

## Comparison of Level of thyroid hormone between pregnant and non-pregnant women

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### Abstract

**Background:** The thyroid diseases hyperthyroidism and hypothyroidism are relatively common in pregnancy and important to treat. During pregnancy, if you have pre-existing hyperthyroidism or hypothyroidism, you may require more medical attention to control these conditions during pregnancy, especially in the first trimester.

**Aims & Objective:** To know optimum values of T<sub>3</sub>, T<sub>4</sub> and TSH during various trimesters of pregnancy. To find rise/fall in values with increasing duration of pregnancy. To compare thyroid profile values of pregnancy cases with the non-pregnant.

**Methodology:** The present case control study was conducted on 100 patients (obstetric cases) attended and managed in the Department of Obstetrics and Gynaecology attached to Geetanjali Medical College and Hospital, Udaipur. The results of the patients were compared with 100 age matched control females having gynaecological problems (with normal thyroid). Fasting blood sample was investigated for the following parameters: T<sub>3</sub> (Triiodothyronine), T<sub>4</sub> (Thyroxine), TSH (Thyrotropin Stimulating Hormone), FT<sub>3</sub>, FT<sub>4</sub> and Hemoglobin(Hb). P-value was calculated by using online student t-test calculator.

**Result:** All the cases of the control group had normal T<sub>3</sub> values. Values below normal were noted in one case each of I and III trimester and normal values were noted in 80.27 per cent in I trimester, 54.75 per cent in II and 55.28 per cent in the III trimester. Only 18.30 per cent cases of I trimester had raised values of T<sub>3</sub> while same was observed in 44.03 per cent in II and 43.51 per cent in III trimester. Variable values of T<sub>4</sub> were observed in various trimesters of pregnancy. Values of T<sub>4</sub> were below normal in 2.81 per cent in I, 1.20 per cent in II and 1.14 per cent in the III trimester. On the other hand in II and III trimester T<sub>4</sub> values were higher than normal in 6.02 per cent and 40.22 per cent respectively. TSH value below normal (0.27 μIU/dl) were observed in 2 cases in I and II trimester each while normal values were noted in most of the cases i.e. 77.45 per cent in I, 71.41 per cent in II and 83.31 per cent in III trimester. Fluctuating values of TSH above 4.2 μIU/dl were observed in 19.71 per cent in I, 26.18 per cent in II and 16.66 per cent in the III trimester.

**Conclusion:** T<sub>3</sub> values increased during pregnancy significantly more so in II trimester. T<sub>4</sub> values were less during I trimester particularly at par during II trimester and increased during III trimester. Raised TSH values were observed during pregnancy as compared to non-pregnant women. Significant increase was observed during II trimester.

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These normal hormonal changes can sometimes make thyroid function tests during pregnancy difficult to interpret. Thyroid hormone is critical to normal development of the baby's brain and nervous system. During the first trimester, the fetus depends on the mother's supply of thyroid hormone, which comes through the placenta. At around 12 weeks, the baby's thyroid begins to function on its own.<sup>[3]</sup>

### Introduction

Too much thyroid hormone is called hyperthyroidism and can cause many of the body's functions to speed up. Too little thyroid hormone is called hypothyroidism and can cause many of the body's functions to slow down.<sup>[1]</sup>

Thyroid hormone plays a critical role during pregnancy both in the development of a healthy baby and in maintaining the health of the mother. Untreated thyroid diseases in pregnancy may lead to premature birth, preeclampsia (a severe increase in blood pressure), miscarriage, and low birth weight among other problems. It is important to talk to your doctor if you have any history of hypothyroidism or hyperthyroidism so you can be monitored before, and during pregnancy and your treatment adjusted if necessary.<sup>[2]</sup>

### Material and Methods

The present case control study was conducted on 100 patients (obstetric cases) attended and managed in the Department of Obstetrics and Gynaecology attached to Geetanjali Medical College and Hospital, Udaipur over a period of 10 months from 25<sup>th</sup> July 2011 to 10<sup>th</sup> May 2012.

The results of the patients were compared with 100 age matched control females having gynaecological problems (with normal thyroid).

The subjects for the study were grouped as follows:-

**Group A (Study Group):** Study group will consist of obstetric cases of various trimesters. (n=100).

**Group B (Control Group):** Females with gynaecological problems, having normal thyroid (control group). (n=100).

Inclusion criteria for study are as follows:

1. Cases having no known thyroid problem were included in the study.
2. Age between 18-48 years.
3. Obstetric cases during I, II and III trimester irrespective of obstetric/medical complication were included.

Exclusion criteria included those with:

The following are the conditions associated with euthyroid hyperthyroxinemia which were excluded from the present study:

1. Familial dysalbuminemic hyperthyroxinemia.
2. Thyroid Binding Globulin (familial excess, acquired excess).
3. Transthyretin (excess, mutations).
4. Medications (Propranolol, Iodate, Popanic acid, Aminodarone).
5. Sick Euthyroid Syndrome.
6. Resistance to thyroid hormone.

In the proposed study the case study was done as per pre laid proforma (CASE RECORD).

All patients were questioned and the information of the interview was recorded on the printed proforma.

Details about patient's name, age, husband's name and address, urban or rural, education status, S/E status were taken.

S/E status was calculated by criteria laid down by A K Agarwal (2008)<sup>[4]</sup>:

- Low (Poor+ Very Poor) Rs. 500-1499 per capita monthly income.
- Middle (Lower+ Upper) Rs. 1500-4999 per capita monthly income.
- High (High+ Upper High) Rs. 5000-10000 and above per capita monthly income.

Details about obstetric history, menstrual history, associated medical problems and obstetric complication (if any) were noted.

The blood collection and sample study was done in clinical laboratory attached to the Department of Biochemistry, Geetanjali Medical College and Hospital, Udaipur.

Fasting blood sample was investigated for the following parameters:-

- T<sub>3</sub> (Triiodothyronine). [Reference range:0.87-1.78 ng/ml]
- T<sub>4</sub> (Thyroxine). [Reference range:6-12.23 µg/dl]
- TSH (Thyrotropin Stimulating Hormone). [Reference range:0.5-5 µIU/ml]
- FT<sub>3</sub> [Reference range:2.5-3.9 pg/ml]
- FT<sub>4</sub> [Reference range:0.61-1.12 ng/dl]
- Hemoglobin

The collected samples were incubated at 37°C for 15 minutes in the incubator and then centrifuged for 10 minutes at approximately 3000 rpm and serum obtained was used in thyroid assay.

All the thyroid parameters were measured by ECLIA (Electro chemiluminescence immunoassay) and were done on Elecsys 2010 using commercial available kits of Cobas.

Hemoglobin was measured by Sahlis method.

Based on biochemical evaluation each individual case was categorized and inference was drawn out.

An obtained result of case group was compared with control group for determination of difference of significance.

P-value was calculated by using online student t-test calculator. p-value less than 0.05 was consider as significant.

## Results

Age and parity wise distribution of participants was done (Table 1, 2).

An obtained result of case group was compared with control group for determination of difference of significance.

p-value less than 0.05 was consider as significant.

**Table 1: Age wise distribution of participants**

Age (Yrs.)	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Below 20	1	1	2	2
20-25	32	32	24	24
26-30	52	52	25	25
31-35	12	12	14	14
36-40	3	3	14	14
>40	Nil	Nil	21	21
Total	100	100	100	100
Mean	27.43	-	32	-
Minimum Age	19	-	18	-
Maximum Age	38	-	50	-

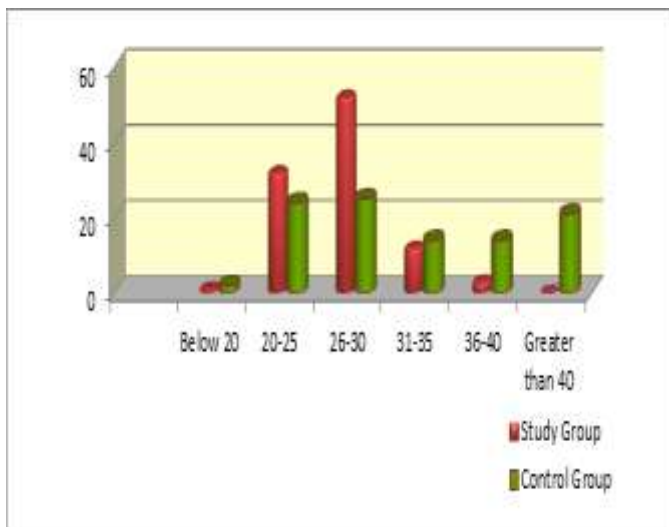


Fig. 1: Graphical presentation of Age wise distribution of participants

Table 2: Showing parity wise distribution

Parity	Study Group	
	No. of cases	%
Primi	48	48
II trimester	28	28
III trimester	16	16
More than III trimester	8	8
Total	100	100

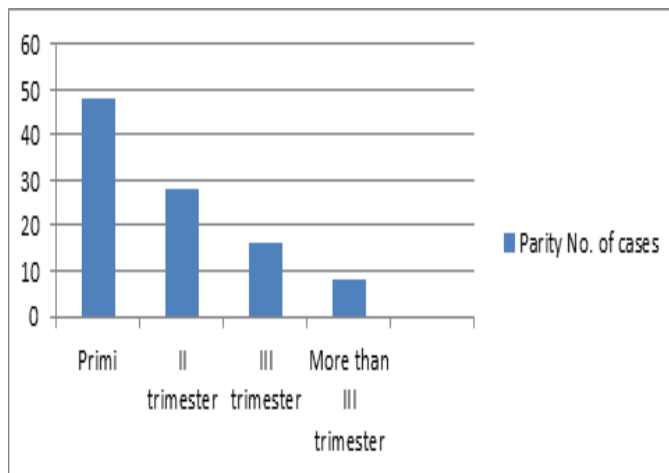


Fig. 2: Graphical presentation of parity wise distribution

Table 3: Socioeconomic status of participants

S/E Status	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Low	2	2	35	35
Middle	45	45	41	41
High	53	53	24	24
Total	100	100	100	100

Only 2 per cent of the obstetric cases were of low S/E status while as much as 35 per cent of cases in the control group had low S/E status. Incidence of middle S/E status was 45 per cent in the study group and 41 per cent in the control group. 53 per cent Of the cases in the study and 24per cent of the cases in the control group were from high S/E status.

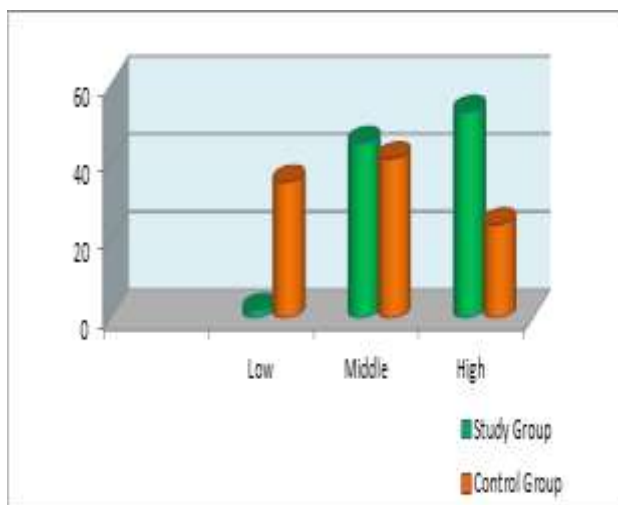


Fig. 3: Graphical distribution of participants based on socioeconomic status

Table 3A: Socioeconomic status of participants

Thyroid disorder during pregnancy	S/E Status					
	High		Middle		Low	
No. of cases	No. of cases	%	No. of cases	%	No. of cases	%
37	21	56.76	15	40.54	1	2.70

Table 4: Educational status of the cases

Educational Status	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Illiterate	6	6	40	40
Primary	2	2	4	4
Middle	7	7	18	18
Intermediate and above	85	85	38	38
Total	100	100	100	100

Only 6 per cent of the cases of the study group and as much as 40 per cent cases of the control group were illiterate. Most of the cases in the study group were well educated (85 per cent).

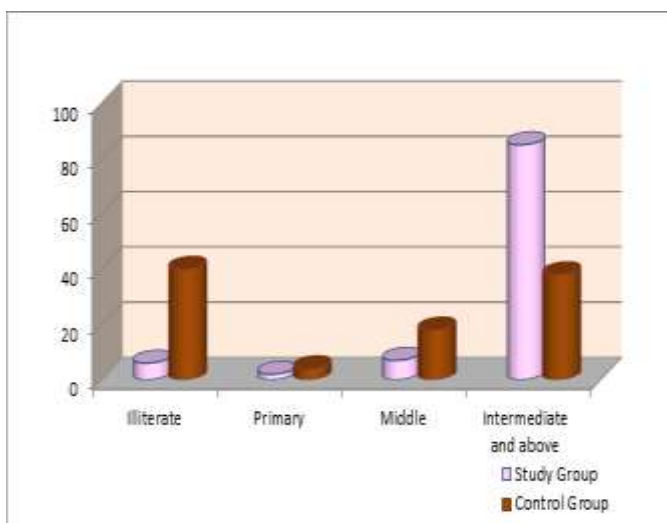


Fig. 4: Educational status of the cases

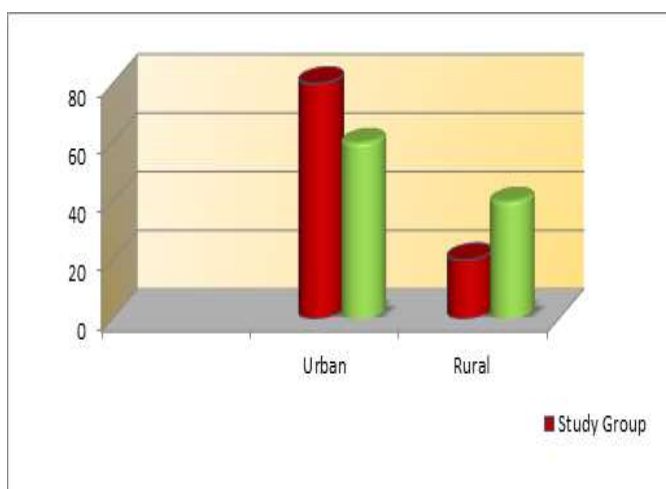
Table 4A: Educational status of the cases

Thyroid disorder during pregnancy	Education							
	Intermediate and above		Middle		Primary		Illiterate	
No. of cases	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
37	28	75.67	4	10.81	1	2.70	4	10.81

The above table depicts that higher was the educational status more was the chance for thyroid disorder in the present study.

**Table 5: Distribution of participants based on locality**

Type of case	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Urban(U)	80	80	60	60
Rural (R)	20	20	40	40
Total	100	100	100	100



**Fig. 5: Graphical Distribution of participants based on locality**

**Table 5A: Distribution of participants based on locality**

Thyroid disorder during pregnancy	R/U			
	Rural		Urban	
No. of cases	No. of cases	%	No. of cases	%
37	8	21.62	29	78.37

**Table 6: Hemoglobin status of participants**

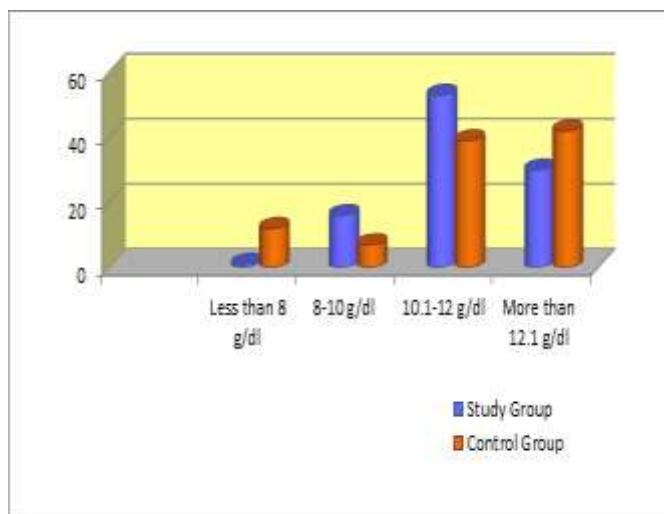
Haemoglobin (g/dl)	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Less than 8	1	1	12	12
8-10	16	16	7	7
10.1-12	53	53	39	39
>12.1	30	30	42	42
Total	100	100	100	100
Mean	11.41	-	11.18	-
Minimum value	7.10	-	3.20	-
Maximum value	14.60	-	13.90	-

Incidence of thyroid disorder in urban population was much higher (78.37 per cent) compared to rural counterparts (21.62 per cent). This may be a repercussion of higher education, better S/E status and more stressful lifestyle.

**Table 6A: Hemoglobin status of participants**

Thyroid disorder during pregnancy	Anaemia	
	No. of cases	%
37	3	8.10

Incidence of anaemia was 17 per cent in the study group with haemoglobin less than 10g/dl while the same in the control group was (19 per cent).

**Fig. 6: Graphical presentation of hemoglobin status of participants****Table 7: Weight wise distribution of participants**

Weight (kg)	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Less than 40	Nil	Nil	1	1
40-50	13	13	39	39
51-60	39	39	28	28
61-60	28	28	20	20
>70	20	20	12	12
Total	100	100	100	100
Mean	61.92	-	56.31	-
Minimum weight	40.00	-	35.00	-
Maximum weight	95.00	-	92.00	-

The minimum weight of the study group was 40kg. On the other hand it was 35kg in the control group. Maximum weight was 95Kg in the study group and 92Kg in the control group. The mean weight of the study group was 61.92kg.

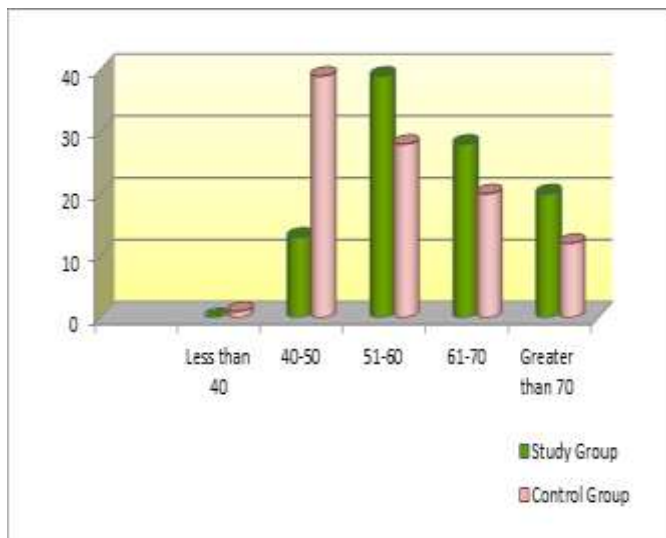


Fig. 7: Graphical presentation of Weight wise distribution of participant

Table 8: Thyroid awareness status

Thyroid awareness	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Yes	57	57	24	24
No	43	43	76	76
Total	100	100	100	100

Status of awareness about thyroid disorder was high in the study group (57 per cent) compared to 24 per cent in the control group.

This may be a reflection of most of the cases belonging to urban population and having higher educational status.

Table 8A: Thyroid awareness status

Thyroid disorder during pregnancy	Awareness about thyroid disorder			
	Yes		No	
No. of cases	No. of cases	%	No. of cases	%
37	18	48.64	19	51.35

Though the awareness status was 57 per cent in the study group, it was there in 18 out of 37 cases which were positive for thyroid disorder during pregnancy (48.64 per cent).

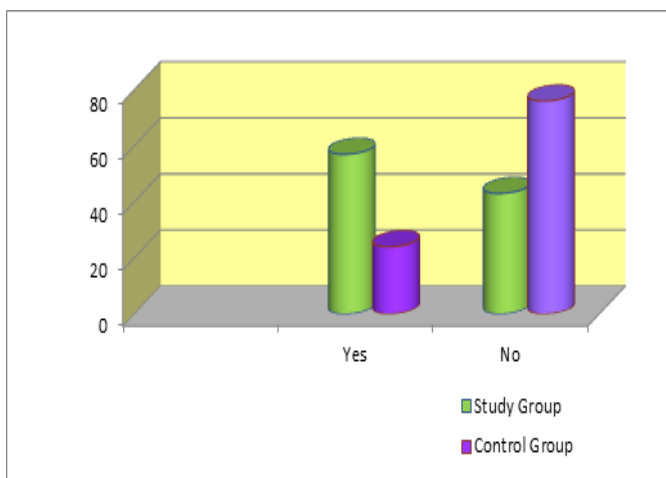


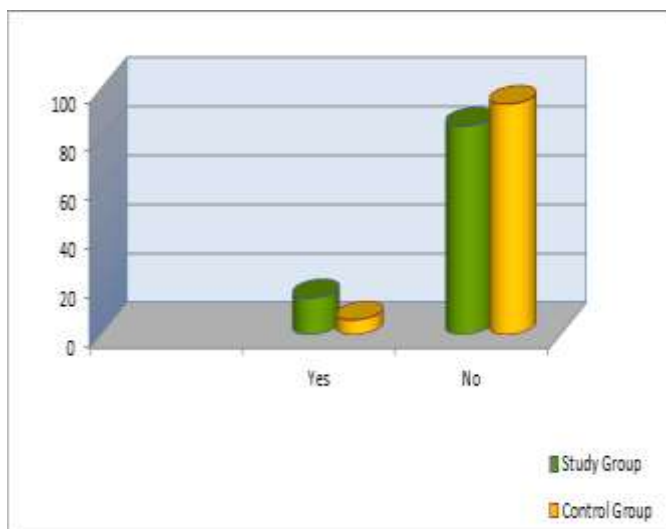
Fig. 9: Graphical presentation of thyroid awareness

**Table 10: Distribution based on family history**

Family history of thyroid disease	Study Group		Control Group	
	No. of cases	%	No. of cases	%
Yes	15	15	6	6
No	85	85	94	94
Total	100	100	100	100

**Table 10A: Distribution based on family history**

Deranged thyroid values	Family history of thyroid disorder			
	Yes		No	
No. of cases	No. of cases	%	No. of cases	%
37	8	21.62	29	78.37

**Fig. 10: Graphical presentation of Family history of thyroid disorder**

Overall 37 of the cases had deranged thyroid values during pregnancy. Out of which 8 (21.62 per cent) had positive family background of thyroid disease and rest of the cases (78.37 per cent) had no such family background.

**Table 11: Associated medical problem of study group**

Associated medical Problems	Study Group	
	No. of cases	%
Toxoplasmosis	1	11.11
Gastroenteritis	1	11.11
Past history of insulin	1	11.11
Past history of tuberculosis	1	11.11
UTI	1	11.11
Asthma	1	11.11
Wheat allergy	1	11.11
Thrombocytopenia	1	11.11
GDM	1	11.11
Total	9	100

**Table 11A: Associated medical problem of study group**

Thyroid disorder in pregnancy	Associated medical problems	
	No. of cases	%
37	3	8.10



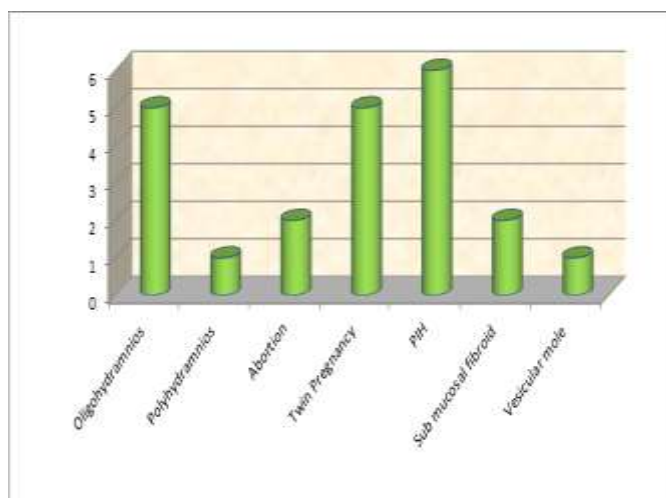
**Table 12: Obstetric complication**

Obstetric Complications	Study Group	
	No. of cases	%
Oligohydramnios	5	22.72
Polyhydramnios	1	4.54
Twin pregnancy	5	22.72
PIH	6	27.27
Sub mucosal fibroid	2	9.09
Vesicular mole	1	4.54
Spontaneous abortions	2	9.09
Total	22	100

In cases having medical disorders associated with pregnancy 3 had deranged thyroid profile and these were the cases having asthma, thrombocytopenia and gestational diabetes mellitus one each.

**Table 12A: Obstetric complication**

Thyroid disorder during pregnancy	Obstetric complications	
	No. of cases	%
37	14	37.83

**Fig. 12A: Graphical presentation of Obstetric complication**

Overall 22 per cent of the cases had some obstetric complications or the other. Commonest being PIH (27.27 per cent). Oligo and polyhydramnios was observed in 27.26 per cent of the cases. Vesicular mole was observed in one of the case having TSH 0.02 $\mu$ IU/dl, indicating hyperthyroidism while 2 of the case had spontaneous abortions and in both of these cases hypothyroidism was present.

**Table 13: Gynecological diagnosis(Control group)**

Gynaecological Diagnosis	Control Group	
	No. of cases	%
Cervicitis	8	8
DUB	40	40
Dysmenorrhea	2	2
Fibroid Uterus	3	3
Infertility	23	23
PCOD	3	3
PID	15	15
UTI	2	2
U V Prolapse	4	4
Total	100	100

40 per cent of the cases had DUB while 60 per cent had other gynaecological problems.

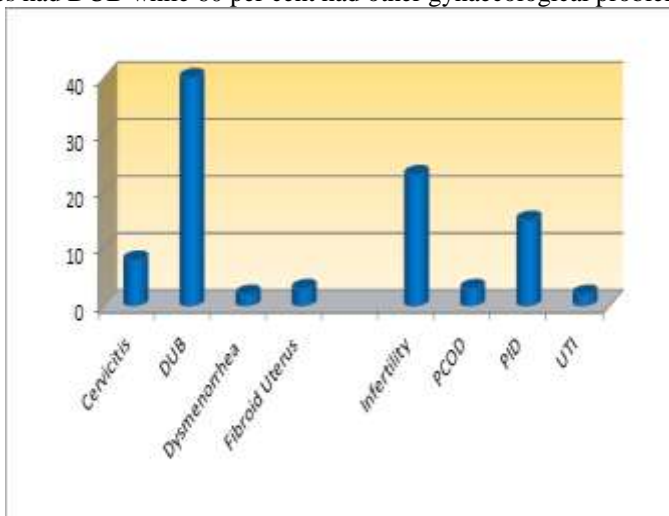


Fig. 13: Graphical presentation of Gynaecological problems (Control group)

Table 14: Showing level of T3 in case and control group (ng/ml)

T <sub>3</sub> (ng/ml)	Study Group						Control group	
	Trimester							
	I		II		III			
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Below 0.8	1	1.40	Nil	Nil	1	1.17	Nil	Nil
0.8-2	57	80.27	46	54.75	47	55.28	100	100
>2	13	18.30	38	44.03	37	43.51	Nil	Nil
Total	71	100	84	100	85	100	100	100
Mean	1.77	-	9.09	-	4.43	-	1.35	-
Minimum value	0.23	-	0.89	-	0.68	-	0.86	-
Maximum value	8.90	-	141	-	38	-	2	-

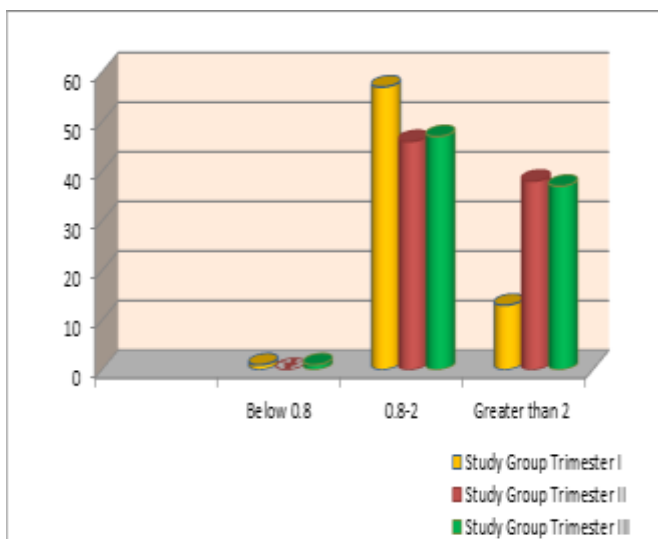
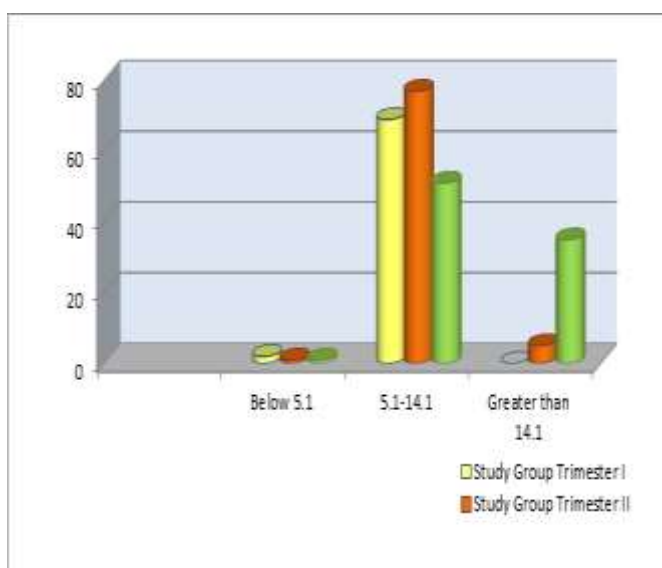


Fig. 14: Showing Graphical presentation of T3 level in case and control group (ng/ml)

All the cases of control group had normal T<sub>3</sub> values. Values below normal were noted in one case each of I and III trimester and normal values were noted in 80.27 per cent in I trimester, 54.75 per cent in the II and 55.28 per cent in III trimester. Only 18.30 per cent cases of I trimester had raised values of T<sub>3</sub> while same was observed in 44.03 per cent in II trimester and 43.51 per cent in III trimester.

**Table 15: Showing level of T4( $\mu\text{g}/\text{dl}$ ) in case and control group**

T <sub>4</sub> ( $\mu\text{g}/\text{dl}$ )	Study Group						Control group	
	Trimester							
	I		II		III		No. of cases	%
No. of cases	%	No. of cases	%	No. of cases	%			
Below 5.1	2	2.81	1	1.20	1	1.14	Nil	Nil
5.1-14.1	69	97.17	77	87.95	51	58.61	100	100
>14.1	Nil	Nil	5	6.02	35	40.22	Nil	Nil
Total	71	100	83	100	87	100	100	100
Mean	6.65	-	9.47	-	13.45	-	9.26	-
Minimum value	1.00	-	3.40	-	1.22	-	5.20	-
Maximum value	13.08	-	24.86	-	20.80	-	14.10	-

**Fig. 15: Graphical presentation of level of T4( $\mu\text{g}/\text{dl}$ ) in case and control group**

Variable values of T<sub>4</sub> were there in various trimesters of pregnancy while all the cases of control group had valuation within normal range. Values of T<sub>4</sub> were below normal in 2.81 per cent in I trimester, 1.20 per cent in II and 1.14 per cent in III trimester. On the other hand in II and III trimester T<sub>4</sub> values were higher than normal in 6.02 per cent and 40.22 per cent respectively.

**Table 16: Showing level of TSH ( $\mu\text{IU}/\text{ml}$ ) in case and control group**

TSH ( $\mu\text{IU}/\text{ml}$ )	Study Group						Control group	
	Trimester							
	I		II		III		No. of cases	%
No. of cases	%	No. of cases	%	No. of cases	%			
Below 0.27	2	2.81	2	2.38	Nil	Nil	Nil	Nil
0.27-4.2	55	77.45	60	71.41	71	83.31	100	100
>4.2	14	19.71	22	26.18	14	16.66	Nil	Nil
Total	71	100	84	100	84	100	100	100
Mean	4.04	-	4.35	-	3.84	-	2.59	-
Minimum value	0.15	-	0.02	-	0.56	-	0.49	-
Maximum value	19.50	-	25.70	-	47.00	-	4.20	-

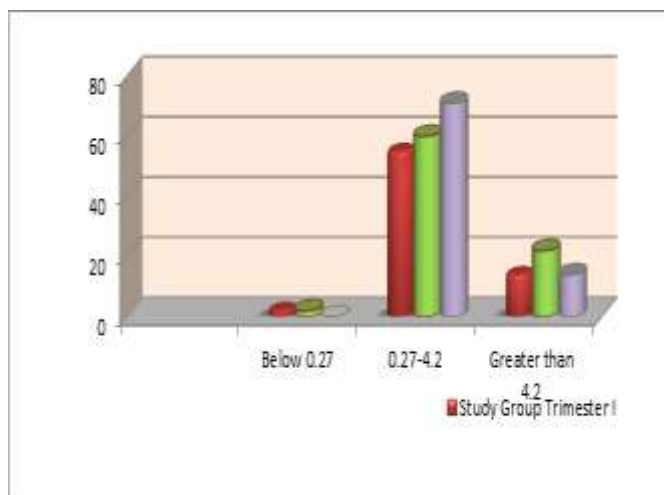


Fig. 16: Graphical presentation of level of TSH (µIU/dl) in case and control group

Table 17: Comparison of thyroid function tests in pregnant and non-pregnant women (mean values)

Subjects	T3(ng/ml) Mean±SD	T4(µg/dl) Mean±SD	TSH(µIU/dl) Mean±SD	FT3(Pg/ml) Mean±SD	FT4(ng/ml) Mean±SD
<b>Non-Pregnant women</b>	1.35±0.33	9.26±2.05	2.52±1.02	3.56±0.603	1.30±0.33
<b>Pregnant women</b>					
<b>I Trimester</b>	1.77±1.73 <sup>a</sup>	6.65±1.55 <sup>b</sup>	4.04±3.53 <sup>a</sup>	3.54±0.43	1.38±0.27
<b>II Trimester</b>	9.09±24.25 <sup>a</sup>	9.47±3.08	4.35±4.55 <sup>a</sup>	3.36±0.30 <sup>b</sup>	1.14±0.19 <sup>b</sup>
<b>III Trimester</b>	4.43 ±6.55 <sup>a</sup>	13.45±3.41 <sup>a</sup>	3.84±5.07 <sup>a</sup>	3.18±0.31 <sup>b</sup>	0.97±0.18 <sup>b</sup>

a= Significant increase compared to non-pregnant; P<0.05.  
b= Significant decrease compared to non-pregnant; P<0.05.

Clinically TSH values are a reflection of thyroid profile as considered mostly in clinical practice. All the cases of the control group had normal TSH values. TSH value below normal (0.27µIU/dl) was observed in 2 cases in I and II trimester each while normal values were noted in most of the cases.

### Discussion

T<sub>3</sub> values were raised during pregnancy. Maximum rise was seen during II trimester. Rising trend was noted in T<sub>4</sub> values in various trimesters of pregnancy except for I trimester.

Raised mean values of TSH were observed during II and III trimester of pregnancy. Peak value was recorded in II trimester. The III trimester fall may be a reflection of appropriate clinical management by the clinician.

Thyroid profile of pregnant versus non pregnant cases was compared by using two-sample *t*-test and it was observed that T<sub>3</sub> values increased during pregnancy significantly more so in II trimester. T<sub>4</sub> values were less during I trimester particularly at par during II trimester and increased during III trimester. Raised TSH values

were observed during pregnancy as compared to non-pregnant women. Significant increase was observed during II trimester.

Ratcliffe WA, *et al.* (1976)<sup>[4]</sup> Stated that during pregnancy the well-known pattern of high serum T<sub>4</sub> and T<sub>3</sub> was observed. The levels were increasing during the I trimester and stayed nearly stable during the II and III trimester, being approximately 1.5 times the values found at the post-partum control.

The observation regarding T<sub>3</sub> in the present study was at par with the observation of Kumar, *et al.* (2003)<sup>[5]</sup> that the mean T<sub>3</sub> increases during the II trimester and then declines in III trimester compared to the I trimester. Regarding mean T<sub>4</sub> value, in the present study the mean T<sub>4</sub> level rose in the II and then decreased in the III trimester. This was in contradiction to the study of Elduff A (1999)<sup>[6]</sup> where he observed the decreasing trend of T<sub>4</sub> values and Kumar, *et al.* (2003) where the author found that mean T<sub>4</sub> level rises in the II and decreases during the III trimester. According to Kumar, *et al.* (2003) mean TSH level rises progressively throughout all the trimester of pregnancy but in the present study peak rise in the mean

TSH value was noted in the II trimester. Zarghami Nosratollah, *et al.* (2005) observed the declining mean FT<sub>3</sub> and FT<sub>4</sub> levels during the pregnancy which was same in the present study too.

Zarghami Nosratollah, *et al.* (2005) [7] has not found significant difference in TSH and T<sub>3</sub> in pregnant as compared with non-pregnant cases on the other hand T<sub>4</sub> level in the III trimester was significant highly as compared to non-pregnant women. In the present study a significant increase in mean TSH values compared to non-pregnant women was observed and the increase in T<sub>4</sub> was significant increase in III trimester. Khandakar M.A., *et al.* (2002)<sup>[8,9]</sup> noted a significant increase in TSH and T<sub>3</sub> in all the three trimesters as compared to non-pregnant. In the present investigation there was significant increase in mean T<sub>3</sub> value in II trimester as compared to non-pregnant counterparts. TSH results were par with the present study.

### Conclusion

From our study it is conclude that serum T<sub>3</sub> values increased during pregnancy significantly more so in II trimester. T<sub>4</sub> values were less during I trimester particularly at par during II trimester and increased during III trimester. Raised TSH values were observed during pregnancy as compared to non-pregnant women. Significant increase was observed during II trimester.

### References

1. Abraham Rebecca, Murugan V Srinivasa, Pukazhvanthen P, Sen Sk. Thyroid disorders in women of puducherry. Indian Journal of Clinical Biochemistry 2009;24(1):52-59.
2. Agarwal AK. Social Classification: The need to update in the Present Scenario. Indian Journal of Community Medicine 2008;33(1):50-51.
3. Allan WC, Haddow JE, Palomaki GE, Williams JR, Mitchell ML, Hermos RJ, Faix JD. Klein RZ. Maternal thyroid deficiency and pregnancy complications: implications for population screening. J. Med. Screen. 2000;7:127-130.
4. Agarwal AK. Social Classification: The need to update in the Present Scenario. Indian Journal of Community Medicine 2008;33(1):50-51.
5. Ratcliffe WA, *et al.* The radioimmunoassay of 3, 3', 5'-triiodothyronine in unextracted human sera. Clin. Endocrinol. (Oxf) 1976;5:631-641.
6. Kumar Ashok, Ghosh BK, Murthy NS. Maternal thyroid hormonal status in preeclampsia. Indian J. Med. Sci. 2005;59(2):57-63.
7. Ekins RP. Measurement of free hormones in blood. Endocr. Rev. 1990;11:5.
8. ZarghamiNosratolla, Rohbani-Noubar Mohammad, Khosrowbeygi Ali. Thyroid status during pregnancy in normal Iranian women. Indian Journal of clinical Biochemistry 2005;20(2):182-185.
9. Khandakar M A, *et al.* Thyroid status of normal pregnant women in Dhaka City. Mymensingh Med. J. 2002;1:1-5.