

# Attitudes of couples towards the destination of surplus embryos: results among couples with cryopreserved embryos in Switzerland

Meichun Mohler-Kuo<sup>1,4</sup>, Ueli Zellweger<sup>1</sup>, Aysun Duran<sup>2</sup>,  
Michael K. Hohl<sup>2,3</sup>, Felix Gutzwiller<sup>1</sup>, and Margot Mutsch<sup>1</sup>

<sup>1</sup>Institute of Social and Preventive Medicine, University of Zurich, Hirschengraben 84, 8001 Zurich, Switzerland <sup>2</sup>Kantonsspital Baden, Baden, Switzerland <sup>3</sup>University of Basel, Basel, Switzerland

<sup>4</sup>Correspondence address. Tel: +41-44-634-46-37; Fax: +41-44-634-49-86; E-mail: m.mohler@ifspm.uzh.ch

**BACKGROUND:** The purpose of this study was to investigate attitudes towards the donation of surplus embryos among couples with cryopreserved embryos/zygotes, and to identify correlates associated with attitudes toward the destinations of surplus embryos/zygotes.

**METHODS:** Eleven of 19 Swiss *in vitro* fertilization (IVF) centers in existence in 2004 participated in the survey. Questionnaires were sent to 888 eligible couples; 458 men (52%) and 468 women (53%) returned them.

**RESULTS:** Fifty-two percent of the participants supported the donation of surplus embryos to other couples, but divided opinions on the disclosure of biological parents' identities were identified. About 70% of participants indicated that donations of surplus embryos for medical research or therapy should be allowed, following strict regulations. Multiple logistic regression analyses revealed couples' position on the moral status of an embryo as the strongest predictor of attitudes toward all destinations of surplus embryos. Having children due to IVF/Intra-Cytoplasmic Sperm Injection (ICSI) treatment was negatively associated with attitudes towards donations to other couples. Perceived importance of religion, age >40, being a resident of the French-speaking region and unsuccessful IVF/ICSI treatment experiences were predictive of supporting donations for medical research.

**CONCLUSIONS:** Swiss couples with cryopreserved embryos/zygotes are open to different options related to donating, rather than discarding, surplus embryos.

**Key words:** surplus embryo donation / attitudes / cryopreservation / moral status of embryo

## Introduction

As of today, more than 3 million babies worldwide have been born out of *in vitro* fertilization (IVF) (International Committee Monitoring Assisted Reproductive Technology, 2006). The development of advanced techniques to cryopreserve embryos for later use has improved pregnancy rates, and reduced risks and costs. However, issues related to the legal regulation and ethical use of surplus embryos for research have sparked extensive, and sometimes heated, public debate and discussion (Fasouliotis and Schenker, 1996; ESHRE Taskforce on Ethics and Law, 2001a, b, 2002; Baylis *et al.*, 2003; Johnson, 2003; Lee and Yap, 2003; The Ethics Committee of the American Society for Reproductive Medicine, 2004; Harris *et al.*, 2005; Lockwood, 2005; Schenker, 2005; Brock, 2006; Dutney, 2007).

In Switzerland, 'surplus embryos' are defined as all embryos generated during a reproductive cycle that are not used for reproduction. Before 2001, cryopreservation of embryos for later use was routine procedure in Switzerland. As of 2001, a revised law on Medical Assistance to Procreation prohibits the creation of embryos that are not intended to immediately induce pregnancy (the cryopreservation is only allowed as the status of zygotes) (Swiss Federal Law on Medical Assistance to Procreation). In addition, all the existing surplus embryos had to be discarded by the end of 2003. In October 2003, the law was adapted and a new deadline for the destruction of the cryopreserved embryos that were destined for reproductive purposes was set for end of 2005. To avoid generating surplus embryos, Swiss law allows a maximum of only three embryos to be developed during an IVF treatment cycle, and all generated embryos have to be transferred to the mother if possible.

However, surplus embryos may still be developed and not used for reproduction under the following circumstances: (i) the embryo did not develop normally and is, thus, not transferred; or (ii) the mother changed her mind or health condition after the embryo was developed (e.g. due to an accident or illness) (Report of the Swiss Federal Council on the Swiss Federal Law on Medical Assistance to Procreation BBl 1996 III 227 and 266).

In November 2004, the Swiss people voted in a referendum, with a clear majority (66%) supporting a new federal law which permits the derivation of human embryonic stem cells from surplus embryos for research, with informed consent required from the couples. Prior to the referendum in November 2004, it was illegal to use surplus embryos for research. The only legal options were to either to implant them or to discard them. The referendum enacted a new law (stem cell research law) that allowed the research with surplus embryos. However, research with intact surplus embryos (Swiss Federal Law on Research with Embryonic Stem Cells StFG), the creation of embryos for research purposes, and the donation of surplus embryos to other couples remain prohibited. By the end of 2004, the Swiss national parliament decided to postpone the deadline for discard of surplus embryos, thus extending the maximal 5-year storage limit to the end of 2008, and to allow surplus embryo use in medical research under certain restricted conditions.

A recent study demonstrated that, out of 11 727 embryos generated in 2003, 94% were transferred into a uterus due to the strict regulations. Only 711 (6%) became surplus, and these became so principally due to poor quality and/or abnormal development. Of these, only 52 (0.4% of all embryos) became available for potential donation for research, due to the strict legal regulations in force at that time (Koeferl Puorger *et al.*, 2006). Therefore, these embryos could hardly contribute to the research given the small quantity. Despite the restricted legal regulations in reproductive medicine, patients' attitude could also be an important factor affecting the donation of surplus embryos. Until now, no data on Swiss patients' attitude toward the destiny of their surplus embryos have been available.

Several studies have been done to evaluate the attitudes of couples towards embryo donation or towards the use of embryos for stem cell research, and various rates of acceptance, from just above 20% to more than 90%, have been found among infertile couples (Bjuresten and Hovatta, 2003; McMahon *et al.*, 2003; Bangsboll *et al.*, 2004; Burton and Sanders, 2004; Choudhary *et al.*, 2004; Hammarberg and Tinney, 2006; Kronen *et al.*, 2006; Newton *et al.*, 2007; Hug, 2008). However, the data for most of these studies were derived from a single clinic or city, and the surveyed samples have tended to be small. The rates of acceptance also have varied depending upon how the questions were asked (for example, whether the questions were asked hypothetically or it was based on actual decision that the couples have had to make). A recent reviewed article has compared the results from different countries, different type of studies (prospective versus retrospective) and different donor samples (Hug, 2008).

This study is the first national survey, assessing attitudes towards the donation of surplus embryos that involves a large representative sample of couples, residing in German-speaking and French-speaking regions of Switzerland, who have had cryopreserved embryos or zygotes. They are a representative sample of couples who potentially have to decide about the destiny of their surplus

embryos in the near future. The study had two aims: (1) to investigate the attitudes towards the donation of surplus embryos among couples who have had cryopreserved embryos or zygotes; and (2) to identify correlates associated with attitudes towards each of three destinations of surplus embryos—donations to other couples, donations for medical research and donations for medical therapy.

## Materials and Methods

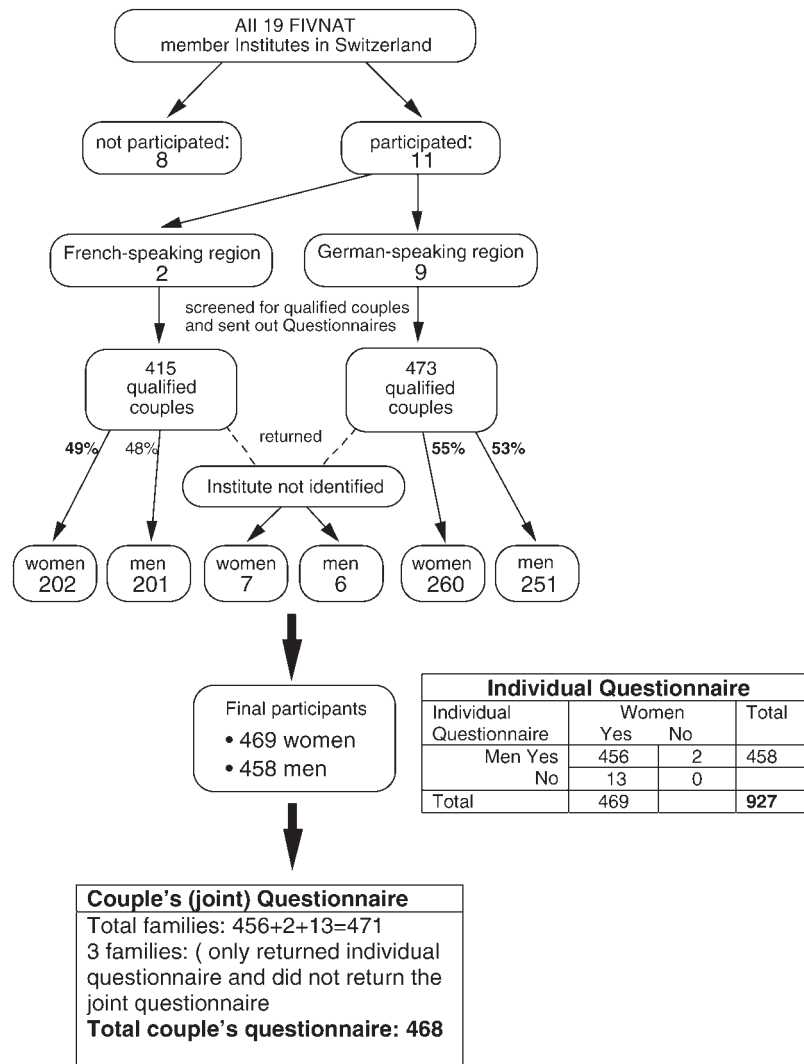
### Participating institutions and participants

In Switzerland, IVF treatments only may be provided by licensed centers. The 'FIVNAT-CH'-society (Fertilization *In Vitro* National) is part of the Swiss Society of Reproductive Medicine, which includes all but one licensed IVF centers in Switzerland. All 19 FIVNAT member-institutes that were in existence in 2004 were asked to participate in the current study. By participation, these centers were asked to send a written questionnaire to all their eligible patients, defined as those who have undergone a cryopreservation procedure at least once in 2002. Eleven of these nineteen centers actually sent the questionnaires to their patients. These 11 centers accounted for the majority (66%) of cycles performed among all patients who received IVF or Intra-Cytoplasmic Sperm Injection (ICSI) fertility treatments in Switzerland in 2004 (69% across the German-speaking and French-speaking regions in Switzerland). A total of 888 couples (473 from the German-speaking and 415 from the French-speaking area) met the above criteria. The sampling procedure is depicted in Fig. 1. This study was reviewed and approved by the Ethics Committee of the canton of Zurich, the Ethics Committee of the canton of Aargau and the Ethics Committee for Clinical Research in the canton of Vaud.

### Procedures

#### Mailings

Due to different procedures required for the ethics committees in the German-speaking and French-speaking regions of Switzerland, the questionnaires were sent in two waves. A written questionnaire was mailed out in March 2004 across the German-speaking regions and in December 2004 across the French-speaking area, due to differences in when approval was received from the corresponding ethics committees. One reminder was sent a month later. In order to assure anonymity, each questionnaire, accompanied by a prepaid return envelope, was sent to the participating centers, and they sent the questionnaires out to their patients directly. All responses were kept anonymous, and participation was voluntary. The completed questionnaires were sent back to the Institute of Social and Preventive Medicine at the University of Zurich. The participating centers were indicated on the questionnaire, in order to calculate institution-specific response rates. Questionnaires were sent to 888 eligible couples. For each couple, one joint questionnaire was included asking about the couple's collective treatment experience and family status, as well as two identical questionnaires, one sent to the male and one to the female in each couple, asking about their individual attitudes towards destinations for surplus embryos, their views regarding the moral status of an embryo, and their personal socio-demographics. We received questionnaires back from 458 men (52%) and 469 women (53%). The response rate varied slightly by region, being 56% in the German-speaking region, and 49% in the French-speaking region. Institution-specific response rates ranged from 33 to 62%. However, only three centers (27%) had a response rate below 50%.



**Figure 1** Study centers and patients recruitment.

### Questionnaire

The questionnaire was divided into two sections. The first section of the questionnaire asked about subjective experiences with therapy, attitudes towards important legal aspects of reproductive medicine, and attitudes toward the destination of surplus embryos. This section was filled out by males and females individually. The second section was filled out jointly by the couple, which comprised of questions asking about background information (demographics, family situation and the couple's treatment course in infertility therapy).

### Measures

#### Individual Measures

- (i) Attitudes toward the destination of embryos were assessed using the following questions: Do you think that the donation of surplus embryos should be allowed (1) to other couples? (2) for medical research? (3) for medical therapy? The response categories for each of these three questions are listed in Table II. In addition, the couples were asked to rank their preferred destinations for surplus embryos (from 1 to 3) for

the following three options: discarding them; donating them to other couples; and donating them for medical research.

- (ii) Sociodemographic variables included age, gender, nationality, education, region of residence and religion. In addition, we asked participants' perceived importance of religious principles on their views towards reproductive medicine. The response options were 'very important', 'less important' and 'not important'.
- (iii) Each respondent's views on the moral status of an embryo were assessed relative to four positions. These positions initially had been presented in a study entitled 'Human Stem Cells' (2003) that was conducted on behalf of the Swiss Centre for Technology Assessment at the Swiss Science and Technology Council (Hüsing et al., 2003). We modified the description of these positions so that they could be asked in a questionnaire. These four positions are (1) We owe the early embryo no respect. It is nothing but a cluster of cells; (2) An embryo's right to life and its worthiness to be protected grow gradually. Early embryos deserve at least some sort of respect; (3) The embryo has human dignity from the beginning of its development. It should be protected as long as no other

**Table 1 Sociodemographic characteristics**

Individual Characteristics (N = 927)	Women (N = 469)	Men (N = 458)
Region of residence		
German-speaking	260 (56.3)	251 (55.5)
French-speaking	202 (43.7)	201 (44.5)
Mean age	35.8 ± 4.0 (25–50)*	38.6 ± 5.4 (25–59)*
<35	166 (35.5)	94 (20.8)
35–39	212 (45.3)	192 (42.4)
≥40	90 (19.2)	167 (36.9)
Nationality		
Swiss	323 (69.3)	342 (76.0)
Swiss & other	65 (14.0)	49 (10.9)
Non-Swiss	78 (16.7)	59 (13.1)
Religion		
Protestant	155 (33.5)	164 (36.6)
Roman Catholic	248 (53.6)	215 (48.0)
Non-Christian religion	19 (4.1)	13 (2.9)
No religion	41 (8.9)	56 (12.5)
Education		
Mandatory or Vocational school 1–2	76 (16.4)	30 (6.7)
Vocational School > 2 years	186 (40.2)	160 (35.7)
College & University	201 (43.4)	258 (57.6)
Importance of religious principles on attitude toward reproductive medicine		
Very important	68 (14.7)	57 (12.6)
Less important	131 (28.4)	136 (30.1)
Not important	263 (56.9)	259 (57.3)
<b>Couple's characteristics (N = 468 couples, in %)</b>		
Have any child (include current pregnant) <sup>1</sup>	337 (72.0)	
Any child from natural pregnancy	67 (14.3)	
Any child from IVF/ICSI	271 (58.8)	
Still possess cryopreserved embryos/zygotes		
Yes	261 (57.5)	
No	185 (40.8)	
Don't know	8 (1.8)	
Unsuccessful IVF treatment experiences		
>3 times unsuccessful embryos transfer/miscarriage from IVF/ICSI induced pregnancy	163 (36.6)	
Wish for more children		
Yes	237 (50.6)	
No	77 (16.5)	
Not sure	154 (32.9)	

N (%).

<sup>1</sup>Any child including any biological, adoptive, and stepchild.

\*Mean age (range).

pressing value or duty stands in the way; and (4) The embryo is entitled to the full protection of human dignity, from the time of its early development. It has the same rights as a human being. The participants were asked to indicate their degree of agreement with each of these four statements. The response options were 'agree totally, agree partially, undecided, disagree partially and disagree totally'.

#### Couple Measures

- (i) 'Unsuccessful experience' with IVF/ICSI treatment was defined as having had more than three unsuccessful embryo transfers and/or having miscarried an IVF-induced pregnancy.
- (ii) Family situation: the couple were asked to indicate number of children they have through (1) natural pregnancy, (2) successful IVF/ICSI therapy, (3) other infertility treatment, (4) stepchildren from other

**Table II Attitudes toward donation of surplus embryos**

(Total N <sup>1</sup> = 927)	N (%)		
1. Allowed donation of surplus embryos to other couples			
Yes, in principle	117 (12.7)		
Yes, with conditions:	394 (39.0)		
If the identity of the biological parents 'cannot' be revealed	160 (17.4)		
If the identity of the biological parents 'can' be revealed	189 (20.5)		
if the identity of the biological parents 'must' be revealed	10 (1.1)		
No	394 (42.8)		
Don't Know	51 (5.5)		
2. Allowed use of surplus embryos in medical research			
Yes, in principle	114 (12.4)		
Yes, with some restrictions	557 (60.7)		
No	216 (23.6)		
Don't Know	30 (3.3)		
<i>If yes . . .</i>			
2.1. Research on embryos should be subject to very strict regulation?			
Yes	614 (93.2)		
No	30 (4.6)		
Don't Know	15 (2.3)		
2.2. Donors must give their personal permission for surplus embryo to be used in research project in general			
Yes	524 (79.5)		
No	125 (19.0)		
Don't Know	10 (1.5)		
3. Allowed use of embryos in medical therapy			
Yes, in general	233 (25.9)		
Possibly	398 (44.2)		
No	189 (21.0)		
Don't Know	20 (8.9)		
4. Preferred choice of surplus embryos <sup>2</sup>			
	Destruction	Donate to others	Available for research
From surplus embryo in general	223 (24.1)	301 (32.5)	312 (33.6)
From their own surplus embryo	267 (28.8)	260 (28.1)	300 (32.4)
From those owners who are deceased, or who can no longer be found	284 (30.6)	251 (27.1)	323 (34.8)

<sup>1</sup>N varied slightly by each question due to missing.

<sup>2</sup>The percentage is the percent of the first choice made by couple. It did not add up to 100% due to missing or the couple did not consider these three options at all.

partner or (5) adoptive children. In addition, the couple was asked whether they wish to have more children and whether they still possessed surplus embryos. The response options were 'yes', 'no' and 'not sure'.

#### Data analysis

All analyses were conducted using the STATA survey estimation procedure, in order to account for the clustered outcomes that resulted from our sampling scheme (with couples as the primary sampling unit.). We used contingency tables to present the prevalence of attitudes towards, and preferred destinations for, surplus embryos, and attitudes regarding the moral status of an embryo. Three multiple logistic regression models were used to examine the correlates associated with three destinations of surplus embryos (donations to others, donations for medical research and donations for medical therapy). The outcomes variables (destinations of surplus embryos) were further dichotomized as 'yes'

(including 'yes', 'in principal' and 'yes, with conditions/restrictions') versus 'others' (including 'no' and 'don't know') in the logistic regression analysis. The results did not appreciably alter when we excluded those who answered 'don't know'. In order to maximize the responses without too many 'missing' data points, we therefore grouped 'no' and 'don't know' together in the multiple regression model. The correlates examined in each model included region, gender, age, nationality, religion, perceived importance of religious principles in reproductive medicine, education, possession of cryopreserved embryos, desire for more children, attitudes regarding the moral status of an embryo, family situation and unsuccessful experiences with IVF/ICSI therapies. Because the moral status of embryos was the strongest correlate associated with couples' attitudes toward the destinations of surplus embryos, all the correlates associated with both the moral status of embryos and attitudes towards embryo destinations also were examined, in order to identify and adjust

for potential confounders. The final multiple logistic regression models for each destination included only those correlates with a  $P$ -value  $< 0.1$ .

## Results

### Characteristics of the participants

The sociodemographic characteristics of the participants are shown in Table I. The mean age of participants was  $38.6 \pm 5.4$  (mean  $\pm$  SD) years among men, and  $35.8 \pm 4.0$  years among women. More than two thirds of the participants were Swiss citizens; about half were Roman Catholic; and 58% of the men and 43% of the women had a college or university degree. About 57% considered their religious principles not important with respect to their attitudes toward reproductive medicine. Three in five couples had children or currently were expecting a child as a result of IVF/ICSI treatment. More than half (57%) of the couples still possessed cryopreserved embryos or zygotes.

### Attitudes towards the destination of embryos

Table II shows couples' attitudes towards the destination of embryos. Although 52% of the participants thought donation of surplus embryos to other couples should be allowed, the majority (39%) of them only supported it under specific conditions, and there were different attitudes regarding whether the identities of the biological parents should be revealed. About 22% supported such donations only if the identities of the parents can be revealed, and 17% supported them only if the identities of the parents are not revealed.

Approximately three quarters of participants felt that the donation of surplus embryos for medical research should be allowed. Among them, more than 90% thought that research on embryos should be subject to strict regulations. In addition, 80% felt that obtaining permission from donors was appropriate.

Regarding the donation of surplus embryos for medical therapy, 70% of the participants answered either 'yes' or 'possibly'. One third of the participants considered 'available for research' and 'donation to other couples' their first choice for surplus embryos, in general, versus 24% who considered 'discarding the embryos' as their first choice. However, for their own surplus embryos, 32% considered 'making available for research', 28% 'donating to others' and 29% 'discarding' as their first choice.

### Moral status of an embryo

Couples' view on the moral status of embryos is shown in Table III. About 77% of the participants disagreed that an embryo is just a bunch of cells, the vast majority (89%) feeling that an early embryo deserves at least some sort of respect. Half of the participants agreed that an embryo should be afforded the same dignity and rights as a human being. We further examined the association between the moral status of an embryo and attitudes towards the destinations of surplus embryos. Among these four positions, a participant's position regarding the statement—'embryos have the same dignity and rights as a human being'—was most strongly associated with his or her attitude towards the destination of surplus embryos. Those who agreed that an embryo has the same rights as a human

**Table III** Patients' view of the moral status of embryos

(N = 927)	Fully agree/ agree	N (%) Not decided	Disagree/ fully disagree
1. We owe no respect to the early embryo. It is nothing but a cell cluster	111 (12.1)	97 (10.6)	709 (77.3)
2. Embryo's right to life and its worth to be protected grow gradually. Early Embryo deserved at least some sort of respect	808 (88.6)	44 (4.8)	60 (6.6)
3. An embryo has human dignity from the beginning of its development. It should be protected as long as no other pressing value or duty stands in the way	617 (69.2)	130 (14.6)	145 (16.3)
4. An embryo has the same dignity and right as a human being	467 (50.4)	159 (17.2)	301 (32.5)

being were less likely to think that the donation of surplus embryos to others (OR = 0.6 [0.5–0.9]), for medical research (OR = 0.4 [0.3–0.6]) or for medical therapy (OR = 0.5 [0.4–0.7]) should be allowed. Since this position on the moral status of an embryo also was the strongest correlate of attitudes toward surplus embryo destination, we further examined correlates associated with this position and included only this position in the logistic regression model. Univariate analyses revealed that females (OR = 1.2 [1.0–1.5]) and those who perceived an important link between religious principles and reproductive medicine (OR = 3.7 [2.2–6.2]) were more likely to agree with the position that an embryo should be afforded the same rights and dignity as a human being. Conversely, those who were more than 40 years old, and those who had a college or university degree were less likely to support this position. This moral position also was used in the following multiple regression models.

### Correlates associated with attitudes regarding the destination of surplus embryos

Table IV shows the results of three separate multiple logistic regression models examining correlates associated with attitudes towards each potential surplus embryo destination—donations to other couples, and donations for either medical research or medical therapy. Among all the correlates entered into the model predicting couples' attitudes on donating to others, the couple's position on an embryos' moral status, having children or currently expecting a child due to IVF/ICSI treatment were the only significant predictors at a  $P < 0.05$  level. Those who believed that an embryo should be afforded the same dignity and rights as a human being, and those who had children or currently were expecting because of IVF/ICSI treatment were less likely to agree to donate surplus embryos to other couples.



**Table IV** Multiple logistic regression of correlates associated with couples' attitude toward the destination of surplus embryos

Correlates	To other couples (N = 927)	To medical research (N = 908)	To medical therapy (N = 900)
Age			
<35		1.0	1.0
35–39		1.4 [0.9–2.1]	1.3 [0.9–2.0]
>40		1.8 [1.1–3.0] <sup>a</sup>	1.6 [1.0–2.5] <sup>a</sup>
Education			
Mandatory or Vocational school 1–2			1.0
Vocational School > 2 years			2.0 [1.2–3.4] <sup>b</sup>
College & University			1.8 [1.1–3.0] <sup>a</sup>
Region of residence			
German-speaking		1.0	1.0
French-speaking		2.2 [1.5–3.4] <sup>b</sup>	1.8 [1.2–2.5] <sup>b</sup>
An embryo has the same dignity and right as human being			
Strong disagree/disagree	1.0	1.0	1.0
Not decided	0.6 [0.4–0.9] <sup>b</sup>	0.4 [0.2–0.7] <sup>b</sup>	0.6 [0.4–1.0]
Strong agree/agree	0.5 [0.4–0.7] <sup>b</sup>	0.3 [0.2–0.5] <sup>b</sup>	0.4 [0.3–0.7] <sup>b</sup>
Perceived importance of Religion			
Unsuccessful IVF/ICSI experiences		2.2 [1.4–3.3] <sup>b</sup>	1.9 [1.3–2.9] <sup>b</sup>
Having IVF/ICSI child/pregnancy	0.6 [0.4–0.9] <sup>b</sup>		
Wish for more children	1.3 [1.0–1.9]	1.4 [0.9–2.0]	
Having children from normal conceived pregnancy			0.6 [0.4–1.0] <sup>a</sup>

<sup>a</sup>P < 0.05.<sup>b</sup>P < 0.01.

Interestingly, although participants' perceptions of the importance of religious principles in reproductive medicine and couple's position on a embryo's moral status were highly correlated, both variables were independently predictive of couples' attitudes towards the donation of surplus embryos for medical research upon multiple regression analysis (OR = 0.4 [0.2–0.6] and OR = 0.3 [0.2–0.5], respectively). In addition, those who were more than 40, those from the French-speaking region, and those with past unsuccessful experiences with IVF/ICSI treatment were more likely to agree that the donation of surplus embryos for medical research should be allowed.

Those who were more than 40, those with a higher level of education, those who were from the French-speaking region, and those who had unsuccessful IVF experiences were more likely to support the donation of surplus embryos for medical therapy. In addition, those who supported an embryo's moral status as a human being, those couples with children from a natural pregnancy were less likely to support the donation of surplus embryos for medical therapy.

## Discussion

The present study is the first survey conducted in Switzerland, on a relatively large representative sample of patients who once owned or still owned cryopreserved embryos or zygotes and potentially

have to decide in the near future about the destiny of their surplus embryos. In spite of strict legal regulations with limited options for embryo donations, our findings showed that couples with cryopreserved embryos are quite altruistic and prefer donating embryos to research or other couples versus discarding them; in fact, only 24% of the participants preferred 'discarding' surplus embryos in general, versus donating them for research (34%) or to other couples (32%). Approximately three quarters of participants who had owned surplus embryos or currently still possess surplus embryos supported the donation of surplus embryos for medical research, but the majority of them thought that research on embryos should be subject to strict regulations. It is interesting to note that more than half of the couples thought that donations to other couples should be allowed; however, opinions were divided as to whether the identities of the biological parents should be revealed.

Our survey was conducted shortly before a Swiss public referendum, in which there was 66% acceptance of using human embryonic stem cells from surplus embryos for research. Our results show that acceptance of donation of surplus embryos for research is even more prevalent among those who own surplus embryos. This high rate of acceptance of surplus embryo donations for research is similar to what has been reported in Nordic countries like Sweden (92%) (Bjuresten and Hovatta, 2003) and Denmark (60%) (Bangsboll et al., 2004).

Similar to previous studies, fewer couples accept the donation of surplus embryos to other couples than for research (Burton and Sanders, 2004; Krones *et al.*, 2006). Currently, Swiss law does not allow the donation of surplus embryos to other couples. Our results reveal much divided attitudes among couples with cryopreserved embryos. Only 13% of the patient couples accept the donation of surplus embryos to other couples in general, but an additional 39% feel that this is acceptable under certain circumstances: 17% accept such donations, so long as the identities of the genetic parents are not revealed; and 22% so long as the identities of the genetic parents can be revealed. Interestingly, we found that couple's attitudes toward donations to other couples only are influenced by their position on the moral status of an embryo and their past success with IVF/ICSI treatment. Other studies have found that couples change their minds from wanting to donate their surplus embryos to other couples or for research, to wanting to discard the embryos after they become parents (de Lacey, 2005; Newton *et al.*, 2007). This change of mind was related to their status as parents and to a change in the symbolism of embryos from 'a chance for pregnancy' to a 'virtual child' in cryo-storage (de Lacey, 2005).

The moral status of human embryos has been an important topic of discussion and debate (Fasouliotis and Schenker, 1996; Lockwood, 2005; Stanton and Harris, 2005; Brock, 2006; Deckers, 2007). However, few studies have assessed couples' views of the moral status of an embryo directly and their association with religious beliefs and the donation of embryos. Previous studies on the influence of religious beliefs on attitudes towards embryo donations have yielded inconsistent results (McMahon *et al.*, 2003; Burton and Sanders, 2004; Krones *et al.*, 2006). The present study found that couples' views regarding the moral status of an embryo is the strongest (negative) predictor of embryo donation; moreover, these views are significantly influenced by their perceptions regarding the importance of religious beliefs in reproductive medicine. In addition, we found that both the perceived importance of religion and viewpoints regarding an embryo's moral status independently predict a couple's attitudes toward the donation of embryos for medical research. Our results are similar to those of a previously published qualitative study, which found that a patient's view of an embryo as a potential life has direct implications with respect to their views on the donation of embryos for stem-cell research (Parry, 2006).

We also found a significant regional difference, in that residents from the French-speaking region of Switzerland were more likely to support embryo donations for research than residents from the German-speaking region. Consequently, those assessing attitudes toward embryo donation should take cultural factors into consideration.

Even though the donation of surplus embryos to other couples is currently prohibited in Switzerland, 28% of the couples in our survey considered 'donation to other couples' as their preferred choice for their own surplus embryos, and almost a third considered it the preferred choice for surplus embryos in general. These results suggest that more options for surplus embryos could be considered in the future. Interestingly, the opinions as to whether the identity of the biological parents should be revealed or not were almost equally divided. Currently, donation of embryos to other couples is prohibited in most countries, with a few exceptions. For example, donation to other couples is allowed with parental consent in UK

and the donor could be disclosed once the child reaches 18 years old. Similarly, embryos adoption is also allowed in Australia (Cheely, 2007). However, whether the donors' identity should be disclosed or not differs by state.

## Conclusions

Despite current restrictive regulations relating to embryo donations in Switzerland, our study showed that a majority of couples with surplus embryos or zygotes support the view that embryo donations for research should be allowed. This rate of support is even higher than the results of the 2004 referendum of the general Swiss population. Admittedly, our results only reflect theoretical views, and might not mirror actual decisions. Nonetheless, given that less than 1% (0.4%) of all generated embryos has been available for research in the recent past, at least some modifications of present regulations should be considered.

## Author's Role

M.M.-K. contributed to the conception of the manuscript, data analyses, and interpretation of the data and drafted the manuscript. U.Z. contributed to the conception and design of the study, and data collection, analyses and interpretation and assisted in drafting the manuscript. A.D. contributed to the development of the questionnaire, data collection and the interpretation of results. M.H. initiated, conceptualized and supervised the study, F.G. contributed to study aims and design. M.M. contributed to data interpretation, and assisted in drafting the manuscript.

## Acknowledgements

Many thanks to the participating centers and to all participating couples. Special thanks to Dr. Bernard Disserens for his help in organizing the study in the French-speaking part of Switzerland and Dr. Costanzo Limoni for calculating the statistical information about the cycles in the FIVNAT-centers.

## Funding

The study was supported by the Swiss Academy of Medical Sciences and Kantonsspital Baden.

## References

- Bangsboll S, Pinborg A, Yding Andersen C, Nyboe Andersen A. Patients' attitudes towards donation of surplus cryopreserved embryos for treatment or research. *Hum Reprod* 2004;**19**:2415–2419.
- Baylis F, Beagan B, Johnston J, Ram N. Cryopreserved human embryos in Canada and their availability for research. *J Obstet Gynaecol Can* 2003;**25**:1026–1031.
- Bjuresten K, Hovatta O. Donation of embryos for stem cell research—how many couples consent? *Hum Reprod* 2003;**18**:1353–1355.
- Brock DW. Is a consensus possible on stem cell research? Moral and political obstacles [see comment]. *J Med Ethics* 2006;**32**:36–42.
- Burton PJ, Sanders K. Patient attitudes to donation of embryos for research in Western Australia. *Med J Aust* 2004;**180**:559–561.



- Cheely ECC. Embryo adoption and the law. In: Brakman SV, Weaver DF (eds). *The Ethics of Embryo Adoption and the Catholic Tradition*, Netherland: Springer, 2007, 275–306.
- 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. *Hum Reprod* 2004;**19**:2091–2096.
- de Lacey S. Parent identity and 'virtual' children: why patients discard rather than donate unused embryos. *Hum Reprod* 2005;**20**:1661–1669.
- Deckers J. Are those who subscribe to the view that early embryos are persons irrational and inconsistent? A reply to Brock [comment]. *J Med Ethics* 2007;**33**:102–106.
- Dutney A. Religion, infertility and assisted reproductive technology. *Best Pract Res Clin Obstet Gynaecol* 2007;**21**:169–180.
- ESHRE Taskforce on Ethics and Law. I. The moral status of the pre-implantation embryo. *Hum Reprod* 2001a;**16**:1046–1048.
- ESHRE Taskforce on Ethics and Law. II. The cryopreservation of human embryos. *Hum Reprod* 2001b;**16**:1049–1050.
- ESHRE Taskforce on Ethics and Law. IV. Stem cells. *Hum Reprod* 2002;**17**:1409–1410.
- Fasouliotis SJ, Schenker JG. Cryopreservation of embryos: medical, ethical, and legal issues. *J Assist Reprod Genet* 1996;**13**:756–761.
- Hammarberg K, Tinney L. Deciding the fate of supernumerary frozen embryos: a survey of couples' decisions and the factors influencing their choice. *Fertil Steril* 2006;**86**:86–91.
- Harris J, Bortolotti L, Irving L. An ethical framework for stem cell research in the European Union. *Health Care Anal* 2005;**13**:157–162.
- Hug K. Motivation to donate or not donate surplus embryos for stem-cell research: literature review. *Fertil Steril* 2008;**89**:263–277.
- Hüsing B, Engels EM, Frietsch R, Gaisser S, Menrad K, Rubin B, Schweizer R, Zimmer R. *Menschliche Stammzellen. Studie des Zentrums für Technologiefolgen-Abschätzung, TA 44/2003 d*, 2003. Bern. ([http://www.ta-swiss.ch/a/biot\\_stam/2003\\_44\\_Stammzellen\\_d.pdf](http://www.ta-swiss.ch/a/biot_stam/2003_44_Stammzellen_d.pdf)).
- International Committee Monitoring Assisted Reproductive Technology. *Word report on ART (assisted reproductive technology) fact sheet*. Prague, 2006.
- Johnson ND. Excess embryos: is embryo adoption a new solution or a temporary fix? *Brooklyn Law Rev* 2003;**68**:853–883.
- Koeflerl Puorger UPS, Buergin M, Wunder D, Crazzolaro S, Birkhaeuser MH. Surplus embryos in Switzerland in 2003: legislation and availability of human embryos for research. *Reprod Bio Med Online* 2006;**13**:772–777.
- Krones T, Neuwohner E, Bock K, Manolopoulos K, Tinneberg HR, Richter G. Attitudes of patients, healthcare professionals and ethicists towards embryonic stem cell research and donation of gametes and embryos in Germany. *Reprod Bio Med Online* 2006;**13**:607–617.
- Lee J, Yap C. Embryo donation: a review. *Acta Obstet Gynecol Scand* 2003;**82**:991–996.
- Lockwood M. The moral status of the human embryo: implications for IVF. *Reprod Bio Med Online* 2005;**10**:17–20.
- McMahon CA, Gibson FL, Leslie GI, Saunders DM, Porter KA, Tennant CC. Embryo donation for medical research: attitudes and concerns of potential donors. *Hum Reprod* 2003;**18**:871–877.
- Newton CR, Fisher J, Feyles V, Tekpetey F, Hughes L, Isacson D. Changes in patient preferences in the disposal of cryopreserved embryos. *Hum Reprod* 2007;**22**:3124–3128.
- Parry S. (Re)constructing embryos in stem cell research: exploring the meaning of embryos for people involved in fertility treatments. *Soc Sci Med* 2006;**62**:2349–2359.
- Report of the Swiss Federal Council on the Swiss Federal Law on Medical Assistance to Procreation: Botschaft zum FMedG, 1996 III 227 und 266).
- Schenker JG. Assisted reproductive practice: religious perspectives. *Reprod Bio Med Online* 2005;**10**:310–319.
- Stanton C, Harris J. The moral status of the embryo post-Dolly. *J Med Ethics* 2005;**31**:221–225.
- Swiss Federal Law on Medical Assistance to Procreation. Bundesgesetz über die medizinisch unterstützte Fortpflanzung: (Fortpflanzungsmedizinengesetz FMedG).
- Swiss Federal Law on Research with Embryonic Stem Cells. Bundesgesetz über die Forschung an embryonalen stammzellen: (Stammzellenforschungsgesetz, StFG).
- The Ethics Committee of the American Society for Reproductive Medicine. Informed consent and the use of gametes and embryos for research. *Fertil Steril* 2004;**82**:251–252.

Submitted on September 1, 2008; resubmitted on March 13, 2009; accepted on March 24, 2009