Intervening to reduce weight gain in pregnancy and gestational diabetes mellitus in Cree communities: an evaluation

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Abstract

Background: A high prevalence of gestational diabetes mellitus and type 2 diabetes has been observed among the Cree of James Bay, Quebec. To address this problem, a diet and activity intervention during pregnancy, which was based on social learning theory, was initiated in 4 Cree communities.

Methods: A prospective intervention compared dietary, weight and glycemic indicators for 107 control subjects and for 112 women who received the intervention during the course of their pregnancy. A control period in 4 communities (July 1995–March 1996) was followed by an intervention period (April 1996–January 1997) when subjects were offered regular, individual diet counselling, physical activity sessions and other activities related to nutrition.

Results: The intervention and control groups did not differ at baseline regarding their mean age (24.3 years [SD 6.29] v. 23.8 years [SD 5.86]), mean prepregnancy weight (81.0 kg [SD 19.46] v. 78.9 kg [SD 17.54]) and mean gestational age at recruitment (17.1 weeks [SD 7.06] v. 18.5 weeks [SD 6.92]). The intervention did not result in differences in diet measured at 24–30 weeks' gestation, rate of weight gain over the second half of pregnancy (0.53 kg per week [SD 0.32] v. 0.53 kg per week [SD 0.27]) or plasma glucose level (50 g oral glucose screen) between 24 and 30 weeks (7.21 mmol/L [SD 2.09] v. 7.43 mmol/L [SD 2.10]). Mean birth weights were similar (3741 g [SD 523] v. 3686 g [SD 686]), as was maternal weight at 6 weeks post partum (88.1 kg [SD 16.8] v. 86.4 kg [SD 19.0]). The only changes in dietary intake were a reduction in caffeine (pregnancy) and an increase in folate (post partum).

Interpretation: This intervention had only a minor impact on diet; finding ways of encouraging appropriate body weight and activity levels remains a challenge.

Research

Recherche

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The Cree of the Eeyou-Istchee region of eastern James Bay have high rates of gestational diabetes mellitus (GDM) at 12.8%.[1] These metabolic disturbances put both women and their children at increased risk of developing type 2 diabetes.[2] In addition, obesity is prevalent in many Aboriginal communities,[3] and obesity is linked to an increased risk of infant macrosomia.[4] The most important risk factors for GDM apart from Aboriginal origin are greater age at pregnancy, higher body mass index, family history of diabetes and, possibly, lower socioeconomic status.[5,6] These risk factors are not readily amenable to change.

There is, however, some evidence to suggest that decreased weight gain during pregnancy among obese women is associated with a lower rise in fasting insulin concentrations.[7] Although a reduction in the rate of weight gain has been observed among women treated for GDM,[8] there is little information as to whether such an intervention is feasible or effective among overweight pregnant women who do not have this condition.

This paper describes the evaluation of an intervention aimed at improving dietary intake during pregnancy, optimizing gestational weight gain, glycemic levels and birth weight, and avoiding unnecessary postpartum weight retention. The research proposal was developed at the request of, and in close collaboration with, the Cree Board of Health and Social Services of James Bay, which provides health and social services to over 12 000 Cree based in 9 communities in northern Quebec.

Methods

All Cree women receiving prenatal services prior to 26 weeks' gestation in the communities of Chisasibi, Wemindji, Waswanipi and Mistissini between July 1995 and January 1997 were eligible. Only women with pregestational diabetes were excluded from the study. Women recruited between July 1995 and March 1996 served as controls, whereas women identified between April 1996 and January 1997 made up the intervention group. All participants gave signed informed consent to be in the study, which was approved by the Ethics Review Board of McGill University. Data on all pregnancies occurring during the study period were used to calculate the participation rate and compare participants with nonparticipants.

During the control period, study participants were seen by the dietitian for dietary evaluations at 24–30 weeks' gestation and at 6 weeks post partum. Data on weight gain and glucose values were collected by the clinic staff following routine procedures.

During both the control and intervention periods, 2 research nutritionists (K.D. and A.C.) lived and worked in 2 communities, the time in each community being proportional to workload. The nutritionists received training in cultural beliefs concerning diet,[9] developed and adapted local teaching aids and worked with a team of health care workers, including a community nutritionist working in the Cree villages. Cree health workers were hired in each of the 4 communities. The intervention was based on the social learning theory.[10] Table 1 outlines strategies and activities used in the intervention. Dietary advice was related to improving the intake of dairy products and fruit and vegetables, while decreasing the intake of high-energy foods with little nutritional value such as soft drinks, fruit drinks and french fries, and staying within guidelines for weight gain during pregnancy.[11]

A baseline questionnaire provided demographic information, a brief prenatal history and information about smoking habits. Dietary data were obtained by having each woman recall everything she had eaten within the previous 24 hours at 24–30 weeks' gestation and a second time at 6 weeks post partum. This dietary measure is accurate for group intake measurement.[12] Food Processor II (Version 5.3) and the 1992 Canadian Nutrient Database File (ESHA Research, Salem, Ore) were used to obtain nutrient intake. Physical activity was measured at the time of the 24-hour diet recalls by a questionnaire related to usual daily activities in both the village and the bush (at hunting camps).[13]

Table 1: Components of the intervention

People	Strategies	Activities
Nutritionists Cree health workers	Modelling Skill training Contracting Self-monitoring	Local radio broadcasts about healthy eating in pregnancy Pamphlets about nutritional choices and encouraging breast-feeding Supermarket tours and cooking demonstrations Exercise/walking groups Individual counselling

Gestational age was assessed by the last-recalled menstrual period date, if this was within 1 week of the dating by ultrasonography that was carried out between 16 and 20 weeks. If the 2 measures did not agree, dating by ultrasonography was used.[14] The rate of weight gain was calculated from 20 weeks to delivery (kg per week). Recalled pregravid weight was used if it was within 5 kg of documented weight up to 10 weeks' gestation and within 7 kg of documented weight between 10 and 14 weeks' gestation, otherwise the earliest prenatal weight (≤ 14 weeks) was used. Pregravid weight was recorded from the women's recalled weight (69%), from an early prenatal visit (23%) or was considered missing (8%). Postpartum weight retention was calculated as measured weight at approximately 6 weeks post partum minus pregravid weight. A 50 g oral glucose screen test was carried out between 24 and 30 weeks of gestation. If the screen value was ≥ 7.8 mmol/L at 1 hour, a 3-hour 100 g oral glucose tolerance test (OGTT) was done to identify women with GDM.[15] In 22 cases where a high screen was not followed by a complete OGTT, the positive predictive value of the high screen value (calculated for those with both screen and OGTT) was used to estimate the number of subjects with GDM. Infant birth weight and type of delivery were obtained from the medical charts. The ratio of the measured birth weight to median birthweights specific to gestational age was used to compare birthweight among the Cree with a non-Aboriginal standard.[16]

Participants were compared with nonparticipants living in their communities at the same time. All participants were included in the intention-to-treat approach to the analysis. Mean nutrient intakes, birth weight, birth weight ratio, gestational age, rate of weight gain, glycemic level on the glucose screen and postpartum weight retention were compared for the treatment groups by independent *t*-tests, after adjusting for normality where warranted. Log transformation was used to normalize pregravid weight, body mass index (BMI) (weight [kg]/ height [m^2]) and postpartum weight. The sample size was sufficient for 80% power, using a 2-sided *t*-test to detect differences in birth weight of 215 g, energy intake of 1396 kJ (12.6%), plasma glucose level of 0.74 (10%) mmol/L, rate of weight gain of 0.10 kg per week and postpartum weight retention of 1.9 kg. It was not possible to have a sufficiently large sample size to detect differences in GDM rates.

Results

A total of 323 pregnant women were potentially eligible. Of these, 7 were excluded: 6 had pregestational diabetes and 1 woman had serious health problems. There were 4 abortions (3 spontaneous and 1 induced), 18 women were not in the community at the time of recruitment, 29 were identified after 26 weeks' gestation, 4 were not contacted prior to the end of recruitment and 42 refused to take part. This resulted in 219 eligible subjects: 107 in the control period and 112 in the intervention period. Women who were not recruited were similar in age, prepregnancy weight, height and BMI. Women in the treatment group were seen at least monthly for the duration of the pregnancy. The mean number of individual counselling sessions was 4.03 (standard deviation [SD] 1.68), averaged over all subjects. Miscarriages occurred in 2 control subjects and in 3 women in the intervention group soon after recruitment. Mean age, prepregnancy weight, height, BMI and gestational age at recruitment were similar for the intervention and control groups (Table 2).

The mean intake of energy and other nutrients at an average of 27 weeks' gestation was similar for the intervention and control groups (Table 3). Mean intake was adequate for most nutrients, but the diet included some very high sources of energy that provide few nutrients. Dietary folate was low in both groups, and the cholesterol level was high, reflecting low intakes of fruit and vegetables and the abundance of eggs in the diets. Only caffeine consumption was significantly reduced as a result of the intervention (p = 0.046), however, given the number of nutrients tested, it was not significant using the Bonferroni correction.

There was a significant association between energy intake, measured by one 24-hour diet recall of the participant, and rate of weight gain ($r = 0.23$, $p < 0.002$). Self-reported levels of physical activity were very low, with 23% of women reporting sedentary behaviour in the control group and a significantly higher percentage, 61%, in the intervention group ($p < 0.001$). Activity in the bush did not differ between the control and intervention periods, but, overall, women reported being more active when in the bush ($p < 0.001$).

The rate of weight gain was similar for the intervention group when compared with the control group and was very high at over 0.5 kg per week in both groups (Table 4). The total weight gain was 13.2 kg (SD 8.3) for control subjects compared with 12.0 kg (SD 6.4, p = 0.29) for women in the intervention group. In both groups combined, overweight women (BMI > 29 kg/m^2) gained significantly less weight (9.5 kg [SD 6.0]) than women who were not overweight (BMI ≤ 29 kg/m^2) who gained 16.1 kg (SD 7.4). In addition, among those who developed GDM (n = 25), the mean rate of weight gain after diagnosis of GDM was the same for both the control and treatment groups (0.36 kg per week [SD 0.44] v. 0.51 kg per week [SD 0.35] respectively, p = 0.39).

Glucose screen values measured at a median gestational age of 28 weeks were the same for the 2 groups. In the control group, there were 10 confirmed cases of GDM and an estimated additional 4 cases among those with a high glucose screen and no OGTT for a prevalence of 14.7% (95% confidence interval [CI] 7.58%–21.8%). In the intervention group, there were 15 confirmed and 2 estimated cases of GDM for a prevalence of 16.2% (95% CI 9.15%–23.3%).

Birth weight and the birth weight ratio were similar for the intervention and control groups. Adjustment for initial BMI, age and smoking did not change the results for infant birth weight. Cree infants in the 2 groups were on average 15% heavier than non-Aboriginal infants, after adjusting for gestational age. There were also no differences in macrosomia, defined as birth weight greater than 4000 g, or rates of cesarean section (Table 4).

At 6 weeks post partum, women in the control group had an average weight of 88.1 kg [SD 16.8] as opposed to 86.4 kg [SD 19.0] among women in the intervention group. This indicates postpartum weight retention of 7.4 kg [SD 8.5] compared with 6.1 kg [SD 6.7]. A cross-sectional analysis, controlling for the known effect of age on body

Table 2: Baseline characteristics of study participants

Variable	No. of women	Control group	No. of women	Intervention group
Age, yr*	107	23.8 (5.86)	112	24.3 (6.29)
Prepregnancy weight, kg	101	78.9 (17.54)	98	81.0 (19.46)
Height, cm	107	163.2 (5.71)	111	162.0 (5.04)
BMI, kg/m^2	101	29.6 (6.45)	98	30.8 (6.85)
Gestational age at entry, wk	107	18.5 (6.92)	112	17.1 (7.06)
No. of smokers	107	45 42%	112	58 52%
No. of cigarettes/d	45	3.6 (1.71)	58	4.4 (3.48)
Parity: 0	40	37%	35	31%
1	28	26%	31	28%
2–4	37	35%	38	34%
> 4	2	2%	8	7%

Note: BMI = body mass index.
*Values are means (and standard deviation), unless otherwise stated.

Table 3: Daily dietary intake of pregnant women measured between 24 and 30 weeks' gestation*

Variable†	Control *n = 93*	Intervention *n = 99*	Recommended intake‡
Energy, kJ	11 090 (4239)	11 558 (3244)	–
Carbohydrate, g	345 (164)	356 (115)	–
Protein, g	109 (50)	112 (45)	63
Fat, g	96 (44)	102 (38)	–
Folate, µg	290 (165)	320 (153)	475
Vitamin B_{12}, µg	5 (0.49)	5 (3.1)	3
Vitamin C, mg	217 (183)	232 (155)	40
Iron, mg	21 (16)	21 (12.1)	18–23
Zinc, mg	12 (8.2)	14 (6.9)	15
Total vitamin A, RE	1000 (1286)	1053 (631)	900
Calcium, mg	1081 (747)	1216 (655)	1300
Dietary fibre, g	14 (11)	14 (7)	–
Cholesterol, mg	415 (273)	425 (235)	–
Caffeine, mg	210 (147)	160 (180)§	–

*The nutrient content of supplements is not included. Dietary data for 22 women (12 controls, 10 intervention) were not available between 24 and 30 weeks' gestation.
†Values are means (and standard deviation).
‡Derived from Health and Welfare Canada recommendations.[17]
§Significant difference from control, $p < 0.05$.

weight by analysis of covariance, indicated that nulliparous women had a mean prepregnancy weight of 76.1 kg as opposed to 82.1 kg in parous women (p = 0.049). Breast-feeding at 6 weeks post partum was prevalent in both groups, with 83% of women in the control group and 87% of women in the intervention group breast-feeding their infants. The mean dietary intake of women in the 2 groups measured at 6 weeks post partum revealed no differences in energy intake (11 934 kJ per day [SD 4188] v. 12 770 kJ per day [SD 4878], p = 0.26, for control and intervention groups respectively). The only difference in intake associated with the intervention was a higher intake of folate in the intervention group than the controls (373 µg [SD 27.2] v. 304 µg [SD 19.9], p = 0.035). During the postpartum period, energy intakes were higher than during pregnancy ($p < 0.05$).

Discussion

This intervention study was planned to help Cree women avoid GDM, infant macrosomia and excessive postpartum weight retention. This was the first attempt to study an intervention aimed principally at reducing the risk of GDM in a community setting. The additional health care resources (2 nutritionists) were viewed positively by the communities, but the intervention did not change any of the outcome measures. This lack of effect is similar to that seen in other trials during pregnancy.[18,19] The study design involved comparing the same communities before and during an intervention. This study design was chosen because randomizing individuals within these small communities might have led to treatment contamination, and randomization of whole communities was problematic because of important differences between the communities.

Most of the women were not physically active, and many were overweight at the start of pregnancy. Energy intakes were high at 142 kJ/kg compared with recommended intakes of 105 kJ/kg for overweight women and 146 kJ/kg for women of normal weight.[11] The dietary intake data indicated a direct correlation with weight gain. The need to reduce dietary intake to reduce weight gain is clear. The large amount of retained weight at 6 weeks post partum compounds the problem of being overweight and the high risk of type 2 diabetes in this population.[20] The rate of infant macrosomia was high, and the rate of low birth weight was substantially lower than that of the general Canadian population.[21,22] In order to maintain this enviable low risk of having small babies, one must be careful not to shift the entire birth weight distribution curve to the left. The percentage of women who reported a sedentary lifestyle was significantly higher in the intervention group. This is probably because the subjects in the intervention group had a more realistic assessment of their activity level because they were consistently encouraged to be more active.

The reasons why the intervention was not successful have been reflected upon by all involved. Discussions with women in the communities made it clear that being plump is desirable, whereas physical activity during pregnancy is not considered desirable, despite the fact that the older community members report that inactivity during pregnancy is a recent phenomenon. Community members say that regular weight gain during pregnancy has always been considered important. Cree elders tell of family members who experienced starvation in the 1930s and 1940s, and early reports confirm this.[23]

The intervention may not have been sufficiently intense either in the frequency of contacts or the approach to diet, or the duration of the project may not have been sufficiently long. The nutritionists each covered 2 communities so they were not always present in each community. Participation in

Table 4: Weight gain, plasma glucose plus birth outcomes in the control and intervention groups of pregnant Cree women

Variable	No. of women	Control group	No. of women	Intervention group
Weight gain, kg/wk*†	96	0.53 (0.32)	104	0.53 (0.27)
Weight gain (kg/wk) BMI ≤ 29 kg/m^2	49	0.63 (0.32)	51	0.62 (0.27)
Weight gain (kg/wk) BMI > 29 kg/m^2	47	0.44 (0.30)	53	0.44 (0.24)
Plasma glucose, mmol/L	87	7.21 (2.09)	97	7.43 (2.10)
Gestational age at delivery, wk	103	39.56 (1.87)	106	39.53 (3.42)
Birth weight, g‡	103	3741 (523)	106	3686 (686)
Birth weight > 4000 g,‡ no. (and %)	103	31 30.1%	106	37 34.9%
Birth weight < 2500 g,‡ no. (and %)	103	2 1.94%	106	3 2.83%
Birth weight ratio§	103	1.15 (0.18)	106	1.15 (0.16)
Cesarean section,‡ no. (and %)	103	13 12.62%	106	15 14.15%
Postpartum weight, kg	75	88.1 (16.8)	62	86.4 (19.0)

*Rate of weight gain is defined as last available weight before delivery minus first available weight at 16, 20 or 24 weeks of gestation divided by weeks of gestation.
†Values are means (and standard deviation), unless stated otherwise.
‡Excluding twin births (n = 3).
§Birth weight ratio is defined as infant's weight at delivery divided by a reference weight at a given gestational age.[16]

community interventions such as food/cooking/shopping events was very low. Increased physical activity was difficult to encourage because walking outdoors can be very cold, and fitness classes were not seen as appropriate for pregnant women. In a hospital setting, non-Aboriginal women diagnosed with gestational diabetes have been seen to decrease their rate of weight gain rapidly as a result of dietary advice,[8] however, even the study participants who developed GDM did not decrease their weight gain.

In conclusion, our intervention did not succeed in changing dietary intake, weight gain or plasma glucose levels among the pregnant Cree women. The study has, however, indicated the important problems concerning body weight and inactivity among the Cree in relation to obesity and diabetes; these problems must be tackled with a profound understanding of the views of Cree society on healthy foods, body weight and physical activity.

Competing interests: None declared.

Contributors: Dr. Gray-Donald proposed the project, supervised the research and wrote the manuscript. Ms. Robinson helped supervise the data collection, train the nutritionists and make contacts with the communities and contributed to many drafts of the manuscript. Ms. Collier and Ms. David are the dietitians who conducted the intervention, collected data, suggested alterations to the protocol, interpreted findings and contributed to the manuscript. Ms. Renaud worked on the protocol for the intervention, made changes to the intervention and contributed to the final manuscript, particularly concerning the theoretical model. Ms. Rodrigues coordinated the data collection and conducted chart reviews in the Cree communities, conducted some of the analyses and worked closely with Dr. Gray-Donald on the interpretation of the data and the writing of the manuscript.

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