



Research paper

Impact of remote prenatal education on program participation and breastfeeding of women in rural and remote Indigenous communities

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ABSTRACT

Background: First Nations (FN) women have a higher risk of diabetes than non-FN women in Canada. Prenatal education and breastfeeding may reduce the risk of diabetes in mothers and offspring. The rates of breastfeeding initiation and participation in the prenatal program are low in FN communities.

Methods: A prenatal educational website, social media-assisted prenatal chat groups and community support teams were developed in three rural or remote FN communities in Manitoba. The rates of participation of pregnant women in prenatal programs and breastfeeding initiation were compared before and after the start of the remote prenatal education program within 2014–2017.

Findings: The participation rate of FN pregnant women in rural or remote communities in the prenatal program and breastfeeding initiation during 1-year after the start of the community-based remote prenatal education program were significantly increased compared to that during 1-year before the start of the program (54% versus 36% for the participation rate, 50% versus 34% for breastfeeding initiation, $p < 0.001$). Availability of high-speed Wi-Fi and/or postpartum supporting team were associated with favorite study outcomes. Positive feedback on the remote prenatal education was received from participants.

Interpretation: The findings suggest that remote prenatal education is feasible and effective for improving the breastfeeding rate and engaging pregnant women to participate in the prenatal program in rural or remote FN communities. The remote prenatal education remained active during COVID-19 in the participating communities, which suggests an advantage to expand remote prenatal education in other Indigenous communities.

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1. Introduction

Near 30% of Canadians are living with diabetes or pre-diabetes [1]. In 2011, the age-standardized prevalence of diabetes in the general population in Canada was 5%; however, it was 17% among First

Nations (FN) people living on rural reserves and 10% among FN people living in urban areas [2]. FN is the largest Indigenous population and Manitoba has the highest proportion of FN population among all provinces in Canada, and 70% of FN people in Manitoba live in rural or remote communities [3]. Among all people with diabetes in Canada, nine out of 10 are living with type 2 diabetes (T2D), a condition characterized in part by insulin resistance and often associated with obesity, unhealthy dietary habits, and a sedentary lifestyle [4].

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Research in context

Evidence before this study

First Nations (FN) people, the largest Indigenous group in Canada, are disproportionately affected by type 2 diabetes (T2D). Manitoba has the highest proportion of FN population among all provinces in Canada. Colonialism and residential schools disrupted the tradition of breastfeeding in FN mothers. The attendance of the prenatal program was low in many FN communities due to a lack of transportation, childcare, and advertisement for the prenatal program. Recent studies suggested that digital education was well accepted by pregnant women particularly in remote areas.

Added value of this study

This study demonstrated that a community-based remote prenatal education composed of social media-assisted prenatal chat groups and prenatal education through the website and community radio or TV broadcast increased the prenatal program participation and breastfeeding initiation in three rural or remote FN communities. Availability of high-speed Wi-Fi and/or postpartum supporting team were associated with favorite study outcomes. Positive feedback on the remote prenatal education was received from participants.

Implications of all the available evidence

The findings suggest that remote prenatal education is feasible and effective for improving the rates of breastfeeding and prenatal program participation in rural or remote FN communities.

pregnant women in urban [16]. The Canadian Prenatal Nutrition Program (CPNP) provides prenatal classes in the majority of rural and remote FN communities in Manitoba. However, the participation rate in the participating communities was 5–20%. Barriers to participation were identified by pregnant or postpartum women, their spouses, Elders, and healthcare workers in the communities. With support from community partners, some barriers were attenuated, but the attendance to prenatal classes still poses a challenge [17].

A recent study demonstrated that the topic of pregnancy weight received the highest attention in a digital media campaign in Alberta, Canada [18]. In Australia, the use of social media for prenatal education in remote areas was 20% higher than the national average [19]. In Manitoba, the majority of pregnant women in FN communities own a smartphone and use social media for communication. Social media has been widely accepted as a popular platform for communication in FN communities. However, some communities, particularly Northern remote communities, have no or low-speed Wi-Fi service. The feasibility, efficacy and culturally safe practice of social media-assisted remote prenatal education in pregnant women and the impact of remote prenatal education on the engagement of pregnant women in prenatal education and breastfeeding in rural or remote FN communities remains unknown.

The objective of the present study is to assess the impact of community-based remote prenatal education on the participation rates of pregnant women in the prenatal program, breastfeeding and pregnancy outcomes in rural or remote FN communities in Manitoba.

2. Methods

2.1. Participating communities

Sagkeeng and Sandy Bay are two rural Ojibwe FN communities located 120 to 180 km from Winnipeg, the major medical center, in the province. Garden Hill is a remote fly-in Anishinew FN community without year-round road access and located 600 km away from Winnipeg (Fig. 1). All three communities have radio stations. In addition, Garden Hill has a community-owned TV station. All of the communities have Wi-Fi and cellular phone coverage, and many public sites in the communities have free-access Wi-Fi. The Wi-Fi signal is of good quality in Sagkeeng and Sandy Bay, but the speed of Wi-Fi in Garden Hill was unable to transfer high-quality video images. All three communities have Nursing Station or Health Centre.

2.2. Perinatal care in the communities

All of the three communities have public health nurses and CPNP workers. The First Nations and Inuit Health Branch of Health Canada provides regular training to CPNP workers. CPNP workers in communities coordinate prenatal programs including prenatal classes for pregnant women. Visiting physicians, prenatal or postnatal nurses provided regular care to pregnant or postpartum women in the communities. Garden Hill and Sagkeeng have the Strengthening Family Maternal Child Health Program (SFMCHP), which provides postpartum support and breastfeeding promotion during home visits. The SFMCHP team in Sagkeeng was twice the size of the team in Garden Hill. Pregnant women in Garden Hill community were transferred to an urban hospital via airplane 3–4 weeks before their due date. Pregnant women in Sagkeeng and Sandy Bay communities were usually transported via medical service vehicles to hospitals close to their due dates. All of the women were admitted to hospitals with proper obstetric facilities for delivery. The majority of postpartum women were discharged from the hospital 1–2 days after delivery. Our group organized community forums, focus group meetings, and traditional circles with community Elders, CPNP workers, pregnant women, and their spouses to identify barriers to face-to-face prenatal classes. Potential barriers suggested by community members for the low participation of pregnant women

Socioeconomic, geographical, genetic, and negative consequences from colonization have contributed to the high prevalence of T2D in FN people [2,5].

The prevalence of youth-onset T2D in Manitoba is 10-fold higher than the national average, and the majority of children living with T2D in the province live in rural or remote FN communities [6]. In contrast to other ethnic groups, FN women in rural communities had a higher prevalence of diabetes than FN men [7]. Contributing factors for the higher prevalence of diabetes in FN women and children include unhealthy diet, lack of prenatal education for pregnant women, and intrauterine exposure to diabetes for offspring. Our previous studies demonstrated that the prevalence of gestational diabetes mellitus (GDM), the major form of diabetes in pregnancy, was 3 times higher in FN women compared to non-FN women in Manitoba [8,9]. Rural FN women had significantly higher rates of GDM than urban FN women [9], which may be related to their lower access to prenatal care or education. GDM is a potent risk factor for future T2D in mothers and their children [8,10]. Breastfeeding initiation has been shown to significantly reduce the risk of subsequent diabetes in mothers and their children [11]. Breastfeeding has been considered a part of FN tradition [12]. Colonialism and residential schools disrupted the traditional role of women and grandmothers in the transmission of Indigenous knowledge on breastfeeding from generation to generation [13]. An administrative database study indicated that FN mothers had a 33% lower rate of breastfeeding initiation compared to non-FN mothers in Manitoba [11]. The prevention of GDM and the promotion of breastfeeding may reduce the risk of T2D in women and their offspring. Dietary education or intervention with or without exercise during pregnancy are associated with a lower prevalence of gestational weight gain, GDM, and cesarean section compared to no intervention [14,15]

Our group has previously demonstrated that FN pregnant women in rural or remote communities had a lower level of physical activity, vegetable intake, and higher cholesterol intake than Caucasian

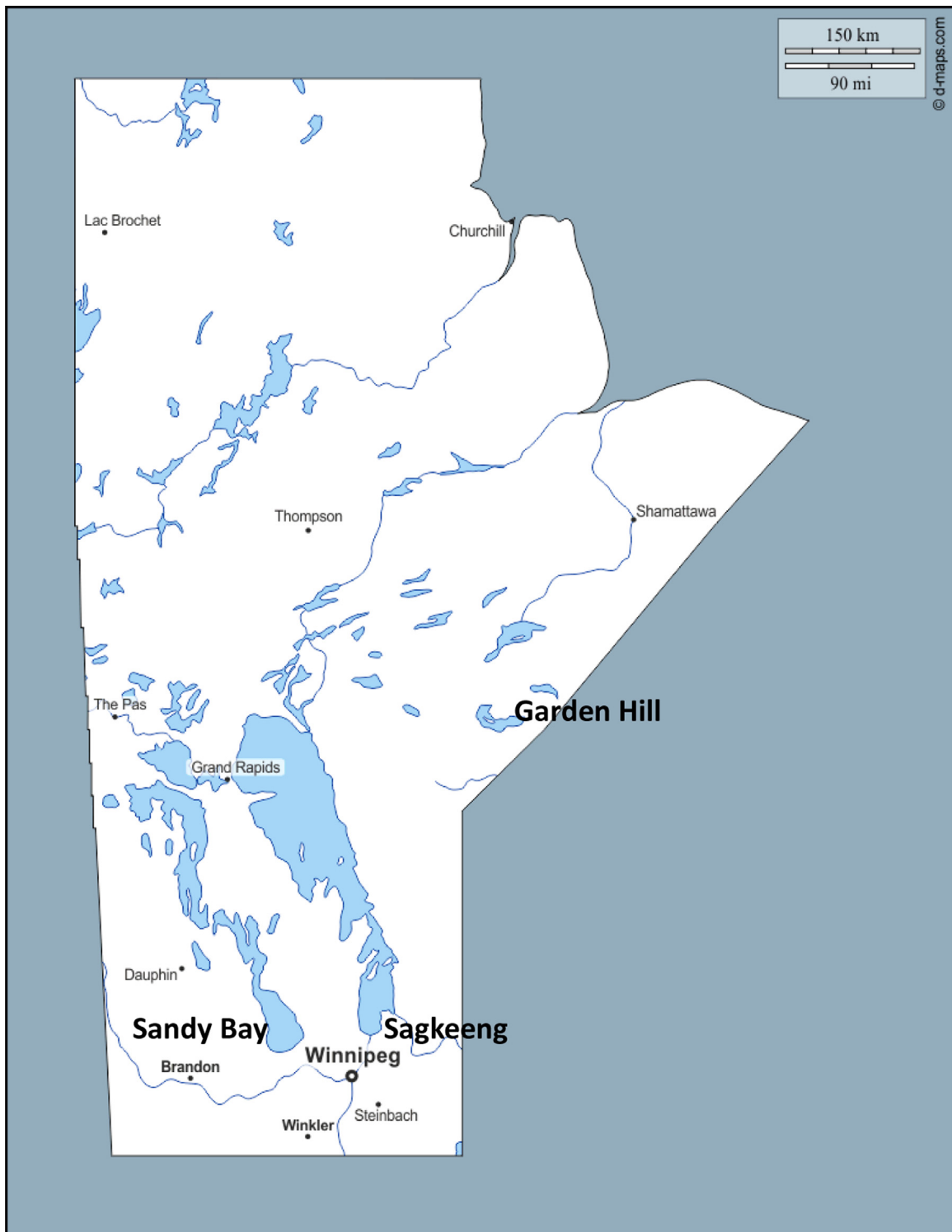


Fig. 1. Map of participating First Nations communities in Manitoba, Canada.

in the prenatal program include lack of transportation, childcare, and advertisement for the prenatal classes [17].

2.3. Remote prenatal education

To promote prenatal education in rural and remote FN communities, our group developed an educational website in 2015 (www.momsinmotion.ca), which contains a variety of educational materials (reading, audio, and video) on pregnancy-related topics, news on the

prenatal or postnatal programming in the communities, and traditional knowledge regarding a healthy pregnancy. Since many pregnant women in the communities did not have access to a computer, but most of them had a smartphone and Facebook accounts, a Facebook link with website was created and participants have access to the website via their smartphone. Social media-assisted prenatal chat groups (Facebook or Messenger) and the educational website in addition to community radio or TV broadcast were introduced to the communities as remote prenatal education between 2015 and 2016.

The research program was first introduced to community leaders and community public health teams in a collaborative effort by researchers and FN Health and Social Secretariat of Manitoba (FNHSSM) partners. Band council resolutions were received from each participating community to authorize the research in the communities. Pregnant women living in the participating communities during the study period were eligible to participate in the study. Participants were recruited via prenatal classes, social media, or advertisement through poster, radio, or TV broadcast. The project and informed consent were approved by the Research Ethics Board at the University of Manitoba, and all participants signed the consent. Community Elders, CPNP workers, or the study coordinator served as the hosts of the chat groups. Participants could join or withdraw from these Facebook chat groups freely. Two-eyed seeing approaches using both Indigenous and non-Indigenous scientific knowledge were applied in prenatal education by community Elders and researchers.

2.4. Breastfeeding promotion

Our previous study demonstrated that FN women in Manitoba had a significantly lower rate of breastfeeding initiation compared to non-FN women [11], which is consistent with the report from a national survey in Canada [20]. In order to improve breastfeeding prevalence in the communities, community Elders were invited to prenatal classes and sharing circles to teach pregnant women the Indigenous tradition of breastfeeding. Traditional methods including prayer, sharing circles, and story-telling, were incorporated in breastfeeding education. CPNP workers broadcasted breastfeeding promotion messages via TV or radio bi-weekly. Community women who had breastfeeding experience and expressed interest were trained as Breastfeeding Peer Support Counselors to support perinatal women in the communities to promote breastfeeding. SFMCHP members provided home visits to post-delivery mothers to promote and support breastfeeding. Breastfeeding photo contests were organized in the communities to enhance mothers' self-confidence and pride in breastfeeding.

2.5. Education on healthy eating and physical activity

The project website contains information on healthy eating, Indigenous recipes, traditional foods, food label reading, and nutrition content for common foods. Interactive education, such as cooking classes and nutrition bingo, was used to help pregnant women learn how to make healthy food choices. The importance of being physically active during pregnancy was emphasized. Prenatal garden, berry picking, or wild rice harvesting were organized in communities for participants and their family members, which promoted healthy eating and physical activity in pregnant or postpartum women, and their family members.

2.6. Outcomes of interest

Definition for “before” and “after” the initiation of remote prenatal education: The establishment of remote prenatal education in Sagkeeng and Sandy Bay communities occurred in May 2015. Therefore, the data for “1 year before” and “1 year after” the start of the remote prenatal education in the two communities were May 2014 and April 2015 (before), and May 2015 to April 2016 (after). The establishment of remote prenatal education in the Garden Hill FN community occurred in June 2016. The “1 year before” and “1 year after” the initiation of the remote prenatal education for the Garden Hill community was June 2015 to May 2016 and June 2016 to May 2017, respectively.

Participation in prenatal education: Pregnant women in the communities who participated in prenatal education in face-to-face

classes or community-based remote prenatal education (joined the chat group and/or access the educational website from home) during a single pregnancy were defined as active participants with a pre-hoc approach.

Breastfeeding initiation: Infant feeding status before hospital discharge was verified by nurses and documented on the hospital record and was faxed by Manitoba Health to the Public or Community Health branch in corresponding communities.

Breastfeeding duration: Information on breastfeeding duration of postnatal women in the communities was not routinely collected in FN communities. Community CPNP workers, healthcare workers helped to collect the information on breastfeeding duration from participants through telephone or reviewing prenatal medical files. Information on the breastfeeding duration of the majority of participants in Sandy Bay and Sagkeeng during the study periods could not be tracked.

Pregnancy outcomes and birth weights of infants: Preterm birth (born <37 gestational weeks) [21], caesarean section, and birth weights were collected from the hospital discharge forms from Manitoba Health. Large-for-gestational-age (LGA) and small-for-gestational-age (SGA) were defined as birth weights above 90 percentile and below 10 percentile of an infant's gestational age and sex [22].

Collection of qualitative data: The study coordinator and CPNP workers collected feedback through online or post-class surveys using open-ended questions regarding the feasibility and satisfaction of the remote prenatal education from participants, healthcare workers, or community assistants.

2.7. Statistical methods

Quantitative data between the two groups were analyzed using the Student t-test. A Chi-square test was used to identify differences in categorical data between groups. SPSS 26.0 software was used for quantitative statistical analyses. Significance was set as $p < 0.05$. Qualitative data on feedback from participants on the remote prenatal education program were collected by the study coordinator and community CPNP workers, and categorized into major themes using NVivo 9 software for thematic analysis by a statistician. The results were verified by participants.

2.8. Role of funding

The operating grants received from the Canadian Institutes of Health Research and the Lawson Foundation supported the expenses for the program activities, including salary and benefits for the study coordinator, transportations for community visits, time compensation for community assistants, and website construction. The operating grant from University of Manitoba was used on this project in prenatal garden, data collection and open access.

3. Results

3.1. Increased program participation in rural or remote FN communities

During 1 year before the start of the remote prenatal education in the three communities, the participation rate in face-to-face prenatal classes was 36% ($n = 85$) of total living singlet birth ($n = 233$) in the communities. During the 1 year after the start of the remote prenatal education program in the three communities, the participation rate of pregnant women in the prenatal program (face-to-face class and/or social media-assisted prenatal chat groups) was 54% ($n = 125/231$, $p < 0.0001$, Table 1). Forty-two percent of total prenatal-attendance ($n = 53$) in the communities joined the social media-assisted prenatal chat groups and the rest of participants attended the face-to-face classes. Two pregnant women in the Sandy Bay community preferred not to use social media-assisted prenatal chat group but they

Table 1
Participation rate of pregnant women in prenatal program in First Nations communities before and after the start of remote prenatal education program.

First Nations communities	During 1 year before the start of remote prenatal education program	During 1 year after the start of remote prenatal education program	P value
Sagkeeng case/total living birth (%)	6/65 (9.2)	16/42 (38.1)	<0.0001
Sandy Bay case /total living birth (%)	25/89 (28.1)	43/92/46.7%	0.02
Garden Hill case/total living birth(%)	54/79 (68.4)	66/97 (68.0)	0.56
Total in the 3 communities case/total living birth (%)	85/233 (36.4)	125/231 (54.5)	<0.0001

Table 2
Breastfeeding initiation rate of mothers in First Nations communities before and after the start of remote prenatal education program.

First Nations communities	During 1 year before the start of remote prenatal education program	During 1 year after the start of remote prenatal education program	P value
Sagkeeng case/total living birth (%)	15/65 (23.1)	28/42 (66.7)	<0.0001
Sandy Bay case/total living birth (%)	30/89 (33.7)	32/92 (34.8)	1.0
Garden Hill case/total living birth (%)	34/79 (43.4)	55/97 (56.7)	0.10
Total in the 3 communities case/total living birth (%)	79/233 (33.9)	115/231 (49.8)	<0.0001

Table 3
Breastfeeding duration (BF) in Garden Hill First Nations Community before and after the start of remote prenatal education.

BF period	Type of BF	BF during 1 year before the start of remote prenatal education in total living birth (n=79): case (%)	BF during 1 year after the start of remote prenatal education in total living birth (n=97): case (%)	P value
Discharge to < 2 months of age	Exclusive	7 (8.8)	11 (11.3)	0.77
	Mixed	27 (34.2)	44 (45.4)	0.18
2-12 months of age	Exclusive	14 (17.7)	31 (32.0)	0.03
	Mixed	6 (7.6)	1 (1.0)	0.07
>12 months	Exclusive	1 (1.3)	4 (4.1)	0.50
	Mixed	0 (0.0)	0 (0.0)	-

attended the face-to-face classes because they felt uncomfortable sharing opinions with other women online. Among the three communities, significant increases in the participation of the prenatal education program after the start of the remote prenatal education program were found in Sagkeeng and Sandy Bay, but not in Garden Hill, communities (Table 1).

3.2. Increased breastfeeding initiation rate in communities

The breastfeeding initiation rate during the 1 year before the start of remote prenatal education and breastfeeding promotion in the communities was 34% in the total postpartum women in the communities ($n = 79/233$). During the 1 year after the initiation of the remote prenatal education, the rate of breastfeeding initiation increased to 50% ($n = 115/231$) ($p < 0.0001$). Sagkeeng had an increase of breastfeeding initiation from 23% to 67% ($p < 0.0001$) after the launch of the remote prenatal education program. The rates of breastfeeding initiation in Garden Hill before and after the start of the remote prenatal education program were 43% and 57% but the difference was not statistically significant ($p = 0.10$). The breastfeeding initiation rates did not differ significantly in Sandy Bay before (34%) and after (35%) the launch of the remote prenatal education program ($p = 1.0$, Table 2)

3.3. Breastfeeding duration in Garden Hill

The complete information on breastfeeding duration before and after the start of the remote prenatal education during the study period was only available in Garden Hill. Before the start of remote prenatal education and breastfeeding promotion programs, the exclusive breastfeeding rate between discharge and 2 months after delivery, 2 and 12 months, and >12 months were 9%, 18% and 1%; respectively. After the start of the remote prenatal education and breastfeeding promotion programs in the community, exclusive

breastfeeding rates during the three periods were 11%, 32%, and 4%; respectively. A significant increase was detected in the exclusive breastfeeding rate in infants with 2–12 months of age after the start of the remote prenatal education ($p = 0.03$). The proportion of babies receiving mixed feeding (breast milk and formula) between 2-12 month of age before the study was 30% (6 out of 20) and this portion dropped to 3% (1 out of 32) after the start of the remote education ($p = 0.07$, Table 3).

3.4. Pregnancy outcomes before and after the start of remote prenatal education

Birth weights, rates of preterm birth, LGA, or SGA during 1 year before and after the start of remote prenatal education in the three communities were not significantly different. In addition, the requirement for caesarean section during 1 year before and after the start of remote prenatal education in the three communities did not differ significantly ($p = 0.64$, Table 4).

3.5. Perceptions of pregnant women and community healthcare workers on remote prenatal education

Participants of the remote education program felt that they were well connected throughout the program by viewing health information updates, receiving program news, and interacting with community healthcare workers, community assistants, and the study coordinator online. Participants felt that they could ask questions or share their concerns freely about eating, activity, breastfeeding, and other issues related to pregnancy and nursing. Since all of the social media-assisted prenatal chat groups were composed of pregnant women and healthcare workers who lived in the same communities, the participants had a feeling of security during communication. One participant said, "We know everyone here in the community, like friends and cousins so it is good." The CPNP workers in the

Table 4

Pregnancy outcomes in Sagkeeng, Sandy Bay and Garden Hill First Nations communities before and after the start of remote prenatal education.

Pregnancy outcome variables	During 1 year before the start of remote prenatal education (total living birth = 233)	During 1 year after the start of remote prenatal education (total living birth = 231)	P value
Birth weights (g) mean \pm SD	3365 \pm 694	3381 \pm 638	0.80
Pre-term birth (< 37 weeks) case/total living birth (%)	34/233 (14.6)	26/231 (11.3)	0.35
Small-for-gestational-age case/total living birth (%)	22/233 (9.4)	17/231 (7.4)	0.52
Large-for-gestational-age case/total living birth (%)	30/233 (12.9)	32/231 (13.9)	0.86
Caesarean section case/total living birth (%)	49/233 (21.0)	53/231 (22.9)	0.64

Table 5

Comments and feedback from participants or healthcare workers in the remote education program in First Nations rural or remote communities.

Themes	Comments and feedbacks
<i>Community-based remote prenatal education enhanced cultural identities and belonging</i>	<p>"We know everyone here in the community, like friends and cousins so it is good." (-participant)</p> <p>"My partner is from this community, so I can join the group on reserve. We don't have anything like this before." (-participant)</p> <p>"Moms feel that they are not alone with all the troubles. They can see other moms having the same struggles and asking same questions in the group." (-healthcare worker)</p>
<i>A social media-assisted prenatal chat group: a safe place to share personal concerns</i>	<p>"I would like to know more about breastfeeding. I always have trouble in the start with latching my babies." (-participant)</p> <p>"Some questions moms might not want to ask in the class (in front of people), but they feel safe to ask in the chat group." (-healthcare worker)</p>
<i>Facebook page and chat groups are interactive and supplement the class</i>	<p>"I do have many questions and sometimes they can't wait until the next (prenatal) class. It is good that I can ask questions and get answers in the group right away." (-participant)</p> <p>"I am kind of shy, watching others asking questions and get answers helps me too" (-participant)</p> <p>"Some girls like to come to class on a regular basis to socialize; some cannot get out the house so having them in the chat group is kind of supplementing the class." (-healthcare worker)</p>
<i>A Chat group is a support circle</i>	<p>"The CPNP coordinator was my support when I was a breastfeeding mom, and I am happy to support any of you as a mom if you would trust me. It was definitely rewarding for baby and me." (-participant)</p> <p>"Thanks for teaching me in breastfeeding, it helped to develop the strong bonding with my baby" (-participant)</p> <p>"My son is going through sleep regression and I didn't know that. Then another mom mentioned the same thing, and then I know." (-participant)</p>

communities felt that the social media-assisted prenatal chat groups helped them better understand the needs of pregnant women in their communities, and it supplemented and enhanced the effectiveness of the face-to-face prenatal classes. Table 5 summarizes the major themes and representative comments from participants and healthcare workers involved in remote prenatal education. Pregnant or postnatal participants and healthcare workers expressed their perception and support for the community-based remote prenatal education.

3.5.1. Traditional education enhances cultural identities and belonging

Community Elders contributed to traditional knowledge teaching to pregnant women for prenatal care and breastfeeding. The traditional education and study logo with traditional image and color in the Facebook page of the prenatal chat group created a sense of belonging to the culture for remote prenatal education. Participants felt that they were connected in their own "cyber community".

3.5.2. A chat group: a safe place to share personal concerns

Using a smartphone to communicate with others created a comfort level for pregnant women in a social media-assisted prenatal chat group. Women could ask pregnancy-related questions and share

concerns about pregnancy in the group chat. For example, questions regarding contractions, skin rashes, and postpartum depression were common topics in the group. Participants could choose to send a personal text message to a nurse, a CPNP worker, or the study coordinator directly if she did not want to post her questions in the group. In addition, participants could ask questions anytime without a time restriction.

3.5.3. Facebook page and chat groups were interactive

Most participants had a Facebook account and use it for social interaction purposes. In the social media-assisted prenatal chat groups, participants expressed that they felt connected and could interact with other pregnant women and healthcare workers in the same communities, which made them feel less isolated during pregnancy. They could make comments on other people's posts and ask questions to others in the group. They also had the option to send a private message to individuals in the group without sharing it with all others in the group.

3.5.4. Chat group as a support circle

Healthcare staff stated that it is hard to determine how much information the audience took from the study website and the

engagement of the website learning. It was easier to see if participants in a social media-assisted prenatal chat group read a post because the response icon appears on the bottom of the message. The dynamic of questions and experience sharing was appreciated by the participants and community healthcare workers. Healthcare staff, CPNP workers, and the study coordinator were able to respond promptly to new questions or issues raised in the group.

4. Discussion

The present study assessed the feasibility and effectiveness of a community-based remote prenatal education program with the combination of social media, website, and local radio/TV broadcast in three rural or remote FN communities in Manitoba. Low rates of breastfeeding and participation of pregnant women in prenatal programming are long-standing issues for maternal care in FN communities. Previous studies suggested that social media could be a very successful tool in health promotion in rural areas compared to traditional phone calls or text messaging [23]. Rural FN pregnant women have a higher risk of unfavorable pregnancy outcomes compared to non-FN pregnant women [24]. Socioeconomic, historical, and geographic factors contribute to the suboptimal prenatal education and unfavorable pregnancy outcome in rural and remote FN communities [25]. The results of the present study indicated that community-based remote prenatal education using multiple types of media communication tools can improve prenatal education and care in rural or remote Indigenous communities.

The results of the present study demonstrated that community-based remote prenatal education significantly increased the participation of pregnant women in the prenatal program and increased breastfeeding initiation. The support from the community health authority, healthcare workers, and pregnant women was critical for the success of the program. The incorporation of Indigenous tradition and culture was crucial for the acceptance of prenatal programming for pregnant women. The information on the duration of breastfeeding was only available in the Garden Hill community during the study period. The results showed the proportion of babies who were exclusively breastfed for 2–12 months after the launch of the remote prenatal education program was significantly high compared to the year prior. This change is likely related to significantly fewer babies received mixed feeding, but more of them received exclusive breastfeeding in the community. The findings suggest a considerable improvement in the acceptance of exclusive and long-term exclusive breastfeeding by new mothers after the launch of remote prenatal education in addition to the efforts of the postpartum support team in the community.

Suboptimal road conditions, lack of private or public transportation in addition to physiological restriction during pregnancy were barriers for pregnant women in rural or remote communities to attend face-to-face prenatal classes [17]. Pregnant women who had toddlers or small children at home had difficulty attending prenatal classes located miles away from their homes. Community-based remote prenatal education allows pregnant women to engage in education regarding healthy pregnancy and newborn feeding-related knowledge without a geographical or time restriction. The study website was designed to provide prenatal education information and tools to pregnant or postnatal women at home; however, most pregnant women in the communities currently do not have access to a home computer. However, the majority of women of reproductive ages in the communities have had access and experience in social media communication via smartphone. Social media provided them with limitless access to online educational resources via a smartphone. Social media-assisted prenatal chat groups created a culturally safe environment for pregnant and postpartum women to share their feelings, ideas and to ask questions or for assistance from community peers or healthcare professionals. Pregnant women were able

to receive education via social media everywhere which is particularly important for those who have small children at home. For communities that have less optimal Wi-Fi service, prenatal education via community-owned radio or TV broadcast is an alternative way to provide remote prenatal education. Multiple formats of remote prenatal education are an important contributing factor for the significant increase in the participation rate of pregnant women and/or breastfeeding initiation or duration in the communities in the present study.

In Indigenous culture, breastfeeding is believed to be both physically nourishing and “a way to nourish a baby’s mind, body and spirit”¹². A Manitoba-based database study demonstrated that breastfeeding initiation reduced the risk of future diabetes in both FN or non-FN mothers and their offspring with or without GDM [11]. Health Canada and CPNP have consistently supported breastfeeding in FN communities. However, the breastfeeding initiation rate in FN mothers was substantially lower than non-FN mothers in Manitoba [11], and the duration of breastfeeding was considerably shorter in the remote Manitoba FN community compared to the national average [20]. The low rates of breastfeeding initiation and duration in FN women may result in part from the negative impact of residential schools (interruption on generation-to-generation knowledge transmission), short of family supports, limited housing space, lack of prenatal education, and the long-distance transportation time between hospitals to communities may create difficulties to breastfeed on the road [15]. Remote prenatal education with the incorporation of Indigenous traditional knowledge provides a potential platform for rural and remote-living FN pregnant women to gain the knowledge and skills for healthy eating, breastfeeding, and to share their concerns and experiences with community peers or supporting healthcare workers, which helps them to prepare for the arrival of newborns in a positive way. In addition to the remote prenatal education, we organized traditional sharing circles and invited community Elders to share their experience and knowledge of pregnancy and breastfeeding with young generation of pregnant women or mothers. Within a year after the start of the remote prenatal education program, a substantial increase in the rate of breastfeeding initiation or duration was detected in two out of three communities.

Previous studies indicate that Canadian Indigenous women have a higher risk for postpartum depression than non-Indigenous women [26]. A recent pilot study suggests that social media communication with persons in a similar situation is expected to reduce the risk of postpartum depression [27]. The flexibility of community-based remote prenatal education provides an optimal supportive alternative to face-to-face prenatal classes in rural and remote FN communities which are expected to reduce the stress and the risk of postpartum depression in participants, which may contribute to the improvement in breastfeeding initiation and/or duration.

A recent study demonstrated that health information technology could further reduce prenatal stress compared to the routine supporter system [28], which could be a possible reason for a substantial increase in the participation of pregnant women in the prenatal program after the launch of the remote prenatal education program in the communities. One feature of social media communication is that it can be performed in many ways such as using abbreviations, symbols (emojis), animations, or photos. These communication accessories minimized language and literacy challenges [29] and may have facilitated the participation of FN pregnant women in the social media-assisted prenatal chat group.

Some participants preferred to stay as observers during their initial participation in the social media-assisted prenatal chat groups, as described in a previous study on social media behavior in Aboriginal people in Australia [30]. These “observers” in the social media-assisted prenatal chat groups read the information posted online but did not participate in the discussion, yet their presence may still help them to gain knowledge related to a healthy diet, staying physically

Table 6
Comparison for relevant common and different factors in participating First Nations communities.

Items	Sagkeeng	Sandy Bay	Garden Hill
Indigenous culture and traditional education	+	+	+
Isolated community	+	+	+
Health centre or Nursing station	+	+	+
CPNP	+	+	+
Community radio station	+	+	+
Community-based remote prenatal education program	+	+	+
Distance away from the service center	+	+	++, *
Community TV station	-	-	+
SFMCHP for postpartum support	++	-	+
Wi-Fi speed in the community residence	++	++	+
Improvement in participation in the prenatal program	++	+	-
Improvement in breastfeeding initiation or duration	++	-	+

CPNP: Canadian Prenatal Nutrition Program (providing prenatal classes); SFMCHP: Strengthening Family Maternal Child Health Program (providing postpartum support and breastfeeding promotion)

+: available; ++: available and strong; -: not available; *: fly-in community

active and breastfeeding, and adopting a healthier lifestyle. Therefore, all kinds of participation should be encouraged as they potentially benefit participants, but it may result in an underestimation of the impact of remote prenatal education.

A previous study suggested that social media could have negative effects resulting from cyberbullying [31]. Two participants in the present study felt uncomfortable sharing their opinions with other women online. While the risk of cyberbullying is very low in community-based programming supervised by healthcare staff, some women may not be ready, or require more time, to accept the format of the social media-assisted prenatal chat group. CPNP workers and the study coordinator regularly checked the chat history to remove irrelevant or inappropriate content. We believe the co-existence of both face-to-face prenatal classes and community-based remote prenatal education programs is necessary to meet the needs and situation of most pregnant and postpartum women in the rural and remote FN communities.

The communities in the present study shared some common features, such as similar culture and tradition, isolated, and rural location, health facilities, pre-existing CPNP, the existence of local radio stations, and the availability of the remote prenatal education program. However, they also have some differences including distance from a full-service medical center, local TV stations (only available in Garden Hill), and the existence or extent of a postpartum support team (Sagkeeng has a larger SFMCHP team than Garden Hill, and Sandy Bay does not have one). In addition, Garden Hill has a lower Wi-Fi speed than the other two communities. The differences in environment, facilities, and support may have affected the outcomes in the present study. Participants in Sagkeeng had the highest participation and breastfeeding initiation rates compared to the other communities, which possibly resulted from both the high speed of Wi-Fi and a larger postpartum supporting team. Sandy Bay has good Wi-Fi service but lacks a postpartum supporting team; therefore, pregnant women in the community had an increase in the participation rate in the prenatal program, but no significant increase in breastfeeding initiation. Although Garden Hill is a remote and fly-in community and has lower-speed Wi-Fi, the community has a postpartum support team and a TV station linked to all residences which allowed CPNP workers and our team members to visually broadcast prenatal and breastfeeding information. Those factors may contribute to the improvement in long-term exclusive breastfeeding after the launch of the remote prenatal education but without an increase in the participation in the prenatal program in the community (Table 6). The

findings suggest that the availability of a postpartum support team is critical for an improvement in breastfeeding in the community. A community-based multi-format remote prenatal education may effectively improve prenatal education and breastfeeding in the Indigenous communities even in a remote community.

During the COVID-19 pandemic, many FN communities and community nursing stations or health centers in Manitoba were locked down. Face-to-face prenatal classes were suspended in most communities due to the requirement for social distancing. The remote prenatal education program became the only realistic format for prenatal education in the communities during the pandemic. CPNP workers and the study coordinator in the communities with established social media-assisted prenatal chat groups provided regular prenatal education to pregnant women in the communities during the pandemic. Pregnant women in the prenatal chat group still actively exchanged experiences and received advice on pregnancy and breastfeeding from CPNP workers and the study coordinator. Some communities in the province without a social media-assisted prenatal chat group contacted our team for developing a social media-assisted prenatal chat group in their communities.

The limitations for the present study include: 1) the results from the study with pre-and post-study design may be affected by uncounted time-based variations that occurred during the observation period; 2) the sample size of the study is limited partially due to a limited number of communities, length of follow-up and the interruption of the pandemic on data collection; 3) breastfeeding duration data was only available in Garden Hill community, since the other two communities did not regularly record breastfeeding duration during postpartum visits.

The results of the present study demonstrated that a community-based remote prenatal education program is a useful supplementation to the existing prenatal program for pregnant women in rural or remote FN communities. The combination of the social media-assisted prenatal chat group, web-based self-education, and radio or TV prenatal education, and community-engaged traditional education successfully increased the prenatal program participation rate and/or improved breastfeeding initiation and/or duration in the communities. The coexistence of face-to-face prenatal class and community-based remote prenatal education may improve prenatal education in rural or remote Indigenous communities. In addition, social media-assisted prenatal chat groups may be particularly helpful during travel restrictions or pandemics such as COVID-19. However, around 50% of the communities in Northern Manitoba still do not have Wi-Fi or cellular phone service. In a number of Northern communities with internet and cellphone coverage, the speed for data transfer is suboptimal, which affects the effectiveness of the social media-assisted prenatal chat group and web-based self-education. To apply the community-based remote prenatal education in all remote communities requires a considerable investment in Wi-Fi or other mobile facilities or the establishment of a community-owned TV station. The results of our study support an urgent need for developing or improving those techniques in rural and remote Indigenous communities with provincial and federal collaboration, which will not only improve the communication capacity, but also the long-term health of women and children in rural and remote Indigenous communities.

Data sharing statement

Individual de-identified participant data, study protocol, and statistical data for the finding described in the above studies will be available to be shared for 5 years with the corresponding author.

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Contributions from coauthors

A.H. was responsible for coordination, recruitment, data collection, and manuscript draft; W.P.B., R.C., S.S., and F.D. were responsible for community liaison, knowledge translation, and manuscript editing; C.K., E.C., M.R., W.M., D.B., E.W., and G.M. were responsible to community coordination and data collection in the communities; S. L., B.W., J.M., E.S., N.N., K.T., C.P., and M.M. were responsible to clinical counseling, prenatal education or manuscript editing; D.J. was responsible to statistical advice; and G.X.S. was responsible for conception, general supervision, and finalization of the manuscript.

Declaration of Competing Interest

No conflicting interest exists between the content of the manuscript and all authors.

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