	.55	42.19	64.65	.02	.65	.51
Other	-62.98	48.90	-.05	-1.29	.20	-50.26	48.16	-.04	-1.04	.30
Marital status (Ref=married)										
Single	1.11	37.55	.01	.03	.98	1.04	36.93	.01	.03	.98
divorced	129.00	144.60	.03	.89	.37	138.76	142.17	.04	.98	.33
Common law	5.15	17.16	.01	.30	.76	6.33	16.88	.01	.38	.71
Separated	46.11	84.15	.02	.55	.58	43.90	82.76	.02	.53	.60
Income	-4.90	5.96	-.04	-.82	.41	-1.81	5.89	-.01	-.31	.76
Pre-pregnancy BMI	-3.02	1.15	-.10	-2.64	.01	-3.44	1.13	-.12	-3.04	.01
Lived children	-4.95	7.98	-.02	-.62	.54	-5.97	7.85	-.03	-.76	.45
Smoker during pregnancy	17.72	46.41	.01	.38	.70	20.63	45.65	.02	.45	.651
Social support	3.23	2.29	.05	1.41	.16	2.55	2.26	.04	1.13	.26
Exercise	-1.16	4.41	-.01	-.26	.79	1.82	4.38	.02	.42	.68
Fructose	1.01	.34	.11	2.99	.01	.34	.36	.04	.95	.34
Total kcal intake						.05	.01	.20	5.08	<.001
R square	.03					.07				
R square change	.03					.03				
F	1.35					2.62**				

Table 25. Regression results for maternal total sugar intake and maternal fatness changes between first and second trimester (n=118).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	18.70	6.84	.26	2.73	.01	18.33	6.84	.25	2.68	.01
Education	-9.94	30.57	-.03	-.33	.75	-7.61	30.62	-.03	-.25	.80
Ethnic (Ref=white)										
Black	155.44	238.85	.06	.65	.52	132.87	239.57	.05	.56	.58
Asian	25.67	86.84	.03	.30	.77	21.28	86.87	.02	.25	.81
Latin	-57.04	177.74	-.03	-.32	.75	-84.96	179.47	-.04	-.47	.64
Arab	-97.82	242.95	-.04	-.40	.69	-81.62	243.22	-.03	-.34	.74
Marital status (Ref=married)										
Single	-212.82	278.45	-.08	-.76	.45	-214.71	278.23	-.08	-.77	.44
divorced	-137.43	70.47	-.18	-1.95	.05	-127.01	71.07	-.16	-1.79	.08
Common law	-33.61	255.05	-.01	-.13	.90	-91.95	260.52	-.03	-.35	.73
Separated	-9.04	33.51	-.03	-.27	.79	-8.81	33.48	-.03	-.26	.79
Income	-19.43	4.08	-.44	-4.77	<.001	-20.36	4.16	-.46	-4.89	<.001
Pre-pregnancy BMI	-26.65	33.46	-.07	-.80	.43	-29.19	33.52	-.08	-.87	.38
Lived children	73.73	176.74	.04	.42	.68	59.59	177.08	.03	.34	.74
Smoker during pregnancy	34.97	14.85	.22	2.36	.02	35.83	14.86	.23	2.41	.02
Social support	-29.57	19.98	-.14	-1.48	.14	-31.62	20.05	-.15	-1.58	.12
Exercise	-.23	.44	-.05	-.53	.60	-.51	.51	-.11	-1.01	.32
Total sugar	-212.82	278.45	-.08	-.76	.45	.05	.05	.11	1.08	.28
Total kcal intake						-214.71	278.23	-.08	-.77	.44
R square	.29					.30				
R square change	.29					.01				
F	2.54*					2.46*				

Table 26. Regression results for maternal added sugar intake and maternal fatness changes between first and second trimester (n=118).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	18.11	6.86	.25	2.64	.01	17.97	6.87	.25	2.62	.01
Education	-8.90	30.48	-.03	-.29	.77	-7.67	30.51	-.03	-.25	.80
Ethnic (Ref=white)										
Black	152.26	238.26	.05	.64	.52	131.12	239.25	.05	.55	.59
Asian	18.04	87.30	.02	.21	.84	13.27	87.44	.01	.15	.88
Latin	-66.26	176.88	-.03	-.38	.71	-97.24	179.66	-.05	-.54	.59
Arab	-107.09	242.74	-.04	-.44	.66	-93.59	243.15	-.03	-.39	.70
Marital status (Ref=married)										
Single	-194.75	278.36	-.07	-.70	.49	-203.89	278.55	-.07	-.73	.47
divorced	-137.15	70.23	-.18	-1.95	.05	-127.14	70.96	-.16	-1.79	.08
Common law	-50.85	255.62	-.02	-.20	.84	-101.21	260.68	-.04	-.39	.70
Separated	-9.13	33.38	-.03	-.27	.79	-9.69	33.39	-.03	-.29	.77
Income	-19.09	4.09	-.43	-4.67	<.001	-19.74	4.14	-.44	-4.76	<.001
Pre-pregnancy BMI	-27.37	33.39	-.08	-.82	.41	-29.19	33.45	-.08	-.87	.39
Lived children	73.12	176.22	.04	.42	.68	64.01	176.48	.03	.36	.72
Smoker during pregnancy	34.02	14.83	.22	2.29	.02	34.20	14.83	.22	2.31	.02
Social support	-29.16	19.91	-.14	-1.46	.15	-30.41	19.96	-.14	-1.52	.13
Exercise	-.51	.58	-.08	-.87	.39	-.70	.61	-.11	-1.15	.25
Added sugar	-194.75	278.36	-.07	-.70	.49	.04	.04	.09	.99	.33
Total kcal intake						-203.88	278.55	-.07	-.73	.47
R square	.29					.30				
R square change	.29					.01				
F	2.58*					2.48*				

Table 27. Regression results for maternal free sugar intake and maternal fatness changes between first and second trimester (n=118).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	17.85	6.82	.25	2.62	.01	17.61	6.81	.24	2.59	.01
Education	-6.35	30.60	-.02	-.21	.84	-3.80	30.60	-.01	-.12	.90
Ethnic (Ref=white)										
Black	173.36	238.26	.06	.73	.47	156.62	238.16	.06	.66	.51
Asian	16.01	86.93	.02	.18	.85	9.56	86.91	.01	.11	.91
Latin	-50.26	176.79	-.03	-.28	.78	-81.43	178.32	-.04	-.46	.65
Arab	-88.15	241.50	-.03	-.37	.72	-62.34	241.94	-.02	-.26	.80
Marital status (Ref=married)										
Single	-196.52	276.45	-.07	-.71	.48	-196.52	276.45	-.07	-.71	.48
divorced	-124.52	70.66	-.16	-1.76	.08	-124.52	70.66	-.16	-1.76	.08
Common law	-95.77	257.45	-.03	-.37	.71	-95.78	257.45	-.03	-.37	.71
Separated	-9.19	33.23	-.03	-.28	.78	-9.19	33.23	-.03	-.28	.78
Income	-19.98	4.12	-.45	-4.85	<.001	-19.98	4.12	-.45	-4.85	<.001
Pre-pregnancy BMI	-30.09	33.29	-.08	-.90	.37	-30.09	33.29	-.08	-.90	.37
Lived children	54.87	175.85	.03	.31	.76	54.87	175.85	.03	.31	.76
Smoker during pregnancy	36.09	14.76	.23	2.45	.02	36.09	14.76	.23	2.45	.02
Social support	-32.08	19.91	-.15	-1.61	.11	-32.08	19.91	-.15	-1.61	.11
Exercise	-.84	.55	-.15	-1.52	.13	-.84	.55	-.15	-1.52	.13
Free sugar	.05	.04	.12	1.20	.23	.05	.04	.12	1.20	.23
Total kcal intake						-196.52	276.45	-.07	-.71	.48
R square	.29					.30				
R square change	.29					.01				
F	2.63*					2.57*				

Table 28. Regression results for maternal fructose intake and maternal fatness changes between first and second trimester (n=118).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	18.90	6.74	.26	2.80	.01	19.03	6.73	.26	2.83	.01
Education	-9.60	30.43	-.03	-.32	.75	-8.19	30.42	-.03	-.27	.79
Ethnic (Ref=white)										
Black	154.88	238.34	.06	.65	.52	131.81	239.01	.05	.55	.58
Asian	25.00	86.59	.03	.29	.77	22.09	86.54	.02	.26	.80
Latin	-49.75	177.71	-.03	-.28	.78	-75.99	179.12	-.04	-.42	.67
Arab	-85.28	242.32	-.03	-.35	.73	-58.77	243.27	-.02	-.24	.81
Marital status (Ref=married)										
Single	-231.05	274.48	-.08	-.84	.40	-257.33	275.24	-.09	-.94	.35
divorced	-138.09	70.29	-.18	-1.96	.05	-127.33	70.90	-.16	-1.80	.08
Common law	-28.78	254.16	-.01	-.11	.91	-77.43	257.72	-.03	-.30	.76
Separated	-7.98	33.47	-.03	-.24	.81	-7.78	33.44	-.03	-.23	.82
Income	-19.55	4.07	-.44	-4.81	<.001	-20.53	4.16	-.46	-4.93	<.001
Pre-pregnancy BMI	-27.97	33.46	-.08	-.84	.41	-30.70	33.51	-.08	-.92	.36
Lived children	76.09	176.19	.04	.43	.67	66.57	176.22	.03	.38	.71
Smoker during pregnancy	34.80	14.81	.22	2.35	.02	35.38	14.80	.23	2.39	.02
Social support	-30.90	20.03	-.15	-1.54	.13	-33.40	20.14	-.16	-1.66	.10
Exercise	-1.07	1.28	-.07	-.84	.41	-1.72	1.41	-.12	-1.22	.23
Fructose	-231.05	274.48	-.08	-.84	.40	.05	.05	.11	1.10	.27
Total kcal intake						-257.33	275.24	-.09	-.94	.35
R square	.29					.30				
R square change	.29					.01				
F	2.58*					2.50*				

Table 29. Regression results for maternal added sugar intake and maternal fatness changes between second and third trimester (n=629).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-2.83	2.15	-.06	-1.32	.19	-2.90	2.10	-.06	-1.38	.17
Education	-5.82	10.22	-.03	-.57	.57	-10.02	10.05	-.04	-1.00	.32
Ethnic (Ref=white)										
Black	65.87	93.27	.03	.71	.48	8.22	92.08	.01	.09	.93
Asian	.50	28.81	.01	.02	.99	9.34	28.28	.01	.33	.74
Latin	27.20	48.45	.02	.56	.58	35.39	47.50	.03	.75	.46
Native	123.32	93.20	.05	1.32	.19	129.90	91.33	.06	1.42	.16
Arab	94.43	105.19	.04	.90	.37	68.26	103.19	.03	.66	.51
Other	-101.29	73.79	-.06	-1.37	.17	-91.42	72.32	-.05	-1.26	.21
Marital status (Ref=married)										
Single	-117.06	60.14	-.08	-1.95	.05	-119.29	58.93	-.09	-2.03	.04
divorced	195.61	205.36	.04	.95	.34	205.55	201.22	.04	1.02	.31
Common law	14.82	26.53	.02	.56	.58	10.90	26.01	.02	.42	.68
Separated	-47.07	120.01	-.02	-.39	.70	-62.43	117.63	-.02	-.53	.59
Income	-5.58	9.88	-.03	-.57	.57	-1.53	9.71	-.01	-.16	.87
Pre-pregnancy BMI	-3.65	1.79	-.09	-2.04	.04	-4.37	1.76	-.10	-2.48	.01
Lived children	.34	12.41	.01	.03	.98	-.23	12.16	-.01	-.02	.98
Smoker during pregnancy	62.68	65.99	.04	.95	.34	77.17	64.72	.05	1.19	.23
Social support	2.74	3.56	.03	.77	.44	1.63	3.49	.02	.47	.64
Exercise	.62	6.80	.01	.09	.93	3.59	6.68	.02	.54	.59
Added sugar	.42	.19	.09	2.21	.03	.01	.21	.01	.02	.98
Total kcal intake						.07	.01	.23	5.13	<.001
R square	.04					.08				
R square change	.04					.04				
F	1.43					2.73^{**}				

Table 30. Regression results for maternal fructose intake and maternal fatness changes between second and third trimester (n=629).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	-2.83	2.15	-.06	-1.32	.19	-2.89	2.10	-.06	-1.37	.16
Education	-5.82	10.22	-.03	-.57	.57	-10.02	10.04	-.04	-.99	.31
Ethnic (Ref=white)										
Black	65.87	93.26	.03	.706	.480	8.22	92.07	.01	.08	.929
Asian	.49	28.81	.01	.017	.986	9.34	28.28	.01	.33	.741
Latin	27.19	48.45	.02	.561	.575	35.39	47.49	.03	.74	.456
Native	123.32	93.20	.05	1.323	.186	129.89	91.32	.05	1.42	.155
Arab	94.43	105.19	.04	.898	.370	68.26	103.19	.02	.66	.509
Other	-101.29	73.78	-.05	-1.373	.170	-91.41	72.32	-.05	-1.26	.207
Marital status (Ref=married)										
Single	195.61	205.35	.04	.95	.34	-119.29	58.92	-.08	-2.02	.04
divorced	14.82	26.53	.02	.55	.57	205.55	201.20	.04	1.02	.31
Common law	-47.08	120.01	-.02	-.39	.69	10.90	26.01	.02	.42	.67
Separated	-5.57	9.87	-.02	-.56	.57	-62.43	117.62	-.02	-.53	.59
Income	-3.65	1.78	-.08	-2.04	.04	-1.53	9.70	-.01	-.15	.87
Pre-pregnancy BMI	.33	12.41	.01	.03	.97	-4.37	1.75	-.10	-2.48	.01
Lived children	62.67	65.99	.03	.95	.34	-.22	12.15	-.01	-.02	.98
Smoker during pregnancy	2.74	3.56	.03	.77	.44	77.17	64.72	.04	1.19	.23
Social support	.62	6.79	.01	.09	.92	1.62	3.49	.02	.46	.64
Exercise	.42	.19	.09	2.21	.02	3.59	6.68	.02	.53	.59
Fructose	195.61	205.36	.03	.95	.34	.01	.20	.01	.02	.98
Total kcal intake						.07	.01	.22	5.12	<.001
R square	.04					.08				
R square change	.04					.04				
F	1.43					2.73^{**}				

Table 31. Regression results for maternal total sugar intake and maternal weight changes at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	30.95	18.97	.08	1.63	.10	32.47	18.99	.09	1.71	.09
Ethnic (Ref=white)										
Black	32.62	301.95	.01	.10	.91	19.80	301.83	.01	.07	.94
Asian	-94.47	48.47	-.10	-1.94	.05	-91.07	48.49	-.10	-1.87	.06
Latin	-55.89	94.71	-.03	-.59	.55	-57.63	94.63	-.03	-.61	.54
Native	-153.14	174.39	-.04	-.87	.38	-173.17	174.92	-.05	-.99	.32
Arab	432.27	299.29	.07	1.44	.14	418.95	299.19	.07	1.40	.16
Other	116.80	151.69	.03	.77	.44	113.33	151.58	.04	.75	.45
Marital status (Ref=married)										
Single	-17.01	125.35	-.01	-.14	.89	19.80	301.83	.01	.06	.94
divorced	181.49	301.02	.03	.60	.54	-91.07	48.49	-.10	-1.88	.06
Common law	42.56	53.14	.04	.80	.42	-57.63	94.6	-.03	-.61	.54
Separated	-269.47	217.02	-.06	-1.24	.21	-173.17	174.9	-.05	-.99	.32
Pre-pregnancy BMI	-4.14	3.43	-.06	-1.21	.22	-3.02	3.47	-.046	-.870	.385
Exercise	-72.02	24.23	-.15	-2.97	.01	.40	12.32	.01	.033	.97
Breastfeeding status	.44	12.19	.01	.04	.97	.29	.11	.137	2.69	.01
Total sugar	.29	.11	.13	2.74	.08	.12	.38	.017	.30	.76
Total kcal intake						-.04	.03	-.071	-1.27	.21
R square	.02					.03				
R square change	.06					.01				
F	1.60					1.61				

Table 32. Regression results for maternal added sugar intake and maternal weight changes at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	31.29	18.94	.09	1.65	.10	32.92	19.00	.09	1.73	.08
Ethnic (Ref=white)										
Black	31.13	301.93	.01	.10	.92	15.61	302.26	.01	.05	.96
Asian	-96.02	48.48	-.11	-1.98	.04	-94.30	48.51	-.10	-1.94	.05
Latin	-56.80	94.71	-.03	-.60	.54	-58.67	94.72	-.03	-.62	.54
Native	-157.49	174.28	-.04	-.90	.36	-175.53	175.11	-.05	-1.01	.32
Arab	427.46	299.26	.07	1.42	.15	414.47	299.48	.07	1.38	.16
Other	115.95	151.82	.03	.76	.44	114.67	151.81	.04	.76	.45
Marital status (Ref=married)										
Single	-15.31	125.19	-.01	-.12	.90	-8.59	125.34	-.01	-.07	.94
divorced	181.02	301.30	.03	.60	.54	193.90	301.52	.03	.643	.52
Common law	42.41	53.14	.04	.79	.42	44.36	53.17	.04	.834	.41
Separated	-264.41	217.10	-.06	-1.22	.22	-252.31	217.38	-.06	-1.16	.24
Pre-pregnancy BMI	-4.11	3.44	-.06	-1.19	.23	-3.02	3.47	-.05	-.870	.385
Exercise	-71.45	24.19	-.15	-2.95	.01	.40	12.32	.01	.033	.97
Breastfeeding status	.39	12.20	.01	.03	.97	.29	.11	.14	2.69	.01
Added sugar	.29	.10	.13	2.75	.01	.12	.38	.02	.30	.76
Total kcal intake						-.04	.03	-.07	-1.27	.21
R square	.06					.06				
R square change	.06					.04				
F	1.59					1.60				

Table 33. Regression results for maternal free sugar intake and maternal weight changes at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	31.31	18.95	.09	1.65	.99	32.83	19.00	.09	1.73	.09
Ethnic (Ref=white)										
Black	31.08	301.91	.01	.10	.92	16.17	302.18	.01	.05	.95
Asian	-96.05	48.42	-.11	-1.98	.04	-94.230	48.44	-.10	-1.96	.05
Latin	-56.70	94.66	-.03	-.59	.55	-60.30	94.71	-.03	-.63	.55
Native	-157.69	174.48	-.0	-.90	.36	-174.53	175.17	-.05	-.99	.30
Arab	427.25	299.39	.07	1.43	.15	415.63	299.54	.06	1.38	.16
Other	115.91	151.81	.04	.76	.44	114.69	151.79	.03	.75	.45
Marital status (Ref=married)										
Single	-15.18	125.28	-.01	-.12	.90	-9.99	125.35	-.01	-.08	.94
divorced	181.60	301.11	.03	.60	.54	185.61	301.08	.03	.62	.54
Common law	42.46	53.15	.04	.79	.42	43.80	53.16	.04	.82	.41
Separated	-264.30	216.99	-.06	-1.21	.22	-251.96	217.27	-.06	-1.16	.24
Pre-pregnancy BMI	-4.11	3.43	-.06	-1.19	.23	-3.80	3.45	-.06	-1.10	.27
Exercise	-71.45	24.19	-.15	-2.95	.01	-69.39	24.27	-.14	-2.86	.01
Breastfeeding status	.39	12.20	.01	.03	.97	.39	12.20	.01	.03	.97
Free sugar	.29	.10	.13	2.75	.01	.29	.11	.13	2.71	.01
Total kcal intake						.15	.37	.02	.39	.69
R square	.08					.08				
R square change	.09					.01				
F	2.08*					2.02*				

Table 34. Regression results for maternal fructose intake and maternal weight changes at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	38.08	18.98	.11	2.01	.46	40.29	19.01	.11	2.12	.04
Ethnic (Ref=white)										
Black	-76.09	303.13	-.01	-.25	.80	-77.70	302.64	-.01	-.25	.79
Asian	-92.37	49.14	-.10	-1.88	.06	-89.41	49.10	-.09	-1.82	.06
Latin	-46.01	95.56	-.03	-.48	.63	-51.71	95.48	-.03	-.54	.58
Native	-166.03	176.29	-.05	-.94	.35	-189.11	176.69	-.05	-1.07	.28
Arab	395.14	301.76	.07	1.31	.19	373.91	301.62	.06	1.24	.21
Other	65.77	152.32	.02	.43	.67	66.40	152.07	.02	.43	.66
Marital status (Ref=married)										
Single	25.27	125.73	.01	.20	.84	30.77	125.58	.01	.24	.81
divorced	148.37	304.87	.03	.49	.63	145.64	304.39	.02	.47	.63
Common law	57.45	53.49	.05	1.07	.28	57.45	53.41	.06	1.07	.28
Separated	-265.81	218.46	-.06	-1.22	.22	-235.42	219.07	-.06	-1.08	.28
Pre-pregnancy BMI	-3.4	3.46	-.05	-.99	.32	-2.92	3.46	-.04	-.84	.40
Exercise	.29	12.34	.001	.02	.98	-.61	12.33	-.01	-.05	.96
Breastfeeding status	.29	.11	.14	2.75	.01	.29	.10	.14	2.74	.01
Fructose	.33	1.09	.02	.30	.76	.99	1.17	.04	.84	.39
Total kcal intake						-.04	.02	-.08	-1.48	.13
R square	.06					.07				
R square change	.06					.01				
F	1.60					1.64				

Table 35. Regression results for maternal total sugar intake and maternal fatness change at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	38.08	18.98	.11	2.01	.46	40.29	19.01	.11	2.12	.04
Ethnic (Ref=white)										
Black	-76.09	303.13	-.01	-.25	.80	-77.70	302.64	-.01	-.25	.79
Asian	-92.37	49.14	-.10	-1.88	.06	-89.41	49.10	-.09	-1.82	.06
Latin	-46.01	95.56	-.03	-.48	.63	-51.71	95.48	-.03	-.54	.58
Native	-166.03	176.29	-.05	-.94	.35	-189.11	176.69	-.05	-1.07	.28
Arab	395.14	301.76	.07	1.31	.19	373.91	301.62	.06	1.24	.21
Other	65.77	152.32	.02	.43	.67	66.40	152.07	.02	.43	.66
Marital status (Ref=married)										
Single	25.27	125.73	.01	.20	.84	30.77	125.58	.01	.24	.81
divorced	148.37	304.87	.03	.49	.63	145.64	304.39	.02	.47	.63
Common law	57.45	53.49	.05	1.07	.28	57.45	53.41	.06	1.07	.28
Separated	-265.81	218.46	-.06	-1.22	.22	-235.42	219.07	-.06	-1.08	.28
Pre-pregnancy BMI	-3.4	3.46	-.05	-.99	.32	-2.92	3.46	-.04	-.84	.40
Exercise	.29	12.34	.001	.02	.98	-.61	12.33	-.01	-.05	.96
Breastfeeding status	.29	.11	.14	2.75	.01	.29	.10	.14	2.74	.01
Total sugar	.33	1.09	.02	.30	.76	.99	1.17	.04	.84	.39
Total kcal intake						-.04	.02	-.08	-1.48	.13
R square	.08					.09				
R square change	.01					.01				
F	1.94*					1.94*				

Table 36. Regression results for maternal added sugar intake and maternal fatness change at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	32.85	17.21	.11	1.91	.01	34.62	19.01	.11	2.12	.04
Ethnic (Ref=white)										
Black	30.77	125.59	.01	.24	.80	-41.07	251.14	-.01	-.16	.87
Asian	145.64	304.39	.02	.47	.63	2.81	44.39	.01	.06	.95
Latin	57.45	53.41	.06	1.07	.28	-29.64	87.76	-.02	-.33	.73
Native	-235.42	219.07	-.06	-1.07	.28	-66.77	251.83	-.01	-.26	.79
Arab	-2.92	3.47	-.04	-.84	.40	292.34	250.50	.06	1.16	.24
Other	-.61	12.34	-.01	-.05	.96	103.01	145.94	.04	.71	.48
Marital status (Ref=married)										
Single	-4.32	113.98	-.01	-.03	.97	6.18	114.05	.01	.05	.95
divorced	-105.18	252.83	-.02	-.42	.67	-86.89	252.77	-.02	-.34	.73
Common law	39.93	46.45	.04	.86	.39	42.39	46.41	.04	.91	.36
Separated	-278.58	183.19	-.08	-1.52	.13	-264.65	183.18	-.07	-1.44	.14
Pre-pregnancy BMI	-10.99	3.07	-.19	-3.57	<.001	-10.49	3.09	-.19	-3.39	.01
Exercise	-4.44	10.82	-.02	-.41	.68	-4.19	10.81	-.02	-.38	.69
Breastfeeding status	-.02	.10	-.01	-.17	.86	-.02	.10	-.01	-.26	.79
Added sugar	-.44	.31	-.08	-1.44	.15	-.24	.34	-.04	-.69	.48
Total kcal intake						-.03	.02	-.08	-1.41	.15
R square	.08					.09				
R square change	.08					.01				
F	1.95*					1.96*				

Table 37. Regression results for maternal free sugar intake and maternal fatness change at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	33.17	17.32	.11	1.93	.06	34.94	17.24	.11	2.03	.04
Ethnic (Ref=white)										
Black	-30.75	251.53	-.01	-.12	.90	-45.69	251.22	-.01	-.18	.86
Asian	3.83	44.45	.01	.08	.93	4.77	44.36	.01	.11	.91
Latin	-24.88	87.96	-.02	-.28	.77	-28.78	87.83	-.02	-.33	.74
Native	-44.51	252.13	-.01	-.17	.86	-65.75	252.01	-.01	-.26	.79
Arab	308.15	251.06	.06	1.23	.22	294.99	250.71	.06	1.17	.24
Other	101.12	146.30	.03	.69	.49	105.89	146.04	.04	.73	.46
Marital status (Ref=married)										
Single	-1.54	114.28	-.01	-.01	.98	6.97	114.20	.01	.06	.95
divorced	-81.84	252.92	-.01	-.32	.74	-74.94	252.46	-.02	-.30	.76
Common law	41.67	46.51	.04	.89	.37	43.24	46.43	.05	.93	.35
Separated	-283.31	183.36	-.08	-1.54	.12	-268.79	183.24	-.08	-1.47	.14
Pre-pregnancy BMI	-11.08	3.07	-.20	-3.60	<.001	-10.53	3.09	-.19	-3.41	<.001
Exercise	-4.39	10.83	-.02	-.41	.68	-4.05	10.82	-.02	-.37	.71
Breastfeeding status	-.02	.10	-.01	-.23	.81	-.03	.10	-.02	-.31	.75
Free sugar	-.34	.29	-.06	-1.17	.24	-.11	.33	-.02	-.32	.74
Total kcal intake						-.04	.03	-.09	-1.52	.13
R square	.08					.09				
R square change	.08					.01				
F	1.90*					1.94*				

Table 38. Regression results for maternal fructose intake and maternal fatness change at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	33.01	17.27	.11	1.91	.06	35.45	17.24	.11	2.06	.04
Ethnic (Ref=white)										
Black	-40.46	252.47	-.01	-.16	.87	-40.43	251.38	-.01	-.16	.87
Asian	7.62	44.69	.01	.17	.86	9.41	44.52	.01	.21	.83
Latin	-25.80	88.14	-.02	-.29	.77	-29.27	87.78	-.02	-.33	.74
Native	-30.99	252.46	-.01	-.12	.90	-62.16	251.88	-.01	-.25	.81
Arab	324.73	251.19	.07	1.29	.20	299.83	250.44	.06	1.20	.23
Other	109.17	146.43	.04	.75	.46	110.65	145.81	.04	.76	.45
Marital status (Ref=married)										
Single	-8.69	114.54	-.01	-.08	.94	2.62	114.19	.01	.023	.982
divorced	-83.80	254.16	-.02	-.33	.74	-86.79	253.07	-.02	-.343	.732
Common law	40.86	46.65	.04	.87	.38	41.99	46.45	.04	.904	.367
Separated	-302.06	183.03	-.09	-1.65	.10	-267.47	183.10	-.08	-1.461	.145
Pre-pregnancy BMI	-11.30	3.07	-.20	-3.67	<.001	-10.43	3.09	-.188	-3.369	.001
Exercise	-3.65	10.89	-.02	-.33	.74	-4.47	10.85	-.023	-.412	.681
Breastfeeding status	-.03	.12	-.02	-.29	.77	-.03	.10	-.018	-.327	.744
Fructose	-.25	.95	-.01	-.26	.79	.59	1.04	.034	.566	.572
Total kcal intake						-.04	.03	-.116	-1.962	.051
R square	.08					.09				
R square change	.08					.01				
F	1.81*					1.95*				

Table 39. Regression results for maternal SSB sugar intake and maternal weight change during pregnancy (n=542).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	6.23	3.48	.08	1.79	.07	6.53	3.47	.09	1.88	.06
Education	32.04	15.82	.09	2.03	.04	29.15	15.82	.09	1.84	.07
Ethnic (Ref=white)										
Black	49.02	140.10	.02	.35	.73	25.38	140.04	.01	.18	.85
Asian	-130.88	41.63	-.14	-3.14	.01	-121.85	41.69	-.14	-2.92	.01
Latin	-61.82	69.43	-.04	-.89	.37	-60.78	69.18	-.04	-.87	.38
Native	-17.77	154.71	-.01	-.12	.91	-12.78	154.18	-.01	-.08	.93
Arab	417.58	310.07	.06	1.35	.18	416.47	308.99	.05	1.35	.18
Other	25.87	127.87	.01	.20	.84	53.51	128.06	.03	.42	.67
Marital status (Ref=married)										
Single	-13.42	103.84	-.01	-.13	.89	-21.77	103.54	-.01	-.21	.83
divorced	182.85	305.66	.03	.59	.55	167.14	304.68	.02	.54	.58
Common law	63.21	44.13	.06	1.43	.15	61.24	43.99	.06	1.39	.16
Separated	-250.90	218.47	-.04	-1.15	.25	-259.37	217.74	-.05	-1.19	.23
Income	7.34	15.14	.02	.48	.63	10.22	15.14	.03	.67	.50
Pre-pregnancy BMI	-2.41	2.89	-.03	-.83	.41	-2.56	2.88	-.03	-.89	.37
Lived children	-72.02	19.51	-.16	-3.69	<.001	-74.00	19.48	-.17	-3.80	<.001
Smoker during pregnancy	-260.09	116.44	-.09	-2.24	.03	-235.15	116.61	-.08	-2.02	.04
Social support	1.34	5.57	.01	.24	.81	-.01	5.58	.01	-.01	1.00
Exercise	-4.75	10.99	-.02	-.43	.67	-3.09	10.98	-.01	-.28	.78
Added Sugar	-.29	.69	-.02	-.42	.67	-.37	.68	-.02	-.54	.58
Total kcal intake						.06	.03	.09	2.16	.03
R square	.09					1.00				
R square change	.09					.01				
F	2.61^{**}					2.73^{**}				

Table 40. Regression results for number of maternal SSB servings and maternal weight change during pregnancy (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	3.02	3.03	.05	.99	.32	3.07	3.03	.05	1.02	.31
Education	22.79	14.69	.08	1.55	.12	20.98	14.72	.07	1.43	.15
Ethnic (Ref=white)										
Black	-25.56	127.19	-.01	-.20	.84	-44.16	127.51	-.02	-.34	.73
Asian	-21.74	39.62	-.03	-.55	.58	-14.33	39.82	-.02	-.36	.73
Latin	-50.48	65.25	-.04	-.77	.44	-49.24	65.14	-.03	-.75	.45
Native	117.04	177.93	.04	.65	.51	121.92	177.65	.03	.68	.49
Arab	418.77	255.68	.08	1.63	.10	415.46	255.25	.07	1.62	.10
Other	71.63	116.02	.03	.62	.54	88.06	116.28	.04	.75	.44
Marital status (Ref=married)										
Single	-136.23	101.89	-.06	-1.33	.18	-137.61	101.72	-.06	-1.35	.18
divorced	-96.42	251.83	-.02	-.38	.70	-107.02	251.49	-.02	-.43	.67
Common law	41.69	38.80	.05	1.08	.28	39.64	38.76	.04	1.02	.31
Separated	-317.69	180.99	-.08	-1.75	.08	-320.76	180.69	-.08	-1.78	.08
Income	-4.29	14.16	-.02	-.33	.76	-3.24	14.15	-.01	-.23	.82
Pre-pregnancy BMI	-7.16	2.57	-.13	-2.78	.01	-7.22	2.56	-.13	-2.81	.01
Lived children	-58.87	17.24	-.16	-3.41	.01	-60.45	17.24	-.17	-3.51	.01
Smoker during pregnancy	-120.88	96.15	-.05	-1.25	.20	-104.91	96.52	-.05	-1.09	.28
Social support	3.69	4.79	.03	.77	.42	2.66	4.83	.03	.550	.58
Exercise	-17.76	9.65	-.09	-1.84	.07	-16.53	9.67	-.08	-1.70	.09
SSB sugar intake	.75	.86	.04	.87	.38	.53	.87	.03	.61	.54
Total kcal intake						.04	.03	.08	1.59	.11
R square	.08					.09				
R square change	.08					.01				
F	2.04*					2.07*				

Table 41. Regression results for maternal SSB sugar intake and maternal fatness change during pregnancy (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	3.02	3.03	.05	.99	.32	3.07	3.03	.05	1.02	.31
Education	22.79	14.69	.08	1.55	.12	20.98	14.72	.07	1.43	.15
Ethnic (Ref=white)										
Black	-25.56	127.19	-.01	-.20	.84	-44.16	127.51	-.02	-.34	.73
Asian	-21.74	39.62	-.03	-.55	.58	-14.33	39.82	-.02	-.36	.73
Latin	-50.48	65.25	-.04	-.77	.44	-49.24	65.14	-.03	-.75	.45
Native	117.04	177.93	.04	.65	.51	121.92	177.65	.03	.68	.49
Arab	418.77	255.68	.08	1.63	.10	415.46	255.25	.07	1.62	.10
Other	71.63	116.02	.03	.62	.54	88.06	116.28	.04	.75	.44
Marital status (Ref=married)										
Single	-136.23	101.89	-.06	-1.33	.18	-137.61	101.72	-.06	-1.35	.18
divorced	-96.42	251.83	-.02	-.38	.70	-107.02	251.49	-.02	-.43	.67
Common law	41.69	38.80	.05	1.08	.28	39.64	38.76	.04	1.02	.31
Separated	-317.69	180.99	-.08	-1.75	.08	-320.76	180.69	-.08	-1.78	.08
Income	-4.29	14.16	-.02	-.33	.76	-3.24	14.15	-.01	-.23	.82
Pre-pregnancy BMI	-7.16	2.57	-.13	-2.78	.01	-7.22	2.56	-.13	-2.81	.01
Lived children	-58.87	17.24	-.16	-3.41	.01	-60.45	17.24	-.17	-3.51	.01
Smoker during pregnancy	-120.88	96.15	-.05	-1.25	.20	-104.91	96.52	-.05	-1.09	.28
Social support	3.69	4.79	.03	.77	.42	2.66	4.83	.03	.550	.58
Exercise	-17.76	9.65	-.09	-1.84	.07	-16.53	9.67	-.08	-1.70	.09
SSB servings	.75	.86	.04	.87	.38	.53	.87	.03	.61	.54
Total kcal intake						.04	.03	.08	1.59	.11
R square	.08					.09				
R square change	.08					.01				
F	2.04*					2.07*				

Table 42. Regression results for number of maternal SSB servings and maternal fatness change during pregnancy (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Age	.42	1.40	.01	.30	.77	.30	1.38	.01	.22	.828
Education	-2.51	6.28	-.02	-.40	.69	-5.10	6.19	-.03	-.82	.411
Ethnic (Ref=white)										
Black	14.05	50.60	.01	.28	.78	-.78	49.84	-.01	-.02	.99
Asian	-5.11	17.13	-.01	-.30	.77	-2.25	16.85	-.01	-.13	.89
Latin	6.45	29.87	.01	.22	.83	11.67	29.39	.02	.40	.69
Native	46.68	55.54	.03	.84	.40	48.84	54.62	.03	.89	.37
Arab	45.20	65.91	.03	.69	.49	42.57	64.81	.02	.66	.51
Other	-59.48	48.94	-.05	-1.22	.23	-49.22	48.17	-.04	-1.02	.31
Marital status (Ref=married)										
Single	6.11	37.53	.01	.16	.87	2.68	36.91	.01	.07	.94
divorced	132.92	144.64	.03	.92	.36	139.26	142.24	.04	.98	.33
Common law	6.97	17.14	.02	.41	.68	7.06	16.86	.02	.42	.68
Separated	55.87	84.21	.02	.66	.51	46.36	82.83	.02	.56	.58
Income	-4.11	5.97	-.03	-.69	.49	-1.62	5.89	-.01	-.28	.78
Pre-pregnancy BMI	-3.21	1.15	-.11	-2.79	.01	-3.48	1.13	-.12	-3.08	.01
Lived children	-5.44	7.98	-.03	-.68	.50	-6.18	7.85	-.03	-.79	.43
Smoker during pregnancy	10.19	46.35	.01	.22	.83	18.17	45.60	.01	.40	.69
Social support	2.73	2.30	.05	1.18	.24	2.44	2.27	.04	1.08	.28
Exercise	.35	4.45	.01	.08	.94	2.20	4.39	.02	.50	.62
Added Sugar	.35	.12	.11	2.86	.01	.08	.13	.02	.58	.56
Total kcal intake						.05	.01	.21	5.10	<.001
R square	.03					.07				
R square change	.03					.03				
F	1.31					2.59^{**}				

Table 43. Regression results for maternal SSB sugar intake and maternal weight change at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	38.16	18.98	.11	2.01	.05	40.04	19.03	.11	2.11	.04
Ethnic (Ref=white)										
Black	-82.92	302.67	-.01	-.27	.78	-91.25	302.53	-.02	-.30	.76
Asian	-95.30	48.84	-.11	-1.95	.05	-95.23	48.81	-.11	-1.95	.05
Latin	-46.01	95.57	-.03	-.48	.63	-49.97	95.55	-.02	-.52	.60
Native	-172.93	175.57	-.05	-.98	.32	-197.85	176.58	-.05	-1.12	.26
Arab	390.76	301.72	.06	1.29	.19	371.15	301.91	.06	1.22	.22
Other	62.35	152.48	.02	.41	.68	62.19	152.36	.02	.41	.68
Marital status (Ref=married)										
Single	25.99	125.71	.01	.20	.83	33.54	125.76	.01	.26	.79
divorced	153.83	304.11	.02	.50	.61	165.01	304.04	.02	.54	.58
Common law	59.13	53.61	.05	1.10	.27	59.36	53.57	.05	1.11	.26
Separated	-267.52	218.59	-.06	-1.22	.22	-242.22	219.38	-.05	-1.10	.27
Pre-pregnancy BMI	-3.34	3.47	-.05	-.96	.33	-3.01	3.48	-.04	-.86	.38
Exercise	.37	12.34	.01	.03	.97	.29	12.34	.01	.02	.98
Breastfeeding status	.29	.11	.13	2.73	.01	.29	.11	.13	2.73	.01
SSB sugar	-.13	.75	-.01	-.18	.85	.05	.77	.01	.07	.94
Total kcal intake						-.03	.02	-.07	-1.24	.21
R square	.02					.02				
R square change	.06					.01				
F	1.60					1.60				

Table 44. Regression results for number of maternal SSB servings and maternal weight change at 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	38.15	18.98	.11	2.01	.05	40.03	19.03	.11	2.10	.04
Ethnic (Ref=white)										
Black	-83.19	302.71	-.01	-.27	.78	-91.33	302.56	-.02	-.30	.76
Asian	-95.15	48.76	-.10	-1.95	.05	-95.38	48.72	-.11	-1.95	.05
Latin	-46.49	95.63	-.02	-.48	.62	-49.84	95.60	-.02	-.52	.60
Native	-172.93	175.56	-.05	-.98	.32	-197.95	176.58	-.05	-1.12	.26
Arab	390.62	301.73	.06	1.29	.19	371.08	301.92	.06	1.22	.22
Other	62.26	152.49	.02	.41	.68	61.98	152.38	.02	.41	.68
Marital status (Ref=married)										
Single	25.58	125.79	.01	.20	.83	33.52	125.86	.01	.26	.79
divorced	153.39	304.19	.02	.50	.61	164.85	304.11	.03	.54	.58
Common law	58.66	53.45	.05	1.09	.27	59.61	53.42	.06	1.11	.26
Separated	-267.52	218.58	-.06	-1.22	.22	-242.54	219.35	-.05	-1.11	.27
Pre-pregnancy BMI	-3.38	3.46	-.05	-.97	.33	-2.98	3.47	-.04	-.86	.39
Exercise	.30	12.38	.01	.03	.98	.29	12.37	.01	.02	.98
Breastfeeding status	.29	.10	.13	2.73	.01	.29	.11	.14	2.73	.01
SSB servings	-4.07	21.82	-.01	-.18	.85	1.07	22.20	.01	.05	.96
Total kcal intake						-.03	.03	-.06	-1.24	.21
R square	.06					.06				
R square change	.06					.01				
F	1.60					1.60				

Table 45. Regression results for maternal SSB sugar intake and maternal fatness change 3-month postpartum (n=389).

Input variable	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	32.86	17.28	.11	1.91	.06	35.27	17.25	.11	2.04	.04
Ethnic (Ref=white)										
Black	-37.78	252.06	-.01	-.15	.88	-47.38	251.13	-.01	-.19	.85
Asian	8.17	44.53	.01	.18	.86	7.13	44.35	.01	.16	.87
Latin	-25.98	88.16	-.02	-.29	.77	-28.99	87.83	-.02	-.33	.74
Native	-29.22	252.29	-.01	-.12	.91	-63.96	251.96	-.01	-.25	.80
Arab	325.42	251.15	.07	1.29	.19	299.08	250.54	.06	1.19	.23
Other	108.27	146.63	.04	.74	.46	110.51	146.09	.04	.76	.45
Marital status (Ref=married)										
Single	-11.67	114.29	-.01	-.10	.92	6.92	114.26	.01	.06	.95
divorced	-90.99	253.49	-.02	-.36	.72	-73.58	252.67	-.02	-.29	.77
Common law	41.11	46.75	.05	.88	.38	42.23	46.56	.04	.91	.36
Separated	-303.39	183.16	-.09	-1.66	.10	-269.36	183.31	-.08	-1.47	.14
Pre-pregnancy BMI	-11.26	3.08	-.20	-3.65	$<.001$	-10.55	3.09	-.19	-3.41	.001
Exercise	-4.07	10.88	-.02	-.37	.71	-3.72	10.84	-.2	-.34	.73
Breastfeeding status	-.03	.10	-.02	-.29	.77	-.03	.10	-.02	-.32	.74
SSB sugar	-.16	.69	-.01	-.23	.82	.17	.71	.01	.23	.82
Total kcal intake						-.05	.02	-.11	-1.89	.05
R square	.08					.09				
R square change	.08					.01				
F	1.81*					1.93*				

Table 46. Regression results for number of maternal SSB servings and maternal fatness change 3-month postpartum (n=389).

Input variables	Model 1					Model 2				
	Coefficients					Coefficients				
	B	Std Err	β	t	*p*	B	Std Err	β	t	*p*
Education	32.86	17.28	.11	1.91	.02	35.15	17.24	.11	2.04	.04
Ethnic (Ref=white)										
Black	-38.66	252.07	-.01	-.15	.88	-48.05	251.16	-.01	-.19	.84
Asian	7.91	44.47	.01	.18	.89	6.45	44.31	.01	.14	.88
Latin	-26.86	88.23	-.02	-.30	.76	-29.04	87.90	-.02	-.33	.74
Native	-29.88	252.28	-.01	-.12	.91	-63.84	251.98	-.01	-.25	.80
Arab	324.62	251.13	.07	1.29	.19	298.58	250.57	.06	1.19	.23
Other	107.49	146.61	.04	.73	.46	109.22	146.06	.04	.75	.45
Marital status (Ref=married)										
Single	-12.64	114.36	-.01	-.11	.91	6.17	114.37	.01	.05	.96
divorced	-92.34	253.53	-.02	-.36	.72	-75.05	252.74	-.02	-.29	.76
Common law	40.56	46.60	.05	.87	.38	43.01	46.44	.05	.92	.35
Separated	-303.93	183.13	-.09	-1.66	.09	-271.05	183.28	-.08	-1.48	.14
Pre-pregnancy BMI	-11.28	3.07	-.20	-3.67	<.001	-10.53	3.09	-.19	-3.40	.001
Exercise	-4.22	10.89	-.02	-.39	.69	-3.82	10.86	-.02	-.35	.73
Breastfeeding status	-.03	.10	-.02	-.30	.76	-.03	.10	-.02	-.33	.74
SSB servings	-6.32	19.53	-.02	-.32	.74	1.62	19.92	.01	.08	.93
Total kcal intake						-.04	.02	-.10	-1.87	.06
R square	.08					.09				
R square change	.08					.01				
F	1.81*					1.93*				