

A Cross-Sectional Study on Correlation Between Age, BMI, Ovarian Reserve and Fertility

Correlation
Between Age,
BMI, Ovarian
Reserve and
Fertility

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ABSTRACT

Objective: To observe the correlation between age, follicle count, ovarian volume and fertility according to BMI.

Study Design: Cross sectional study

Place and Duration of Study: This study was conducted at Radiology Department DHQ Teaching Hospital D.I.Khan for 10 months from March 2013 to December 2013.

Materials and Methods: This comparative, cross-sectional study was conducted in the Department of Anatomy, Gomal Medical College, D.I.Khan, Pakistan from March 2013 to December 2013. Sample Size was 100 women selected by consecutive non probability sampling technique. Sample size was calculated using online calculator Raosoft. Inclusion criteria were women aged 18-50 years, married, fertile and infertile. Color Doppler sonoscape with multi frequency transvaginal probes were used in measurements on any day in the start of menstrual cycle by the same observer. The volume was calculated by applying formula for ellipsoid called Prolate ellipsoid formula. The total volume was represented by sum of volume of two ovaries. Data collection site was out patient department of Radiology DHQ Teaching Hospital, D.I.Khan. Demographic variable were age groups, height, weight and presence of fertility. Research variables were ovarian volume and follicle count. Mean and standard deviation were calculated for ovarian volume and follicle count whereas frequency and percentages were calculated for age groups, BMI and presence of fertility. Descriptive statistics along with estimation of parameter was done at 95% confidence interval for proportion and mean. Student- t test was used for significance of difference in ovarian volume between fertile and infertile women with p value <0.05 considered significant. SPSS was used for data analysis.

Results: The correlation between age, BMI and fertility parameters (ovarian volume and follicle count) was non-significant (0.105) in fertile females whereas highly significant negative correlation (-0.75) was observed between age and antral follicle counts in infertile females.

Conclusion: Ovarian reserve is directly affected by age and weight of females specially among fertile women.

Key Words: Ovarian reserve, antral follicle count, ovarian volume, sonography and BMI.

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INTRODUCTION

The term ovarian reserve refers to the remaining collection of oocyte-granulosa cell, at a required age, which will be available for reproduction¹. Fertility decreases significantly in the early 30,s and most of the females are infertile at 45 years of age. In historical units, the rates of infertility who got married at the ages of 20-24, 25-29, 30-34, 35-39 and 40-44 years were 6%, 9%, 15%, 30% and 64% respectively².

The linear age is known to be the main determinant of ovarian reserve but the rate of ovarian maturity varies

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from person to person so other tests are required for the evaluation of ovarian reserve. Estimation of ovarian reserve will help in foreseeing the remaining reproductive life span and predictable success of assisted reproductive techniques (ART) like in vitro fertilization (IVF)^{3,4,5}. The beginning and conservation of reproductive functions depends upon an ideal body weight in females⁶. More than 30% of the women in the age group of 25-44 years are overweight and 20% are obese according to an international survey. Overweight women have increased threat of menstrual problems and anovulation while obese women even with regular menstrual cycles have reduced fertility⁷.

BMI is defined as weight in KG divided by height in meters (KG/M²). It is a measure to objectively calculate obesity⁸. Underweight females have BMI under 19kg/m², overweight have over 25kg/m² whereas obese have over 30kg/m² all are associated with an increased risk for definite disorders⁶.

Ovarian reserve and BMI are inversely related, with a decrease in ovarian volume associated with increase in

BMI. This is clinically important as obesity is known to affect the fertility of a woman⁹. Now a day's ultrasound is considered to be a useful tool for the evaluation of current ovarian function^{4,10}. The parameters we have selected for determining ovarian reserve are the ovarian volume and antral follicle count. The ovarian volume and antral follicle count are useful indicators of menopausal status¹¹. Because of rapid increase in the use of transvaginal ultrasound, ovarian volume measurement has become very fast, precise and economical¹². The size of the ovary is better described as volume because of changes in its shape and configuration. The volume is calculated by using the formula for an ellipsoid: the prolate ellipsoid formula which is calculated as length x breadth x width x 0.523. Antral Follicle Count is defined as number of follicles which are less than 10mm in diameter detected in the early follicular phase with the help of transvaginal ultrasound. The number of follicles less than 18mm are called antral follicles¹³. The number of follicles in the ovaries is directly related to the embryonic follicle pool from which they were recruited. So the numerical aspect of ovarian aging is characterized by the antral follicle count. As a result of progress and advancement in ultrasound technology we can now easily count antral follicles¹⁴. The threshold for the definition of low AFC is different according to different studies¹⁵. Inconsistency among cycles is more significant in young women and those with high AFC. So a young infertile female with low AFC but ovulatory, does not necessarily indicate poor ovarian reserve¹⁶. The diameters may be different as there is no consensus regarding the size of follicles that still will represent ovarian reserve¹⁷.

MATERIALS AND METHODS

This comparative cross-sectional study was conducted in the Department of Anatomy, Gomal Medical College, D.I. Khan, Pakistan from March 2019 to December 2019. Sample Size was 100 women selected by consecutive non probability sampling technique after fulfilling inclusion and exclusion criterias. A written

informed consent was obtained from all the subjects. Scan of the ovaries was carried out on any day in the start of menstrual cycle. All the measurements were done by the same observer using colour Doppler Sonoscape. Each ovary was scanned in three dimensions; D1 (Longitudinal), D2 (Antero posterior) and D3 (Transverse). The volume was calculated by applying formula for ellipsoid called Prolate ellipsoid formula (viz D1 x D2 x D3 x 0.523 cm³). The total volume was represented by sum of volume of two ovaries. Follicles 2 to 10mm in size were counted and sum of follicles in the two ovaries was noted. Demographic variable were age groups (18-26, 27-34, 35-42, 43-50 years) and BMI groups (Less than 20, 21-25, 26-30, Above 30) and presence of fertility (Yes, No). Research variable were ovarian volume in cm³ and follicle count. The height and weight of each patient was also noted to determine the BMI according to the formula:

$$\text{Weight in kg/Height in m}^2$$

Statistical analysis: The data feeding and study was done on computer package SPSS (Statistical Package for Social Sciences). The results were given in the text as mean, standard deviation of significantly quantitative variables (age, weight, height). Mean and standard deviation of quantitative variables were evaluated by using student t-test for mean differences and found the correlation coefficient of ovarian volume, ovarian follicle count against age and BMI¹⁸. In all statistical analysis, only p-values <0.05 were considered significant. The results were presented as tables.

RESULTS

Highly significant negative correlation (-0.75) was observed between age and antral follicle counts. Similarly highly significant negative correlation was found between age and fertility parameters like ovarian volume in infertile patients. The fertility parameters are positively correlated with each other. The ovarian volume has highly significant positive association with antral follicle count.

Table No.1: Correlation coefficients of infertile group

	Age	height	weight	ov.vol TA	ov.vol TV	ov.fol.count	BMI
Age(years)	1						
Height(m)	-0.042	1					
Weight(kg)	0.38*	0.136	1				
ov.vol(TAS)cm ³	-0.80**	0.103	-0.41*	1			
ov.vol (TVS)cm ³	-0.89**	0.035	-0.42*	0.91**	1		
AFC	-0.75**	-0.003	-0.45*	0.81**	0.87**	1	
BMI(kg/m ²)	0.17	-0.354*	0.56**	-0.13	-0.13	-0.16	1

*, ** are significant at 1% and 5% level of probability respectively.

Table No.2: Correlation coefficients of fertile group

	Age	height	Weight	OV(TAS)	OV(TVS)	AFC	BMI
Age(years)	1						
Height(m)	0.094	1					
Weight(kg)	0.214	0.189	1				
Ov volume(TAS)cm ³	-0.94**	-0.001	-0.203	1			
Ov volume(TVS)cm ³	-0.96**	-0.089	-0.218	0.97**	1		
AFC	-0.95**	-0.076	-0.226	0.96**	0.98**	1	
BMI(kg/m ²)	0.105	-0.39	0.214	-0.22	-0.17	-0.16	1

*, ** are significant at 1% and 5% level of probability respectively.

Correlation Coefficient of Age and fertility parameters in fertile group: The association of age with fertility parameters in fertile patients was highly significant and negative. When the fertility parameters were correlated with each other they showed that they are highly significantly positively correlated with each other.

Comparison of ovarian volume between fertile and infertile groups according to BMI: The ovarian volume decreases as BMI increases. The volume is maximum (14.33cm³) when BMI is lowest i.e. < 20kg/m².

Comparison of AFC in fertile and infertile groups according to BMI: The antral follicle count is inversely proportional to BMI i.e. as BMI increases the follicle count decreases. Antral follicle count is maximum in both fertile and infertile when BMI < 20kg/m².

Table No. 3: Comparison of ovarian volume in fertile and infertile patients of various BMI groups

BMI(kg/m ²)	Fertile	Infertile
less than 20	14.33	4.91
21-25	9.38	4.74
26-30	9.57	4.22
more than 30	8.77	4.95
SD	2.56	0.34

Table No.4: Comparison of antral follicle counts in fertile and infertile patients of various BMI groups

BMI(kg/m ²)	fertile	Infertile
less than 20	17	6.57
21-25	10.85	7.43
26-30	11.28	6.42
more than 30	10.88	6.53
SD	3.00	0.46

DISCUSSION

Our study showed the correlation between age, BMI and fertility parameters like ovarian volume and follicle

count. In infertile group, the correlation between age and weight was significant (p value <0.01) whereas there was a significant negative correlation with ovarian volume (p value <0.05) which were similar to the observations made by Ernest in his study¹⁹. The correlation with AFC was highly negatively significant (p value < 0.05) and that with BMI was positive but non-significant. The correlation of height with BMI was negatively correlated and was significant (p value < 0.01). The correlation between weight and fertility parameters was significantly negative whereas BMI was positively correlated and highly significant. Volume and follicle count were positively correlated with each other and highly significant but their correlation with BMI was negative and non significant in the same way as a study conducted by Halawaty in premenopausal women in Egypt who didn't find any effect of obesity on AFC but correlation with ovarian volume was highly significant (p value < 0.05)⁷. This was in accordance with observations by Zaidi et al., who showed a significant negative correlation between volume and BMI in aged fertile females only⁹. Similarly Sammel did not find any significant correlation of BMI with AFC²⁰. The reasons for these controversies might be due to the different characteristics of population used and different techniques used to measure ovarian volume and follicle count⁷.

When the volume was compared in fertile and infertile females according to BMI it showed that volume decreases with increase in BMI. Halawaty et al., showed that ovarian volume was significantly reduced in obese than in non obese women but did not find any effect on follicle count⁷. It was also supported by Zaidi et al., which showed that there was a significant negative correlation between ovarian volume and BMI in old fertile women only⁹. But Sammel didn't find any correlation between volume and BMI²⁰. We showed that at BMI <20 kg/m² the ovarian volume was maximum in fertile group which decreased to 9.38, 9.57 and 8.77 in BMI groups of 21-25, 26-30 and > 30kg/m² respectively. The decline in volume with BMI was gradual in infertile group.

The most important finding in our study was that decrease in volume and follicle count with BMI was more pronounced in fertile as compared to infertile females.

CONCLUSION

Ovarian reserve is directly affected by age and weight of females specially among fertile women.

Author's Contribution:

Concept & Design of Study: Sarah Yunus
 Drafting: Sarah Yunus, Shehla Aman, Sadaf Rasheed
 Data Analysis: Sarah Yunus, Usman Ullah, Shehla Aman
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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