



# Lactating nurses' experiences of return to work after lifting COVID-19 lockdown: A qualitative study

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## ABSTRACT

**Aim:** To explore the lactating nurses' experiences of return to work after lifting COVID-19 lockdown.

**Background:** Return to work is a key reason for the low rates of breastfeeding. Especially after lifting COVID-19 lockdown, case counts reached recorded highs. So lactating nurses face more challenges when they return to work.

**Method:** The empirical phenomenology method was used to conduct a qualitative study. Lactating nurses were recruited in a tertiary hospital through purposive and snowball sampling, and participated in semi-structured video interviews. Colaizzi's method was used to analyze the data. **Results:** Three themes and 10 sub-themes emerged from the interview data of 15 participants. The first theme was "preparation for return to work", which helped lactating nurses adapt to return to work quickly. The second was "experiences of return to work". The inconvenience of pumping was mentioned repeatedly. In addition, the flexible work schedule was highlighted. The third was "experiences of infection". The attitudes toward breastfeeding differed due to different perceptions of COVID-19.

**Conclusions:** Lactation nurses easily interrupted or stopped breastfeeding when they returned to work after lifting COVID-19 lockdown. Recommendations include the further provision of longer periods of leave, flexible working arrangements, separate facilities for breast pumping, and breastfeeding strategies for epidemics.

## 1. Introduction

Breastfeeding is considered an important strategy to promote maternal and child health [1]. The World Health Organization (WHO) recommends that by 2025, at least 50 % of infants will receive exclusive breastfeeding (EBF) for the first six months of life [2]. However, the latest data showed that only 29.5 % of infants were breastfed exclusively at 6 months in China [3], far below the global

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target. Many factors affect breastfeeding rates, of which return to work (RTW) is the main one [4–6]. Many women gave up breastfeeding within the first month after RTW [7], and the EBF rate of mothers returning to work was 1.54 times lower than that of mothers who did not [8]. The reason for stopping breastfeeding might be the difficulty in balancing RTW and breastfeeding [9]. The heavier workload of nurses means that their postpartum RTW is more challenging.

The novel coronavirus (COVID-19) was declared a pandemic by WHO on March 11, 2020, which led to some form of lockdown across almost all countries of the world [10]. Although the lockdown has effectively contained the spread of the virus, it has also brought inconvenience to life, especially for lactating mothers. One survey showed that 41.8 % of mothers felt that breastfeeding was protected by the lockdown, but 27.0 % said that the lockdown created many barriers to breastfeeding [11]. As the pathogenicity and lethality of Omicron declined and treatment improved steadily, the lockdown measures were lifted [12,13]. People infected with COVID-19 were no longer isolated centrally [14], which might increase the risk of people being exposed to the virus, especially nurses on the front line of the epidemic [15]. To make matters worse, case counts reached recorded highs after lifting COVID-19 lockdown [16]. Thus, lactating nurses, as a special group, encounter more challenges when they return to work after lifting COVID-19 lockdown, such as heavy workload, high risk of infection and maternal separation anxiety.

RTW may increase the risk of stopping breastfeeding prematurely, so it is important to understand the challenges faced by nurses in balancing RTW and breastfeeding. After lifting COVID-19 lockdown, RTW is even more difficult due to the surge of patients. However, up to now, little is known about lactating nurses' experiences with RTW after lifting COVID-19 lockdown. This research aimed to explore the lactating nurses' experiences of RTW after lifting COVID-19 lockdown, which would help facilitate RTW adaptation and breastfeeding.

## 2. Methods

### 2.1. Design

We conducted a qualitative study via an empirical phenomenological approach. Semi-structured video interviews were used to explore lactating nurses' experiences of RTW after lifting COVID-19 lockdown in Wuhan. Empirical phenomenological research focuses on the commonalities of experiences among participants [17]. We paid more attention to lactating nurses and described their return-to-work experiences and breastfeeding strategies. We followed the Standards for Reporting Qualitative Research guidelines (SRQR) throughout this study [18].

### 2.2. Participants

Participants were recruited through purposive and snowball sampling in a tertiary hospital in January and February 2023. The sample size was determined according to the principle of data saturation, that is, when no new themes emerged [19]. The inclusion criteria were: (1) nurses who returned to work after delivery, (2) having a child under 12 months, (3) breastfeeding when they return to nursing work, (4) working for more than one week after lifting COVID-19 lockdown, and (5) being willing to participate. Furthermore, nurses who had no time to conduct an interview or suffered from mental illness were excluded. Variations in years of work experience, education, department, days of RTW, and the number of pregnancies were considered to gain diversity in RTW experience after lifting COVID-19 lockdown. Three participants were already known by our researchers, and the rest were approached via snowball sampling.

### 2.3. Data collection

First, an interview outline was developed through the relevant literature review and was revised with the comments of two experts (a maternal-child nursing specialist and a nursing management specialist). Subsequently, we conducted a pilot test with 2 lactating nurses to adjust the ambiguities and leading questions. Finally, semi-structured interview guides were formed, including two main themes: (1) experiences and feelings of RTW and (2) coping with COVID-19. Besides, we also used probing questions to enhance the

**Table 1**  
Semi-structured interview guide.

| Themes                          | Questions  |
|---------------------------------|--|
| Experiences and feelings of RTW | (1) What was your experience of RTW?<br>(2) How did you feel on your first day back to work?<br>(3) Are you adjusting to the job now?<br>(4) How did you balance work and family?<br>(5) What do you think of breastfeeding when you return to work?             |
| Coping with COVID-19            | (1) What influence do you think COVID-19 has on RTW?<br>(2) How has COVID-19 affected your breastfeeding program?<br>(3) What difficulties did you have? How do you cope with it?<br>(4) Have you ever experienced physical discomfort? How do you cope with it? |
| Probing questions               | (1) Can you give me some examples?<br>(2) Can you describe it in detail?<br>(3) Do you have anything to say?   |

RTW: return to work.

depth of the interview. The final interview guide is presented in [Table 1](#). We conducted the video conference at the convenience of participants. At the beginning of the formal interview, we collected the general demographic of participants through an electronic questionnaire.

#### 2.4. Data analysis

Haase's adaptation of Colaizzi's method was used to analyze the transcript: (1) familiarization; (2) identification of significant statements; (3) formulation of meanings; (4) clustering of themes; (5) development of an exhaustive description; (6) production of the fundamental structure; (7) verification of the fundamental structure [20]. Within 24 h after the interview, the interviewer (SY) transcribed the audio recordings verbatim and recorded the modal words, pauses, expressions, or body movements at the time. Additionally, the transcript was reviewed by another researcher (MF) to ensure its authenticity and accuracy. During the process of data analysis, group discussions were held several times to reduce bias caused by subjective assumptions until a consensus was reached on the themes, sub-themes, and quotations.

#### 2.5. Ethical considerations

This study has been approved by the Medical Ethics Committee of Tongji Hospital affiliated to Tongji Medical College, Huazhong University of Science and Technology (TJ-IRB20230129), which was registered on the Chinese Clinical Trial Registry as ChiCTR2300067927. Before each video interview, the researchers clearly explained the purpose and content of the study to the participants, promising that the interview materials would only be used for academic research. After obtaining oral informed consent, all dialogues were recorded. Confidentiality was robustly ensured by using numbers instead of names (e.g., N1, N2, etc.) and removing identifying information from the transcriptions. The audio recordings and related notes are kept on a password-protected computer.

### 3. Results

#### 3.1. Sample characteristics

Thematic redundancy was realized in the 14th interview and a further participant was subsequently interviewed to confirm

**Table 2**  
Characteristics of the participants (n = 15).

| Participants | Age, years | Work experience, years | Education       | Department                        | Days of RTW before the interview | Number of pregnancies | Age of childs on RTW, months | Type of breastfeeding |
|--------------|------------|------------------------|-----------------|-----------------------------------|----------------------------------|-----------------------|------------------------------|-----------------------|
| N1           | 32         | 11                     | Bachelor degree | Orthopedics                       | 35                               | 2                     | 5~6                          | NEBF                  |
| N2           | 30         | 5                      | Bachelor degree | Geriatrics                        | 44                               | 1                     | 4~5                          | EBF                   |
| N3           | 28         | 6                      | Bachelor degree | Hematology                        | 33                               | 1                     | 5                            | NEBF                  |
| N4           | 29         | 6                      | Bachelor degree | Gynecology                        | 31                               | 1                     | 5~6                          | NEBF                  |
| N5           | 32         | 7                      | Bachelor degree | Neurosurgery                      | 28                               | 2                     | 5~6                          | NEBF                  |
| N6           | 27         | 1                      | Master degree   | Obstetrics                        | 10                               | 1                     | 5~6                          | NEBF                  |
| N7           | 29         | 1                      | Master degree   | Thyroid-breast Surgery            | 32                               | 1                     | 5~6                          | NEBF                  |
| N8           | 27         | 5                      | Bachelor degree | Stomatology                       | 9                                | 1                     | 5~6                          | NEBF                  |
| N9           | 31         | 6                      | Master degree   | Geriatrics                        | 22                               | 1                     | 5~6                          | NEBF                  |
| N10          | 34         | 11                     | Bachelor degree | Emergency Department              | 11                               | 3                     | 5~6                          | NEBF                  |
| N11          | 27         | 5                      | Bachelor degree | Cardiovascular Surgery            | 23                               | 1                     | 5~6                          | NEBF                  |
| N12          | 29         | 5                      | Bachelor degree | Gastroenterology                  | 8                                | 1                     | 5~6                          | EBF                   |
| N13          | 27         | 6                      | Bachelor degree | Anesthesiology                    | 7                                | 1                     | 5~6                          | EBF                   |
| N14          | 34         | 10                     | Bachelor degree | Hepato-biliary-pancreatic surgery | 41                               | 2                     | 5~6                          | NEBF                  |
| N15          | 30         | 3                      | Bachelor degree | Traditional Chinese Medicine      | 13                               | 1                     | 4~5                          | NEBF                  |

RTW: return to work; EBF: exclusive breastfeeding; NEBF: nonexclusive breastfeeding.

thematic redundancy. Ultimately, we recruited 15 lactating nurses, aged 27–34 years. Before the interview, participants returned to work for 7 days–44 days, with an average of 23.13 days. All respondents were infected with COVID-19 and 11 of them were infected after RTW. The duration of the interview ranged from 43 to 76 min (mean = 58.47, standard deviation = 11.32). More characteristics of the participants are described in Table 2.

### 3.2. Themes and sub-themes

Three main themes emerged from the 15 interviews: preparation for RTW, experiences of RTW and experiences of infection. More details are presented in Table 3.

#### 3.2.1. Theme 1: preparation for RTW

**3.2.1.1. Feed preparation.** Most participants (n = 9) stockpiled breast milk for later. N2 noted: “I had a lot of breast milk ... I used to pump out excess milk and store it in the fridge so that my baby could still drink it when I went to work.” Three participants prepared milk powder due to an insufficient milk supply. N4 noted: “One month before RTW, my breastfeeding began to decrease gradually, probably due to anxiety (sigh heavily), and then I started to adapt my baby to milk powder.” In addition, two participants adopted a weaning strategy. N6 noted: “I think it is inconvenient to breastfeed at work, so half a month before I returned to work, I began weaning with acupuncture.”

**3.2.1.2. Self-directed learning.** After lifting COVID-19 lockdown, the nursing workflow was updated again. Six participants updated their knowledge by attending meetings remotely or reviewing courseware. N3 noted: “I participated in all the online meetings notified in the workgroup ... I also reviewed the relevant courseware in the OA system (office automation).” Interestingly, the popularity of videos on online platforms has made learning enjoyable for returning nurses. N9 noted: “I often watched some videos of injection techniques in Douyin (a short video platform), which were very short but very interesting.”

**3.2.1.3. Choice of caregiver.** When choosing a caregiver, all participants preferred family members, such as retired grandmothers,

**Table 3**  
Summary of identified themes and supporting quotes.

| Themes                   | Sub-themes                    | Primary codes  | Quotes   |
|--------------------------|-------------------------------|--|--|
| Preparation for RTW      | (1) Feed preparation          | 1) Store breast milk in advance<br>2) Prepare powdered milk  | “I used to pump out excess milk and store it in the fridge.” (N2)<br>“I started to adapt my baby to milk powder.” (N4)   |
|                          | (2) Self-directed learning    | 1) Online meetings in the hospital<br>2) Learning on social media video tools                                  | “I participated in all the online meetings notified in the workgroup.” (N3)<br>“I often watched some videos of injection techniques in Douyin.” (N9)   |
|                          | (3) Choice of caregiver       | Family members take over the baby’s care   | “I asked my mother to take care of my baby.” (N7)  |
| Experiences of RTW       | (1) Breastfeeding             | 1) Lack of breastfeeding facilities<br>2) Decreased breast milk<br>3) Limited breastfeeding and parental leave | “I always pump when the nurses’ lounge is empty ... I think a separate pumping space is very necessary.” (N9)<br>“Uh ... the milk gradually decreases (sigh heavily).” (N13)<br>“I think 7 days of parental leave per year is not enough.” (N15) |
|                          | (2) Physical challenge        | 1) Lack of sleep<br>2) Back pain or swollen feet   | “I sleep for 4 or 5 h every day ... I feel a lack of sleep” (N7)<br>“I’m too busy at work to sit down ... My back is sore and sometimes my feet are swollen.” (N14)  |
|                          | (3) Work adaptation           | 1) Transition to positions<br>2) Learning updated nursing skills or workflow                                   | “At first, the head nurse let me go to work in the physical examination center, where the work was relatively easy.” (N14)<br>“I had to relearn techniques ... prone ventilation, high-flow oxygen therapy, and so on.” (N12)                    |
|                          | (4) Emotional burden          | 1) Maternal separation anxiety<br>2) Feeling guilty about babies and colleagues                                | “I often watched my baby through home monitoring systems” (N14)<br>“I felt guilty about my co-workers ... they had to take more work.” (N2)  |
| Experiences of infection | (1) Status before infection   | 1) Personal protection<br>2) Do not go out unless necessary  | “I came home from work, used ultraviolet light to disinfect clothes ...” (N1)<br>“I rarely went out for fear of infection.” (N15)  |
|                          | (2) Response to infection     | 1) Isolation at home or in a nearby hotel<br>2) Do not dare to drink medicine                                  | “After feeling a little feverish, I went to stay at a nearby hotel.” (N3)<br>“Considering breastfeeding, I did not drink any medicine when I had a fever.” (N10)   |
|                          | (3) Reflection after recovery | 1) Fear of reinfection<br>2) Long-term effects of COVID-19   | “Even after we recover, we still seldom go out because we don’t want to be infected again (frowning).” (N15)<br>“I have recovered for a long time, but I still lactate less than before ...” (N8)  |

RTW: return to work.

which was also the lowest-cost option for child care. N7 noted: “One month before RTW, I asked my mother to take care of my baby so that I had enough time to teach her and the baby could adapt slowly.” N10 noted: “During puerperium, I hired a confinement nanny, but I had to pay 12,000 yuan (\$ 1791) per month, which was too expensive for me to afford ... When I was infected, the baby slept with my grandmother and slept well ...”

### 3.2.2. Theme 2: experiences of RTW

**3.2.2.1. Breastfeeding.** Considering the inconvenience of distance and time to commute, all participants chose to pump in the hospital. Regrettably, there was not enough pumping equipment and time. N9 noted: “I always pump when the nurses’ lounge is empty ... I feel so embarrassed. I think a separate pumping space is very necessary.” Some participants (n = 5) chose to discard breast milk due to the lack of hygienic milk storage facilities. N4 noted: “Breast milk is pumped in the lounge, but it is discarded ... There is only one fridge in the department, which stores many medicines for patients ... Breast milk can be polluted.”

All participants reported a gradual decrease in breast milk after RTW, possibly influenced by working pressure and pumping frequency. N13 noted: “During my ML, I pumped every 3 or 4 h. I only pumped once in the hospital. Uh ... the milk gradually decreases (sigh heavily).” In addition, breastfeeding and parental leave were available in the hospital, but most participants (n = 10) indicated that these leave periods were limited. N15 noted: “My working hours are flexible, which can be adjusted according to breastfeeding leave (1 h per day). But I think 7 days of parental leave per year is not enough.”

**3.2.2.2. Physical challenge.** Most participants (n = 13) described physical challenges upon RTW. Sleep deprivation was the most frequently cited, affecting the efficiency and quality of work. N7 noted: “I sleep for 4 or 5 h every day because I also breastfeed at night ... I feel a lack of sleep, I have no energy at work, and then I make mistakes easily.” Busy ward work also aggravated nurses’ back pain or swollen feet to some extent. N14 noted: “I’m too busy at work to sit down ... My back is sore and sometimes my feet are swollen.”

**3.2.2.3. Work adaptation.** Four participants mentioned that the nurse manager assigned them relatively easy or safe jobs at the beginning of their RTW. N14 noted: “At first, the head nurse let me go to work in the physical examination center, where the work was relatively easy ... One month later ... I returned to the original department (hepato-biliary-pancreatic surgery). This transition period helped me greatly adapt to work.”

The surge in cases after lifting COVID-19 lockdown also posed additional challenges for RTW, such as the risk of infection at work, more workload, and updated nursing skills or workflow. N12 noted: “When I returned to work, the epidemic was severe. We formed an emergency medical unit to treat patients with viral lung, so I had to relearn techniques ... prone ventilation, high-flow oxygen therapy, and so on.”

**3.2.2.4. Emotional burden.** In the early stages of RTW, emotional burdens seemed inevitable, including missing, worrying, guilt, and anxiety. N14 noted: “I often watched my baby through home monitoring systems ... I felt guilty that I could not be home to take care of my baby. And I had insufficient milk supply for my baby (sobbing sadly).” N2 noted: “I felt guilty about my co-workers. I had breastfeeding leave, so I left work an hour earlier each day, but that also meant they had to take more work.”

### 3.2.3. Theme 3: experiences of infection

**3.2.3.1. Status before infection.** All participants were infected and reduced the risk of virus transmission by washing their faces, showering, or disinfecting their clothing with UV light. Furthermore, more than half of participants were uneasy about going out and were reluctant to receive the COVID-19 vaccine until they stopped breastfeeding. N15 noted: “Considering breastfeeding, I did not get the COVID-19 vaccine, so I rarely went out for fear of infection.”

**3.2.3.2. Response to infection.** After infection, participants were isolated at home or in nearby hotels to avoid infecting their families. N3 noted: “After feeling a little feverish, I went to stay at a nearby hotel ...” N8 noted: “I isolated myself at home and then my mother took care of the baby.”

Breastfeeding attitudes also differed due to differences in perceptions toward COVID-19. Eight participants gave up breastfeeding during the infection, four continued breastfeeding after the fever disappeared, and others continued breastfeeding regardless of the infection or not. In addition, participants who adhered to breastfeeding were extra cautious in their choice of medication and prioritized physical therapy. N10 noted: “Considering breastfeeding, I did not drink any medicine when I had a fever. I did physical cooling ... warm water baths and cold compresses ...”

**3.2.3.3. Reflection after recovery.** Many participants (n = 8) expressed their concern about reinfection. N15 noted: “Even after we recover, we still seldom go out because we don’t want to be infected again (frowning).” The long-term effects of COVID-19 also caused some problems with breastfeeding or RTW. N8 noted: “I have recovered for a long time, but I still lactate less than before ... My memory has decreased and I get tired and sweaty easily.”

#### 4. Discussion

This study used an empirical phenomenological approach to understand the RTW experiences of lactating nurses after lifting COVID-19 lockdown, summarizing three themes: preparation for RTW, experiences of RTW, and experiences of infection. In general, the surge of patients after lifting the COVID-19 lockdown made it more difficult for lactating nurses to RTW, but it would have been relatively easy and rewarding with adequate preparation for RTW. These findings provide important guidance to improve RTW and breastfeeding of healthcare workers after lifting COVID-19 lockdown.

ML makes nurses leave their jobs for a long time, and the constant changes of nursing work make returning nurses more anxious and worried. Adequate preparation for RTW was found to be a powerful means of reducing the pressure of return to work for lactating nurses. To adapt to clinical work as soon as possible, participants have begun to learn new nursing procedures and regulations before RTW. The comprehensive construction of office information systems and the rapid development of social media video tools provide participants with convenient distance learning [21]. In terms of infant-caregiver selection, participants preferred retired family members who could provide full-time care. Previous studies have also mentioned that working mothers preferred trusted older family members as caregivers for their infants [22]. Although confinement nannies have more experience in childcare, they also result in higher childcare costs, which are unaffordable to many families. Additionally, outside caregivers are not as reassuring as family members.

In addition to childcare, the most difficult part of RTW is breastfeeding. The WHO recommends that infants under 6 months old should receive EBF [23]. However, in our study, only 3 out of 15 participants exclusively breastfed until 6 months of age, well below the global breastfeeding rate target (50 %) [2], and similarly below the EBF rate in China (29.5 %) [3], which may be influenced by RTW. Our interviews revealed that most of the participants chose NEBF because they did not have sufficient breast milk. However, some participants took weaning measures to RTW. RTW interrupted the breastfeeding program early, which was consistent with previous research findings [5,24]. In addition, a recent review also found a positive association between the length of ML and the duration of breastfeeding [25]. The average length of maternity leave in OECD countries was just over 32 weeks, with most countries providing 26–52 weeks of maternity leave, and evidence suggested that paid ML over 6 months was related to an increase of nearly 9 % in EBF [6]. However, neither of the two types of ML in this study reached six months: 173 days for cesarean sections and 158 days for vaginal births. Participants also reported insufficient length of ML. Extending the duration of ML is expected to increase the rate of continued breastfeeding, especially paid ML. Previous studies in China have shown that if the length of paid ML is increased by 30 days, the probability of breastfeeding for six months increases by 12% points [26].

Furthermore, supportive workplaces were relatively absent, such as private spaces, adequate breaks, and flexible schedules. The results are consistent with other studies, that is, the construction of a supportive workplace still needs to be strengthened [27–29]. Lack of adequate breastfeeding facilities was almost twice the rate of breastfeeding interruptions [5]. Unfortunately, participants in our study described that pumping in public restrooms was often interrupted due to embarrassment. The cornerstone of milk supply maintenance is regular pumping [30]. Upon RTW, the frequency and duration of pumping were greatly reduced, emotional pressure such as anxiety and guilt increased, sleep was severely deprived, and eventually, lactation continued to decrease, which was not conducive to continued breastfeeding [5,11]. Furthermore, adequate breaks and flexible schedules have also proved to be helpful for the transition back to work [31]. Nursing managers can flexibly adjust work schedules for returning nurses based on breastfeeding schedules, which also helps to reduce their guilt toward colleagues.

After lifting COVID-19 lockdown, lactating nurses bore the dual pressure of infection risk and RTW, making them vulnerable to interrupting or terminating their breastfeeding program early. WHO recommended that mothers with COVID-19 should be encouraged to start or continue to breastfeed and it was also safe to breastfeed while taking preventive measures, such as washing their hands before and after touching the infant and the breast [32]. However, our participants, as healthcare professionals who can get medical information more easily, still showed a lack of knowledge about breastfeeding during the epidemic. For example, some participants continued to breastfeed because they believed that breast milk carried antibodies to strengthen infant resistance, while others stopped breastfeeding because they feared that breast milk carried the virus. A previous study found that EBF rates would not be affected by the pandemic if mothers were fully informed about the importance of breast milk, the transmission way of COVID-19, and the hygiene rule when breastfeeding [33]. Therefore, it is essential to provide more targeted information on COVID-19 to lactating nurses, such as maternal and infant protection, timing of vaccination, medication guidance, and response to a sudden drop in breast milk supply.

#### 5. Limitations

There are also several limitations in this study. First, due to the constraints of the pandemic, we had to use remote video interviews instead of face-to-face interviews to minimize the loss of interview data, such as facial expressions and body language. Although video interviews were easily affected by disruptions in communication technology, their convenience and flexibility are more acceptable to participants [34]. Second, the different start dates of participants' RTW resulted in different levels of memory blurring, which might bring about bias in the interview information. In addition, the interview materials were translated from Chinese into English, which might lead to cultural misunderstanding in translation. For example, a confinement nanny, also known as a confinement lady or maternity nurse, is a woman experienced in the skill of post-delivery care and newborn babies. Finally, although we reached saturation of the interview data, the participants were all from the same hospital, so care should be taken when transferring these findings to other clinical settings.

## 6. Conclusion

Lactating nurses experienced psychological and physical problems when they returned to work after lifting COVID-19 lockdown. Their breastfeeding programs were easily interrupted or terminated in advance. Not only do longer periods of leave, flexible work arrangements, and separate breast pumping facilities need to be further provided, but epidemic-specific breastfeeding strategies also cannot be ignored.

## Data availability statement

The data collected are confidential. However, anonymized interview data were included in the article with the approval of all authors and participants.

## Ethics statement

This study has been approved by the Medical Ethics Committee of Tongji Hospital affiliated to Tongji Medical College, Huazhong University of Science and Technology (TJ-IRB20230129), which was registered on the Chinese Clinical Trial Registry as ChiCTR2300067927.

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## CRedit authorship contribution statement

**Suya Li:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Wenyan Zhang:** Writing – original draft, Supervision, Methodology, Data curation. **Yu Liu:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Mingfeng Yu:** Writing – review & editing, Supervision, Project administration. **Siyu Yang:** Validation. **Mengdan Luo:** Methodology. **Qing Yang:** Software.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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