



Perceptions and Effectiveness of an Educational Intervention on Stem Cell Banking among Women in Chennai: A Mixed Method Study

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ABSTRACT

Background: Stem cell banking has gained increasing attention as an innovative approach in regenerative medicine because of its potential applications in the prevention and treatment of various haematological, metabolic, and genetic disorders. Despite its promising clinical benefits, awareness and understanding of stem cell banking among women in India remain limited. Furthermore, misconceptions, insufficient knowledge, and financial concerns continue to influence women's attitudes and decision-making regarding stem cell preservation. **Purpose:** To explore women's perceptions of stem cell banking and to evaluate the effectiveness of a structured educational intervention on knowledge and attitude among women in Chennai. **Methods:** An exploratory sequential mixed-method design was adopted to explore women's perceptions and subsequently evaluate the effectiveness of an educational intervention. Phase I included semi-structured interviews with 18 women selected through purposive sampling to explore awareness, perceptions, and barriers related to stem cell banking. Findings guided the development of a culturally appropriate 60-minute educational intervention. Phase II used a one-group pre-test post-test design among 60 women selected through convenience sampling. Knowledge and attitude were assessed using validated tools and analyzed using descriptive and inferential statistics. **Results:** Qualitative findings revealed poor awareness, misconceptions, financial concerns, and preference for simple educational content in the local language. Post-intervention knowledge and attitude scores improved significantly. A positive correlation was observed between knowledge and attitude. Education and parity were significantly associated with knowledge improvement. **Conclusion:** The educational intervention effectively improved women's knowledge and attitude regarding stem cell banking. **Implications for Nursing:** Given their central role in health promotion and patient education, nurses are well positioned to enhance awareness and facilitate informed decision-making regarding stem cell banking through evidence-based community outreach and educational programs.

Keywords: Stem cell banking, Women's health, Educational intervention, Mixed-method design; Knowledge, Attitude.

What does this paper add?

1. It explores the perceptions, awareness levels, and educational needs of women regarding stem cell banking.
2. It evaluates the effectiveness of a structured teaching program in improving knowledge and attitude of women regarding stem cell banking.

Introduction

Maternal healthcare begins at conception, and recent advancements in regenerative medicine have expanded opportunities for long-term therapeutic protection through stem cell and umbilical cord blood banking (Harris, 2014). Stem cells possess the ability to regenerate damaged tissues and treat a wide range of haematological, genetic, metabolic, and immune disorders, making stem cell preservation a rapidly growing component of health services globally (Mayani et al., 2020; Mahato, 2018). Umbilical cord blood, collected immediately after childbirth, is a rich source of hematopoietic stem cells and was once discarded as biological waste; today, it is recognized as a valuable medical resource (Ballen, 2017).

In India, public and private stem cell banks have grown substantially, yet awareness and participation remain limited among women of reproductive age. Multiple factors hinder uptake, including limited antenatal counseling, financial constraints, misconceptions about the procedure, lack of regulatory clarity, fear of unethical use, and social or cultural influences (Fernandez et al., 2003; Perlow, 2006; Katz

et al., 2011). Many women rely on informal information sources, such as family, peers, and social media, which may lead to confusion and misinformation (Ballen et al., 2015).

Educational interventions delivered through trusted health professionals can play a significant role in improving knowledge and shaping positive attitudes toward stem cell banking. Community-based awareness programs, particularly those tailored to language, literacy level, and cultural context, have been shown to enhance women's understanding and decision-making in reproductive and maternal health care (Upadhyay et al., 2017; Marskole et al., 2021).

Recognizing these gaps, the present mixed-method study was conducted to:

1. Explore the perceptions, awareness levels, and educational needs of women regarding stem cell banking through qualitative inquiry.
2. Evaluate the effectiveness of a structured, culturally adapted teaching program in improving knowledge and attitude in a community setting in Chennai.

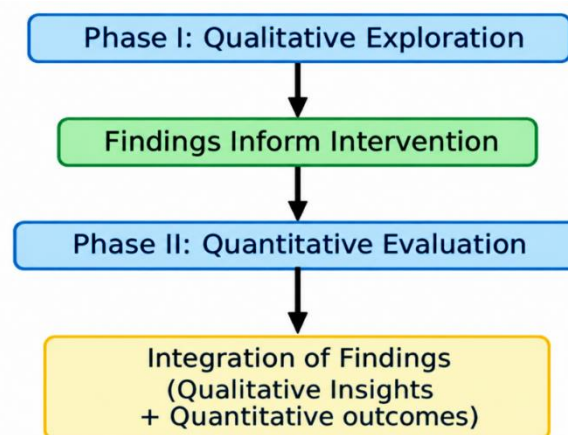


Figure 1. Exploratory sequential mixed-method design

Methodology

Research Design

An exploratory sequential mixed-method design (QUAL → QUAN) was adopted to explore women's perceptions and subsequently evaluate the effectiveness of an educational intervention. The study was conducted and reported according to the GRAMMS (Good Reporting of a mixed-method study) guidelines to ensure proper integration and reporting of qualitative and quantitative findings.

Phase I involved a qualitative inquiry to explore women's awareness, perceptions, and informational needs related to stem cell banking, and findings were used to develop a culturally appropriate educational intervention. Phase II consisted of a quasi-experimental one-group pre-test post-test design to evaluate the effectiveness of the intervention in improving knowledge and attitude. Integration occurred at two levels:

1. Using qualitative findings to develop the

intervention package, and

2. Comparing and interpreting qualitative and quantitative results jointly.

Phase I - Qualitative Phase

Sampling Technique

A total of 15-20 women aged 21-40 years from Nilankari, Chennai, were selected using purposive sampling. Inclusion criteria were:

- permanent residents of the study area,
- ability to communicate in Tamil, and
- willingness to participate and provide written consent.

Women with cognitive impairment, communication difficulties, those medically unwell during data collection, or those unwilling to allow audio recording were excluded.

Sample Size Justification

Sample size was guided by data saturation, which was anticipated between 15 and 20 interviews. This decision aligned with the concept of “information power,” considering the focused study aim, sample characteristics, and depth of interview data.

Data Collection Procedure

Prior to data collection, administrative permission was obtained from the concerned community authorities. Written informed consent was obtained from all participants before participation in the study. Confidentiality, anonymity, and participants’ right to withdraw from the study at any stage were ensured throughout the research process. Data collection was conducted over three weeks in familiar community settings to ensure participant comfort and openness. Semi-structured face-to-face interviews lasting 30-40 minutes were audio-recorded with permission. Interviews explored baseline awareness, perceived benefits and risks, decision-making influences, misconceptions, and expectations for information delivery. Interviews were conducted in Tamil, transcribed verbatim, and translated into English for analysis.

Data Analysis

Data was analyzed using Braun and Clarke’s six-step thematic analysis framework. An inductive coding process was employed, supported by NVivo 12 software

for data management. Trustworthiness was enhanced through member checking (credibility), maintenance of audit trails (dependability), thick narrative descriptions (transferability), and peer debriefing (confirmability).

Development of the Intervention

Qualitative findings indicated low awareness, several misconceptions, and a strong preference for simple teaching in Tamil supported by audiovisual aids. Based on these results, a 60-minute structured intervention was developed and expert-validated.

The intervention included:

- a 30-minute interactive lecture using visuals and flashcards covering types of stem cells, collection procedure, benefits, risks, ethical and legal considerations, and costs;
- a 10-minute illustrated pamphlet in Tamil as reinforcement material;
- a 20-minute group discussion and question-answer session to encourage participation and clarification of doubts.

This approach ensured cultural appropriateness, clarity, and suitability for women across different literacy levels.

Phase II - Quantitative Phase

Research Purpose

The purpose of Phase II was to determine the effectiveness of the structured educational package in improving women’s knowledge and attitude toward stem cell banking.

Research Design

A quasi-experimental one-group pre-test and post-test design was used. The same structured knowledge questionnaire and attitude scale were administered before and after the intervention to measure improvement.

Study Sample

Sixty women aged 21-40 years from Nilankari, Chennai, were selected through convenience sampling. Inclusion criteria included the ability to read and write Tamil or English and willingness to provide informed consent. Women who previously received training on stem cell banking or could not attend both pre- and post-tests were excluded.

Sample Size Calculation

Sample size was calculated using G*Power 3.1 software with effect size= 0.5, α = 0.05, and power = 0.80, resulting in a minimum requirement of 54 participants. To offset potential attrition, the final sample was increased to 60.

Tools for Data Collection

Three instruments were used:

1. **Structured knowledge questionnaire (20 items)**
 - Content validity index (CVI) = 0.89.
 - KR-20 reliability = 0.87.
2. **Attitude scale (15 items, 3-point Likert format)**
 - Cronbach's α = 0.91.
3. **Demographic pro forma**
 - Included variables, such as age, education, occupation, and parity.

Data Collection Procedure

Data collection occurred in three stages:

1. Pre-test on knowledge and attitude (20-25 minutes),
2. Delivery of the 60-minute intervention in small groups, and
3. Post-test conducted on the seventh day using the same tools (20 minutes).

Each participant spent approximately 100-110 minutes in total.

Data Analysis Methods

SPSS version 25 was used for data analysis.

- Descriptive statistics (frequency, mean, percentage, and SD) summarized demographic, knowledge, and attitude scores.
- Paired t-test compared pre- and post-test differences.
- Pearson correlation assessed relationships between knowledge and attitude.
- Chi-square test examined associations between demographic variables and post-test scores. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

Administrative permission was obtained from community authorities. Written informed consent was secured from all participants. Confidentiality and anonymity were maintained throughout the study, and participants were informed of their right to withdraw at any stage. Audio files and transcripts were securely stored with restricted access.

Results

Phase I: Qualitative Findings

Thematic analysis of the interviews with 18 women generated five major themes and fourteen subthemes. Illustrative quotes with participant numbers are presented in Table 1.

Table 1. Themes, subthemes, and illustrative quotes from participants (n = 18)

Theme	Subtheme	Illustrative Quotes (with Participant No.)
1. Awareness and Knowledge Gaps	Lack of baseline awareness	"I have never heard about stem cell banking before this interview." (P3)
	Misunderstanding the concept	"Is it the same as donating blood? I thought it was like blood banks." (P7)
	Limited knowledge of process	"I did not know it is collected from the cord after delivery." (P1)
2. Perceived Benefits and Motivations	Biological insurance	"If something happens later in life, this will be like a backup for my child." (P10)
	Treatment potential	"They say it can be used for cancer or blood disease; that sounds very useful." (P14)
	Future promise (regenerative medicine)	"Maybe in future it can help in making organs. Science is going very far." (P12)
3. Barriers and Concerns	Financial constraints	"It is too costly; how can a middle-class family afford it?" (P6)
	Ethical/safety concerns	"Will it harm my baby at birth? I feel nervous about that." (P2)

	Mistrust of private companies	"Private banks may misuse it; we can't be sure what happens to it." (P9)
4. Expectations for Information and Support	Need for simple, culturally relevant education	"If you explain in Tamil with pictures, everyone can understand." (P4)
	Group learning preference	"In a group we can discuss doubts, it is better than only reading." (P13)
	Role of health workers	"Nurses should tell us during pregnancy. We will trust their words." (P8)
5. Myths and Misconceptions	Placenta as waste	"I thought the placenta and cord are just waste, I did not know they can save life." (P5)
	Fear of misuse	"I heard they may sell it for money, that makes me doubt." (P16)

Linkage of Qualitative Findings to Intervention Package

The intervention package was systematically developed from the themes and subthemes identified in

Phase I. Each qualitative insight was translated into a targeted educational component to ensure cultural appropriateness, relevance, and effectiveness.

Table 2. Integration of qualitative findings into intervention package design

Theme (Phase I)	Key Insights from Participants	Intervention Component (Phase II)
Awareness and Knowledge Gaps	• Most had never heard of stem cell banking. • Confused it with blood donation. • Limited understanding of process.	Interactive lecture with audiovisual aids explaining: ✓ Definition of stem cell banking ✓ Collection process after delivery ✓ Difference between stem cells and blood donation
Perceived Benefits and Motivations	• Saw it as "biological insurance." • Believed it could treat serious diseases. • Curious about future regenerative medicine.	Pamphlet (Tamil, with illustrations) covering: ✓ Benefits in treatment (leukemia, thalassemia, diabetes, Parkinson's, etc.) ✓ Role in future therapies (organ/tissue regeneration)
Barriers and Concerns	• Financial cost considered unaffordable. • Fear of harm to baby during collection. • Distrust of private companies.	Group discussion & Q&A session addressing: ✓ Safety of collection procedure ✓ Ethical/legal safeguards ✓ Options of public vs. private banking ✓ Clarifying cost-benefit considerations
Expectations for Information and Support	• Wanted teaching in Tamil, with visuals. • Preferred group learning. • Trusted nurses and midwives most.	Delivery format tailored to preferences: ✓ Simple Tamil language ✓ Use of posters & visuals ✓ Nurse-led sessions in small groups (10-12 women)
Myths and Misconceptions	• Believed placenta/cord is waste. • Worried cord blood may be "sold" or misused.	Myth-busting section in lecture & pamphlet explaining: ✓ Placenta/cord blood as valuable, not waste ✓ Legal frameworks to prevent misuse ✓ Transparency of collection & storage process

Phase II: Quantitative Findings

Demographic Characteristics of Participants

(N = 60)

Among the 60 women who completed both the pre-test and post-test, the majority were between 26 and 30 years of age, followed by those aged 21-25 years. More than a half of the women were graduates, while a smaller proportion had completed secondary school or postgraduate studies. Over a half of the participants were homemakers, and the remaining were employed in either private or government sectors. Most were primipara mothers, and about one-third belonged to the

low socioeconomic group, while nearly a half were from the middle-income category.

Knowledge on Stem Cell Banking

Table 3 shows that the results showed a significant improvement in knowledge after the intervention. The mean pre-test score of 7.8 ± 2.4 increased to 15.6 ± 2.1 in the post-test. The difference was statistically significant ($t = 16.84$, $p < 0.001$), indicating that the structured teaching package was highly effective in enhancing women's understanding of stem cell banking.

Table 3: Knowledge on stem cell banking

Knowledge Scores (Max. = 20)	Mean $\pm$ SD	t-value	p-value
Pre-test	7.8 ± 2.4	16.84	<0.001***
Post-test	15.6 ± 2.1		

Attitude toward Stem Cell Banking

Table 4 shows that there was a clear positive change in attitude following the intervention. The mean attitude score increased from 22.1 ± 3.8 in the pre-test to $34.4 \pm$

4.2 in the post-test. This improvement was statistically significant ($t = 14.62$, $p < 0.001$), showing that the intervention successfully strengthened women's perceptions toward stem cell banking.

Table 4: Attitude toward stem cell banking

Attitude Scores (Max. = 45)	Mean $\pm$ SD	t-value	p-value
Pre-test	22.1 ± 3.8	14.62	<0.001***
Post-test	34.4 ± 4.2		

Correlation between Knowledge and Attitude (Post-test)

Table 5 shows that the post-test findings showed a moderate positive correlation between knowledge and attitude ($r = 0.46$, $p < 0.01$). This indicates that women with higher knowledge scores also tended to have more favourable attitudes toward stem cell banking. In other words, as understanding increased, attitudes became more positive.

Table 5. Correlation between knowledge and attitude (post-test)

Variable	r-value	p-value
Knowledge $\leftrightarrow$ Attitude	0.46	<0.01**

Association with Demographics

The analysis showed that education level and parity

had a significant association with post-test knowledge scores, indicating that women with higher education and those who were primiparous demonstrated greater improvement after the intervention ($p < 0.05$). In contrast, no significant association was found between knowledge gains and other demographic factors, such as age, occupation, or socioeconomic status, suggesting that the intervention was effective across these groups regardless of their background.

Discussion

This mixed-method study explored women's understanding of stem cell banking and assessed the impact of a structured community-based educational program. The qualitative findings showed that most women had low awareness, held misconceptions, faced financial concerns, and needed simple and culturally relevant information. The quantitative results showed a

significant increase in knowledge and positive attitudes after the intervention, proving its effectiveness.

Baseline Awareness and Perceptions

Most women had little or no prior knowledge about stem cell banking. Similar findings in India showed that many antenatal mothers lack awareness, because they receive limited counseling and often depend on informal sources for information (Sonam et al., 2022; P.M., 2021; Sahoo & Rana, 2020). Although women were interested and understood that stem cell preservation could be useful in the future, they were unclear about how it is collected, when it is needed, the cost involved, and related ethical issues. Other studies also reported that without reliable and accessible information, women cannot make informed choices (Shokeen et al., 2024; Rahman et al., 2023; WHO, 2016; Bhandari et al., 2017).

Financial Concerns and Trust Barriers

High cost was a major barrier, as the expensive initial and yearly storage charges made many women hesitant to use private stem cell banking services (Awad et al., 2023; Stewart et al., 2013; Ministry of Health and Family Welfare, 2017). Participants also had doubts about service quality, government regulation, and what would happen after the cells were stored. Similar concerns have been reported in India and other developing countries, where many women are unsure whether the money spent will provide real benefits in the future (Mohammed et al., 2022). These issues suggest that publicly funded or government-supported banking systems could improve participation and make access more equitable (Buja & Vela, 2010; Rani et al., 2026).

Effectiveness of the Intervention

The structured educational intervention resulted in a significant improvement in knowledge and attitude. Post-test knowledge and attitude scores increased markedly, with strong statistical significance. Similar results have been reported in studies where audiovisual and group-based teaching improved awareness of stem cell therapy, cord blood banking, and genetic counseling among women and antenatal mothers (Suen et al., 2011; Saleh, 2019). The positive correlation between knowledge and attitude observed in this study indicates that improved understanding enhances acceptance and willingness to consider stem cell banking.

Role of Community-based Teaching

Participants expressed preference for learning delivered in Tamil, using visuals and interactive strategies. This supports evidence that culturally adapted education improves retention, comprehension, and confidence in reproductive health decision-making (Almaeen et al., 2021; Azzazy & Mohamed, 2016). Nurses and community health workers are well positioned to deliver such programs due to their trusted role and accessibility, especially in urban and rural community settings.

Relationship with Socio-Demographic Variables

Education and parity were significantly associated with post-intervention knowledge scores, reflecting prior research where higher education levels correlated with better understanding of advanced maternal health topics (Rani et al., 2026). No significant association was observed with age, occupation, or income, consistent with studies showing that effective educational processes can improve knowledge across diverse demographic categories (Pandey et al., 2016; Sadi et al., 2025).

Limitations of the Study

This study has some limitations. The study used a one-group pre-test post-test design without a control group. Convenience sampling and selection of participants from a single community in Chennai may limit the generalization of the findings. The sample size was small, and the post-test was conducted only after seven days; therefore, long-term retention of knowledge and attitude could not be assessed. Future studies with larger samples, control groups, and longer follow-up periods are recommended.

Conclusion

This mixed-method study demonstrated that women had limited baseline knowledge and mixed perceptions regarding stem cell banking. Misconceptions, financial concerns, and limited access to reliable information were major barriers to informed decision-making. The structured educational intervention, developed based on qualitative findings and delivered in the local language with audiovisual aids, significantly improved women's knowledge and attitudes. These results reinforce the importance of incorporating culturally appropriate health education within community maternal health

services. Nurses and community health workers can play a strategic role in providing evidence-based information, empowering women to make informed reproductive decisions, and supporting ethical uptake of stem cell preservation services. Expanding such programs and integrating them into routine antenatal education could enhance awareness and trust, contributing to improved maternal and child health outcomes.

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Conflict of Interests

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