

Factors Shaping Infertility Patients' Attitudes Towards Embryo Disposal: A Consecutive Cohort Study

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Abstract: *This study aims to investigate the elements that impact the decision-making process related to the disposition of cryopreserved embryos among individuals undergoing assisted reproductive technologies. This study investigates the elements influencing the decision-making process regarding the disposition of cryopreserved embryos among individuals undergoing assisted reproductive technologies in Gujarat, India. Utilizing a consecutive cohort survey, the study gathered data from 123 respondents 40 response rate across various stages of the IVF journey. Analysis using SPSS software revealed that donation to research was significantly more common than other options, with no significant demographic factors influencing disposition choices. The findings highlight the need for comprehensive support and effective counseling to assist patients in making informed decisions regarding embryo disposal. Participants encompassed various stages of the IVF journey, and data collection involved a questionnaire covering demographic information and decision-making processes. Patient consent was obtained, and data were analyzed using SPSS software, employing statistical tests to examine associations between variables. This comprehensive method allowed for a thorough exploration of attitudes towards embryo disposal among infertility patients. The findings comprised 123 respondents, representing 40 of the couples contacted. A diverse demographic profile was observed, with 78% being female and 95% married. No significant associations were found between demographic factors and disposition choices. Donation to research was significantly more common than donation to another couple or disposal ($\chi^2 = 21.73, P < 0.0001$). No difference was noted in disposition choices between couples using donor gametes versus their own. Embryo disposition choices were varied, with donation to research being the most common (42%). Couples reported difficulty in decision-making (45%), which correlated with a longer decision-making duration ($t = -1.98, P = 0.05$) and a lower inclination to donate embryos ($\chi^2 = 6.21, P = 0.01$). Most couples expressed willingness to donate embryos for stem cell research (69%), with motivations primarily focused on scientific progress ($\chi^2 = 16.54, P < 0.0001$). In conclusion, this research underscores the need for comprehensive support in embryo disposition decisions, revealing a preference for options beyond disposal. Effective counseling was crucial to meet patients' diverse needs.*

Keywords: Cryopreserved embryos, Decision-making, Embryo disposal, Embryo donation, Infertility patient

1. Introduction

The expansion of assisted reproductive technologies has broadened the choices available to individuals facing infertility challenges. Advancements in in vitro fertilization (IVF) have led to a higher yield of embryos per ovarian stimulation cycle, offering potential solutions for conception. However, to mitigate risks associated with multiple pregnancies, embryo cryopreservation has become standard practice in IVF clinics [1]. Despite this, a significant number of cryopreserved embryos remain in storage without definite plans for utilization, as evidenced by recent reports estimating approximately 400,000 such embryos stored in the United States [2-6].

In vitro fertilization (IVF) is one of the infertility treatments that have changed reproductive medicine and given hope to infertile couples. One of the critical decisions faced by couples undergoing IVF is the fate of their surplus embryos. This decision involves complex ethical, emotional, and practical considerations, and understanding patients' preferences and the factors influencing their decisions is essential for providing appropriate support and guidance.

As scientific advancements and clinical services progress, profound moral dilemmas emerge concerning the ethical responsibilities towards human embryos [7-10]. Particularly contentious is the issue of human embryonic stem cell research, which has sparked significant division [11-14]. Despite these debates, scant data are available regarding the perspectives of individuals who are tasked with deciding the fate of frozen embryos, namely, those who have undergone IVF or utilized assisted reproductive technologies [15-18].

Multiple investigations indicate that a considerable portion of patients perceive the embryo disposition decision (EDD) as challenging, as demonstrated by studies such as McMahan et al. (2000), Klock et al. (2001), and numerous others [19-21]. Limited qualitative research has explored the intricate nature of infertility patients' conceptualization of their embryos. These studies indicate that patients hold diverse perspectives, and their understanding of embryos significantly influences their views on disposition options, as evidenced by works such as de Lacey (2005) and Fuscaldo et al. (2007) [22,23].

However, certain studies have concentrated solely on one or two disposition options, as noted in works by Parry (2006) and de Lacey (2007) [24]. Conversely, other studies have

centered on patient demographics, such as those utilizing donor material.

In addition, Nachtigall et al. (2005) explained the psychological response of patients during the decision-making process. This leads to a dynamic process where patients initially feel reassured by having extra embryos but then avoid deciding about their disposition. Eventually, they are confronted with the decision and have to face it. However, besides the psychological process that patients experience, it is still largely uncertain how patients cope with the decision itself [25].

This study aims to elucidate the determinants influencing the decision-making process among individuals contemplating the disposition of their cryopreserved embryos. The insights gained will be instrumental in enhancing the quality of care provided to infertility patients by clinicians, facilitating decision-making processes for individuals with long-frozen embryos. Additionally, these findings will offer valuable guidance to policymakers in formulating counselling protocols, ensuring informed consent, and upholding ethical standards in stem cell research endeavors.

2. Material and Methods

2.1. Study Design

The study adopts a Consecutive Cohort Survey-based study to comprehensively explore infertility patients' attitudes towards embryo disposal. This method involves systematically surveying consecutive cohorts of infertility patients to gather comprehensive data on their perspectives regarding the disposal of embryos. By employing this approach, the study aims to capture a representative sample of patients over a defined period, allowing for a comprehensive exploration of attitudes and experiences related to embryo disposal within the infertility patient population.

2.2. Participants

The research encompassed infertility patients and their partners undergoing IVF/ICSI treatment across Gujarat, India. The study included participants at various stages of the IVF journey: those yet to undergo IVF, individuals in the early stages, those who had achieved pregnancy using fresh or frozen embryos, those who had undergone IVF without achieving pregnancy, and individuals with embryos stored for over five years. Sampling concluded upon reaching saturation, denoting the point where no new or pertinent data emerged concerning a theoretical category. This saturation indicated a thorough development of the category's properties or dimensions, along with well-established relationships among theoretical categories. The quantitative data collection aimed to encompass all couples seeking infertility treatment at the clinic over one year, with an estimated total of approximately 311 couples. This approach allowed for a thorough examination of quantitative aspects of infertility treatment, ensuring a comprehensive understanding of the subject matter. Additionally, individuals voluntarily reached out to us, expressing interest in participating in the questionnaire after we engaged with clinics in Gujarat. All

participating couples received a single mailing containing an explanatory statement written in clear language about the research, along with the questionnaire. Participants were instructed to complete the questionnaire and return it via mail using the provided Mail.Id.

2.3. Data Collection

2.3.1 Questionnaire

The questionnaire covered demographic information without identifying details, inquiries about the decisions made by couples regarding their embryos, and the primary reasons behind their choices. Couples were presented with various options concerning their frozen embryos and asked to indicate their chosen option. Each option was accompanied by a list of common reasons for choosing it, which respondents could underline if they endorsed them. These reasons encompassed a range of considerations commonly addressed during counselling sessions regarding surplus embryos.

For instance, reasons for discarding embryos included concerns about potential future relationships with resulting children, moral or religious beliefs about embryo status, and preferences regarding embryo research. Conversely, reasons for donating embryos to another couple included altruistic motivations to help infertile couples or give embryos a chance at life. Similarly, space was provided for respondents to articulate any additional reasons for their decision.

Respondents were also asked to indicate the level of agreement between partners regarding the decision, ranging from complete agreement to disagreement after discussion. The difficulty of the decision-making process was rated on a four-point scale, ranging from easy to very distressing. Additionally, respondents were presented with a hypothetical scenario about donating embryos for stem cell research and asked whether they would have considered this option. Finally, respondents were asked to specify whether the questionnaire was completed by the female partner, the male partner, or jointly by both partners.

2.4. Ethical Consent

Informed consent was obtained from all participants, ensuring voluntary participation, confidentiality, and data protection.

2.5. Data Analysis

Left Margin 17.8 mm (0.67") The SPSS (Version 26) software was used to perform the statistical tests. For the quantitative data analysis, proportions were calculated for qualitative variables, and their association with the disposal of embryos was examined using the chi-square test. Appropriate tests of significance were employed based on the normality of the data, with a significance level set at $p < 0.05$.

3. Results

3.1 Demographic Characteristics of Participants

Questionnaires were sent by mail to a total of 311 couples who requested assistance on what to do with their frozen embryos within a specific period. Remarkably, 123 couples, constituting 40% of the total sample, responded to the questionnaire via mail. Since the questionnaire was designed to be anonymous, it precluded the identification of respondents, thus limiting the ability to draw comparisons between those who responded and those who did not.

The demographic and fertility features of the 123 survey respondents who currently have embryos preserved exhibit a diverse population. Most respondents were female (78%) and married (95%). Regarding age distribution, a significant proportion were between 31 to 40 years old (30%–34%), with fewer respondents aged 30 or below (9%) or over 40 (27%). Education levels varied, with a notable percentage holding graduate degrees (43%). Religiously, respondents were diverse, with Jainism (24%) and Hindu (29%) being the most represented. In terms of fertility characteristics, the number of embryos stored ranged from 1 to over 11, with a considerable percentage having 3 to 5 embryos (37%). The longest time embryos were stored predominantly fell within the 1 to 3-year range (55%). Additionally, most respondents reported having one child (36%) and one IVF pregnancy (67%).

Table 1: Profile of Participants: Demographic and Fertility Attributes

Demographic characteristic	Number (%)
Female sex	96 (78)
Age (years)	
≤30	9 (9)
31–35	30 (30)
36–40	34 (34)
>40	27 (27)
Married	117 (95)
Partner’s Age (years)	
≤30	8 (6)
31–35	35 (28)
36–40	40 (32)
>40	40 (33)
Level of Education	
Less than High School	1 (<1)
High School Diploma	15 (12)
Associate degree	11 (9)
Bachelor’s Degree	44 (36)
Graduate Degree	52 (43)
Religion	
Jainism	30 (24)
Hindu	36 (29)
Christian	23 (18)
Muslim	1 (1)
None	20 (17)
Other	7 (5)
Fertility Characteristic	
Number of Embryos	
1–2	34 (27)
3–5	45 (37)
6–10	28 (22)
>11	13 (10)
Unsure	3 (4)
Longest Time Stored (Years)	
<1	32 (26)
1–3	68 (55)

4–5	12 (10)
>5	11 (9)
IVF Pregnancies	
0	15 (12)
1	84 (67)
2	20 (16)
>3	4 (6)
Number of Children	
0	24 (19)
1	45 (36)
2	40 (32)
>3	14 (12)
Children from IVF	
0	31 (25)
1	52 (41)
2	36 (29)
>3	4 (4)

3.2 Disposition Choices for Frozen Embryos

The choice to contribute embryos for research purposes was considerably more prevalent compared to the choice to donate them to another couple or to discard them ($\chi^2 = 21.73, P < .0001$ and $\chi^2 = 4.52, P < .03$, respectively). The choice selected by the couple was not influenced by factors such as maternal and paternal ages, level of education, number of embryos frozen, duration of storage time, and whether they already had children.

There was no significant difference in the likelihood of couples who used donor gametes to develop their embryos and couples who used their gametes to opt to transfer surplus embryos to another couple (2 out of 8 vs. 18 out of 115, respectively).

The alternatives chosen for the frozen embryos were shown in Table 2, respectively. Among the options, donating embryos to research emerged as the most common choice, selected by 42% of respondents, followed by disposal (30%), donation to another couple (16%), and seeking an extension of storage time (3%). A small proportion intended to use the embryos soon (2%), while 7% were unable to reach a decision. This distribution underscores the complexity and variability of decision-making in this context, reflecting the multifaceted ethical, emotional, and practical considerations involved. The prominence of donating embryos to research suggests a willingness among participants to contribute to scientific advancement, potentially indicating a nuanced understanding of the potential benefits of stem cell research. Conversely, the significant percentage opting for disposal highlights the challenges and uncertainties individuals face when confronting the fate of their embryos, underscoring the need for comprehensive support and guidance throughout the decision-making process.

Table 2: Options chosen for frozen embryos (N = 123).

Option chosen	n	%
Intended to use embryos soon	2	2
Applied for an extension of storage time	4	3
Disposed	37	30
Donated to research	52	42
Donated to another couple	20	16
Were unable to decide	8	7

Table 3 outlines the primary reasons cited by couples who did not intend to use their embryos, categorized by the chosen disposition option. Among those opting for disposal, the most prevalent reason (51%) was the reluctance to donate embryos due to concerns about resulting children being full siblings to their own. Conversely, for those choosing to donate to research, the overwhelming motivation (92%) was to contribute to scientific progress, emphasizing a desire to help advance science. Additionally, a significant proportion (65%) expressed a reluctance to waste embryos as a reason for selecting this option. For couples opting to donate embryos to another couple, the predominant motivations were altruistic, with all participants citing a desire to help another infertile couple, while 70% expressed the intention to give the embryos a chance at life. These findings underscore the complex interplay of ethical, emotional, and practical considerations influencing decision-making regarding embryo disposition, highlighting the importance of tailored support and guidance to navigate this intricate process.

Table 3: Primary Reasons for Embryo Disposition Chosen by Couples Not Intending to Use Embryos (N = 109).

Main reason	n	%
<i>Disposal (n = 37)</i>		
Not wanting to donate as a resulting child would be full sibling to own child	19	51
Not wanting research performed on embryos	16	16
<i>Donation to research (n = 52)</i>		
Want to help advance science	48	92
Not wanting to waste the embryos	34	65
<i>Donation to another couple (n = 20)</i>		
To help another infertile couple	20	100
To give the embryos a chance at life	14	70

3.3 Agreement and Difficulty in Decision-Making

A notable proportion of participants (45%, n = 56) faced significant challenges or distress when deciding about the fate of their embryos. Interestingly, this difficulty was consistent regardless of whether couples had children or not. Couples experiencing decision-making struggles were notably less likely to reach a unanimous consensus compared to those who found the decision easier (26% vs. 64%, $\chi^2 = 16.54$, $P < .0001$), and they took longer to reach a decision (2.7 years vs. 2.1 years, $t = -1.98$, $P = .05$). Moreover, individuals who found the decision challenging were significantly less inclined to donate embryos for research or to another couple compared to those who did not face such difficulty (46% vs. 69%, $\chi^2 = 6.21$, $P = .01$).

A considerable majority of couples (69%) expressed their willingness to donate their cryopreserved embryos to stem-cell research, indicating a strong inclination towards contributing to scientific advancement. Among the 123 couples surveyed, 85 were open to this option, highlighting a significant subset of the population eager to support research endeavors. The primary drivers behind this willingness were twofold: a desire to facilitate scientific progress and promote the well-being of others, cited by 89% of those open to donation, and a motivation to prevent the wastage of embryos, endorsed by nearly half (49%) of the willing participants. Conversely, 31% of respondents (n = 38) opted against donating embryos for stem-cell research. Among them, over half (53%) held the belief that embryos represent the early

stages of life and should not be subjected to research purposes. Instead, a notable proportion (26%) favored the transfer of embryos to another couple, providing them with a chance for life. Notably, the decision to donate embryos for stem-cell research remained unaffected by factors such as the presence of children or the level of education, suggesting that these considerations did not significantly sway attitudes towards research donation.

Table 4: Navigating Decisions Regarding Frozen Embryos (N = 123).

Perception	n	%
Easy, already knew what to do	29	24
Rather easy after some discussion	38	31
Uncertain and found it quite difficult	31	25
Were very distressed	20	25

4. Discussion

Cryopreservation of surplus embryos is a standard practice in IVF treatments to optimize the likelihood of a successful and secure pregnancy. However, embryos have amassed globally and currently around to hundreds of thousands [26,27]. This study employed quantitative methodologies to assess the intentions and views of a geographically varied cohort of fertility patients about disposing of cryopreserved embryos. This research used quantitative methods to measure the intents and attitudes of a geographically diverse group of fertility patients on the disposal of cryopreserved embryos. It has been discovered that individuals undergoing fertility treatment often encounter an unexpected dilemma upon completing the treatment: they must choose from a range of unsatisfactory options for what to do with any remaining embryos [28,29]. Approximately 50% of the embryos currently stored are not intended for reproduction. However, there is a lack of suitable alternatives for deciding what to do with these embryos. Patients either prefer options that are not commonly available to them, such as donating the embryos for research, or they reject the available options, which include donating the embryos for reproduction or simply discarding them by thawing. The determinants of these preferences were discovered, including a unique understanding of responsibility that was associated with choices that led to the destruction of embryos [30,31].

The research findings provide insight into the challenges faced by couples who must make decisions regarding preserved embryos, as well as the factors that influence their judgments on the future of these embryos. However, as the study group primarily comprised individuals who contacted the medical facility to determine the fate of their surplus embryos, the reasons for choosing not to divulge their decision were examined.

The response rates for anonymous surveys that do not offer the chance to follow up with non-respondents are often low [32]. Recent research has found that anonymous surveys about donor gametes and surplus embryos have resulted in response rates ranging from 29% to 45%. The survey's response rate of 40% is deemed satisfactory. However, it is plausible that the non-responding couples may differ in terms of the subjects being investigated compared to those who did respond. An omission of the study is the absence of data

regarding the religious affiliation of the participants in the survey. Therefore, it was not possible to examine the potential impact of faith on the decisions taken by couples concerning their embryos [33-36].

Like earlier studies such as Bangs et al. (2004), Newton et al. (2003), and Skoog-Svanberg et al. (2001), the primary reason cited for not utilizing embryos in therapy was the achievement of the desired family size. Nevertheless, there were variations among couples in this and other research about the choices they made regarding the destiny of these embryos [37-39]. These variances suggest a preference for options that involved utilizing the embryos rather than discarding them. In contrast to previous studies such as Kovacs et al. (2003), Darlington et al. (1999), and Loranger et al. (1996), which consistently found that disposal is the most common choice for couples dealing with excess frozen embryos, The participants in this study shown a greater propensity to contribute their embryos for research purposes rather than disposing of them [40-42].

Unlike the findings of a previous nationwide survey, which reported that 87% of embryos are being stored for patient treatment, our research revealed that just 67% of patients were inclined (with 54% being highly inclined) to utilize embryos for reproductive purposes [43-45]. Consistent with prior estimates, 86% of the subset of respondents who desired a baby expressed a high likelihood of using embryos for reproduction. This discrepancy arises from the fact that the process of making reproductive decisions is constantly changing. Many patients who initially freeze embryos for reproductive purposes discover that they no longer require them after achieving pregnancy through IVF with fresh embryos or conceiving naturally (at an estimated rate of 12.5% over 36 months). Alternatively, they may no longer desire the frozen embryos due to changes in their reproductive goals and life circumstances. Out of the almost 500 participants who do not want to have children in the future, 40% have not yet chosen a preferred option for what to do with their reproductive cells, and almost 20% say they are likely to preserve their embryos permanently [46].

In Victoria, there has been a lively public debate on the ethical implications of researching human embryos, as well as the rights of couples with frozen embryos to make decisions about the fate of their embryos. This may have increased awareness of the potential benefits of this research for other couples with infertility and may have encouraged certain participants to donate their embryos for research to improve results in the field of assisted reproductive technology (ART). Similarly, the continuous and vigorous debate about the potential benefits of embryonic stem cells for regenerative medicine would have impacted the significant number of individuals who declared their readiness to contribute their embryos for stem-cell research if it had been possible [47-49]. Although donating embryos to another couple was not the most chosen option, a greater proportion of couples (16%) chose to give their fertilized eggs to another spouse compared to what has been typically reported in previous studies [50]. Under the law in Victoria, couples who opt to donate their embryos to another couple are required by legal obligation to provide detailed personal information. Moreover, the donor's identity may be revealed in the event of a child being

conceived because of the gift. Unlike the findings of Newton et al. [38], the participants in this study did not feel discouraged from donating their embryos to another couple, even though they had to reveal personal information and there was a possibility of being identified as biological parents in the future.

The willingness of a significant proportion of respondents to consider donating embryos to stem cell research indicates a nuanced perspective on the ethical considerations surrounding embryo use in research [51]. While some couples expressed concerns about the sanctity of early life and preferred to donate embryos to other couples, others viewed research donation as contributing to scientific progress and potentially improve the quality of life for others. These differing viewpoints underscore the need for comprehensive counselling and informed consent processes to ensure that patients are fully aware of the implications of their decisions [52].

Overall, this research contributes valuable insights into the factors shaping infertility patients' attitudes towards embryo disposal, highlighting the importance of considering diverse perspectives and providing tailored support to couples throughout the decision-making process. By understanding the underlying determinants influencing embryo disposition decisions, clinicians and policymakers can develop more effective strategies for supporting patients and upholding ethical standards in assisted reproductive technologies.

5. Conclusion

This research provides valuable insights into the decision-making process surrounding the disposition of cryopreserved embryos among infertility patients. The findings reveal a preference for donating embryos to research rather than disposal, underscoring the need for comprehensive counseling and support to address patients diverse needs. By understanding the factors influencing these decisions, clinicians and policymakers can enhance the quality of care and uphold ethical standards in assisted reproductive technologies.

References

- [1] Cedars MI. Embryo cryopreservation. In *Seminars in reproductive endocrinology* 1998 Sep (Vol. 16, No. 03, pp. 183-195). Copyright© 1998 by Thieme Medical Publishers, Inc..
- [2] Stolberg SG. Clinics full of frozen embryos offer a new route to adoption. *The New York Times on the Web*. 2001 Feb 1:NE1-7.
- [3] Van Voorhis BJ, Grinstead DM, Sparks AE, Gerard JL, Weir RF. Establishment of a successful donor embryo program: medical, ethical, and policy issues. *Fertility and Sterility*. 1999 Apr 1;71(4):604-8.
- [4] Gayá-González L. Reflexiones bioéticas sobre la clonación de seres humanos. *Puerto Rico Health Sciences Journal*. 2002;21(4).
- [5] Krasner J. Technology, legal gaps leave embryos in limbo. *Boston Globe*, May. 2005;18.

- [6] Hoffman DI, Zellman GL, Fair CC, Mayer JF, Zeitz JG, Gibbons WE, Turner Jr TG. Cryopreserved embryos in the United States and their availability for research. *Fertility and sterility*. 2003 May 1;79(5):1063-9.
- [7] Annas GJ. Ulysses and the fate of frozen embryos—Reproduction, research, or destruction?. *New England Journal of Medicine*. 2000;343:373.
- [8] Parens E. What research? Which embryos?. *The Hastings Center Report*. 1995 Jan 1;25(1):36-7.
- [9] Parens E, Knowles LP. Reprogenetics and public policy: reflections and recommendations. *The Hastings Center Report*. 2003 Jul 1;33(4):S1-.
- [10] Saunders DM, Bowman MC, Grierson A, Garner F. Frozen embryos: too cold touch?: The dilemma ten years on. *Human Reproduction*. 1995 Dec 1;10(12):3081-2.
- [11] Holland S, Lebacqz K, Zoloth L. The human embryonic stem cell debate. Cambridge, MA: Massachusetts Institute of Technology. 2001.
- [12] Sandel MJ. Embryo ethics—the moral logic of stem-cell research. *New England Journal of Medicine*. 2004 Jul 15;351(3):207-9.
- [13] Green RM. The human embryo research debates: Bioethics in the vortex of controversy. Oxford University Press; 2001 Jun 28.
- [14] Faden RR, Gearhart JD. Facts on stem cells. *The Washington post*. 2004 Aug 23:A15.
- [15] Lo B, Chou V, Cedars MI, Gates E, Taylor RN, Wagner RM, Wolf L, Yamamoto KR. Consent from donors for embryo and stem cell research. *Science*. 2003 Aug 15;301(5635):921-.
- [16] McMahon CA, Gibson FL, Leslie GI, Saunders DM, Porter KA, Tennant CC. Embryo donation for medical research: attitudes and concerns of potential donors. *Human Reproduction*. 2003 Apr 1;18(4):871-7.
- [17] Svanberg AS, Boivin J, Bergh T. Factors influencing the decision to use or discard cryopreserved embryos. *Acta obstetrica et gynecologica Scandinavica*. 2001 Jan 1;80(9):849-55.
- [18] Choudhary M, Haimes E, Herbert M, Stojkovic M, Murdoch AP. Demographic, medical and treatment characteristics associated with couples' decisions to donate fresh spare embryos for research. *Human Reproduction*. 2004 Sep 1;19(9):2091-6.
- [19] De Lacey S. Decisions for the fate of frozen embryos: fresh insights into patients' thinking and their rationales for donating or discarding embryos. *Human Reproduction*. 2007 Jun 1;22(6):1751-8.
- [20] Klock SC, Sheinin S, Kazer RR. The disposition of unused frozen embryos. *New England Journal of Medicine*. 2001 Jul 5;345(1):69-70.
- [21] Hammarberg K, Tinney L. Deciding the fate of supernumerary frozen embryos: a survey of couples' decisions and the factors influencing their choice. *Fertility and sterility*. 2006 Jul 1;86(1):86-91.
- [22] De Lacey S. Parent identity and 'virtual' children: why patients discard rather than donate unused embryos. *Human Reproduction*. 2005 Jun 1;20(6):1661-9.
- [23] Fuscaldo G, Russell S, Gillam L. How to facilitate decisions about surplus embryos: patients' views. *Human Reproduction*. 2007 Dec 1;22(12):3129-38.
- [24] Parry S. (Re) constructing embryos in stem cell research: exploring the meaning of embryos for people involved in fertility treatments. *Social Science & Medicine*. 2006 May 1;62(10):2349-59.
- [25] Nachtigall RD, Becker G, Friese C, Butler A, MacDougall K. Parents' conceptualization of their frozen embryos complicates the disposition decision. *Fertility and sterility*. 2005 Aug 1;84(2):431-4.
- [26] Hoffman DI, Zellman GL, Fair CC, Mayer JF, Zeitz JG, Gibbons WE, Turner Jr TG. Cryopreserved embryos in the United States and their availability for research. *Fertility and sterility*. 2003 May 1;79(5):1063-9.
- [27] Baylis F, Beagan B, Johnston J, Ram N. Cryopreserved human embryos in Canada and their availability for research. *Journal of Obstetrics and Gynaecology Canada*. 2003 Dec 1;25(12):1026-31.
- [28] Lyster AD, Steinhilber K, Voils C, Namey E, Alexander C, Bankowski B, Cook-Deegan R, Dodson WC, Gates E, Jungheim ES, McGovern PG. Fertility patients' views about frozen embryo disposition: results of a multi-institutional US survey. *Fertility and sterility*. 2010 Jan 15;93(2):499-509.
- [29] Raphael-Leff J. 'A Precipice in Time'—Reproductive Biotechnology: Psychosocial Impact and Unintended Consequences. In *Handbook of Perinatal Clinical Psychology 2020* Mar 26 (pp. 44-60). Routledge.
- [30] Lyster AD, Steinhilber K, Voils C, Namey E, Alexander C, Bankowski B, Cook-Deegan R, Dodson WC, Gates E, Jungheim ES, McGovern PG. Fertility patients' views about frozen embryo disposition: results of a multi-institutional US survey. *Fertility and sterility*. 2010 Jan 15;93(2):499-509.
- [31] Davis DS. Genetic dilemmas: Reproductive technology, parental choices, and children's futures. Oxford University Press; 2010.
- [32] TA H. Factors affecting response rates to mailed questionnaires: a quantitative analysis of the published literature. *Am Sociological Review*. 1978;43:447-62.
- [33] McMahon CA, Gibson FL, Leslie GI, Saunders DM, Porter KA, Tennant CC. Embryo donation for medical research: attitudes and concerns of potential donors. *Human Reproduction*. 2003 Apr 1;18(4):871-7.
- [34] Klock SC, Stout JE, Davidson M. Psychological characteristics and factors related to willingness to donate again among anonymous oocyte donors. *Fertility and Sterility*. 2003 Jun 1;79(6):1312-6.
- [35] Greenfeld DA, Klock SC. Disclosure decisions among known and anonymous oocyte donation recipients. *Fertility and sterility*. 2004 Jun 1;81(6):1565-71.
- [36] Ahuja KK, Mostyn BJ, Simons EG. Egg sharing and egg donation: attitudes of British egg donors and recipients. *Human Reproduction (Oxford, England)*. 1997 Dec 1;12(12):2845-52.
- [37] Bangsbo S, Pinborg A, Yding Andersen C, Nyboe Andersen A. Patients' attitudes towards donation of surplus cryopreserved embryos for treatment or research. *Human Reproduction*. 2004 Oct 1;19(10):2415-9.
- [38] Newton CR, McDermid A, Tekpetey F, Tummou IS. Embryo donation: attitudes toward donation procedures and factors predicting willingness to donate. *Human Reproduction*. 2003 Apr 1;18(4):878-84.
- [39] Svanberg AS, Boivin J, Bergh T. Factors influencing the decision to use or discard cryopreserved embryos. *Acta*

- obstetricia et gynecologica Scandinavica. 2001 Jan 1;80(9):849-55.
- [40] Kovacs GT, Breheny SA, Dear MJ. Embryo donation at an Australian university in-vitro fertilisation clinic: issues and outcomes. *Medical journal of Australia*. 2003 Feb;178(3):127-9.
- [41] Darlington N, Matson P. The fate of cryopreserved human embryos approaching their legal limit of storage within a West Australian in-vitro fertilization clinic. *Human Reproduction*. 1999 Sep 1;14(9):2343-4.
- [42] Lornage J, Chorier H, Bouliou D, Mathieu C, Czyba JC. Six year follow-up of cryopreserved human embryos1. *Human Reproduction*. 1995 Oct 1;10(10):2610-6.
- [43] Hug K. Motivation to donate or not donate surplus embryos for stem-cell research: literature review. *Fertility and sterility*. 2008 Feb 1;89(2):263-77.
- [44] Forman DL. Embryo disposition and divorce: Why clinic consent forms are not the answer. *J. Am. Acad. Matrimonial Law.* 2011;24:57.
- [45] Andreescu M. The impact of the use of immunosuppressive treatment after an embryo transfer in increasing the rate of live birth. *Frontiers in Medicine*. 2023;10.
- [46] Osmanagaoglu K, Collins JA, Kolibianakis E, Tournaye H, Camus M, Van Steirteghem A, Devroey P. Spontaneous pregnancies in couples who discontinued intracytoplasmic sperm injection treatment: a 5-year follow-up study. *Fertility and sterility*. 2002 Sep 1;78(3):550-6.
- [47] Millbank J. Reflecting the 'human nature' of IVF embryos: disappearing women in ethics, law, and fertility practice. *Journal of Law and the Biosciences*. 2017 Apr;4(1):70-93.
- [48] Annas GJ. The ethics of embryo research: not as easy as it sounds. *Law, Medicine and Health Care*. 1986 Sep;14(3-4):138-48.
- [49] Green RM. *The human embryo research debates: Bioethics in the vortex of controversy*. Oxford University Press; 2001 Jun 28.
- [50] Elford K, Lawrence C, Leader A. Research implications of embryo cryopreservation choices made by patients undergoing in vitro fertilization. *Fertility and Sterility*. 2004 Apr 1;81(4):1154-5.
- [51] Haines E, Taylor K. Fresh embryo donation for human embryonic stem cell (hESC) research: the experiences and values of IVF couples asked to be embryo donors. *Human Reproduction*. 2009 Sep 1;24(9):2142-50.
- [52] Bernat JL, Peterson LM. Patient-centered informed consent in surgical practice. *Archives of Surgery*. 2006 Jan 1;141(1):86-92.