Stem cell management is truly a primary bio-insurance for the well-being of babies- A study on Indian pregnant women

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ABSTRACT

Background: In recent years, Non-communicable diseases (NCDs) have been shown in developed countries to have an increasingly important impact on their health status worldwide. The NCDs are the world's leading cause of death and a significant threat to public health in developing countries. Almost 71 per cent of deaths worldwide are individually responsible for non-communicable diseases including cardiovascular diseases, stroke, cancer, diabetes and chronic condition. Almost three-fourths patients with non-communicable diseases have died before the age of 70 and 82% of 16 million prematurely deaths are in small and average countries are due to NCDs as per the WHO report 2018. India is undergoing rapid transitions with increase in Non-communicable diseases (NCDs), that are resulting into significant rise in morbidity and mortality in Urban and rural populations.47% of the patients in India are bearing the treatment cost (Out of Pocket) themselves. Stem cell therapy is becoming the crucial line of treatment for these diseases. In fact, from last two decades, Stem cells derived from cord blood were used for treatment of blood disorders, immune systems and metabolic diseases as an alternative to bone marrow transplants. In 2016, Non-communicable diseases (NCDs) control initiative was implemented by the Indian government to educate about the use of stem cells to treat non-communicable diseases. Doctors and biotech companies are helping to educate pregnant women to encourage the use of stem cells so they can decide to store their child's cord blood as needed for future use. Henceforth, this paper aims for understanding the attitude of Indian pregnant women for the storage and usage of stem cell that would be a critical bio-insurance for baby's well –being.

Methods: A cross sectional questionnaire was constructed based on ABC model of attitude. The sample for the study comprised of 130 pregnant women associated with various gynecologist clinics and hospitals of Delhi-NCR.

Results: The study found that out of the 130 participants, 20 subjects had never heard about the term stem cells and rest 110 participated were moderately aware about stem

cells and had little knowledge about the same with majority of the participants having positive attitudes towards stem cell management. Changes in positive behavior towards a healthy life can be accomplished by diligent interaction with individuals or in a group. According to National Multi-sectored Action Plan for Prevention and Control of common NCDs (2017-2022) Non-communicable diseases are seriously affected by major health environmental factors, for example lifestyle, rapid growth, globalization, and the socio-economic conditions of human beings. Instead now, a secure environment must be provided for treating major diseases and maintaining a healthy life. Health professionals have been identified as the preferred information source for pregnant women about stem cell management.

Conclusions: Therefore, it can be concluded that most pregnant women are positive about the process of stem cell management. This can also be encouraged via health professionals and stem cell management companies linked to different health centers. Many pregnant women were concerned about use of stem cells in the treatment of non-communicable diseases as the private sector is more involved in stem cells than the public sector. Barriers have to be overcome in order to improve stem cell management in India and the use of stem cells in treatment of NCD can only be encouraged.

Keywords: Stem Cells, Attitude, ABC model of attitude, Stem Cell Banking, Bio-Insurance, Pregnant Women, Stem cell Management

1. Introduction

According to WHO(World Health Organization) more than 60% of global deaths are due to non-communicable diseases (NCDs) and all the countries are suffers from this major public health challenges irrespective of their economic status. Within next decade, non-communicable diseases constitute a risk to economic, social growth and are expected to increase without serious efforts at country level. It's also stressful for all developed nations to choose how best to allocate health and health facilities. Such major problem is even more concerned for average and low income countries as there is less incentive to invest in health than a country that spends more on health care.

India is undergoing rapid demographic and social changes, with NCDs leading to significant disorder, morbidity and mortality in both urban and rural populations and across all socio-economic strata. According to the ICMR State-level Disease Burden Initiative, non-communicable diseases are responsible for an estimated 6.0 million deaths and 62% of death rate by 2016.

According the world economic forum annual meeting the present demand in stem cell therapy is rising at 36% per year and will grow rapidly if there is breakthrough treatment or life-style factor for non-communicable diseases. (Moradi, Jan 2020) Most of the main causes of death in 1900 were infectious / communicable diseases. While the incidence of most causes has declined, heart disease cancer is the common diseases. That is partially because of the doubling in life expectancy and the reduction of mortality from other

causes. Scientists and physicians, however, can cure these challenging diseases, given time and resources.

According to Global Burden of Diseases In 2017, 55.9 million people died. When we quantify all life years lost as a result of premature death–the amount of the discrepancies between the age of death of each person and their life expectancy at that age–we consider the world population lost 1.65 billion years of potential life as a result of premature death that year. Disease and illness led to the loss of another 853 million years of healthy lives. (Ritchie, 2020) Six of the seven main causes of death today are non-communicable diseases (heart disease, stroke, lung disease, cancer, Alzheimer's disease, and diabetes). Regenerative medicine may be our best hope to solve the great non-communicable diseases of our time, and perhaps the most important medical innovation in a century. Stem cell therapy, also known as regenerative medicine used for promote the repair response of diseased and injured tissues using the stem cells. Globally, scientists are making significant efforts to use various types of stem cells to treat different health conditions.

Stem cells are unspecialized cells present in the human body that can divide repeatedly and can form any cells within the human body, and thus have the great potential for future therapeutic applications for tissue regeneration and repair. Preservation of stem cell and use it in future is called stem cell banking. Stem cell management is managing the processing from stem cell research, stem cell collection, stem cell preservation, stem cell commercialization and use of stem cells to treat or prevent a disease or condition. The umbilical cord blood (UCB) has emerged for hematological and regenerative uses as a vital source. UCB provides a range of advantages over adult cells, including mobility, higher frequency and improved proliferative ability of transplantable stem cells and restore immunological function in patients requiring care (Merlin G. Butler, 2011).

Cord blood is the blood remains in the umbilical cord of the baby after it has been cut and is a rich source of stem cells. Cord blood is considered to be a valuable resource before being used as waste for disposal after conception. It is important to explore the evolving applications of stem cells to better understand the significance and potential of Stem cell banking. While Gluckman performed his first cord blood transplant in 1988 (Gluckman et al,1989), Dr. Pablo Rubinstein, the first National Cord Blood Banking system in New York Centre (The National Health Institute of the USA) was pioneers in the idea of banking cable blood. (Saboohi Nasim, 2015)In India, the Mumbai Cancer Research Institute began research on umbilical cord in 1990. However, there has been no support by government for establishing the stem cell bank.(Dastur, 2005). However, India's first private stem cell bank was established in 2002. Private stem cell storage has grown due to parents' concern about the necessity of "biological insurance" in the condition that a family member is sick who can be treated with stem cell transplantation. (Ballen, 2010).Cord blood is more like a' biological future health cover' for a newborn baby and its siblings; thus, this important source can give a renewed hope and prove to be a life-saver (Amit Kumar, 2011).A better awareness and understanding of stem cell management are needed to increase the use of stem cell banking by pregnant women; because the attitude towards stem cell management is positive then stem cell

management can take out to be an important tool for bio-insurance. In addition to determining the role of stem cell management as a child bio-insurance in India, the purpose of this paper is to analyze the attitude of pregnant women towards stem cell management in India.

2. Literature review

Studies in Swiss which investigated mother attitudes towards non-related cord blood banking after 6 months of donation show that most mothers want to donate and preserve their baby's umbilical cord. Mothers are satisfied but they are worried about the unlawful application of cord blood, including genetic testing and experimentation. (Enrico Danzer, 2003).Although 334 pregnant women in Turkey interviewed, they found that most pregnant women were very little aware of stem cell banking, they were provided with some details on the internet before pregnancy by TV and newspapers. They want more details through an obstetrician and they want to store the cord blood of their child in public stem cell banking after scientific evidence on stem cell banking (H. Dinc, 2009). So, after the decade knowledge of pregnant women on stem cell banking improved it's shown on the study conduct in Erzurum city, Turkey shows that only a limited number of participants had adequate information about stem cells banking and knowledge rates among expecting mothers should be improved, the key sources of information for mothers were the newspapers and the internet. The majority of mothers were found to have a positive attitude about preserving the cord blood of their infants. (Sibel Ozturk, 2017)

According to study in 2016, only one-fourth of women are aware about stem cell banking, with most of them is not confidence to preserve their baby umbilical cord. Women's know more about public cord blood banking than private banking because of public banking advertising. Mostly pregnant women receive information from their obstetricians, which means the information on umbilical cord banking given by obstetricians will play a very critical role in their lives. Only one third of our population's women have been involved in umbilical cord banking, if they seek correct advice (Deeksha Pandey, 2016). Doctors only give information to those parents who are interested in knowing about, and affording, umbilical cord banking. Parental education and age play an important role in the selection of umbilical cord banking services. Middle age peoples are much worried about the health condition then they are more positive reaction to stem cell banking. (Chetan V Dubey, 2016)

Table 1 **Review of previous existing research**

S. N O.	Author Name	Objective of the research	Result
1.	(Savita, 2015)	To understand the Knowledge of antenatal mothers regarding cord blood banking	The result conclude that majority of antenatal mothers had average knowledge of cord blood banking and

			needs to be improved through pamphlets.
2.	(Chetan V Dubey, 2016)	To study the awareness about Cord Blood Banking in Vidarbha Region	The result show less awareness and the factors affecting consumer perception are communication gap, quality of employment, socioeconomic status.
3.	(Poomalar G. K., 2016)	To evaluate the awareness of cord blood banking among pregnant women in semi urban area public.	The results show the lack of knowledge and higher funding by government and private organizations will be needed to improve the service.
4	(Deeksha Pandey, 2016)	To study determine the level of awareness about banking UCB among pregnant women in India	The study suggested that women were more aware of private banking than they were of public banking due to advertisement..
5.	(Sultan, 2017)	To assess the knowledge and attitude about stem cells of expectant mothers in Srinagar city.	The gap was found in parental education as there was no knowledge that stem cell treatment was beneficial for pregnant women.
6.	(N.Tiwari, 2016)	To determine the level of awareness about Umbilical cord blood banking among individuals in India.	Obstetrics can also play a more active part in advising patients of the advantages and disadvantages of UCB banking.

7.	(Nisha Philip, 2017)	To assess the effectiveness of information booklet on the knowledge and attitude of antenatal mothers regarding umbilical cord stem cell banking	The information booklet had a positive effect and Healthcare professionals should be aware of current information, guidance and informed consent guidelines.
8.	(Rachna Gill, 2017)	To study assess the knowledge and attitude of health care professionals regarding cord blood banking.	The result revealed that medical professionals had insufficient knowledge and had a positive attitude.
9.	(Abha Ashish Wankhede, 2015)	To explores the pregnant women's awareness and acceptance of cord blood stem cells in Mumbai region.	The result concludes that stem cell banking awareness expecting mother's profile like, Education and occupation.
10.	(Moni Tuteja, 2015)	To assess the knowledge of the general population and the medical specialists.	The result concludes that cord-blood is used as a biological insurance should be encouraged. .

Pregnant women had a good outlook towards stem-cell management, but opposed being more expensive and less secure by private cord blood-banking, saying that if they could afford this service they would use it. (H. Dinc, 2009) Positive attitudes among parents towards stem cell management, with the option considered an ethical and altruistic choice for the parents. Participants who preferred to store their infant's cord blood in private banking because they saw this as an opportunity for potential use, insurance or security (Lisa Peberdy, 2018) The relatively high level of knowledge about the stem cells management may explain the high degree of positive attitude. (Hanan M. M. Tork, 2018) The ABC model of attitude is also referred to as a tripartite model. Affect refers to feelings or impulses like anger, joy, grief, and sensorial experiences (Dr. Halimahtun M. Khalid, 2012). The behavior is the action component which consists of the predisposition to behave in a specific way towards the consumer attitude. Cognition is a mental part of belief and interpretation. (Mzomwe Yahya Mazana, 2019). Most participants had insufficient knowledge of stem cells and their banking, and they chose to receive training. Most pregnant women wanted to protect their stem cells, and favored attitude towards public cord blood banking. (D Vignesh, 2017). Henceforth, gradually

pregnant women are considering stem cell management as critical bio insurance for their babies across world.

3. Research objective

1. To understand the role of stem cell management in becoming critical bio insurance for the baby in India.
2. To explore the attitude of pregnant women through ABC model of attitude.
3. To suggest corrective measures for adopting stem cell management among pregnant women.

4. Research Methodology

This study has been conducted in a descriptive way, where 130 pregnant women from different hospitals and gynecologists' clinics in the Delhi NCR area have been included in the primary survey. The information was collected through a questionnaire to determine pregnant women's attitude towards stem cell management in India. Of the 130 questionnaires 20 were rejected because of the lack of value. Therefore the final sample comprised of only 110 respondents accounting a response rate of 84%. For the purpose of data analysis various statistical techniques such as factor analysis, correlation test and one sample t-test was implemented by means of SPSS 21 software.

5. Data Analysis

The subsequent section outline the demographic analysis of participants followed by analysis of the research question aimed at attaining the objective of the study.

5.1 Demographic Analysis

Four demographic variables, age, education status, occupational status and monthly family income were measured in this survey.

The majority of respondents between 31- 35 years of age are 48.7% of respondents, while between 26 -30 years of age are 34.2% and over 35 years are 11.8% of respondents. More than 60 % are post graduated, 30% graduated and others belong to higher education. Full-time employees are 42% of those interviewed, homemaker are 38.2% and self-employed 17 %. About 47 percent of those surveyed recorded a monthly income of over Rs 90,000 family members and 37% reported a monthly income of less than Rs90, 000 family members but over Rs60, 000. Only 14.5% of the income is between 30,000 and 60,000 and the remaining 2.6% is below 30,000.

According to the data collected for paper, 97% of pregnant women's are aware about stem cell management. The preferred sources of stem cell are umbilical cord, bone marrow, dental pulp etc., mainly 86% of pregnant women's are well known about them. Mostly 72% of women know about the cost of stem cell management that means only 72% women are more interested towards stem cell management. The primary source for women to get the information about stem cell management are doctors 25%, then 21% are getting information through internet. Internet is the second major source for getting the information about stem cell management in India and remaining get information

through advertisement, family and company counselor present in hospitals/clinics are 15%, 17% and 18%. 72% pregnant women's are expecting their first child. Only 7% women's preserved their first baby umbilical cord.

5.2 Reliability test

A reliability test performs to check the internal consistency among the items in the variables. Cronbach's alpha, which is a common measure of internal consistency, was applied in this research. The cronbach's alpha $\alpha \geq 0.70$ is considered as acceptable (Whiston, 2009). In this study the value of cronbach's alpha for each variable is for affective is .883, for behavior is .794 and cognition is .770. The items used in each variable to determine the scale of attitude; Affective have 5 items scale, behavior and cognitive have 4 items scale.

5.3 Factor analysis

The 13 items from the questionnaire were identified in three different factors with Eigen values greater than 1.0 and thus of interest to this analysis. The factors explained 68.45% of the total variance, which is above the accepted variance explained of approximate 60 %. (Naresh Malhotra, 2007)

The KMO (Kaiser-Meyer-Olkin) value for this study was found to be 0.850 while the Bartlett's Test of Sphericity (Bartlett, 1954) also reached statistical significance (sig. 0.000). Thus the scale was found suitable for exploratory factor analysis.

To investigate underlined meaning of items the factor analysis technique is performed. The factor analysis transforms list of items into new variable that are not correlated and emphasize the same meaning. The number of new variables is reduced as much as possible. Generated components are then rotated by Varimax rotation. As showed in the rotated components matrix three factors, were revealed by factor analysis. Factor loadings of these three factors are mentioned in the below table no. 2, which is greater than .5 means accepted (Joseph F. Hair, 2010).

Table 2 Factor Analysis

	Component		
Variables	1	2	3
I believe in numerous benefits of stem cell for the future treatment as informed by my gynecologist.	.802		
It is better to use baby stem cell instead of using stem cells of any other human being.	.800		
I feel that stem cell management is synonym of Bio-insurance for child.	.759		
I want to protect my baby from future illness by storing stem cells.	.734		
I shall /will recommend about the stem cell management to my friends and family.	.688		
I carefully read all the terms and condition for stem cell management.		.848	

I consciously enrolled for stem cell management.	.780	
I become more confident, once I see the positive response of healthcare provider for stem cell management.	.700	
I opted for stem cell preservation as other family members have already done.	.585	
I believe that extraction of stem cell does do not causes any trouble for me and my baby.		.838
I know about the average life of storage of stem cells.		.618
I am aware that sibling stem cell can be preserved for treating my second child.		.563
I know that organizations promoting stem cell management share complete information.		.509

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

5.3.1 Empathy on Bio-Insurance (Factor 1) –This factor reveals 26.2% of total variance. This factor comprises of the statements they were of future usage of stem cells (.802) +procuring of baby stem cell (.800) + stem cell is a bio-insurance (.759) +prevention of baby from future illness (.734) + recommending stem cell to family and friends (.688).The statement contained in factor are shown that stem cell management is the form of bio insurance and pregnant women feel it is essential for prevention of baby from major diseases. According to (Daniela Grieco, 2018) pregnant women have a strong emotional connection with stem cell management. Study has shown the ability to repair the heart damage and neurologically deficient children through gene therapy (Harris, 2008).

5.3.2 Faith in stem cell management (Factor 2) - This factor reveals 26.1% of total variance. This factor comprises of the statements dealing with stem cell treatment such as the terms and conditions (.848) + enrolled for stem cell management (.780) + positive response by health care professional (.700) +opted for stem cell preservation (.585). These statements show that an attitude of pregnant woman is crucial in taking decision regarding stem cell management. Pregnant women seem to be encouraged about stem cell management while health professionals respond positively; similar study on pregnant women in Egypt has shown that counseling for pregnant women has showed significant positive attitude on the stem cell management (Hanan El-Sayed Mohamed El-Sayed, 2018). Confident respondents take their own stem cell management decision.(Lisa Peberdy, 2018)

5.3.3 Concern for baby well-being (Factor 3) - This factor shows 16.1% of total variance. This factor comprises of the statements dealing with future safety of baby,

such as harmless for baby and mother (.838) +average life span of stem cell (.618) + useful for sibling (.563) and trust for the organization of stem cell management (.509). These statements show that pregnant woman's are very much concern for their baby's future well-being. According to the study by (Anupam Sachdeva, 2018) shown that Private banking is highly recommended for existing family members with a condition that can be treated with a stem cell transplant (e.g. leukemia, hemoglobinopathy, failure of the bone marrow, etc.). Patients with cancer and their families have a strong belief in stem cells and their treatment abilities (E Frick, 2007).

Thus, Factor 1 is the strongest factor validating the Affective component, Factor 2 validating the behavioral and Factor 3 validating the Cognitive component of ABC model of attitude.

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6. T test

On the basis of the literature review it stated that there has been both positive and negative attitude of pregnant women's thus we assume that pregnant women tend to have neither the positive nor the negative attitude towards stem cell management in India. Therefore one sample t test were undertaken with the test value/mean value = 3 as the attitude of pregnant women was measured on a five likert scale with 1= strongly agree 5= strongly disagree. The hypothesis as shown below:

H0: Pregnant women neither have a positive attitude nor a negative attitude towards stem cell management in India.

Ha: Pregnant women either a positive attitude towards stem cell management in India.

Table 3

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Attitude	110	1.9445	.57805	.06631

Table 4

	Test Value = 0				
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference

					Lower	Upper
Attitude	29.326	110	.000	1.94452	1.8124	2.0766

From the above table 3 and 4, it can stated that pregnant women do have a positive or negative attitude towards stem cell management in India with t (29.326) =1.944, p=0.00 which is less than p<0.05.Therefore, alternative hypothesis had been accepted. Similarly, the 2017 study found that most expectant mothers are positive attitudes and some are encouraging in favor of stem cell management.(Nisha Philip, 2017)

7. Correlation

Further, in order to test the relationship among the variable based on ABC model of attitude, the Pearson correlation method is performed as it helps in identifying the relationship among the three variables (affective, cognition and behavior). This analysis is mainly used to summarize the correlation between the existing variables. In the table number 5, there is shown the correlation between the Attitude and three variables.

Table 5 Correlation

Correlations		Attitude	Affective	Behavior	Cognition
Attitude	Pearson Correlation	1	.889	.807	.839
	Sig. (2-tailed)		.000	.000	.000
Affective	Pearson Correlation	.889	1	.633	.609
	Sig. (2-tailed)	.000		.000	.000

Behavior	Pearson Correlation	.807	.633	1	.476
	Sig. (2-tailed)	.000	.000		.000
Cognition	Pearson Correlation	.839	.609	.476	1
	Sig. (2-tailed)	.000	.000	.000	

From the table, it can be clearly stated that all the three components of attitude, affective, behavior and cognitive have a strong and positive correlation with attitude as the value of p was found to be p= 0.00 for all three components which is less than p<0.05.The strength of relationship can be measured by means of correlation coefficient. From table the correlation coefficient for all the three components of attitude; affective, behavior and cognitive with that of attitude was found to be r= .889, r=.807and r=.839. Therefore, among the three components affective components (followed by cognitive component and behavior).have a strong impact on attitude of pregnant women's towards stem cell management in India. According to the Pune survey, the attitude of pregnant women towards stem cell management also revealed their behavior to acceptance on stem cell management (Abha Ashish Wankhede, 2015).

8. Discussion

This study examined the concept of ABC model of attitude for assessing the attitude of pregnant women's towards stem cell management in India in response to the suggestions of Eagly& Chaiken 1998, with respect to applying the concepts of ABC model to check the attitude (Van den Berg et al. 2006). Results of the study have important implications for stem cell management and added to existing knowledge pool by identifying that ABC component of attitude for pregnant women's towards stem cell management. Specifically, the study examined that pregnant women attitude about stem cell management have significant effects on affective, behavior and cognitive aspect of attitude (ABC Model). Further, factor analysis gave satisfactory statistical results to identify the relationship between affective, behavior and cognitive aspect of attitude among pregnant women for stem cell management. Then, correlation analysis had shown that affective component has strongest impact on attitude of pregnant women's then behavioral and cognitive as affective component reveals the emotional connection of pregnant women with their stem cell that indicates secure future well-being of their child. Given good knowledge and understanding of stem cell management, very few pregnant women choose to take part in the process, as government policies are lacking and the participation of health professionals is limited. Finally, this study reveals that pregnant women tend to have appositive attitude towards stem cell management in India

as justified by the t test. Therefore, if the healthcare professionals and the government take the right approach to stem cell management, the scope will be larger.

9. Conclusion

This study examines the attitude of pregnant women towards stem cells management from existing reviews, it is clear that pregnant women have slightly positive attitude towards stem cell management in India after gaining the information from doctors.

Moreover, this study had resulted into strong relations between affective, cognitive and behavioral aspect of attitude among pregnant women. Affective component is most critical as it highlights the future benefits of child through stem cell management (bio insurance). Most participants had lack of knowledge of stem cells and also want the stem cells of their babies stored and preferred through public cord blood banking. The consortium of medical professionals and paramedics will exploit their knowledge more. While pregnant women prefer this information from their gynecologist, companies still need to provide more information to pregnant women by different medium like advertisement, executives etc. Henceforth, stem cell management companies need to satisfy parents as well as provide accurate scientific advice at a time of counseling. Nevertheless, our study has some limitations including that it had consisted of a small, select sample of women in two antenatal outpatient clinics in Delhi-NCR hospitals, so the results cannot be generalized to all of society. However, the results are valuable because this study was the first time ever conducted in Delhi-NCR on the subject of stem cell management, which is still developing in Delhi.

Conflict of interest statement

We declare that we have no conflict of interest.

Authors' contributions

S.C. conceptualized the work. Both S.C. and S.A drafted the manuscript, revised and approved the final version of the manuscript.

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