ORIGINAL RESEARCH

Do sperm motility, morphology or associated factors predict the success rate of intrauterine insemination?

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Abstract

Objective: Infertility is a global health issue among couples of reproductive age. Intrauterine insemination (IUI) is a fertility treatment method where the processed sperms are deposited in the female uterus during the time of ovulation. The aim of this study was to explore the factors predicting the success rate of IUI (IUI-SR).

Materials and Methods: A descriptive retrospective study was conducted analysing SFA and corresponding IUI reports of couples who underwent IUI from January 2017 to August 2021 at the Professorial unit of Colombo South Teaching Hospital, Sri Lanka. The data were analysed using SPSS version 22.0.

Results: A total of 140 SFA and corresponding IUI reports were used. The IUI-SR was 18.57% (n=26). A significantly high IUI-SR was noted when the female partner aged <30 years compared to >30 years (p=0.000, OR=1.87), with first two IUI attempts compared to multiple IUI attempts (p=0.017, OR=0.271), pre-processed sperm concentration >30M/ml compared to <30M/ml (p=0.019, OR=3.12), and pre-processed sperm motility (progressive and non-progressive) >40% compared to <40% {p=0.039, OR=5.31). The period of abstinence (p-value=0.222), pre-processed sperm parameters such as total count (p-value=0.093), normal form morphology (p-value=0.082), viability (p-value=0.093), or post-processed sperm parameters such as concentration, progressive motility did not significantly influence the IUI-SR.

Conclusion: A significantly high success rate of IUI can be achieved when the female partner is aged <30 years and with the first two IUI attempts. Pre-processed sperm concentration >30M/ml, and pre-processed sperm motility of progressive >32% and non-progressive <15% also predict a higher success rate of IUI.

Keywords: Intrauterine insemination, sperm concentration, motility, morphology

Introduction

At present, infertility has become a major health issue among couples who try to conceive. World Health Organization defines infertility as a disorder of the male or female reproductive system or both reproductive systems, which fails to accomplish clinical pregnancy within one year or more with

unprotected regular sexual intercourse1. Globally, 8% to 15% of couples have fertility-related health problems (1). It is estimated that 35% of female factors, 30% of male factors, and 20% of both female and male factors lead to infertility. On the other hand, approximately 15% have unexplainable infertility (2).

In males, fertility can be affected by several factors such as genetic factors, hormonal imbalance, congenital anomalies, environmental and occupational factors, and psychological status leading to changes in sperm parameters resulting male infertility. Spermatozoa are produced through the process of spermatogenesis in the seminiferous tubules of the testis. Seminal fluid is a pale white, viscid, and opalescent secretion produced by male reproductive organs during sexual intercourse. Semen is composed of spermatozoa and seminal fluid. Seminal fluid analysis (SFA) is an investigation used to detect the fertility level of a semen sample. Microscopic sperm parameters such as sperm concentration, motility, morphology, vitality, and agglutination as well as macroscopic sperm parameters of semen appearance, volume, viscosity, and liquefaction time can be obtained through SFA (3).

Semen quality reduction may visualize as a reduction of sperm count (Oligozoospermia), reduction of sperm motility (asthenozoospermia), a combination of both reduced sperm count and sperm motility (Oligoasthenozoospermia), absence of sperms (azoospermia), or a high percentage of sperms with abnormal morphology (teratozoospermia). Additionally, reduced semen liquefaction time or reduction of semen volume or reduction of sperm vitality can contribute to low semen quality. (4)

Several assisted reproductive techniques (ARTs) are in use to treat various types of infertility conditions. Intrauterine insemination is one of the first-line fertility treatment techniques where processed healthy sperms are directly placed in the uterus at the time of ovulation to facilitate the fertilization process. Currently, this less invasive and less expensive fertility treatment method is more popular with increasing infertility cases among couples (5). Infertility related to less sperm counts, reduced sperm motility, unexplainable infertility, hostile cervical conditions, and ejaculatory dysfunction, have more advantages with the intrauterine insemination technique.

The IUI procedure is composed of several steps; ovarian stimulation, triggering ovulation following follicular tracking, sperm preparation, insemination and resting. Synthetic ovarian stimulants are used to stimulate ovaries. Ovulation triggering can be achieved using human Chorionic Gonadotropin (HCG) (6). Processed sperms are introduced to the uterus at the time of the ovulation. In Sri Lanka, intrauterine insemination (IUI) is a well-known fertility treatment technique used in many fertility treatment clinics.

There are two main methods to process raw semen samples, the density gradient method and swim up method. The density gradient method is considered best to select good-quality spermatozoa (7). This method is mostly used for patients with low initial sperm counts in order to concentrate good quality sperms.

The results obtained through the density gradient method are more consistent and easier to standardize than swim-up or other processing methods.

Published literature shows controversial associations between sperm parameters (sperm concentration, motility etc. and the intrauterine insemination success rate (IUI-SR). Different sources have suggested different correlations between IUI-SR and demographic factors such as age of the female partner, number of IUI attempts, sperm parameters such as sperm concentration, sperm motility, sperm morphology, sperm count, and sperm vitality related to IUI-SR (9). According to Advanced Fertility center of Chicago, the first IUI attempt is the most effective IUI attempt to gain a successful IUI pregnancy (9). Also, the IUI success rate after three IUI attempts is much lower than first three. Related to female age, a high IUI-SR can be achieved with age of female below 30 years of age and advancing female age has negative impact on IUI-SR(9). Total motile perm count >20 million has shown high IUI-SR compared to 5-10 million and 10-20 million (9).

The purpose of the present study was to explore the association of demographic factors such as the age of the female partner, number of IUI attempts, and period of abstinence from last ejaculation, and pre-processed sperm parameters such as concentration, total motility, progressive motility, non-progressive motility, sperm morphology, viability, total sperm count; further the post-processed sperm parameters such as concentration and percentage of progressive sperm motility with IUI-SR which identified through SFA and with semen processed through density gradient method.

Materials and Methods

A descriptive retrospective study was conducted including 140 SFA reports and the corresponding IUI reports of couples who underwent IUI treatment at the Fertility and Andrology clinic of the Professorial unit of Colombo South Teaching hospital, during January 2017 to August of 2021. The sample size was calculated using the Cochran Formula for sample size calculation. The statistical power of the study or the probability to reject the null hypothesis was (not to commit type 2 error) was high with acquired sample size (140) of the study which mentioned in the results section. The Cronbach's Alpha value of the study was 0.849 with a significance of $P < 0.05$. So the internal consistency was "Good" and the research tool was reliable. All IUI reports related to couples with female factor infertility such as tubal patency, ovulation failures, endometriosis, polycystic ovarian syndrome and etc., and the IUIs which did not have the corresponding SFA report were excluded from the study. The ethical clearance was obtained from the Ethics Review Committee of Colombo South Teaching hospital.

The considered key factors of the study were categorized into three main categories, demographic factors, pre-processed sperm parameters and post-processed sperm parameters. The data of demographic details (age of the female partner, period of abstinence from ejaculation, number of IUI attempts), pre-

processed sperm parameters (sperm concentration, percentages of total, progressive, non-progressive sperm motilities, percentage of normal form of sperm morphology, percentage of sperm viability, total sperm count), post-processed sperm parameters (concentration and percentage of progressive sperm motility) and pregnancy status were systematically extracted to a pre-designed data extraction form, from the SFA and IUI registries which were available in the Fertility and Andrology clinic of CSTH. Pregnancy status has been confirmed by urine or blood HCG (Human Chorionic Gonadotropin) tests. The data were analysed with the correlation test, cross-tabulation, and frequency test using the SPSS statistical software version 22.0.

Results

Out of 140 study samples, 26 (18.57%) reported IUI pregnancies were noted. The mean age ±SD of females and males were 33.28±6.00 and 35.28±5.29 years respectively. Female age factor was stratified into five categories for the purpose of statistical analysis. A significantly high IUI-SR was noted (Pearson correlation= 0.310, p=0.000) when the age of the female partner is less than 30 years compared to females aged above 30 years. The number of IUI attempts was stratified into seven categories from one to seven, according to the IUI attempt number. A significantly (Pearson correlation=0.180, p value=0.017) high IUI-SR was noted with the first two IUI attempts compared to multiple IUI attempts (more than two IUI attempts).

Figure 01: Distribution of age categories of females and corresponding pregnancy success.

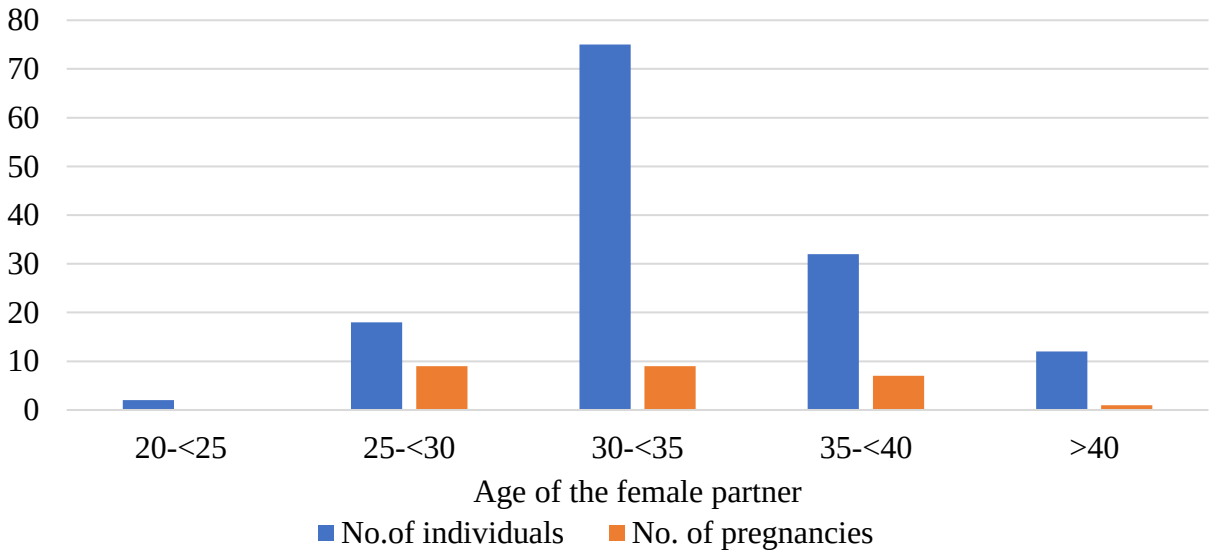
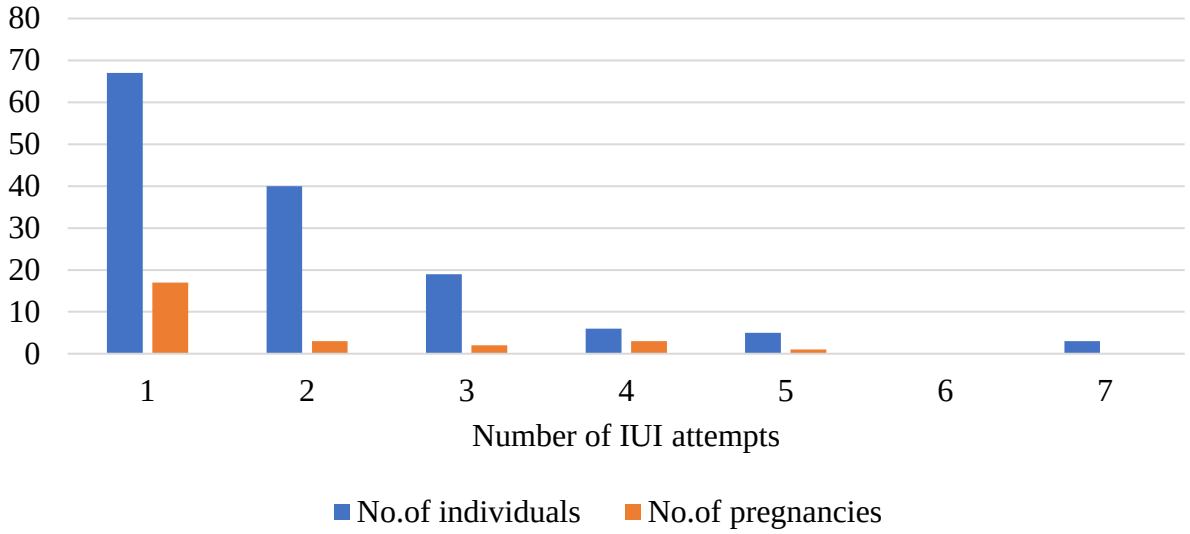
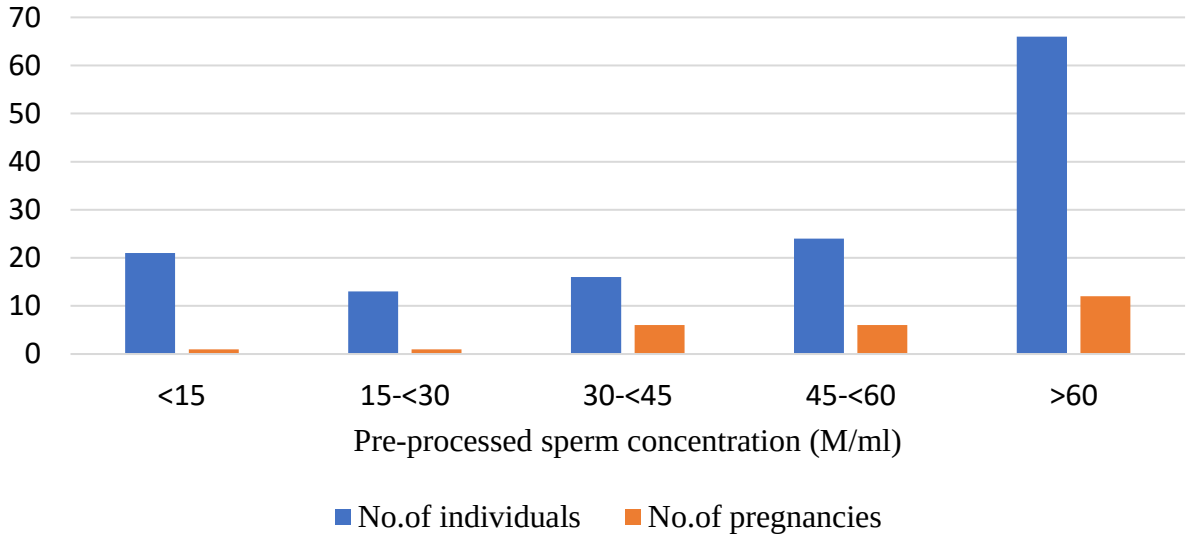


Figure 02: Distribution of number of IUI attempts and corresponding IUI success.



Pre-processed sperm concentration was categorized into five groups. A significantly (Pearson correlation=0.175, p- value=0.019) high IUI-SR was noted when the pre-processed sperm concentration is more than 30 million/ml compared to less than 30 million/ml.

Figure 03: Distribution of categorized pre-processed sperm concentrations and corresponding IUI success



Percentages of pre-processed total sperm motility were stratified into three categories, 0-39 %, 40-80 %, and more than 80 %. A significantly high IUI –SR (Pearson correlation=0.149, p=0.039) was noted, when pre-processed total sperm motility is above 40 % compared to less than 40% of pre-processed total sperm motility. Also, pre-processed progressive sperm motility was stratified into three categories, 0-31%, 32-64% percentage, and more than 64%. The lower reference values for

progressive sperm motility suggested by the Human semen processing and analysis laboratory manual 2021, World Health Organization17, were used for the above categorization.

A significantly high (Pearson correlation=0.155, p value=0.034) IUI-SR was noted when the percentage of progressive sperm motility is more than 32% compared to less than 32%. Pre-processed non-progressive sperm motility was stratified into three different categories as, 0-7 %, 8-15 %, and more than 15%. A significantly (Pearson correlation=0.227, p value=0.003) high IUI-SR was noted when pre-processed non-progressive sperm motility is less than 15 % compared to more than 15% of pre-processed non-progressive sperm motility.

Table 01: Distribution of different categories of pre-processed total, progressive and non-progressive sperm motilities and corresponding IUI success

Sperm motility parameter		Total number of couples	Total number of successful pregnancy
Total (%)	0-39%	21 (15.0%)	01 (4.7%)
	40%-80%	119 (85.0%)	25 (21.0%)
	>80%	00 (0%)	00 (0.0%)
Progressive (%)	0-31%	30 (21.4%)	02 (13.3%)
	32%-64%	104 (74.3%)	23 (22.1%)
	>64%	06 (4.3%)	01 (16.6%)
Non-progressive (%)	0-7%	40 (28.6%)	03 (7.5%)
	8%-15%	86 (61.4%)	22 (25.5%)
	>15%	14 (10.0%)	01 (7.1%)

However, parameters such as the period of abstinence from ejaculation, pre-processed total sperm count, percentage of the pre-processed normal form of sperm morphology, percentage of pre-processed sperm viability, post-processed sperm concentration, and percentage of post-processed progressive sperm motility did not show any significant association with IUI-SR. The period of abstinence from ejaculation was categorized into four categories, less than 2 days, 2-4 days, 5-7 days, and more than 7 days. However, there was no significant association (Pearson correlation=-0.065, p-value=0.222) was noted between the period of abstinence from ejaculation and the IUI-SR. The percentage of the pre-processed normal form of sperm morphology was stratified into three categories, 0-3 %, 4- 32 %, and more than 32%. However, there was no significant association (Pearson correlation= -0.118, p value=0.082) noted between the IUI-SR and

the percentage of the normal form of sperm morphology.

The percentage of sperm viability was categorized into two categories, 0-58%, and more than 58%. However, there was no statistically significant association (Pearson correlation=0.112, p value=0.093) noted between the IUI-SR and the percentage of sperm viability. When considering post-processed sperm concentration and IUI-SR, the analysis of different categories of post-processed sperm concentrations (less than 30- less than 45 million/ml, 15 million/ml, 15- less than 30 million/ml, 45- less than 60 million/ ml and more than 60 million/ml) did not show statistically significant use to predict the (Pearson correlation= 0.080, p value=0.175) IUI-SR. Finally, the percentage of post-processed progressive sperm motility was stratified into four categories, 0-31%, 32-64%, 65-96 %, and more than 96%. However, there was no statistically significant use of post-processed progressive sperm motility (Pearson correlation= 0.081, p value=0.172) to predict the IUI-SR.

Discussion

The study sample was composed of a total of 140 SFA reports and the corresponding IUI reports of couples who visited the Fertility and Andrology clinic of the Professorial unit of Colombo South Teaching Hospital from January 2017 to August 2021. The total IUI-SR of the present study was 18.57% (n=26). A significantly high IUI-SR was noted when the age of the female partner below 30 years of age compared to more than 30 years of age, with first two IUI attempts compared to multiple IUI attempts (more than two), pre-processed sperm concentration above 30 million/ml compared to less than 30 million/ml, sperm motilities of total above 40% compared to less than 40%, progressive above 32% compared to less than 32% and non-progressive less than 15% compared to more than 15%. However, the period of abstinence from ejaculation, pre-processed total sperm count, percentage of the normal form of sperm morphology, post-processed sperm concentration, and percentage of post-processed progressive sperm motility shows no significant use to predict the IUI-SR.

According to published literature (9) the IUI-SR is generally 15% to 20% of total IUIs. When considering the age of the female partner and IUI-SR, a significantly high IUI-SR was noted in the present study, when the age of the female partner is less than 30 years compared to more than 30 years. A recently published study (10) has concluded that the female age as one of the most predictive factors of the IUI-SR. Above finding strengthens the findings of the present study. In the present study, a significantly high (Pearson correlation=0.180, p value=0.017) IUI-SR was noted with the first two IUI attempts compared to multiple IUI attempts. Interestingly, with fourth IUI attempt an unusually high IUI-SR (50.0%) was observed in the present study. This odd (OR=0.271) value may perhaps be due to a less number of participants in the fourth IUI category. Literature (11) suggests that the number of IUI needed for a couple should be an individualized factor depending on the type of infertility. It is also stated that (11) the IUI-SR appears as a plateau after 05 IUI attempts,

in a graph of IUI-SR with number of IUI attempts. When considering the pre-processed sperm concentration and IUI-SR, a significantly (Pearson correlation=0.175, p-value=0.019) high IUI-SR was noted if the pre-processed sperm concentration is more than 30 million/ ml compared to less than 30 million/ ml.

In the present study, a significantly high IUI-SR was noted when pre-processed sperm motility of total above 40% compared to less than 40%, progressive sperm motility more than 32% compared to less than 32%, and non-progressive sperm motility less than 15% compared to more than 15%. According to a published literature (12), pre-processed sperm motility should be above 30% compared to less than 30% to obtain a significantly (p-value=0.001) high IUI-SR. Further, according to study (13), if the percentage of pre-processed sperm motility is 24 ± 22 %, a significantly high IUI-SR can be achieved (p=0.0001) However, according to study (14) (p-value=Not significant) the IUI-SR has no significant association with the percentage of pre-processed sperm motility. Nonetheless, most of the published literatures have shown a significant association between the IUI-SR and the percentage of pre-processed progressive sperm motility. The present study results show a negative correlation between IUI-SR and pre-processed total sperm count. A recent study (15) has shown a negative correlation between the pre-processed sperm count and the IUI-SR.

Conclusions

A significantly high IUI-SR can be achieved when the age of the female partner is < 30 years of age, with the first two IUI attempts, pre-processed sperm factors of concentration >30M/ml, total sperm motility >40%, progressive sperm motility >32%, and non-progressive sperm motility <15%. Interestingly, period of abstinence from last ejaculation, pre-processed sperm factors such as percentage of sperm viability, the percentage of normal form of sperm morphology, post-processed sperm concentration, and the percentage of post-processed progressive sperm motility have no significant value in predicting the IUI-SR.

Acknowledgement

I acknowledge the support received from the Fertility and Andrology clinic of the Colombo South Teaching Hospital, Sri Lanka.

Conflict of Interest

None declared

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