# ASSESSING THE TREND OF INFERTILITY AMONGST MEN IN ANAMBRA STATE

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***ABSTRACT***
*This study examined the trend of infertility amongst men in Anambra State. The objectives of the study include: to determine the best fit for estimating monthly reported cases of infertility in men; and to ascertain the impact of age on reported cases of infertility in men. A secondary source of data collection obtained from the records department of Nnamdi Azikiwe University Teaching Hospital Nnewi and Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Amaku Awka was used in this study. The data comprises of reported cases of infertility in men between the ages of 21 to 70 years. The statistical tools used in this study include: the least square regression analysis, augmented Dickey-Fuller test, measures of accuracy in times series analysis. The findings showed that the series on reported cases of infertility has no unit root and is stationary over time, and can be used to make a forecast for future behaviour of the process. The linear model was found to be better for estimating the number of reported cases of infertility. Also, it was found that in December 2021 the reported cases of infertility are expected to be 10 cases. Further findings revealed that age has a significant impact on the number of reported cases of infertility.*

Keyword: Age, Men, Infertility, Quadratic model, Time series.

## 1 Introduction

In as much as the problem of infertility has gotten permanent solution especially for the rich and well-placed people in the society but the poor masses cannot afford the high cost of the present medical technology that achieved zero infertility with 90.8 million of Nigerian's population still living in extreme poverty, hence the need to conduct this study.
Male infertility is the failure of a man to get his wife pregnant after one year of regular and unprotected intercourse. It will be important to note that one-third of infertility problem is due to female infertility while another one third is due to male infertility (WHO, 1975). In Nigeria, it has become very worrisome as many young couples are finding it very difficult to have children. In 2007, estimates show that between 3% and 7% of worldwide couples have unresolved problems of infertility (Weiner and Craighead, 2010).

Approximately 25% of all male infertility is caused by a sperm defect. About 40- 50% of infertility cases have a sperm defect as the main cause or a contribution cause (Chandra and Stephen, 1998). A sperm defect is present when sperm are irregularly shaped, have poor motility, no sperm count and low sperm count. It takes more than looking at sperm under the microscope to assess the ability of sperm to fertilize the female egg. Semen analysis is however the central testing component used to determine if a sperm disorder is a cause for male infertility (Berger, 1980).

Infertility and sexual dysfunction have become critical issues in Nigeria given their high rate and negative implications. Report by International Women's Health Coalition (2000) observed that 97% of marital issues in Nigeria were as a result of sexual dysfunction. Available data over the past 20 years reveal that in approximately 30%-50% of the cases of infertility, the cause is found in the man alone, and in another 20%, the causes are found in both and 50%-70%, the causes are found in the female alone (Abarikwu, 2013; Ekwere et al., 2007; Singh 1996).
The objectives of this study include: to determine the best fits estimating monthly reported cases of infertility in men in Anambra State; and to ascertain the impact of age on reported cases of infertility amongst men in Anambra State.

## 2 Review of related Literature

Male infertility refers to a male's inability to cause pregnancy in a fertile female. According to WHO (2001), infertility is a disease of the reproductive system defined by the failure to achieve the clinical pregnancy after 12 months or more of regular unprotected sexual intercourse. WHO (2001) estimates that 60-80 million couples worldwide suffer or experience infertility, and countries with higher population or fertility rates tend to experience a higher rate of infertility. Andrews et al. (1991) in their study, found out that the trend of infertility in male is at an increasing rate; and that the high rate of infertility in male depends on the population of the country. Sharan et al. (2001) examined the effects of Male Age on Semen Quality and Fertility and the finding of their study revealed that increase in the age of male is associated with a decline in semen volume, sperm motility and sperm morphology. Also, they found that infertility is more in the male that is in their late 50's and above than male below 50 years. According to Oakley et al. (2008), approximately 25% of all infertility is caused by a sperm defect. About 40-50% of infertility cases have a sperm defect as the main cause or a contributing cause. This is the legacy of male factor infertility. However, in cases of male factor infertility, defects are caused by poor sperm quality or other sperm disorders more than 90% of the time.

Mahboubi et al. (2014) determined the most common risk factors for male infertility in Iranian men. The study used a case-control approach which included 268 men attending an infertility clinic in Shiraz, Iran. The study comprises of 161 fertile men compared with 108 infertile ones regarding risk factors such as smoking habits, drug consumption, hernia, varicocele, job, and body mass index (BMI). The data were analyzed using logistic regression analysis and t-test. The findings of the study showed that the mean age of the fertile and infertile participants was $37.5 \pm 7$ and $36.3 \pm 10$, respectively. The findings showed that a significant relationship exists between male infertility and hernia, varicocele, taking ranitidine, job, and BMI. With an increase of 1 cigarette per day, there was a 1% decrease in the motility of the sperm. Moreover, with an increase of 1 year of cigarette smoking, 800,000 sperm are lost. Hence, the results revealed varicocele and hernia as the most common risk factors in men attending the infertility clinics in Shiraz. Also, strenuous work could cause testicular injury.

Uadia and Emokpae (2015) reviewed the main factors that are responsible for the problem and also highlights the need to focus on prevention and management; how those affected could be assisted by government, agencies and the private sector. The findings of their review showed that the major causes of infertility in Nigeria are sexually transmitted infections and hormonal abnormalities. They suggested that effort should be made in arriving at a proper diagnosis, and adequate treatment is given where causes are treatable. Otherwise, patients should be adequately counselled. In irreversible cases, assisted reproductive techniques may be suggested. This procedure as at now is beyond the reach of the average Nigerian citizen. Centres, where such facilities are available, may be subsidized by the government to reduce the cost.

Chimbatata and Malimba (2016) stated that infertility or childlessness is a major reproductive health issue for females as well as males respectively. Many couples suffer from infertility worldwide and in Sub-Saharan Africa, which has a cultural preference for high fertility; women shoulder the highest infertility consequences. In his review on male infertility, etiological factors causes, diagnosis and management in human, Sharma (2017) stated that infertility has become an ominous problem. On an average, about 10% of all couples face difficulty in starting a family and this creates a feeling of great personal failure, particularly in India where religious and socio-economic traditions have made it almost imperative for everyone to have children. A significant association had been found between impaired semen quality including sperm count, motility and morphology. The findings of his review indicate the need to emerge at the indiscriminate use and disposal of environmental chemicals. Especially pesticides and industrial chemicals as the chemicals enter the food chain, surface and groundwater which had the potential for exposure during the critical period of development further avoiding tobacco smoking, excessive alcoholism, excessive heat exposure to the testes can help in improving the semen quality.

## 3. Material and Methods

### 3.1 The Least Square Regression

The least square method of estimating regression parameters aims at generating estimators in such a way that the sum of squares of the error is minimized (Franses, 1996).

Suppose,

$$y_t = X_t \beta + \varepsilon_t \tag{1}$$

Where, $X_t$ is an n x (k+1) matrix of full rank,

$\beta$ is a (k+1) x 1 vector of unknown parameters,

and $\varepsilon_t$ is an n x 1 random vector with mean 0 and variance $\sigma^2 I$.

Bowerman and O'Connell (1990) stated that the least squares estimator for $\beta$ is denoted by b and is given by

$$\hat{b} = \left(X_t' X_t\right)^{-1} X_t' y_t \tag{2}$$

### 3.2 Stationarity Test

This study commences its investigation by first testing the properties of the time series used for analysis. A unit root test was performed on each of the variables since the variables are time series in nature and prone to fluctuations.

Traditionally, econometric methods require that the data be stationary. Most of the macroeconomics time series, instead, display a trend and heteroscedasticity, failing to fulfil stationarity conditions. As a consequence, the time series must be modelled taking into account non-stationary features detected in the data. Also, statistical and econometric methods assume that the data arise from a stationary process. A stochastic process is stationary if all of its random variables are identically distributed. This condition implies that all of the statistical moments of the variable are identically distributed.

A stationary time series is one whose statistical properties such as mean, variance or autocorrelation are all constant over time. Most times, statistical forecasting methods are based on the assumption that the time series can be rendered approximately stationary through the use of mathematical transformations. Stationarity of a process implies that predictions of the statistical properties will be the same in the future as they have been in the past. Also, the stationary assumption allows the straight forward calculation of the long-run equilibrium distribution of the process.

**3.3 The Augmented Dickey-Fuller (ADF) Test**

The augmented Dickey-Fuller test is used for testing whether there exist unit root in a time series sample data. The augmented Dickey-Fuller statistic, used in the test is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence. The one classical procedure for testing for unit root is to test using augmented Dickey Fuller and with intercept. If the test statistic < critical value (i.e. less than the negative value) reject $H_o$. No unit root. Otherwise choose first difference and continue until you reject $H_o$. The amount of differencing required to reject $H_o$ equals to order of integration equals to number of unit roots.

On the basis of an Auto regression (AR)(1) process, Equation (3), Dickey and Fuller (1981) obtain the critical values to test if a unit root exists as well as the significance of deterministic components.

$$y_t = \rho\, y_{t-1} + \varepsilon_t \tag{3}$$

where the null hypothesis $\rho = 1$. Hence, Equation (3) can be rewritten as (4).

$$\Delta y_t = \phi\, y_{t-1} + \varepsilon_t \tag{4}$$

The null hypothesis for a unit root is $\phi = 0$, and the corresponding t-statistic is given as

$$T_\phi = \frac{\hat{\phi}}{\hat{\sigma}_{\hat{\phi}}} \tag{5}$$

The alternative hypothesis is $-2 < \phi < 0$. As $\phi > 0$ implies $\rho > 1$, which is an explosive behaviour of the process and can only be detected in the graphics of the original data.

### 3.4 Accuracy Measure in Time Series Analysis

Time series models are often times validated using some indicators called accuracy measures. This measure includes the mean absolute percentage error, the mean absolute deviation and the mean square deviation.

**3.4.1 Mean Absolute Percentage Error (MAPE):** The mean absolute percentage error (MAPE), also known as mean absolute percentage deviation (MAPD), measures the prediction accuracy of a forecasting method in a time series model (for example in trend estimation). It usually expresses accuracy as a percentage, and is defined by the formula:

$$MAPE = \sum_{t}^{N} \left| \frac{y_t - \hat{y}_t}{y_t} \right| \times \frac{100}{N} \qquad (6)$$

where:
$y_t$ is the actual time series data and,
$\hat{y}_t$ is the estimated value of time series

**3.4.2 Mean Absolute Deviation (MAD):** The mean absolute deviation is the average distance between each data point and the mean. It gives an idea about the variability in a dataset.
The formula is given as:

$$MAD = \sum_{t}^{N} \left| \frac{\hat{y}_t - \bar{\hat{y}}_t}{n} \right| \qquad (7)$$

$\hat{y}_t$ is estimate of trend value at time t and
$\bar{\hat{y}}$ is the mean of estimated values

**3.4.3 Mean Square Deviation (MSD):** This is known as variance. The variance of the estimated is given as:

$$MSD = \sum_{t}^{N} \left( \frac{\hat{y}_t - \bar{\hat{y}}_t}{n} \right) \qquad (8)$$

The decision rule for the accuracy measure is that the model with the least accuracy measure becomes the selected model.

### 3.7 Model Specification

The Ordinary Least Square method of regression analysis will be used in this study.
The models were established as:

$$\mathrm{INFR_t} = \tau_0 + \tau_1 \mathrm{t} + \varepsilon_\mathrm{t}, \qquad (9)$$

where,
$INFR_t$ represents the reported cases of Infertility index by a time parameter month,
$\tau's$ represents the model coefficient and the average change from one period to the next ($\tau_0$ is the intercept and $\tau_1$ is the slope)
$\varepsilon_t$ represents the random error or noise in the system

$$SDYF = \varphi_0 + \varphi_1 \times Age + \varepsilon_t \quad (10)$$

where,
SDYF represents the reported cases of sexual dysfunction
$\varphi's$ represents the model coefficient ($\varphi_0$ is the intercept and $\varphi_1$ is the slope)
$\varepsilon_t$ represents the random error or noise in the system

## 4.0 Data Analysis and Result

The number of reported cases of infertility is presented in figure 1 .

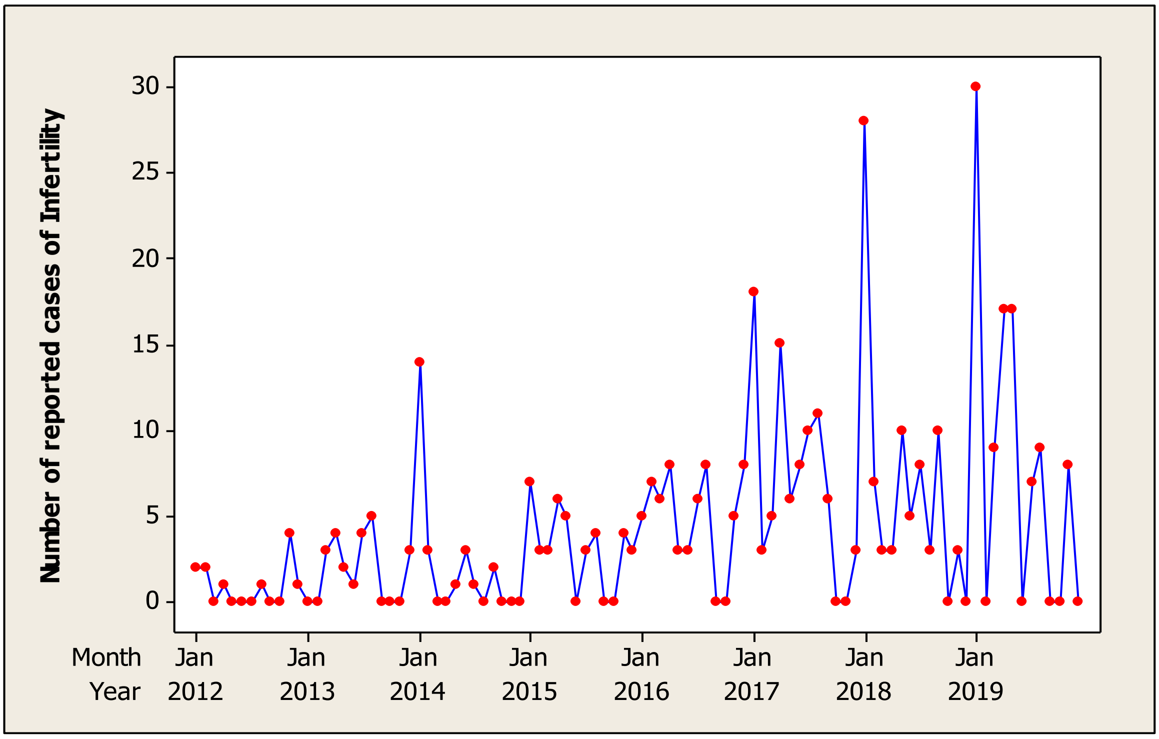


Fig. 1: Time Series Plot of Reported cases of Infertility in male in Anambra State.

The result of Fig. 1 shows that the reported cases of Infertility in male in Anambra State has a steeply increasing trend and recorded highest in 2020.

## 4.1 Testing for Stationarity for Infertility

**Table 1: Augmented Dickey-Fuller unit root test**

| Variables | Level | | 1st Difference | |
|---|---|---|---|---|
| | No Trend | With Trend | No Trend | With Trend |
| Infertility | -8.4334 | -9.92 | -7.4786 | -7.4217 |
| Critical values | | | | |
| 1% | -3.5007 | -4.071 | -3.5103 | -4.071 |
| 5% | -2.8922 | -3.4642 | -3.5298 | -3.4642 |

The result of the unit root test on the variable Infertility presented in Table 1 found that the Infertility has no unit root and is stationary overtime at the first difference since the test statistic value has a more negative value than the critical values assuming a 95% confidence level. This result implies that the series has no unit root and is stationary over time and can be used to make a forecast for future behaviour of the process.

## 4.2 Trend Analysis of Infertility

**Table 2: Result of Trend Analysis of infertility**

| S/N | TYPE OF TREND | MODEL | MAPE | MAD | MSD |
|---|---|---|---|---|---|
| 1 | Linear | $Y_t = 0.44 + 0.0802*t$ | 47.38 | 3.29 | 25.72 |
| 2 | Quadratic | $Y_t = 0.34 + 0.1281*t - 0.000494*t^2$ | 51.12 | 3.30 | 25.61 |
| 3 | S-Curve Model | $Y_t = (10**2) / (7.84846 - 35.7258*(0.97143^t))$ | 70.15 | 3.89 | 28.62 |

The result of the trend analysis presented in Table 2 revealed that the linear model is better for estimating infertility since it recorded the lowest MAPE of 47.38 and MAD of 3.28.This result implies that the best model for estimating Infertility is

$$Y_t = 0.44 + 0.0802*t \qquad (11)$$

Where, t is the time in months

Also, the linear trend analysis was expressed in Fig. 2.

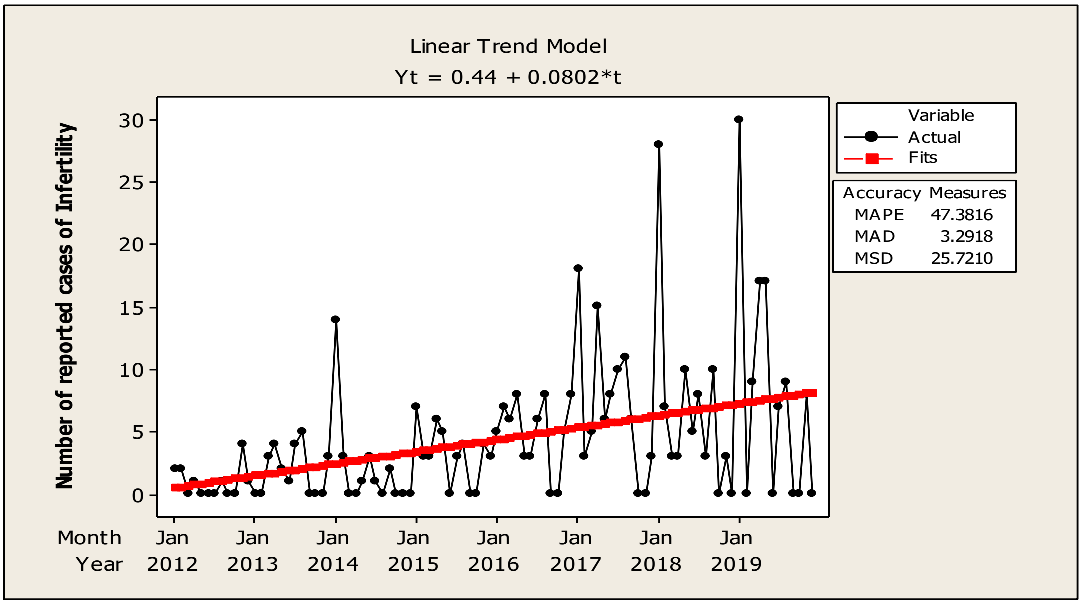


Fig. 2: Linear Trend of reported cases of sexual dysfunction in Anambra State

**Table 3: Two-Year Forecast of Infertility Data**

| Month/Year | 2021 | 2022 |
|---|---|---|
| JANUARY | 8.222807 | 9.185151 |
| FEBRUARY | 8.303002 | 9.265346 |
| MARCH | 8.383198 | 9.345542 |
| APRIL | 8.463393 | 9.425737 |
| MAY | 8.543588 | 9.505932 |
| JUNE | 8.623784 | 9.586128 |
| JULY | 8.703979 | 9.666323 |
| AUGUST | 8.784174 | 9.746518 |
| SEPTEMBER | 8.86437 | 9.826714 |
| OCTOBER | 8.944565 | 9.906909 |
| NOVEMBER | 9.02476 | 9.987104 |
| DECEMBER | 9.104956 | 10.0673 |

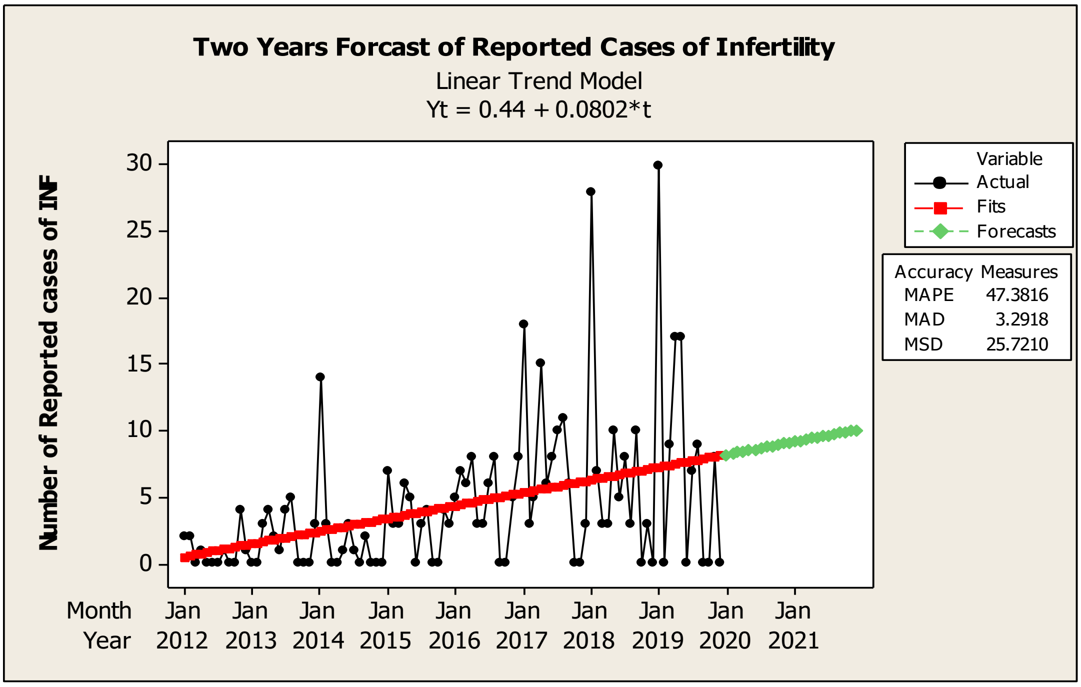


Fig. 3: Two-year forecast of reported cases of infertility in Anambra State

The result of the two-year forecast presented in Table 3 and Fig 3 showed that in December 2021 the reported cases of infertility are expected to be 10 cases supposing the data remains stable over time.

**Table 4: Least Square Analysis on the impact of Age on number of reported cases of Infertility**

| | | | | |
|---|---|---|---|---|
| Dependent Variable: NUMBER_OF_REPORTED_INFERTILITY | | | | |
| Method: Least Squares (Gauss-Newton / Marquardt steps) | | | | |
| Sample: 1 10 | | | | |
| Included observations: 10 | | | | |
| NUMBER_OF_REPORTED_INFERTILITY=C(1) + C(2)*AGE_MARK | | | | |
| | Coefficient | Std. Error | t-Statistic | Prob. |
| C(1) | 113.0764 | 32.02313 | 3.531084 | 0.0077 |
| C(2) | -1.570909 | 0.671166 | -2.340567 | 0.0474 |
| R-squared | 0.506451 | Mean dependent var | | 41.60000 |
| Adjusted R-squared | 0.432258 | S.D. dependent var | | 37.30118 |
| S.E. of regression | 30.48084 | Akaike info criterion | | 9.848930 |
| Sum squared resid | 7432.655 | Schwarz criterion | | 9.909447 |
| Log likelihood | -47.24465 | Hannan-Quinn criter. | | 9.782543 |
| F-statistic | 5.478253 | Durbin-Watson stat | | 2.003049 |
| Prob(F-statistic) | 0.047374 | | | |

The result of the least-squares regression model obtained in Table 4, found R-square value of 50.65% which implies that the independent variable was able to explain 50.65% of total variation on the number of reported cases of infertility in Anambra State over the observed years. It was found that Age has a negative significant impact on reported cases of infertility with a coefficient of -1.570909 and p-value of 0.0474 which falls on the rejection region of the hypothesis. This result implies inverse relationship thereby, the number of reported cases of infertility increases by a unit, age decreases by 1.570909. The model was found to be serial correlation free with a Durbin-Watson value of 2.003 which is approximately 2.

The obtained model was expressed as

NUMBER_OF_REPORTED_CASE_INFERTILITY = 113.08 -1.57*AGE_MARK (12)

## 5. Conclusion

This study examines the trend of reported cases of Infertility in the male in Anambra State between 2012-2019. The findings of the study revealed that the number of reported cases of Infertility is stationary over time and can be used to make a forecast for future behaviour of the process.

It was found from the trend analysis that the linear model is better for estimating the number of reported cases of infertility. The result of the two years forecast from the quadratic model for sexual dysfunction revealed that in December 2021 the reported cases of infertility is expected to be 10 cases supposing the data remains constant over the year. Findings showed that age has a significant impact on the number of reported cases of infertility. Based on the findings of this study, it is recommended that sensitization on sexual and reproductive health education should be adopted as an important tool that can minimize the negative social perception of infertility in men. Also, education could as well help resolve the misconceptions on infertility in men regarding its causes, treatment and health-seeking behaviour.

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