

Experiences and Perceptions of Perinatal Depression Among New Immigrant Chinese Parents: A Qualitative Study

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Abstract

Background: Immigrant status, acculturation level, race and ethnicity have been found to contribute to the utilization of mental health services in the perinatal period. This study explored perinatal experiences and perceptions among Chinese immigrant mothers and their spouses, as well as the possible barriers and facilitators that affect their health care utilization.

Methods: We recruited 13 women ages 18-35 years born in mainland China, living in Rochester, New York, and residing less than five years in the United States, whose primary language was Mandarin Chinese and who had given birth to at least one live infant within the past seven years. Participants' age was at least 18 years old at the time of delivery. Five spouses also participated. We divided women in two focus groups and held one for men, with data collection including questionnaires and semi-structured focus group interviews conducted in December 2014. Data were analyzed following thematic analysis.

Results: Four themes emerged: experiences of perinatal depression; perceptions of perinatal depression; general preventive and coping strategies; and attitude towards mobile health in perinatal period. Participants had limited knowledge of perinatal depression and had difficulty distinguishing between normal perinatal mood fluctuations and more severe symptoms of depression. They discussed immigrant-related stress—conflicts with parents/in-laws while “doing the month”, the perceived gap between the ideal of “perfect moms” and reality, and challenges with parenting as the causes of perinatal depression. Women approved of screening for the condition but were conservative about follow-up interventions. As for the management of perinatal depression, participants preferred to deal with the problem within the family before seeking external help due to potential stigma as well as Chinese traditional culture. However, they were receptive to using mobile health applications to receive information and support.

Conclusion: Recent immigrant Chinese parents to the United States had limited knowledge of perinatal depression and did not make full use of mental health services for support due to language and cultural barriers. Future research should explore what interventions may serve as an acceptable approach to overcoming these gaps.

Trial registration: Not applicable.

Background

Perinatal depression, defined as depression that occurs during pregnancy or after delivery, affects approximately 6.5% to 12.9% of pregnant and postpartum women worldwide¹. As s one of the most common complications of pregnancy and the postpartum period², it jeopardizes maternal health^{3,4} and the growth and development of the offspring^{5,6}.

Researchers have found that immigrants suffer a higher risk of perinatal depression than native born peers⁷⁻⁹. Isolation and lack of social support and loss of familiar rituals and traditions in the new

environment may influence immigrants' mental health and induce depression^{10,11}. As well, immigrant status, limited acculturation¹², lack of access to resources¹³, stigma¹⁴, and language barriers¹⁵ may prevent immigrant women from optimal utilization of medical and mental health services during the perinatal period. Therefore, it is necessary to explore the experiences of immigrant populations during the perinatal period, as well as their attitudes and preferences for seeking care for mental health concerns in order to explore how best to provide culturally attuned, accessible services and improve their mental health.

Persons of Chinese background comprise the largest Asian-American group in the United States¹⁶. We explore in this study how Chinese immigrant women, and several of their spouses, dealt with pregnancy and postpartum care, with specific attention to perinatal depression. There are many deeply held Chinese traditions that support new mothers and families, which may influence postpartum well-being and mental health^{17,18}. Many Chinese immigrant families seek to retain perinatal Chinese customs such as “doing the month”¹⁹. “Doing the month” is a time when a new mother is advised to restrict her activities following delivery, including staying at home and taking nutritious food^{17,20}. Typically, mothers and mothers-in-law stay with the family during the month, providing support and supervision.

Thus, the purpose of this study was to learn more about Chinese immigrant mothers' experiences during the perinatal period and to explore possible barriers and facilitators that can affect their use of mental health services.

Method

We recruited a convenience sample of participants from Monroe County and Rochester, NY, USA. The inclusion criteria were: Chinese women born and raised in mainland China who had resided in the US less than 5 years; ages 18-35 years; able to read and speak Mandarin Chinese as their primary language; having given birth to one or more live infants within the past seven years in the US or in China; and over 18 years of age when the child was delivered. We excluded anyone unable to engage in the informed consent process. The spouses of the female participants were invited to participate if they were ≥ 18 years, residing with the enrolled mother, able to read and speak Mandarin Chinese as their primary language; the biological father of at least one of the children. We recruited women by posting recruitment messages on social media platforms (e.g. Weibo, WeChat) popular among Chinese scholars and students in Rochester; posting recruitment flyers at Chinese schools and churches in Rochester; referrals from friends and neighbors, and word of mouth. When potential participants initially contacted us, we reviewed inclusion criteria, and invited those who qualified and were interested to attend a focus group. The final sample resulted in 18 participants—13 women and five men. Each participant received a gift-card in recognition of the time devoted to participation. The study was reviewed and approved by the University of Rochester Research Subject Review Board.

We used questionnaires to collect demographic information (See Appendix 1 and Appendix 2). Semi-structured focus group interviews were developed and conducted by the lead investigator in Chinese

Mandarin (WJG), a Chinese obstetrician-gynecologist with training in qualitative research. Another investigator(XQ) assisted conducting the interviews. The questions of the interviews included: knowledge about perinatal depression; recounting their own emotional experiences during pregnancy and the postpartum period; coping with any perinatal depressive symptoms, if they had experienced them; defining potential barriers and facilitators that might affect their use of health services in the US; potentially accepting mobile health applications (apps) as interventions for perinatal depression. (See Appendix 3 and Appendix 4).

Focus groups were conducted in a private, comfortable room conveniently located for the participants, with childcare provided. Women participants were divided into groups of six and seven (FG1 and FG2, respectively) based on convenience of scheduling; the men met once (FG3). Before the formal start of each focus group, interviewees gave written informed consent and completed a demographic questionnaire. Each group interview lasted for 60-90 minutes and was audio-recorded. Two researchers transcribed the interviews verbatim from the audio recordings into Chinese within four weeks and kept records of non-verbal information.

Demographic data were summarized by descriptive statistics. The qualitative data were collated and analyzed using MAXQDA 2020 based on thematic analysis²¹: 1) familiarizing with the data, by reading through all the participant accounts several times; 2) generating initial codes to identify important sections of text and attach labels to index them as they relate to a theme or issue in the data; 3) searching for themes by bringing together components or fragments of ideas or experiences; 4) reviewing themes—assessing the coded data extracts for each putative theme to consider whether they appear to form a coherent pattern; 5) defining and naming themes: determining what aspect of the data each theme most clearly captured and identifying what is of interest and why; 6) describing the fundamental structure of the phenomenon; and 7) producing the report.

In this study, the researchers (QL and WQX) first analyzed the interview records in Chinese. To achieve better understanding of participants' subjective expressions and experiences, the researchers collaborated closely comparing their analyses in a stepwise fashion to achieve consistency and agreement. A team member (XQ) fluent in both Chinese and English translated the analysis results, including codes and quotations, into English. In the last step, a lifelong Chinese-English, bilingual researcher (KK) checked the accuracy of the translation.

Results

The average age of our 13 female participants was 31.0 ± 4.0 years old and the average length of residence in the United States was 27.1 ± 16.6 months. All women participants were married, had health insurance, and their educational attainment was a bachelor's degree or higher. The age of the five spouse participants was 31.0 ± 6.0 years old and their average length of residence in U.S. was 28.6 ± 18.7 months, and each had at minimum a bachelor's degree.

Eleven of the 13 women had nuclear families only in the US; 10 had a household annual income less than \$60,000. Their primary daily supports during pregnancy involved their husbands (n=5), themselves (n=4), their mothers (n=3), and their mother-in law (n=1). In contrast, primary postpartum support included their mothers (n=7), mothers-in law (n=5), and husband (n=1). (See Table 1)

Table 1
SAMPLE CHARACTERISTICS (N = 18)

Characteristics	N	
	WOMEN (N = 13)	MEN (N = 5)
Age (in years)		
Mean (SD)	31±4	31±6
Range	25-38	25-40
Marital Status		
Married	13	5
Employment status in the perinatal period		
Employed	5	2
Unemployed	8	3
Education level		
4-year college degree	7	0
Master's degree	2	1
Doctoral level degree	2	2
Current graduate student	2	2
Months lived in the US		
Mean (SD)	27.1±16.6	28.6±18.7
Range	1-50	13-60
Main caregiver throughout pregnancy for the woman		
Her mother	3	NA
Mother-in-law	1	NA
Husband	5	NA
Herself	4	NA
Main caregiver for the woman during the postpartum		
Her mother	7	NA
Mother-in-law	5	NA
Husband	1	NA

Herself	0	NA
Whether adhere to the tradition of " Doing the month "		
Yes, for all my children	3	NA
Yes, for my children born in China only	1	NA
No	7	NA
Other	1	NA
Whether adhere to the tradition of " Doing the month "		
Yes	6	NA
No	7	NA
Way paid for the delivery services		
Entirely on her own	13	NA
Partly by medical insurance	0	NA
Family annual income during the most recent pregnancy		
< \$60,000	10	4
≥\$60,000	3	1
Whether have children born in China		
Yes	3	4
No	10	1
Whether have children born in the US		
Yes	10	1
No	3	4
Family structure		
Nuclear family	9	4
Dyadic nuclear family	1	0
Live with own parents	2	0
Live with parents-in-law	0	1
Live with child only	1	0
NA used to mean "not applicable".		

Note: To aid the readers' comprehension of the results, all quotes presented below, shown in *italic*, identify the speaker's participant identification number for each focus group, followed by the focus group (FG) number. Themes were defined as arising in multiple groups, in addition to being expressed by multiple members of the same group only.

Experiences of perinatal depression

Emotional distress was a theme that emerged in both mother focus groups. Whether the pregnancy was planned or not, the women interviewed generally were happy to learn that they were pregnant: It wasn't in the cards, but I was especially happy when I found out I was pregnant. (04,FG1) However, with the onset of pregnancy, the physical discomfort made it difficult and even depressing for some women: Serious pregnancy symptoms made me sick, even gave me that depressed feeling. I would vomit when I smelled anything or just drank water. (01,FG1) Most of the women interviewed reported frequent feelings of stress, fear, and anxiety during the perinatal period due to worrying about the baby: I suffered from sinusitis ten days after delivery. The doctor advised me to do a CT scan, but I thought CT had radiation and I was really worried that it would influence the breast feeding so I insisted on an MRI at that time. I didn't feed my baby breast milk when I used antibiotics until the half-life of the antibiotic was gone. The radiation, the antibiotic, everything led to my anxiety. (02,FG2). Some women become emotionally sensitive during the perinatal period, especially concerned about others' appraisal of them, contributing to unhappiness, irritability, unprovoked tears or anger: During pregnancy, I think I became more sensitive and sometimes when someone said something, I would feel like it was directed at me and it upset me. And I would want to cry.(05,FG1) Well, I just didn't feel well at all. My whole state was not very good. I guess I was just very irritable, and it was irritable. I felt down when my baby made noises. But It was really not because of it. I just felt down for no reason. (07,FG2) Several expressed the view that women with baseline depression could suffer greater depression during pregnancy. Two women with a history of depression before pregnancy had suspended their antidepressants during pregnancy because of concerns about their adverse effects on the fetus: I stopped taking them(antidepressants) right after I got pregnant...then I felt like my depressive symptoms worsened. (04,FG2)

Perceptions of perinatal depression

Partial understanding of perinatal depression.

Participants of all three focus groups had heard the terms "postpartum depression" or "perinatal depression." Nearly all identified some symptoms: Sometimes I was unable to control my emotions and suddenly cried for no reason. And it was hard for me to fall asleep. (04,FG1)

Four out of five male respondents mentioned they had noticed their partners' reluctance to communicate as an important sign of depression: I think the salient feature of the depression is that she didn't want to

talk to you. (02,FG3) However, they had difficulty distinguishing between normally expressed uncertainties and emotions arising during perinatal period and symptoms indicative of significant perinatal depression: I could distinguish the differences when it (my wife's mood) had big changes, but I was not sure whether it could be regarded as depression or not. (03,FG3)

Describing factors associated with perinatal depression.

The respondents identified several potentially important factors that could contribute to the development of significant depression—based on both their own experiences and what they had observed with others. They described depressed feelings related to being an immigrant—i.e., having a small social circle, a sense of isolation, and difficulty adjusting to living far from home: I have heard from my wife that one of her friends lived in an apartment, and there were few friends to communicate with in the perinatal period. She said she felt depressed at that time. (03,FG3) They also reported that conflict with mothers-in-law can be associated with depression: I don't want to recall the first weeks after delivery. My mother-in-law refused to take care of me and my baby. She didn't help during nighttime as she said the baby didn't seem happy to be cared for by her at night. So, I had great conflicts with her during that time. (01,FG2). Women participants additionally described depressive symptoms associated with conflicts with the elders, especially involving "doing the month ": If I thought 'doing the month' was a good idea, and others suggested that I should do so, that's fine. However, if I didn't like the idea, and my mother-in-law kept saying I should, I would feel depressed. (07,FG2) The men uniformly expressed the same view: I support my wife, and she can do everything she wants. She can follow what the elders say if she wants it (doing the month), or ignore it if she thinks it's wrong. If she keeps happy, she would recover better. If she is not happy, then even taking ginseng wouldn't help. If I don't support her, she would be more depressed, (02 FG3) Lastly, the gap between ideal expectations of parenthood and the realities of caring for a newborn may be related to depression. Some of the women interviewed thought to have a baby was a wonderful thing before pregnancy, but after the birth they found themselves struggling to cope with problems: When I saw pictures of other moms breastfeeding their babies, I thought 'what a happy scene'. But with the baby in my own arms, screaming hard as if I was abusing him, then all the happy scenes you imagined in the past seemed to just turn into big struggles. (03 FG1). And: I thought the baby would be born knowing how to suckle but he didn't do so until two weeks after delivery. I felt so bad about it that I just fell apart. (04 FG1)

Screening for perinatal depression.

All women participants approved of universal screening for perinatal depression by their obstetrical providers. They reported depression screening is more acceptable when partnered with other routine prenatal testing, such as general bloodwork, glucose monitoring, or ultrasound exams: Yeah, they gave me a questionnaire to fill out in at the hospital. I didn't pay much attention as there were plenty of exams and blood tests anyway during the prenatal visits. It's just another task in the whole thing. (03,FG1)

General preventive and coping strategies for perinatal depression

Solve within the family first.

Due to a lack of understanding or distrust of mental health professionals, as well as the stigma associated with the traditional Chinese concept of minimizing mental illness, respondents tended to address any mental health concerns first within their family: People always think that seeing a doctor is a very sensitive matter, especially when you go to see a doctor for depression. You really don't want others to think that you have problems. (02,FG3) Participants reported trying to identify strategies to improve their emotional state, such as learning about coping skills or posting their thoughts on virtual forums such as WeChat: I had some (depressive) symptoms. But the book I read suggested that it had something to do with hormonal changes and it would fade away slowly. So, I just tried to think in a positive way. (04,FG1). Women identified distraction as a common strategy: I would choose to work when I am pregnant again because I think I need some distraction. Focusing entirely on the baby may make the pregnancy seem longer and I'd feel worse. Therefore, I preferred working and I was pretty happy working. (02,FG1) Social support also was identified as protective. Husbands, especially, can help alleviate their wives' distressed emotions, by providing emotional support or by sharing housework and child care: It's comforting that my husband was good at talking. He would talk to me when I was not happy. The role of husband was very important. He talked a lot to me and made me feel that some conflicts in the family can be solved through communication. He was nice to me and I felt peaceful in the perinatal period (01,FG2) Similarly, sharing feelings with close or trusted family members, such women's parents, was valued by both women and men. To solve this problem (depression), I will find her parents to talk to her if they were around. I think she would like to talk to people she can trust. (02,FG3)

Seek outside help later.

When efforts within the family fail to improve perinatal depression, respondents would consider seeking outside help through new social connections or professionals. Participants were encouraged to attend tea parties for mothers in the community and vent their emotions to new friends in US. Through communicating with peers, they learned about parenting and got support and comfort by other mothers who also experienced mood fluctuations during the perinatal period: If it was a friend of mine who was experiencing perinatal mood swings, I'd share my own experience with her, and I thought it might be helpful. Because I had a similar experience, I was more likely to understand what she was feeling. (04,FG1) For those who still find themselves struggling after talking with friends or family, the women might seek help from a mental health professional if their mood remained distraught or uncontrollable: I feel like the depression ... If it gets so bad that it becomes unmanageable, I'd probably go to a doctor. (04,FG1) Participants noted that if a deeply distressed woman continued to resist seeing a psychiatrist, her family could try having a psychologist or psychiatrist talk with her outside the clinic: Right, if it comes

to the point of looking for a doctor, my idea may be to say for example, well, getting a psychologist or psychiatrist to meet with my wife and me in places like a café...mainly because I'm afraid she might feel ashamed of her illness in the setting of clinics. (02,FG3). Respondents generally were not interested in medication treatments: Maybe the drug is not the best way to cure her, maybe she(my wife) should change the whole way of life. (03,FG3)

Attitude towards using mobile health technologies during the perinatal period

Receptivity to mobile health.

Respondents generally reported that they would be trusting and receptive to educational information published on social media platforms by authoritative organizations or individuals: I followed what she (a gynecologist from Beijing) said in Weibo (a social media platform), because she is very famous in China. I can learn how to take care of babies there. (04,FG2) Nearly all of the respondents have used perinatal apps or obtained perinatal health-related information through social media platforms. They expressed a positive attitude toward implementing mobile health strategies during the perinatal period: It's good to spread mental health information through such social media platforms. (03,FG3) The apps they accessed cover a wide range of topics, providing pregnant women and their spouses with information including: pregnancy care, estimated due date, post-natal rehabilitation, mental health, and infant feeding. They were described as helping inexperienced mothers and fathers navigate these novel tasks more comfortably. My wife was confused about many things in the perinatal period, and she could get a great deal of useful information from these apps. (04,FG3) However, when the women and their spouses were experienced with newborns and related postpartum challenges, their use of apps lessened: The app would be useful with your first child. But after one or two weeks, you gradually work out what to do and when to do them. At that time, you would not rely on the app to take care of the baby anymore. (02,FG3) Language was an obstacle for some when using local resources—whether apps or talking to her doctor: My wife's does not speak very good English. She may have trouble telling her doctor the changes in her mood during the perinatal period. So, it'd be hard for her doctor to understand her condition. (03,FG3)" Thus some respondents followed the accounts of specific Chinese doctors through social media platforms to obtain needed the information or to ask questions in Chinese: I followed the Weibo account "I work in hospital" which often publishes some useful information such as, "What should I do if the baby is choking?" (04,FG2) Additionally, many women joined the mother's communication groups on WeChat to gain useful parenting tips or encouragement from other women.

Expect personalized service.

Respondents described a desire to have access to a range of options to learn about perinatal depression: Every person has her own preference. When she needs the information, you need to give them choices of

how such information is conveyed...(otherwise)the health messages you send out would be disposed of as junk text messages or junk Email (02,FG3) Women respondents generally reported they preferred social media platforms over text messaging because the former gave them more sources of information to follow, who to follow, when to view it, and greater anonymity: Text messages make me feel I am a passive recipient. If it's something on Weibo or WeChat(social media platforms), I can decide whether to read it based on my need. If the information on perinatal health comes from these authoritative sources, I will selectively read it. (04,FG2) The male respondents indicated that health education information about perinatal depression should be sent directly to mothers, interspersed with infant feeding information: I think husbands are usually careless, they wouldn't read (the mental health messages). So, it is better to send the messages directly to the cell phones of the moms. It'd be best giving some parenting tips at the same time. Actually, moms care a lot about their babies' health conditions. (04,FG3)

Discussion

Although perinatal depression was rarely discussed in China in 2014 at that time of this study, several organizations in the U.S have recommended routine screening²²⁻²⁴. Although all of our participants had lived most of their lives in China and all of their early development, they all expressed willingness to be screened for perinatal depression. This did not indicate, however, that they were willing to be referred or evaluated further. They reported they often did not complete questionnaires and certainly did not want referrals for service. A systematic review by our team has identified similar issues in many countries²⁵ and there is a serious lack of data on perinatal depression screening and referral patterns in China or among Chinese members of other societies.

The qualitative findings in this study offer potential directions for future research. Our findings are consistent with what has been reported previously²⁶⁻²⁹ about attitudes in Chinese culture regarding the shame associated with mental health concerns, and women's reticence to reveal their distress. It also underscores the priority placed on a family-first approach to resolving problems if they are, in fact, shared at all^{30,31}. Perinatal depression screening now is being advocated in China³², but there remains insufficient data regarding how best to accomplish effective identification and subsequent referrals to care for those women who need it the most. The well-known stigma associated with help-seeking is compounded by the relative lack of training among Chinese health providers in dealing with perinatal depression³³, a deficiency that now is being more actively addressed in the U.S. and other western nations.

Chinese immigrants such as our participants express doubts about the role and value of mental health professionals (e.g., psychologists, psychiatrists and others), describing evident cultural barriers in fundamental terms: *The professionals cannot really improve my situation*. Language limitations add further to the cultural barriers confronting immigrant women when seeking health services¹⁵; they are reluctant to speak about their emotional problems and worry that their doctors will not understand their symptoms or concerns. The tendency of women of Asian cultural backgrounds to less frequently seek

help for perinatal depression than other immigrant women³⁴ may be the result of a combination of these factors.

A strength of our study derives from the involvement of a few men as well as the women participants. Most of our women participants, as well as those in another study³⁵, were hopeful that perinatal depressive symptoms would subside naturally over time. The Chinese immigrant men, on the other hand, tended to take initiative and believed that they, as spouses, played an important role in detecting their wives' mood disorders and providing support for them. These Chinese husbands provided social support to their wives by sharing household chores, taking care of children, and reconciling conflicts between their mothers and their wives. The husbands thought health education about perinatal depression was desirable and that knowledge of mental health should be integrated with parenting tips, consistent with women's view in another study³⁶. The husbands suggested sending health education information only to their wives because they were more careless and tended to ignore this information. Unlike their wives, who were more concerned about the development of depression, husbands were more concerned with how deal with it. While their perspective was positive and action oriented, it was less attuned to initial exacerbating circumstances and thus less likely to preventing the initial emergence or recurrence of depression.

It remains uncertain whether 'doing the month' is a risk factor for perinatal depression or serves as a protective factor in some fashion^{37,38}. Although the women in our study generally reported "doing the month", their approach differed from the traditional one. Our participants did not reject the idea of 'doing the month,' despite being better educated and having lived in the U.S. for a longer period of time than reported by others¹⁹, but they reported considerable stress related to implementing it here. They acknowledged a hope to be cared for by their family, especially their mother or mothers-in-law, they encountered difficulties when being instructed to "do the month" according to the strictures of the older women rather than following their own ideas. These conflicts served as the major reported source of emotional fluctuations.

The high level of acceptance of mobile health technologies among these Chinese immigrant women and their spouses is similar to other reports^{31,39}. Even in 2014, use of mobile services were common practice throughout China, a nation with a many decades' pattern of internal migration and the need for inexpensive long-distance communication. Our immigrant participants were very familiar with these tools; they relied heavily on mobile platforms and internet-based social media to keep in touch with friends and family in China. Mobile health has a degree of invisibility that may reduce the stigma women feel when face-to-face contact is not required, as noted previously⁴⁰. Mobile health tools can help overcome language barriers, allowing couples to seek help from specialists in China or from distant centers internationally. Our participants used mobile health for parenting and physical health, but rarely for mental health concerns, similar to previously reported results^{41,42}. They also were receptive to a perinatal depression intervention using mobile health. We caution, however, that there may be a significant gulf between expressed acceptance and actual use.

We see several shortcomings in our study. Ours was a self-identified convenience sample. All participants held bachelor's degrees or higher, and we have no way to infer extrapolation to less educated women and men. Inherently the study potentially was subject to recall bias; nine of the 13 women were not in the perinatal period when they participated in the focus group interviews. We set a seven-year limit on the time since birthing their last baby, but we cannot be assured that this interval was sufficiently short to avoid bias. Lastly, not having access to their medical records. We had no way of confirming any results from their perinatal depression screening tests, leaving us to depend solely on their recall of what they had experienced and the depth of their reported distress.

Taken together, our results point the need for clinicians who work with Chinese women to recognize that screening for perinatal depression is only the first step. They must be proactive and thoughtfully inquire about emotional issues and interpersonal tensions, while respecting long-held sensitivities about mental disorders that have deep cultural roots. As much as care providers recognize the individual nature of perinatal depression, there are strong family focused values, especially pertaining to husbands, mothers, and mothers-in-law, such that clinicians will need to work with women to carefully navigate and balance their needs for privacy and tradition-based expectations of family openness and control. Finally, our results are qualitative and very preliminary, which in turn emphasizes the need for more research regarding perinatal depression among women of diverse Asian backgrounds, and the additional burdens associated with giving birth in a nation and culture far from their original home.

Declarations

Ethics approval and consent to participate:

Methods of the study were carried out in accordance with the Declaration of Helsinki. The study was approved by the Ethics Committee of the University of Rochester Research Subject Review Board (RSRB00054121). Written Informed consent was obtained from all the participants in the current study.

Consent for publication:

Not applicable.

Availability of data and materials:

The data generated and/or analyzed during the current study are not publicly available due to restrictions related to confidentiality i.e., they contain information that could compromise the privacy of research participants, but are available from the corresponding author WJG on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

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Authors' contributions:

QL: Data curation, Writing- Original draft preparation, Visualization. WQX: Data curation, Software, Validation. Wenjie Gong: Conceptualization, Project administration, Investigation. XQ: Investigation, Validation. QLL: Methodology. LX: Methodology. RX: Writing - Review & Editing. EC: Resources ,Writing - Review & Editing. EP: Supervision ,Writing - Review & Editing. All authors critically reviewed and approved the final version of the manuscript.

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