Journal of Family and Reproductive Health Summer 2007; 1(1): 41-46

Body Mass Index and success rate of IVF

Farshad Savadkouhi [1] M.D., Mina Jafarabadi [2] M.D., Fatemeh Ramezanzadeh [2] M.D.

1 Military University of Medical Sciences, Tehran, Iran.
2 Vali-e-Asr Reproductive Health Research Center, Medical Sciences/University of Tehran,Iran.

Received March 2007; Revised and accepted June 2007.

Abstract

Objective: This study investigated the effect of body mass index (BMI) on the success rate of IVF for couples with different causes of infertility.

Materials and methods: In a descriptive- analytic study conducted simultaneously in Mehr IVF center and Vali-e-Asr Reproductive Health Research Center, the success rate of IVF was examined in 396 consecutive women undergoing IVF cycles. Clinical pregnancy rate per first cycle of IVF was evaluated with regard to BMI. SPSS 11 software was used for statistical analyses. Significance level was identified as $P< 0.05$ in data analysis.

Results: Women with a BMI of ≥27 kg/m^2 had a significantly lower pregnancy rate compared with normal weight women (BMI ≥20 and <27 kg/m^2), OR = 0.67 (95% CI 0.48–0.94).For male infertility the rate of pregnancy per cycle was significantly lower than unexplained infertility, OR = 0.70 (95% CI 0.57–0.86.) For tubal pathology the rate was slightly lower than unexplained infertility, OR = 0.86 (95% CI 0.70–1.01).

Conclusion: Overweight unfavorably affects the pregnancy rate after IVF. Infertile couples may improve the outcome of IVF treatment by lifestyle changes.

Key words: Body Mass Index, IVF, pregnancy rate, infertility diagnosis

Introduction

To improve success rates of infertility management, IVF initially developed as a technique to assist reproduction in women with bilateral tubal obstruction (1). Other studies on the success rate of IVF by cause of infertility have shown inconsistent results (2, 3). However, in the largest study on IVF effectiveness (4), carried out in the UK including 36961 cycles, no significant differences were observed in live birth rate comparing tubal pathology, endometriosis, unexplained infertility and cervical and uterine infertility. The prognostic model developed by Templeton *et al.* did not give additional predictive information for the majority of IVF patients in The Netherlands in the study by Smeenk *et al* (5). Lifestyle factors were not included in these studies. The main goal of the present analyses was to explore possible predictive factors such as duration of infertility, and female age, for infertile couples with different causes of infertility. As there is evidence of an overall detrimental effect of extremes of body mass index (BMI) on the outcome of fertility treatment (6- 9), we studied

Correspondence:
Mina Jafarabadi,Vali-e-Asr Reproductive Health Research Center, Imam Hospital Complex, Keshavarz Blvd., Tehran, 14194, Iran. Tel: +98-2166939320 Fax: +98-2166937321
E-mail: ramezanz@tums.ac.ir

BMI as a possible prognostic factor. Like the Templeton model we distinguished the major causes of infertility, and added male infertility and some lifestyle factors.

Materials and methods

Women with infertility of ≥1 year duration were included if they had completed at least one IVF treatment cycle between January 1 and August 1, 2006, in one of the two selected IVF centers in Tehran. The centers included Vali e Asr Reproductive Health Research Center, the infertility center affiliated to Tehran University of Medical Sciences and Mehr IVF center a private infertility center. Laboratory settings were copied and treatment protocols were similarly applied by the same group of gynecologists in the two centers. During the evaluation period 396 IVF cycles were studied. A questionnaire was filled for women by trained IVF coordinators to obtain information on gynaecological disorders before and after infertility treatment, and some lifestyle factors. Data from both the patient records and pregnancy follow-up were collected by trained research assistants, who abstracted data from the medical files on gynaecological history, infertility diagnosis, fertility hormones used prior to IVF treatment, and detailed information about each IVF cycle, the number of retrieved oocytes, occurrence of complications and whether or not the treatment resulted in a pregnancy.. After deleting dropout cases 362 women completed IVF cycles and were included in final analyses. Infertility diagnosis was based on medical record information and divided into four categories: male infertility, tubal pathology, unexplained infertility, polycystic ovarian syndrome (PCOS), endometriosis and ovarian failure. Each woman was only categorized once, the one assumed to contribute most to the infertility. Duration of infertility was determined by the period between the start of the involuntary childlessness, as reported by the woman, and the date of first IVF attempt. Education level was divided into low (those with less than 5 grades training), middle (with to 12 grades training) and high (with high vocational training or academic degrees). Underweight was defined as having a BMI <20 kg/m^2, normal weight as a BMI of 20–27 kg/m^2 and overweight as a BMI ≥27 kg/m^2. The BMI was calculated with the women's weight at the time of first visit to the gynaecologist. If an IVF attempt had started within 4 weeks of the estimated conception date, the pregnancy was considered to be the result of the IVF attempt, unless the medical record stated that a spontaneous pregnancy followed the IVF attempt. The implantation rate was defined as the number of chemical pregnancy per embryo transferred. Clinical pregnancy was defined as detectable fetal heart motion in transvaginal sonography 4 weeks after positive serum pregnancy test. Total fertilization failure (TFF) was defined when none of the oocytes was fertilized after IVF. An abortion was defined as a pregnancy loss between 6 and 16 weeks of amenorrhoea. The following complications were registered: ovarian hyperstimulation syndrome (OHSS) leading to hospitalization, other medical problems resulting in admission and ectopic pregnancies.

The statistical program SPSS 11 software was used for statistical analyses. Univariate frequencies and means were calculated to describe the women and their first IVF cycles. All analyses were done first on all women, including those with unknown cause of infertility, and then by cause of infertility.

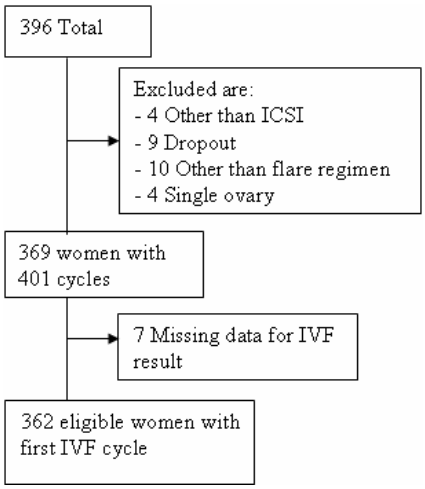
Multivariate logistic regression was done to study the independent and combined effects of potential determinants on the pregnancy rate. We included cause of

infertility, BMI (continuous and in three categories) and period of IVF in the model, together with factors that have previously been reported in the literature to predict the success rate of IVF. These factors were: primary versus secondary infertility, age at treatment (continuous and in two categories) and duration of infertility. The results for variables included in the study did not change according to whether we included age and BMI as categorical or continuous variables. We included the results for the categorical variables in table 1 and added the estimates for the continuous variables per unit change to the text. The resulting regression estimates were transformed to present odds ratios (OR) for those in a category as compared with the reference category,with all other factors equal.

Results

The study population was consisted of 396 women who underwent their first cycle of IVF. Figure I gives a graphical presentation of the study population.

Figure 1: Description of the recruitment of eligible women and cycles.



Education was comparable to the Iranian population of women of childbearing age in the period studied and the different education levels were equally represented in all infertility categories and the two understudy centers. There was no difference in duration of infertility before the first treatment between the major subgroups we analyzed. No significant differences in the distribution of extreme over- or underweight women between diagnostic categories were observed. The outcome of the first cycles in women with a main diagnosis of tubal pathology (131 cycles), male infertility (95 cycles) and unexplained infertility (79 cycles) were analysed, using various outcome measures. Cycles with other known causes of infertility (27) were also examined.

The average number of embryos per transfer was 2.2 (range 0–7, median 2). The overall pregnancy rate per cycle was 15.2%. The overall implantation rate per cycle was 10.7%.

For the three major infertility causes analyzed, we found evidence of a clear and significant (p<0.0001) trend of declining pregnancy rates with increasing female age. The overall pregnancy rate per cycle decreased with 2% (p=0.03) for each additional year of the female age.

The effect of BMI was compared per diagnostic category. There was a significantly higher pregnancy rate per cycle in women with normal weight (BMI ≥20–25 kg/m^2) and slight overweight (BMI 25–27 kg/m^2) compared with women with evident overweight with a BMI ≥27 kg/m^2. The unfavorable effect of overweight was largest for women with unexplained infertility. Underweight women had similar pregnancy rates compared to women of normal weight.

Table 1 shows the results of multivariate analyses of predictors of the ongoing pregnancy rate as a result of the first IVF cycle, after successful oocyte retrieval and after embryo transfer. The first row gives the intercept, and the corresponding pregnancy rate for those

with reference values for all variables. Overweight women (BMI >27 kg/m^2) had a 33% reduced chance of a pregnancy in their first IVF cycle. The association with overweight was strongest in women with unexplained infertility. BMI and age were also both included as continuous variables. The effect estimates were similar for pregnancy rate per cycle, per oocyte retrieval and per embryo transfer: BMI per unit OR = 0.98 (0.95–1.00) and age per year OR = 0.98 (0.96–1.00). Women with primary infertility had the same pregnancy rate as women with secondary infertility. The duration of infertility did not influence the pregnancy rate for the three major infertility categories.

Table 1: Multivariable logistic regression model of the probability of pregnancy after first cycle of IVF

	Per cycle	Per oocyte retrieval	Per embryo transfer
Intercept	–1.4426	–1.2229	–0.9500
Pregnancy rate (%)[a]	19.1	22.7	27.9
Age (years)			
<35	1	1	1
≥35	0.80 (0.67–0.96)	0.83 (0.69–1.00)	0.83 (0.69–1.00)
Body mass index (kg/m^2)			
20–27	1	1	1
<20	0.99 (0.82–1.19)	0.97 (0.80–1.17)	0.97 (0.80–1.18)
≥27	0.67 (0.48–0.94)	0.72 (0.51–1.02)	0.73 (0.52–1.03)
Unexplained infertility	1	1	1
Tubal pathology	0.86 (0.70–1.01)	0.86 (0.71–1.05)	0.81 (0.66–0.99)
Male infertility	0.70 (0.57–0.86)	0.69 (0.56–0.85)	0.93 (0.75–1.16)
Other known factor	0.92 (0.68–1.23)	0.94 (0.70–1.27)	0.92 (0.68–1.25)
Secondary infertility	1	1	1
Primary infertility	0.96 (0.81–1.15)	0.96 (0.81–1.15)	0.99 (0.83–1.16)
Duration of infertility (years)			
<8	1	1	1
≥8	0.79 (0.62–1.00)	0.84 (0.66–1.08)	0.90 (0.70–1.16)

Values are odds ratios (95% confidence intervals) unless otherwise indicated.
[a] Calculated pregnancy rate.
The final model to calculate the pregnancy rate (PR) is shown below. All variables are indicators: ln (PR/(1–PR))=–1.4426–0.3285 age ≥35–0.010 BMI <20–0.4005 BMI ≥27–0.1508 tubal pathology–0.3567 male subfactor–0.0834 other factor–0.041 primary subfactor+0.0432 treatment ≥1990 –0.236 duration subfactor ≥8 years.

Discussion

This study showed that overweight during IVF treatment had significant deteriorating effects on the pregnancy rates. In this dataset we found that the pregnancy rate for male infertility was significantly lower compared to unexplained infertility and tubal pathology. Advancing female age had an unfavorable effect on the success rate of IVF for all infertility causes. Overweight during IVF treatment had deteriorating effects on the pregnancy rates.

When interpreting our results, the strengths and limitations of our study must be considered. Advantage of our analyses is to include both private and university centers in the study population and the availability of nearly complete information on details of IVF treatment from the medical records and outcome of

all pregnancies from the women themselves. The other advantage is that the analysis was not based on women's response rate since the questionnaires were completed at the time of patients' primary admission.

Most of our results correspond with the results of the study by Templeton *et al* (4). For tubal pathology the pregnancy rate was significantly lower given an embryo transfer, compared to unexplained infertility and male infertility. The explanation for this difference could be the negative effect of tubal pathology on the implantation processes and the embryotoxicity of hydrosalpinx fluid (10).

There is a clear association of an increased BMI, risk of complications during pregnancy and a higher chance of abortion and subfertility (6- 8). After multivariable logistic regression modelling, we also found a significant effect of overweight (BMI ≥27 kg/m^2) on the pregnancy rate per cycle, with an OR of 0.67 (95% CI 0.48–0.94).

Besides dependency on calendar period, prognostic models for IVF depend on the success rate of the treating hospital (4, 11, 12), patient characteristics and the number of previous IVF cycles (3, 4, 13). Publications suggest constant success rates for each of the first three cycles (14, 15). Some attribute this to active censoring, which leads to withdrawal of couples with poor prognosis (16). For reasons of comparability we therefore restricted our analyses in the present study to the first IVF treatment cycle only.

As a suggestion in order to assess the differences in success rates of IVF between the various infertility causes or different BMI groups a long-term clinical trial will be the best option, comparing the pregnancy rates of IVF or ICSI treatments with no treatment. A second-best option is the comparison of the spontaneous pregnancy rate in infertile couples on the waiting list for IVF or ICSI, with the results of IVF- or ICSI-treated couples.

In conclusion, we observed differences in success rate between infertility causes in favor of unexplained infertility. Overweight had a strong harmful effect on the live birth rate after IVF. The effect of overweight was largest among women with unexplained infertility. These results suggest that women, and in particular those with unexplained infertility, may be able to improve the outcome of infertility treatment by losing weight.

Acknowledgement

We greatly thank Miss Maryam Bagheri for her attempts in case selection and accurate data gathering during the study.

References

1- Steptoe PC, Edwards RG. Birth after the reimplantation of a human embryo. Lancet 1978; 2(8085): 366.
2- Alsalili M, Yuzpe A, Tummon I, Parker J, Martin J, Daniel S,et al. Cumulative pregnancy rates and pregnancy outcome after in-vitro fertilization: > 5000 cycles at one centre. Hum Reprod 1995; 10(2): 470-474.
3- Tan SL, Royston P, Campbell S, Jacobs HS, Betts J, Mason B, Edwards RG. Cumulative conception and livebirth rates after in-vitro fertilisation. Lancet 1992; 339(8806): 1390-1394.
4- Templeton A, Morris JK, Parslow W. Factors that affect outcome of in-vitro fertilisation treatment. Lancet 1996; 348(9039): 1402-1406.
5- Smeenk JM, Stolwijk AM, Kremer JA, Braat DD. External validation of the templeton model for predicting success after IVF. Hum Reprod 2000; 15(5): 1065-1068.
6- Norman RJ, Clark AM. Obesity and reproductive disorders: a review. Reprod Fertil Dev 1998; 10(1): 55-63.
7- Wang JX, Davies M, Norman RJ. Body mass and probability of pregnancy during assisted reproduction treatment: retrospective study.BMJ 2000 25; 321(7272): 1320-1321.

8- Wang JX, Davies MJ, Norman RJ. Obesity increases the risk of spontaneous abortion during infertility treatment. Obes Res 2002; 10(6): 551-554.
9- Nichols JE, Crane MM, Higdon HL, Miller PB, Boone WR. Extremes of body mass index reduce in vitro fertilization pregnancy rates. Fertil Steril 2003; 79(3): 645-647.
10- Johnson NP, Mak W, Sowter MC. Laparoscopic salpingectomy for women with hydrosalpinges enhances the success of IVF: a Cochrane review. Hum Reprod 2002; 17(3): 543-548.
11- Haan G, Bernardus RE, Hollanders JM, Leerentveld RA, Prak FM, Naaktgeboren N. Results of IVF from a prospective multicentre study. Hum Reprod 1991; 6(6): 805-810.
12- Kremer JA, Beekhuizen W, Bots RS, Braat DD, van Dop PA, Jansen CA, et al. [Results of in vitro fertilization in the Netherlands, 1996-2000] Ned Tijdschr Geneeskd 2002; 146(49): 2358-2363.
13- de Mouzon J, Rossin-Amar B, Bachelot A, Renon C, Devecchi A. FIVNAT. Influence of attempt rank in in vitro fertilization] Contracept Fertil Sex 1998; 26(7-8): 466-472.
14- Haan G, Bernardus RE, Hollanders HM, Leerentveld BA, Prak FM, Naaktgeboren N. Selective drop-out in successive in-vitro fertilization attempts: the pendulum danger. Hum Reprod 1991; 6(7): 939-943.
15- De Vries MJ, De Sutter P, Dhont M. Prognostic factors in patients continuing in vitro fertilization or intracytoplasmic sperm injection treatment and dropouts. Fertil Steril 1999; 72(4): 674-678.
16- Land JA, Courtar DA, Evers JL. Patient dropout in an assisted reproductive technology program: implications for pregnancy rates. Fertil Steril 1997; 68(2): 278-281.