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**Predictors of In-Vitro Fertilization Preferences in Cyprus:**

**A National Survey**

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**Abstract**

**Objective**: The study objective was to evaluate the association of demographics including religiosity with Cypriot IVF preferences.

**Methods**: A national telephone survey was conducted in Cyprus using a random sampling approach. The questionnaire included information on participants’ demographics, religiosity and preferences on IVF.

**Results**: A total of 1.000 individuals (female – 69.2 %), age categories: 20-40 (27%), 40-60 (44%) and 60+ (29%) participated in the survey. About a third (32.2%) reported tertiary education. More than two thirds reported that they would be highly likely to accept IVF even if they knew that many embryos would be destroyed. Only 29% would agree to IVF if donor sperm and/or eggs would be used. Females were less likely to undergo IVF with donor sperm or eggs however females were more likely to accept IVF even if multiple embryos would be destroyed. People with religious beliefs were less likely to agree with IVF. In multivariable-adjusted logistic regression models, gender, age-group, and religiosity were significant predictors of IVF.

**Discussion**: Younger, more educated and less religious Cypriots are more positive to follow IVF. Addressing ethical and religious concerns may result in higher utilization of such methods related to infertility.

**Keywords:** In-Vitro Fertilization (IVF), Fertility, Infertility, Demographics, Religiosity, Survey, Cyprus

**Introduction**

Infertility is defined as “the inability to conceive after a year of unprotected sexual contact”. [1] It also refers to women that are unable to carry a pregnancy to full term. It is a relatively common problem affecting more than 6% of married women and 12% of all women 15-44 years of age. [1] In addition, about 9% of men are reported to be infertile. In women, the risk of infertility increases with age reaching 30% at the age of 44. [1] There has been no change to the infertility rates worldwide over the last two decades (1990 – 2010) apart from Sub-Saharan regions and Southeast Asia where a small increase in fertility was noted. [2] It was suggested that the rise was a result of the good obstetric care and a reduction in sexually transmitted diseases (STDs).

Several social and psychological implications of infertility have been reported in the international literature. [3 – 8] Infertility may result in distress, anxiety and depression for both women and men. It could also alienate a couple and stigmatise them in society leading to family instability. Such difficulties may also affect the functioning of these individuals at their work and society in general. Therefore, the social and psychological implications and the bioethical concerns for infertility management make the study of this problem an important global public health issue. Infertility treatment may differ between countries due to national legislation, religion and other cultural factors.

One of the most important management approaches for infertility includes assisted reproductive technologies (ART) such as in-vitro fertilization (IVF). IVF is characterized by the fertilization of one or multiple eggs outside of the body [9]. IVF treatment involves several invasive steps and constitutes a cyclical process. [3] This procedure may require several cycles for a successful pregnancy to be achieved. A study in the UK has shown that IVF has a success rate of 29% for a live birth after one cycle and 43% after six cycles. [10] USA results are similar with success rates as high as 50% for women younger than 35 years of age, while the success rate decreases to less than 10% for women 40-44 years of age. [11] The success rate is higher when donor embryos are utilized (55%). IVF has several benefits including the opportunity for those suffering from infertility to have a child and/or for women who desire to become pregnant at an older age. Individuals with illnesses (i.e. genetic disorders) may also be able to consider having a child with donor sperm and/or eggs. Pre-implantation genetic diagnosis although with considerable ethical concerns allows for the prevention of genetic disorders. [9, 12] In addition, the birth of a child to a couple suffering from infertility could help alleviate its negative social and psychological impact to the family.

Although reports exist on multiple aspects of infertility including its management, little is known about IVF population preferences (a choice as to whether someone agrees to have IVF) and how these may be associated with personal characteristics including religiosity. The objective of our study was to investigate population preferences regarding IVF and their association with demographic characteristics and religiosity in Cyprus.

**Methods**

*The Sample*

The study sample consisted of a national sample of the Cyprus population using a stratified random sampling methodology. One thousand adults from all five districts of Cyprus participated in the telephone survey. The selection process required 2.027 telephone calls to achieve a sample of 1.000 participants (response rate of 49%). The participant characteristics such as age, gender, education, marital status, and religiosity were collected using an anonymous telephone-administered questionnaire.

*The Survey*

A fourteen-question validated anonymous questionnaire was administered via telephone. [13] Six of the questions referred to the participant characteristics [age, gender, education, marital status, occupation and religiosity (an individual’s conviction, devotion, and veneration towards a divinity)]. [14] The religiosity response category listed as “other” was not used in the analyses.

The outcome of interest addressed IVF population preferences. There were four choices for each IVF question with the fourth choice being “do not know/do not answer” (not included in the analyses). Specifically, the first question on IVF preferences inquired whether participants would agree to IVF treatment knowing that there is a risk of embryo loss (*Question 1: If you did not have children would you agree to IVF if you knew that many embryos would die (be destroyed) in the process?)*. The second question elicited individual preferences in the case where donor sperm and/or eggs would be utilized (*Question 2: If you did not have children would you agree to IVF if you knew that donor sperm and eggs would be utilized?).* No written consent was obtained since the questionnaire was anonymous and all participants were adults that agreed to participate in the survey at the beginning of the telephone call.

*Statistical Analysis*

All analyses were conducted using SAS v. 9.4. The Pearson Chi-square statistic provided evidence of association among the participant characteristics and IVF preferences. Bivariable logistic regression was used to evaluate the relationship of each personal characteristic with the IVF preferences. [15] The two categories of IVF preference, “Do not agree” and “low agreement” were combined due to small sample sizes. [16] It was expected that this combination would result in a more conservative estimate. The association of religiosity and other personal characteristics with IVF preferences was also evaluated using multivariable-adjusted logistic regression models. Statistical significance was considered at the traditional alpha level of 0.05 (two-sided for all tests).

**Results**

A total of 1.000 participants participated in the telephone survey. Descriptive data for study participants are shown in Table 1 and Table 2 in association with IVF preferences. The majority of study participants were between 40 – 60 years old and most of them were females. All participants had some form of education with about one third having tertiary education. More than 90% were married and a similar high percentage did not work within the healthcare sector. About two thirds reported high religiosity and one third low religiosity.

Statistically significant associations were found between participant characteristics such as age, gender, marital status, educational level and religiosity with IVF preferences in the bivariable level (Tables 1 and 2). In addition, bivariable logistic regression models for the above characteristics regressed on the IVF population preferences provided effect estimates for those associations (Table 3). Individuals at younger age were more likely to agree to IVF. In fact, the age-group 20 - 40 years old was about 3 times more likely to agree on both questions for IVF preferences compared to the oldest studied group. Educated individuals were also more likely to agree to IVF. Those having achieved only primary education were about 1.9 – 2.8 times less likely to agree to IVF compared to those with tertiary education. Married participants were less favorable towards IVF, while gender preferences had a mixed response. There was no statistically significant difference noted among healthcare workers and those in other occupational categories with respect to IVF preferences. Finally, individuals with high levels of religiosity were about 2.2 – 3 times less likely to agree to IVF compared to those with no religiosity. Statistically significant associations were found between participant characteristics such as age, educational level and religiosity for both IVF preferences examined (Table 3).

After controlling for personal characteristics in the multivariable-adjusted logistic regression models, age, marital status, educational level and religiosity remained statistically significant predictors of IVF preferences. The direction of effects remained the same as in the bivariable statistical analyses with the exception of marital status (Table 4).

Comparing the multivariable-adjusted logistic regression results for the two IVF preference questions, we found that the direction of effects were similar for all characteristics examined with the exception of gender and marital status. Males were less likely to accept IVF if they knew that multiple embryos could be lost during the process, while males were more likely to agree to IVF when donor sperm and/or eggs would be used. On the other hand, married individuals were twice as likely to express positive IVF preferences even if they knew that embryos could be lost during the process, while marital status was not positively associated with IVF preference knowing that donor sperm and/or eggs would be used.

**Discussion**

To our knowledge, this is the first study reported on the association of personal characteristics and IVF population preferences in Cyprus. Based on a telephone survey of a national sample of the Cypriot population, we found that younger individuals (age-group 20 – 40 years of age) were more favourable towards IVF. In addition, people with higher educational level were also more favourable to IVF. Gender preferences for IVF were mixed with females more likely to follow IVF even if embryos could be lost during the process and males more likely to agree to IVF when donor sperm and/or eggs would be used. Working in the healthcare sector was not a significant predictor of IVF preferences, while marital status was significantly associated with IVF population preferences. Finally, religiosity was statistically significantly associated with IVF preferences. Those participants who reported high religiosity were less likely to express positive preferences for IVF treatment.

To some degree, our finding regarding younger age being predictive of favourable preferences towards IVF is not surprising given that younger individuals are more likely to consider starting a family and having a child. In addition, research shows that younger individuals are more likely to succeed in IVF when needed compared to older adults. Contrary to our findings, a prior study reported that older adults were more likely to undergo IVF. [17] Younger adults are more likely to be educated than the average older individual, which may provide an explanation why in our study the highly educated participants were also more agreeable to IVF. In fact, education can be critical to IVF. Counselling is an essential component of infertility treatment at all stages (before, during and after the procedure). [4, 6] Maternal education has been shown to affect the continuation of IVF to egg retrieval. [18] Despite the importance of education, women aged 18 – 41 had little knowledge about fertility options. [19] It has also been reported that abortion and fertility are not sufficiently taught in medical education curriculums. [20] Patient education is an important component for such preferences. It is therefore promising that online patient education has improved over the years with a high percentage of physicians in different fields of medicine using online resources to educate their patients. [21, 22] Furthermore, an experimental study showed that patients exposed to online learning reduced their fertility anxiety and improved their self-efficacy in managing their own treatment. Therefore, patient education about fertility should always be considered as part of the treatment process. Initiating fertility education early in life is important for helping individuals of all ages preventing and/or overcoming infertility problems.

Gender was also associated with IVF preferences in both the bivariable and the multivariable-adjusted logistic models although at a borderline statistically significant level. Gender was found to be significant in the second IVF question where males were more likely to agree to IVF when donor sperm and/or eggs would be used. The opposite was found for the first question where females where more agreeable to IVF even though embryos could be lost during the process. There may be several potential explanations for the above findings. Women in general lack specific information and/or education about the IVF procedure. In addition, a strong desire to become a mother may overcome associated ethical dilemmas (explaining the findings of both questions). Finally, our gender result could be a random finding or specific to our study sample. Nevertheless, gender differences we documented and this finding should be considered when addressing IVF education and patient concerns.

Marital status would be expected to be associated with an increased desire to undergo IVF and in fact, in our study, marital status was a significant predictor of IVF preferences even when embryos could be wasted during the IVF process. This finding could also be correlated with the relatively high religiosity of our sample.

Occupational category was not statistically significantly associated with IVF preferences although healthcare professionals were less likely to express preferences for IVF compared to other occupations. This could be a finding related to the small sample size in the healthcare sector professional category of our study. Another explanation may be that the desire for a family is not affected by the occupational status. This finding is contradictory to what is expected since healthcare professionals are well educated and thus are expected to be more knowledgeable about IVF and perhaps more agreeable to the procedure. However, this is in line with prior findings that medical trainees and GPs are not well educated about sexual health and/or fertility issues. [20, 23]

Religion is defined as “The way in which people (communities, families and the individuals within them) negotiate their prosperity in relation to the powers that bear upon and sustain them”. [24] Fertility is related to marriage, childbirth, family formation and the social structure of the community, thus treatment for infertility such as IVF is regarded as a religious and/or ethical dilemma. Also, religion is of significance when considering IVF due to the individual differences in opinion that exist on the moral status of the embryo. [25] IVF acceptability differs by religion across and within different countries. [26] Christianity with several denominations provides an important example of the variability in choice among individuals. Roman Catholics are against all forms of IVF. The Eastern Orthodox Church supports assisted reproductive technologies however it does not agree on the involvement of donor sperm and/or eggs. The Protestant Church with hundreds of different denominations within has different positions on IVF. In general they are more permissive on IVF procedures. Judaism appears to be the most liberal religion agreeing to all forms of assisted reproductive technologies. Within the Islam, fertility is considered a duty and IVF is acceptable only when it involves the husband and wife. In our study, high religiosity was found to be a inversely related to IVF population preferences and should be considered when educating individuals about fertility treatment. The findings of our study are consistent with a prior publication that reported religiosity to be a factor associated with infertility treatment. [27] Due to the significance of religion, counsellors, educators and medical staff should consider religious background when providing counselling and medical services related to infertility treatment including IVF.

Several strengths and limitations of our study have been identified. This is the first study in Cyprus which specifically associated IVF population preferences with personal characteristics including religiosity. In addition, we used a simple, well-validated sampling methodology with a relatively large sample size (n=1000) that improves precision and generalizability of our findings. Limitations of our study include potential non-response bias (a common limitation in surveys). [28] In addition, our study sample was skewed towards female gender compared to the national average. The combination of some categories of the IVF preferences and other personal characteristics within the multivariable-adjusted models may have resulted in loss of information. This was done to account for small samples in certain variable categories and the inaccuracy of the model due to the difficulty in calculating the Maximum Likelihood Estimator. This prohibited the use of Multinomial logistic regression. An Ordinal regression was also not attempted because there was no clear order in the IVF preferences. Besides, the survey questions were presented to the participants over the telephone which may have provided limited time for an informed decision. Furthermore, conversations over the telephone may have not been clear and understandable to certain individuals including those with a lower educational level, thus affecting our findings through potential information bias. This is evident in the greater than 10% responses of “do not know/do not answer” for IVF preferences. Finally, the high level of homogeneity of the Cypriot population with regards to religion should be considered when generalizing the findings from this report to other multi-cultural and/or multi-religious societies.

Conclusion

Our study has documented important differences among individuals with respect to IVF preferences even within a relatively homogeneous social, cultural and religious environment. Understanding how people make their decisions to undergo such a procedure / treatment is important for future reference so that educational tools and methods may be used to assist individuals with such important and morally loaded decisions.[29] The future employment of qualitative studies where individuals could express their thoughts, feelings and concerns in their own environment towards IVF preferences may be warranted in order to explore individual differences given that the decision to undergo IVF treatment is considered a highly personal and sensitive issue.

Within the Greek Cypriot population, those at younger age and with higher education were more favourable for IVF treatment. On the other hand, people with high religiosity in Cyprus, which is characterized by a more homogeneous cultural environment including an Eastern Orthodox religion and culture, were less likely to agree on IVF used as an infertility treatment. Gender differences also exist when considering IVF however their effect was more complex. Educating and counselling individuals (starting at a young age) by addressing personal and religious concerns should provide a more informed decision on IVF preferences and ultimate choices.

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| **Table 1: Cross tabulation between participant characteristics and IVF preferences (based on the knowledge that multiple embryos would be wasted in the IVF process).** | | | | | | |
| **Participant characteristics** | **Total (%)†** | **Strongly agree**  **N (%)** | **Low agreement**  **N (%)** | **Do not agree**  **N (%)** | **Do not know / Do not Answer**  **N (%)** | **p – value** |
| **Age-group (years)**  20 – 40  40 – 60  > 60 | 276(27.6)  437(43.7)  287(28.7) | 193(70)  285(65)  142(49) | 18(6)  25(6)  14(5) | 38(14)  72(17)  85(30) | 27(10)  54(12)  46(16) | 0.0001\* |
| **Gender**  Male  Female | 308(30.8)  692(69.2) | 180(58)  441(64) | 17(6)  40(6) | 68(22)  127(18) | 43(14)  84(12) | 0.3826 |
| **Education**  Primary  Secondary  Tertiary | 203(20.3)  475(47.5)  322(32.2) | 105(52)  294(62)  222(69) | 14(7)  26(5)  17(5) | 45(22)  103(22)  47(5) | 39(19)  52(11)  36(11) | 0.0018\* |
| **Marital status**  Married  Single – Other | 905(90.5)  95(9.5) | 556(61)  65(69) | 53(6)  4(4) | 176(19)  19(20) | 120(73)  7(7) | 0.3277 |
| **Type of Work**  Healthcare  Other | 46(4.6)  953(95.3) | 30(65)  590(62) | 1(2)  56(6) | 11(24)  184(19) | 4(9)  123(13) | 0.5279 |
| **Religiosity\*\***  High  Low  None | 580(58.0)  362(36.2)  55(5.5) | 340(59)  236(65)  44(80) | 36(6)  21(6)  0(0) | 130(22)  56(12)  7(13) | 74(13)  49(14)  4(7) | 0.0124\* |

\* Statistical significance at α=0.05

\*\* 3 participants responded “other” to the Religiosity question and were excluded

† Percentages for the Total column are vertical

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| **Table 2: Cross-tabulation between participants characteristics and IVF preferences (knowing that donor sperm and/or eggs would be used)** | | | | | |
| **Participant characteristics** | **Strongly agree**  **N (%)** | **Low agreement**  **N (%)** | **Do not agree**  **N (%)** | **Do not know / Do not Answer**  **N (%)** | **P – value** |
| **Age-group (years)**  20 – 40  40 – 60  > 60 | 62(22)  72(16)  26(9) | 26(9)  21(5)  9(3) | 134(49)  235(54)  169(59) | 54(20)  109(25)  83(29) | 0.0001\* |
| **Gender**  Male  Female | 64(21)  96(14) | 17(5)  39(5) | 153(50)  385(56) | 74(24)  172(25) | 0.0497\* |
| **Education**  Primary  Secondary  Tertiary | 17(8)  73(15)  70(22) | 6(3)  27(6)  23(7) | 110(54)  267(56)  161(50) | 70(35)  108(23)  68(21) | 0.0001\* |
| **Marital status**  Married  Single – Other | 134(15)  26(27) | 48(5)  8(8) | 491(54)  47(50) | 232(26)  14(15) | 0.0023\* |
| **Type of Work**  Healthcare  Other | 6(13)  154(16) | 1(2)  55(6) | 26(57)  511(54) | 13(28)  233(24) | 0.6579 |
| **Religiosity**  High  Low  None | 77(13)  67(18)  16(29) | 30(5)  20(6)  6(11) | 341(59)  171(47)  23(42) | 132(23)  104(29)  10(18) | 0.0005\* |

\* Statistical significance at α=0.05

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| **Table 3: Bivariable logistic regression associations between participant characteristics and IVF population preferences**  **(IVF preference = 1 when response was a high or low agreement, and IVF preference = 0 when there was no agreement)** | | | | | | |
|  | **IVF preferences knowing that multiple embryos could be wasted during the IVF process** | | | **IVF preferences knowing that donor sperm and/or eggs would be used** | | |
|  | **N** | **OR (95% CI)** | **P-value** | **N** | **OR (95% CI)** | **P-value** |
| **Age-group (years)**  20 – 40  40 – 60  >60 | 873 | 3.025 (1.959 – 4.674)  2.354 (1.629 – 3.401)  1.0 | <0.0001\*  <0.0001\* | 754 | 3.171 (2.017 – 4.986)  1.911 (1.236 – 2.955)  1.0 | <0.0001\*  0.0036\* |
| **Gender**  Male  Female | 873 | 0.765 (0.546 – 1.072)  1.0 | 0.1201 | 754 | 1.510 (1.082 – 2.107)  1.0 | 0.0153\* |
| **Education**  Primary  Secondary  Tertiary | 873 | 0.520 (0.327 – 0.827)  0.657 (0.465 – 0.929)  1.0 | 0.0058\*  0.0118\* | 754 | 0.362 (0.216 – 0.607)  0.648 (0.460 – 0.914)  1.0 | 0.0001\*  0.0134\* |
| **Marital status**  Married  Single – Other | 873 | 0.953 (0.558 – 1.627)  1.0 | 0.8609 | 754 | 0.512 (0.319 – 0.822)  1.0 | 0.0056\* |
| **Type of Work**  Healthcare  Other | 872 | 0.803 (0.396 – 1.628)  1.0 | 0.5423 | 753 | 0.659 (0.281 – 1.540)  1.0 | 0.3353 |
| **Religiosity**  High  Low  None | 870 | 0.460 (0.202 – 1.047)  0.730 (0.313 – 1.705)  1.0 | 0.0642  0.4674 | 751 | 0.328 (0.176 – 0.612)  0.532 (0.281 – 1.008)  1.0 | 0.0005\*  0.0529 |

\* Statistical significance at α=0.05

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| **Table 4: Multivariable-adjusted logistic regression models evaluating the association between religiosity and other participant**  **characteristics with IVF population preferences**  **(IVF preference = 1 when response was a high or low agreement, and IVF preference = 0 when there was no agreement).** | | | | |
| **IVF preferences knowing that multiple embryos**  **could be wasted during the IVF process (N=869)** | | | **IVF preferences knowing that donor sperm and/or eggs would be used (N=750)** | |
|  | **OR (95% CI)** | **P-value** | **OR (95% CI)** | **P-value** |
| **Religiosity**  High  Low  None | 0.471 (0.199 – 1.114)  0.851 (0.354 – 2.046)  1.0 | 0.0863  0.7189 | 0.427 (0.220 – 0.828)  0.706 (0.361 – 1.380)  1.0 | 0.0117\*  0.3092 |
| **Age-group (years)**  20 – 40  40 – 60  >60 | 3.504 (2.007 – 6.118)  2.282 (1.526 – 3.412)  1.0 | <0.0001\*  <0.0001\* | 2.889 (1.672 – 5.024)  1.791 (1.126 – 2.848)  1.0 | 0.0001\*  0.0139\* |
| **Gender**  Male  Female | 0.719 (0.492 – 1.049)  1.0 | 0.0869 | 1.347 (0.932 – 1.946)  1.0 | 0.1124 |
| **Education**  Primary  Secondary  Tertiary | 0.817 (0.462 – 1.445)  0.598 (0.386 – 0.925)  1.0 | 0.4871  0.0211\* | 0.672 (0.369 – 1.223)  0.790 (0.538 – 1.160)  1.0 | 0.1932  0.2285 |
| **Marital status**  Married  Single | 1.959 (1.012 – 3.794)  1.0 | 0.0461\* | 0.982 (0.558 – 1.725)  1.0 | 0.9483 |
| **Type of work**  Healthcare  Other | 0.568 (0.266 – 1.210)  1.0 | 0.1426 | 0.497 (0.205 – 1.204)  1.0 | 0.1215 |

\* Statistical significance at α=0.05