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Dr. Reyya Mohan Sundar
MD, Assistant Professor,
Department of Physiology,
TRR Institute of Medical
Sciences, TRR Nagar, Inole,
Patancheru, Sangareddy,
Telangana, India

A comparative study of blood indices in rural and urban non-pregnant female population of East Godavari district, Andhra Pradesh

Dr. Reyya Mohan Sundar

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Abstract

Background: Anemia is still a major health problem in females of both rural and urban areas of the developing countries like India. The objective of the present study was to find out the hematological parameters and blood indices among non - pregnant females in rural and urban areas of East Godavari District, Andhra Pradesh, India and correlate to type of anemia, degree of anemia, and percentage of anemia in both the rural as well as urban areas non-pregnant female subjects.

Methods: A cross-sectional study was conducted among non-pregnant female subjects of age group 18 – 35 years comprised of n = 100 subjects selected from rural area and n = 100 subjects from urban areas of East Godavari District, Andhra Pradesh, India. The haematological parameters, Hb gm%, MCV (fL), RBC count / mm³, MCH (pg), PCV (%), MCHC (gm / dL) were investigated by Haematology Analyser - automated blood cell counter.

Results: among the total sample of n = 200 non-pregnant female subjects of age group 18-45 years, the overall prevalence of anemia was observed 58%, recording 60% in rural area females and 56% in non-pregnant female subjects of urban area. The overall microcytic anemia was observed maximum (40%), recording 70% in rural area subjects and 67% in urban area subjects. The overall macrocytic anemias and normocytic anemias were recorded 9% each. The macrocytic anemias were recorded 13.5% in the rural area and 17.8% in urban area. The normocytic anemias recorded 16.6% in rural area and 14.2% in urban area non-pregnant female subjects. Anova test done between non-anemic and anemic microcytic, macrocytic and normocytic groups, t-test done between every two parameters were statistically significant at $p \leq 0.005$.

Conclusion: The present study results indicates the prevalence of anemia is slightly higher among rural non-pregnant female subjects of age group 18 – 35 years compared to urban area female subjects considering it to be a major health problem in the females of both rural as well as urban areas of developing countries like India. The current study results suggests, need of due emphasis on iron and folic acid supplementation and health and education on the consumption of iron rich foods, so as to bring down the prevalence of anemia among the adolescent girls.

Keywords: Anemia, blood indices, non-pregnant females

Introduction

Anemia appeared as a serious public health problem throughout the world, particularly in developing countries^[1, 2]. WHO estimates the number of anemic people worldwide to be a staggering two billion i.e. 27% of the world's population had anemia in 2019^[3]. It is also estimated that one third of all women of reproductive age are anemic^[4]. The World Health Organization (WHO) reported that 58% of the pregnant women with anemia were also anemic before being pregnant^[5]. Prevention of anemia in non-pregnant women could improve the health status of the pregnant women, eventually contributing to the reduction of both maternal and perinatal mortality.

India is said to account for approximately a quarter of all cases of anemia globally. In India, nationally representative data from the National Family Health Survey 1998-1999 (International Institute of Population Sciences and ORC Macro 2000) on anemia of women of reproductive age describe the magnitude of the problem. The prevalence of anemia among all women in the Indian sample is 52%.

Anemia or Anaemia (hereby referred as Anemia) is characterized as decreased quantity of red blood cells in body, which is accompanied by diminished haemoglobin levels or altered red blood cell morphology^[2].

Corresponding Author:
Dr. Reyya Mohan Sundar
MD., Assistant Professor,
Department of Physiology,
TRR Institute of Medical
Sciences, TRR Nagar, Inole,
Patancheru, Sangareddy,
Telangana, India

It is estimated that anemia affects 29% (496 million) of non-pregnant women, 38% (32.4 million) of pregnant women aged 15 - 49 years and 43% of children worldwide [6, 7]. According to the World Health Organization (WHO), an anemic condition may be termed severe, mild or moderate, depending on the Hb status of the individual.

Maxwell Wintrobe [8] worked out Blood indices and applied them to the classification of anemias. Red cell indices are valuable in the morphologic classification of anemias. Blood indices include, MCV, (mean corpuscular volume), MCH, (mean corpuscular haemoglobin), MCHC (mean corpuscular haemoglobin concentration).

Based on these Blood Indices, anemias are categorized into microcytic anemia, macrocytic anemia, normocytic anemia and hypochromic and normochromic type. Anemia of any type affects tests such as Hb valus, RBC count, haematocrit (Hct). The haemoglobin test is a measure of haemoglobin (a protein in red blood cells) concentration of blood. Haematocrit is a measurement of the amount of red blood cells or space occupied by red blood cell in the blood. Both hemoglobin and hematocrit are used to diagnose anemia.

The values of Hct, Hb, RBC, are converted into blood indices viz., MCV, MCH, MCHC, through mathematical formulas and these blood indices categories the anemias into microcytic (decreased MCV), macrocytic (increased MCV), normocytic (normal MCV) and hypochromic and normochromic types.

Anemias are major health problem in females of reproductive age women, in developing and developed countries of the world. In India, more than 50% of all the females are suffering from anemia both in rural as well as urban areas. The most common type by which females of reproductive age women are suffering are "Iron deficiency anemia, vitamin B12 and folic acid deficiency anemias, anemias due to blood loss and haemolytic anemias. These anemias are categorized as microcytic anemias, macrocytic anemias, and normocytic anemias. Microcytic anemia is iron deficiency anemia, commonly occurring in females of reproductive age women in India. Macrocytic anemias are Vitamin B12 or folic acid deficiency anemias, also occurring in females of reproductive age group. Normocytic anemias occurring in females are due to blood loss or hemolytic anemias. In India more than 50% females of reproductive age women are suffering from iron deficiency anemia which is a type of microcytic anemia. Iron deficiency anemias are majorly due to dietary deficiency, Hookworm infestations, menstruation blood loss, depletion of iron stores due to increased physiological demands in reproductive age, pregnancy, multiparity, reduced space between pregnancies, postpartum haemorrhage, breast feeding. Iron deficiency anemia is the common type occurring in both rural and urban females of reproductive age women, but more commonly occurring in rural females than urban. This is correlated to lack of education, low economical status, poor nutrition, poor hygiene, hookworm infestations, early marriage, multi parity, reduced spacing between pregnancy and lack of health infrastructure. Examples of macrocytic anemias are vitamin B12 deficiency anemias observed in vegetarians and folic acid deficiency observed in those taking vegetarian food, which is observed in elderly than younger females. The other types are normocytic anemias due to blood loss, acute or chronic and some due to hemolytic anemias. There are two main ways to classify the anemias:

a. Morphologically (based on red cell size and haemoglobin content)

- 1) Microcytic hypochromic
- 2) Macrocytic
- 3) Normocytic normochromic

b. Pathophysiological (based on causative factors)

- 1) Blood Loss
- 2) Impaired RBC production
- 3) Increased RBC destruction

The type of anemia occurring in rural and urban females is categorized by these blood indices (MCV, MCH, MCHC). MCV measures the average volume of red blood cell and is the indicator of RBC size and discriminate between microcytic or macrocytic anemias. Microcytic anemias have small RBCs and decreased MCV. Microcytic anemias reflected low MCV due to defective Hb production either from ineffective haeme or globin synthesis. Microcytic anemia examples are iron deficiency anemia, anemia of chronic illness, beta thalassemia. Iron deficiency anemia the most common type of microcytic anemia. Macrocytic anemia occurs with nutritional deficiency examples are vitamin B12 and folic acid deficiency. Normocytic anemia with normal MCV and normal sized RBC's occurring in acute blood loss or hemolytic anemia. MCH is the average weight of Hb in red blood cell. MCHC measure the average concentration of Hb in a red blood cell. Cells with normal concentration of Hb are called normochromic. Cells with decreased concentration of Hb are hypochromic. Anemias are categorized as hypochromic or normochromic according to MCHC index. So the comparative study of blood indices categorises the type of anemia in females. Decreased MCV, MCH and MCHC values discriminate them into microcytic, hypochromic anemias. Increased MCV and normal MCHC and MCH discriminate them into macrocytic anemia. Normal MCV, MCHC and MCH values are seen in normocytic normochromic anemia. The purpose of the comparative study of blood indices is to derive MCV, MCH, MCHC from haematological parameters Hb, total RBC count, PCV or hematocrit, from a sample population including females of reproductive age group (18 - 35 years) in both rural and urban areas. Statistical analysis was done and the prevalence of anemia and types of anemias area-wise and age-wise noted and compared in both rural and urban non-pregnant females which will help further in preventive, differentiating and diagnostic aspects of anemia in non-pregnant females of rural and urban areas of East Godavari District, Andhra Pradesh, India.

Most of the previous studies were focused on the prevalence and determinants of anemia among pregnant women [4, 9, 10]. However, there are a few studies assessing the prevalence of severe anemia among non-pregnant women.

In view of the above, the present study was carried out to find out the prevalence of anemia in non-pregnant female population of rural and urban areas of East Godavari District, Andhra Pradesh, India.

The present study was aimed to find out the haematological parameters such as Hb (gm%), Total RBC (count / mm³), and packed cell volume (PCV in %) among non-pregnant females of age group (18 - 35 years) in rural and urban areas of East Godavari Dist, Andhra Pradesh, India. To derive blood indices: MCV (fL), MCH (pg), MCHC (g/dL). The blood indices study helps anemia detection and typing of

anemias. Hence, these blood indices of non-pregnant females of age group (18 – 35 years) were compared among rural and urban areas of East Godavari district.

Material and Methods

The study sample population and sample size included non-pregnant females of age group 18 - 35 years constituting n = 100 subjects (cases) in rural area and n = 100 subjects in urban area.

The study population included

- The subjects in the field practicing areas of UHC (Urban Health Center) and RHC (Rural Health Center) under GSL Medical College and General Hospital, Rajahmundry.
- The rural and urban areas of East Godavari District viz., Rajahmundry, Rajanagaram and Kakinada.

Haematological parameters and blood indices were done and calculated at (a) Central Lab of GSL Medical College and Hospital, Rajahmundry (b) Rajanagaram PHC and Lab. (Pvt.) (c) Kakinada (Pvt. Maternity Hospital and Lab).

Inclusion criteria included normal adult females of age group between 18 - 35 years.

Exclusion criteria included pregnant women, elderly women, children, females suffering from haematological disorders, leukemia, myeloproliferative disorders.

The study design was cross sectional study using simple random sampling, appropriate sample size was taken. The study was conducted for a period of one year.

Study variables included: age, gender, marital status, education, family back ground, nutrition, income.

Permission from Head of the Department was taken. The approval from the Ethical committee of the institution was taken. All the study subjects were informed about this study protocol and written consent was obtained from the subjects prior to the procedure.

Procedure

A sterile 5ml syringe was taken for collection of blood sample following strict aseptic measures. Venous blood samples were collected into anti-coagulant (EDTA) added sample tubes.

The haematological parameters such as hemoglobin (gm %), Total RBC Count / mm³, PCV (%) were investigated. Blood Indices like MCV (fL), MCH (pg) and MCHC (g / dL) were calculated.

All the above haematological parameters were analyzed by Hematology analyser- automated blood cell counter (SYSMEX XP-100) in the central Lab of GSL Medical College General Hospital.

Following normal ranges for haematological parameters and blood indices were followed:

As per NFHS (National Family Health Survey)

Hb – 12 - 15.5 gm%

RBC - 4.5 - 5.5 mm³

PCV - 37 - 47%

Hb - < 12 gm% - anemia

Hb = 12 - 15.5 gm% - non-anemic

MCV - 78 - 96 (fL)

On the basis of blood indices the subjects with:

MCV - < 78 fL (considered as microcytic anemia)

MCV - > 96 fL (macrocytic anemia)

MCV - < 78 - 96 fL (normocytic anemia)

MCH - 27 - 33 (pg)

MCHC - 30 - 37% (normochromic anemia)

MCHC - < 30% (hypochromic anemia)

Statistical analysis

The statistical analysis data is correlated to distribution and percentage of anemia, degree of anemia, types of anemia in both rural and urban areas compared, which helps in preventive, differentiating and diagnostic aspects of anemia. The statistical analysis was done by using SPSS software version-20 and MS excel- 2007.

All descriptive statistical values were presented in the form of mean ± standard deviations and percentages.

Student-t test and ANOVA Test was performed to compare the means of different groups, correlation was performed to assess the relation among the various variables

ANOVA Test was done between non-anemic and anemic females and microcytic, macrocytic, normocytic groups.

Student-t Test was done between every two parameters. The statistical analysis *p* value ≤ 0.05 was considered as statistically significant.

Results

The statistical analysis data of comparison of haematological parameters and blood indices in non-pregnant females of age group between 18 - 35 years and between anemic and non-anemic in rural areas is presented in the Table 1. The statistical analysis data in the Table shows that there is a highly significant (*P*< 0.01) difference in all parameters studied except for RBC in non-pregnant females of age group between 18 – 35 years.

Table 1: Comparison of haematological parameters and blood indices in non-pregnant females subjects of age group (18 - 35 yrs) between anemic and non-anemic in rural area

Parameters	Group	n	Mean	SD	<i>p</i>	INF
Hb (gm %)	Anemic	60	9.97	0.997	0.000	HS
	Non anemic	40	12.56	0.396		
RBC (millions / mm ³)	Anemic	30	4.390	.3745	0.793	NS
	Non anemic	20	4.415	.2412		
PCV (%)	Anemic	30	34.507	3.4495	0.000	HS
	Non anemic	20	40.710	2.0201		
MCV (fL)	Anemic	30	78.500	11.5021	0.000	HS
	Non anemic	20	91.085	3.8429		
MCH (pg)	Anemic	30	22.667	3.5706	0.000	HS
	Non anemic	20	28.130	1.4357		
MCHC g / dL	Anemic	30	28.840	2.4319	0.000	HS
	Non anemic	20	31.340	2.0184		

SD- Standard Deviation; HS- highly significant

The statistical analysis data of comparison of haematological parameters and blood indices in non-pregnant female subjects of age group 18 - 35 years between anemic and non-anemic in urban area is given in the Table 2. The statistical analysis data in the table shows that there is a highly significant (*P*< 0.01) difference in all the parameters studied except for the RBC count in non-pregnant female subjects of age group 18 - 35 years.

Table 2: Comparison of haematological parameters and blood indices in non-pregnant female subjects of age group (18 - 35 yrs) between anemic and non-anemic in urban area

Parameters	Group	n	Mean	Std. Deviation	p Value	INF
Hb (gm %)	Anemic	56	10.15	.532	0.000	HS
	Non anemic	44	12.56	.645		
RBC (millions / mm3)	Anemic	28	7.379	10.6352	0.185	NS
	Non anemic	22	4.318	.3002		
PCV (%)	Anemic	28	35.696	3.0789	0.000	HS
	Non anemic	22	38.932	2.4396		
MCV (fL)	Anemic	28	79.568	12.2190	0.001	HS
	Non anemic	22	89.609	3.7369		
MCH (pg)	Anemic	28	22.529	3.3554	0.000	HS
	Non anemic	22	28.882	1.6112		
MCHC g / dL	Anemic	28	28.971	2.3442	0.000	HS
	Non anemic	22	32.505	1.8123		

Table 3: Comparison of the parameters between microcytic, macrocytic, normocytic anemias and non-anemic among non-pregnant female subjects in rural area

Dependent Variable		Hb gm%		RBC count / mm3		PCV%		MCV (fL)		MCH (pg)		MCHC g / dL	
(I) GRP	(J) GRP	P-Val	Inf	P-Val	Inf	P-Val	Inf	P-Val	Inf	P-Val	Inf	P-Val	Inf
Macrocytic	Microcytic	0.001	HS	0.016	NS	0.000	HS	0.000	HS	0.000	HS	0.010	NS
Macrocytic	Normocytic	0.235	NS	0.666	NS	0.000	HS	0.000	HS	0.012	NS	0.000	HS
Macrocytic	Non anemic	0.000	HS	0.076	NS	0.812	NS	0.000	HS	0.013	NS	0.000	HS
Macrocytic	Microcytic	0.000	HS	0.016	NS	0.000	HS	0.000	HS	0.000	HS	0.010	NS
Macrocytic	Normocytic	0.000	HS	0.002	HS	0.568	NS	0.000	HS	0.000	HS	0.000	HS
Macrocytic	Non anemic	0.000	HS	0.238	HS	0.000	HS	0.000	HS	0.000	HS	0.000	HS
Macrocytic	Microcytic	0.235	NS	0.666	NS	0.000	HS	0.000	HS	0.012	NS	0.000	HS
Macrocytic	Microcytic	0.000	HS	0.002	NS	0.568	NS	0.000	HS	0.000	HS	0.000	HS
Macrocytic	Non anemic	0.000	HS	0.013	HS	0.000	HS	0.008	NS	0.497	NS	0.044	NS
Non anemic	Microcytic	0.000	HS	0.076	NS	0.812	NS	0.000	HS	0.013	NS	0.000	HS
Non anemic	Normocytic	0.000	HS	0.238	NS	0.000	HS	0.000	HS	0.000	HS	0.000	HS
Non anemic	Microcytic	0.000	HS	0.013	NS	0.000	HS	0.008	NS	0.497	NS	0.044	NS

Table 4: Comparison of the parameters between microcytic, macrocytic, normocytic anemias and non-anemic among non-pregnant female subjects in urban area

Dependent Variable		Hb gm%		RBC count / mm3		PCV%		MCV (fL)		MCH (pg)		MCHC g / dL	
(I) GRP	(J) GRP	P-Val	Inf	P-Val	Inf	P-Val	Inf	P-Val	Inf	P-Val	Inf	P-Val	Inf
Macrocytic	Microcytic	0.000	HS	0.016	NS	0.000	HS	0.000	HS	0.000	HS	0.705	NS
Macrocytic	Normocytic	0.876	NS	0.666	NS	0.000	HS	0.000	HS	0.731	NS	0.060	NS
Macrocytic	Non anemic	0.000	HS	0.076	NS	0.812	NS	0.000	HS	0.018	NS	0.001	HS
Macrocytic	Macrocytic	0.000	HS	0.016	NS	0.000	HS	0.000	HS	0.000	HS	0.705	NS
Macrocytic	Normocytic	0.000	HS	0.002	HS	0.568	NS	0.000	HS	0.000	HS	0.010	NS
Macrocytic	Non anemic	0.000	HS	0.238	HS	0.000	HS	0.000	HS	0.000	HS	0.000	NS
Normocytic	Macrocytic	0.586	NS	0.666	NS	0.000	HS	0.000	HS	0.731	NS	0.060	NS
Normocytic	Microcytic	0.000	HS	0.002	NS	0.568	NS	0.000	HS	0.000	HS	0.010	NS
Normocytic	Non anemic	0.000	HS	0.013	HS	0.000	HS	0.011	NS	0.011	NS	0.353	NS
Non anemic	Macrocytic	0.000	HS	0.076	NS	0.812	NS	0.000	HS	0.018	NS	0.001	HS
Non anemic	Normocytic	0.000	HS	0.238	NS	0.000	HS	0.000	HS	0.000	HS	0.000	HS
Non anemic	Microcytic	0.000	HS	0.013	NS	0.000	HS	0.011	NS	0.011	NS	0.353	NS

The data of Anova analysis of all the parameters studied in non-pregnant subjects among rural and urban areas is represented in the Table 5. The Anova analysis data of all parameters studied shows that the *p*-values are highly significant (*p* < 0.005) for all hematological parameters and blood indices in female subjects of both rural as well as urban areas, except for RBC counts, where *p*-value is > 0.005 which is not statistically significant. This implies that the data of the parameters studied shows that the anemia prevails in the selected subjects of both rural as well as urban areas. The statistical analysis data of *p*-values showed statistically significant correlation with blood indices MCV, MCH, MCHC, indicating the presence of microcytic, macrocytic and normocytic anemias.

Table 5: ANOVA analysis data showing *p* values of all the parameters studied among non-pregnant female subjects of rural and urban areas

Parameters	Rural		Urban	
	<i>p</i> value	INF.	<i>p</i> value	INF.
Hb (gm %)	0.000	<i>P</i> < 0.005 (HS)	0.000	<i>P</i> < 0.005 (HS)
RBC(millions / mm3)	0.004	<i>P</i> < 0.005 (HS)	0.027	<i>P</i> < 0.005 (NS)
PCV (%)	0.000	<i>P</i> < 0.005 (HS)	0.000	<i>P</i> < 0.005 (HS)
MCV (fL)	0.000	<i>P</i> < 0.005 (HS)	0.000	<i>P</i> < 0.005 (HS)
MCH (pg)	0.000	<i>P</i> < 0.005 (HS)	0.000	<i>P</i> < 0.005 (HS)

The percentage distribution of anemia in female non-pregnant subjects of rural and urban areas is presented in Table 6. The data shows that in a total sample of *n* = 200

subject females (18 - 35 yrs), the overall prevalence of anemia is 58%, in rural females the anemia prevalence is 60%, while in urban females it is 56%. Among the total n = 200 subjects, the microcytic anemia was observed to be maximum in prevalence recording 40%, the microcytic anemia in the females of rural area was observed 70% and in urban females 67.8%. Out of the total n = 200 subjects the overall macrocytic and normocytic anemia recorded were 9% each. In the female subjects of the rural area the macrocytic anemia was 13.5% and in urban area 17.8% and the normocytic anemia in the rural area was recorded 16.6% while in urban area 14.2%.

Table 6: Percentage distribution of anemia among non-pregnant female subjects in rural and urban areas

Types of anemia	Rural (n=100)	Urban (n=100)	Total (n=200)
Anemia (%)	60	56	58
Microcytic anemia	70	67.8	40
Macrocytic anemia	13.5	17.8	9
Normocytic anemia	16.6	14.2	9
Non anemic	40	44	42

The results of comparison of haematological parameters and blood indices in non-pregnant female subjects of anemic and non-anemic in rural and urban areas are shown in the Fig. 1. The data recorded showed that there is a high statistically significant ($P < 0.001$) difference in the parameters such as Hb levels, Hct, MCV, MCH and MCHC values between anemic and non-anemic female subjects of the rural area. There is a low significant ($P > 0.001$) difference in RBC counts between anemic and non-anemic female subjects of the rural area. There is a high statistically significant ($P < 0.001$) difference in Hb levels, Hct, MCV, MCH and MCHC values between anemic and non-anemic female subjects of the urban area. However, there is no significant ($P > 0.001$) difference observed in RBC counts between anemic and non-anemic females of the urban area.

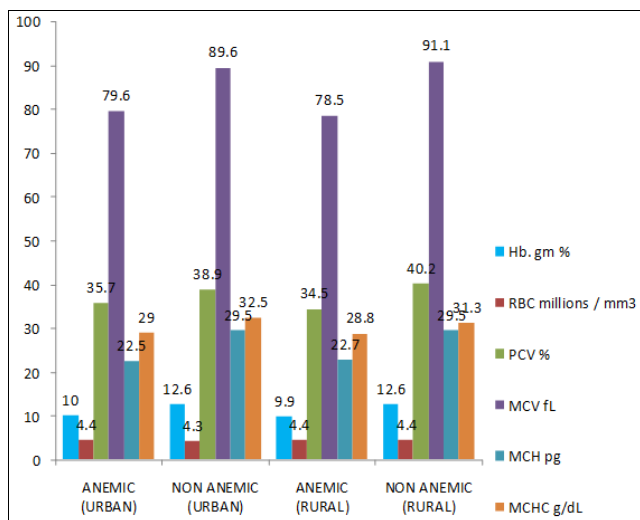


Fig 1: Comparison of haematological parameters and blood indices in non-pregnant female subjects of anemic and non-anemic in rural and urban areas

The data of comparisons of the parameters studied between microcytic, macrocytic, normocytic anemic and non-anemic non-pregnant female subjects of the urban areas presented in the Fig. 2a shows that there is high statistically significant ($p < 0.001$) difference seen among fib, PCV, MCV, MCH

values compared to microcytic and macrocytic groups in females of the urban area. There is high statistically significant ($p < 0.001$) difference observed among MCV, MCH values compared to microcytic and normocytic groups in the females of urban area. There is a high statistically significant ($p < 0.001$) difference observed among Hb, PCV values compared to microcytic and non-anemic groups in female subjects of the urban area. There is highly significant ($p < 0.001$) difference seen among Hb, MCV values compared to macrocytic and normocytic groups in female subjects of the urban area. There is a highly significant ($p < 0.001$) difference observed among Hb, MCV, MCH values compared to macrocytic and non-anemic groups in females of urban area. There is a high statistically significant ($p < 0.001$) difference observed among PCV, MCV, MCH, MCHC values compared to normocytic and non-anemic groups in females of the urban area.

The statistical analysis data shows that there is statistically highly significant ($p < 0.001$) difference recorded in all the parameters studied except RBC count between anemic and non-anemic non-pregnant females of the urban area.

The statistical analysis data of the comparisons of parameters studied between microcytic, macrocytic, normocytic anemic and non-anemic non-pregnant females of the rural area is presented in Fig. 2b. The statistical analysis data showed that there is statistically highly significant ($p < 0.001$) difference observed in all the parameters studied except RBC counts between anemic and non-anemic non-pregnant females of rural area.

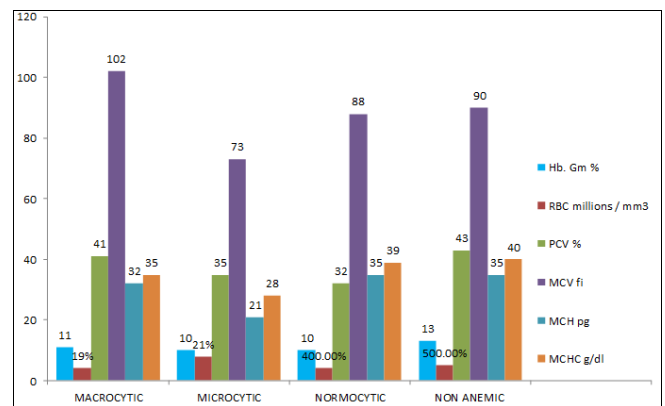


Fig 2a: Comparison of parameters between microcytic, macrocytic, normocytic anemic and non-anemic female subjects of the urban area

The data shows that there is highly significant ($p < 0.001$) difference observed among Hb, PCV, MCV, MCH values compared to microcytic and macrocytic groups, and among Hb, PCV, RBC, MCV, MCH, MCHC values compared to microcytic and normocytic groups in females of the rural area.

Similarly there is highly significant ($p < 0.001$) difference noted in Hb, PCV values compared to microcytic and non-anemic groups and among PCV, MCV, MCHC values compared to macrocytic and normocytic groups in female subjects of the rural areas. There is statistically significant ($p < 0.001$) difference observed among Hb, MCV, MCHC values compared to macrocytic and non-anemic groups and among Hb, PCV, MCV, MCH, MCHC values compared to normocytic and non-anemic groups in non-pregnant subjects of the rural area.

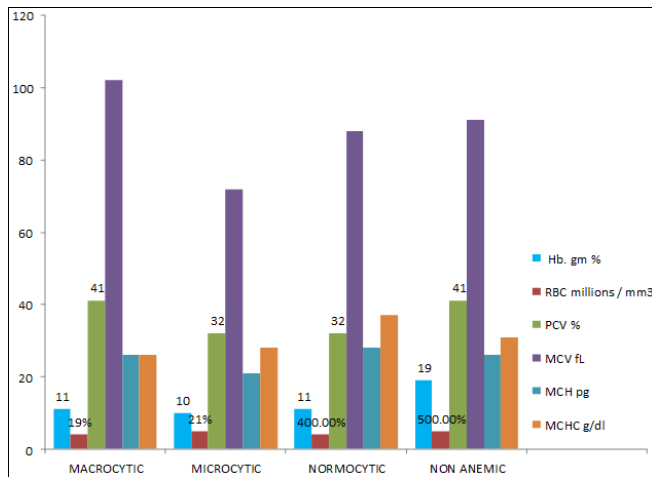


Fig 2b: Comparison of parameters between microcytic, macrocytic, normocytic anemic and non-anemic non-pregnant female subjects of the rural area

The data of distribution of anemia types in rural and urban non-pregnant females shows that microcytic anemia cases are n = 42 subjects, normocytic anemia subjects are n = 10, macrocytic anemia n = 8 in non-pregnant females of rural area while, in rural area microcytic anemia cases are n = 38, normocytic anemia cases are n = 8, macrocytic anemia subjects are n = 10.

The data of the distribution of anemic and non-anemic subjects in non-pregnant female subjects of rural and urban area shows that anemic cases are n = 60 in rural females and n = 56 in urban females while, non-anemic cases are n = 40 in rural females and n = 44 in urban female subjects.

The mean age of the urban and rural non-pregnant females is 25.76 and 25.72 respectively which is almost similar in both the areas.

The data of comparison of haematological parameters and blood indices in non-pregnant females of both rural and urban areas is shown in Fig. 3. The data of all parameters studied ($p > 0.005$) indicates that anemia prevails both in rural and urban non-pregnant females. However, it is slightly higher in females of the rural area compared to urban area females.

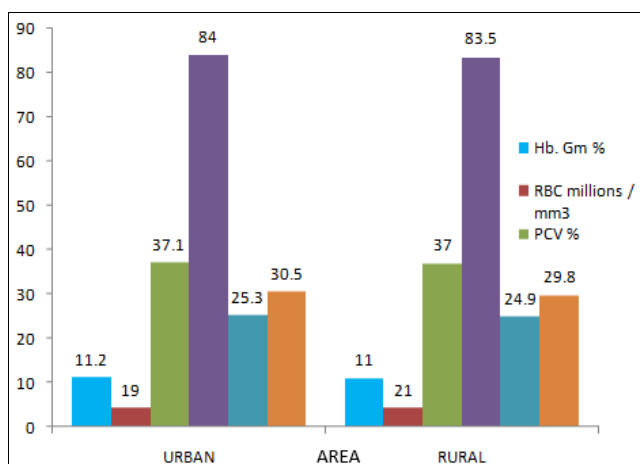


Fig 3: Comparison of haematological parameters and blood indices in non-pregnant female subjects of both rural and urban areas

Discussion

Over the past few decades most of the anemia related studies were performed on infants, children, adolescents,

pregnant women and elderly women. Very few studies were conducted on adult healthy non-pregnant women. In view of this the present study was aimed at detection of anemia and anemia types in the selected non-pregnant females of rural and urban areas of East Godavari district, A.P., India.

In this study the parameters such as Hb, RBC, PCV were taken to determine blood indices viz. MCV, MCH, MCHC and were used to classify anemia. The types of anemias occurring in non-pregnant females of rural and urban areas were categorized based on these blood indices.

A similar study was carried out by Ahmad Hassan et. al [11]. In the present study, for adult healthy female subjects of age group 18 - 35 yrs, the normal ranges of Hb values were 12 - 16 g / dl, RBC 4.0 - 5.5 millions / mm3, PCV 37 - 47%, for blood indices MCV were between 78 - 96 fL, MCH between 27 - 33 pg and MCHC 30 - 37%. According to WHO (1992) [12] criteria, Hb level < 12 g / dL was considered anemia in adult female. On basis of RBC indices anemia with (MCV < 78 fL) considered as microcytic anemia, (MCV > 96 fL) as macrocytic anemia, (MCV 78-96 fL) as normocytic, MCHC (30 - 32%) as normochromic and MCHC (< 30%) considered as hypochromic anemia. As per NHFS (National Family Health survey, Hb levels 11.9 - 10 g / dl was considered as mild anemia, 9.9 - 7.0 g / dl as moderate and Hb < 7.0 g/dl as severe anemia.

Mcfee [13] studies suggested that at child bearing age women generally suffered from anemia where insufficient diet, multiple pregnancies and excessive hemorrhages are the main causes of anemia. Bentley and Griffiths [2] suggested anemia in south Asia as highest in the world. Maninder and Kochar [14] study results reported that rural women have higher prevalence of anemia compared to urban women. Mcfee [13] suggested effects on iron deficiency anemia are protein energy malnutrition (19%), bleeding from alimentary track (56%), high bleeding (29%) during menstruation, pregnancy (6%). Kapil et al. [15], Saxena et al. [16] reported that 18 - 30% women taken diet less than recommended dietary allowance. NFHS (National Family Health Survey) 98 - 99, in A.P. [17] reported that 83% rural women are married before 18 years. In a study at Ecuador, Brazil, Iron deficiency anemia is the most common, followed by normocytic and megaloblastic anemias. Khan et al. [18] study on anemia in rural adult females reported that low level of Hb may be due to inadequate food consumption, mal-absorption, worm infestation or excessive menstrual bleeding. Earlier studies suggested that anemia was more prevalent in rural areas due to lack of health education, inadequate nutrition, improper medication, also observed that macrocytic hypochromic anemia is the most frequent form of anemia followed by microcytic and other types. Chandra et al. [19] study suggests that B12 deficiency was observed in vegetarian families and infants of breast feeding, as cobalamin content of milk is low in vegetarian mothers. Macrocytic anemia seen in elderly women, ageing process may be the intrinsic factor in development of this type of anemia. Our results indicated that overall prevalence of anemia (Hb < 12 g / dl) is 58%. In rural females it is 60% and in urban females 56%. In urban females anemia is observed to be mild type (11.9 - 10 g / dl) and in rural females mild to moderate type. Overall the commonest type is microcytic anemia, where MCV (< 78 fL) is 40% and macrocytic anemia (MCV > 96 fL) and normocytic anemia (MCV 78 - 96 fL) was 9% each. The mean age group is 25.7 years. The current study results observed that mean Hb values were below normal in both rural and urban non-pregnant females. Mean Hb value was 11 g / dl in rural female subjects, and 11.2 g / dl in urban females indicating

that anemia prevails both in rural as well as urban females. Mild type of anemia was observed in urban females, mild to moderate in rural females. The RBC indices such as MCV, MCH, MCHC, p value ($p < 0.005$) significantly correlates with microcytic, macrocytic and normocytic anemia. In the present study, occurrence of anemia is slightly higher in rural females compared to urban female subjects. In rural females the most common type of anemia was microcytic, followed by normocytic and finally macrocytic anemia. In urban females the most common type of anemia was microcytic followed by macrocytic and normocytic anemia. The investigations like serum ferritin, iron, TIBC, transferrin saturation, serum B12 or folate levels, electrophoresis are expensive and unavailable to rural area females and also expensive. Rural females usually suffer with chronic infections and inflammatory diseases and the tests available may not correlate significantly with anemia as the tests expensive are unavailable to rural females. Thus, a brief dietary history, family history, local examination with blood indices study helps the clinician greatly in differentiating and diagnostic aspects of the anemia.

In the current study, anemia occurrence slightly higher in rural area females compared to urban area females, in rural females most common types are microcytic anemia followed by normocytic and macrocytic anemia. In urban females the commonest type are microcytic anemia followed by macrocytic and normocytic anemia in female subjects of age group 18 - 35 years among rural and urban areas of East Godavari district, Andhra Pradesh. As per the national guidelines antenatal programs included, however there is a still a need to reinforce this key element and give sufficient importance to it as an intervention for reducing maternal morbidity and mortality. Delaying the first pregnancy in 20 years of age and improvement in pre-pregnancy nutritional status should be emphasized. Periodical studies will highlight problems related to anemia in females if anemia surveys are conducted in multiple project areas the sample size will be large enough, by combining the data from all the projected areas. The present study warrant a need for attention to anemia among the age group studied and further study on a large population sample and eventually encouraging the development of directed educational and nutritional programs to safe guard the well being of the future mothers.

Conclusion

The present study results indicates the prevalence of anemia is slightly higher among rural non-pregnant females compared to urban females considering it to be a major health problem in the females of both rural as well as urban areas of developing countries like India. The results showed that in urban females mild type of anemia is common, while in rural mild to moderate type. The current study results suggests, need of due emphasis on iron and folic acid supplementation and health and education on the consumption of iron rich foods, so as to bring down the prevalence of anemia among the adolescent girls. Prevention of anemia in non-pregnant female could improve the health status of the pregnant women and safe guard the wellbeing of the future mothers, eventually contributing to the reduction of both maternal and perinatal mortality.

References

1. Sharma P, Mehta S, Nagar R. Prevalence of anemia and socio-demographic factors associated with anemia among pregnant women attending antenatal Hospital in Jaipur City, India. *IOSR J Pharm. Biol. Sci.* 2013;6:1-5.
2. Bentley ME, Griffiths PL. The burden of anemia among women in India. *Eur. J Clin. Nutr.* 2003;57:52-60.

3. Worldwide prevalence of anaemia: WHO global database on anaemia / Edited by Bruno de Benoist, Erin McLean, Ines Egli and Mary Cogswell. 1993-2005.
4. Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N, Lozano R, *et al.* A systematic analysis of global anemia burden from 1990 to 2010. *Blood Journal.* 2014;123:615-624.
5. World Health Organization (WHO). The Prevalence of Anaemia in Women: A Tabulation of Available Information; World Health Organization: Geneva, Switzerland. 1992.
6. Stevens GA, Finucane M, De-Regil LM, Flaxman SR, Branca F, Peña-Rosas JB, *et al.* Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. *Lancet Glob Health.* 2013;1:16-25.
7. World Health Organization. Global Nutrition Targets 2025: Anaemia Policy Brief. World Health Organization. 2014.
8. Wintrobe MM. Anemia: classification and treatment on the basis of differences in the average volume and hemoglobin content of red corpuscles. *Arch Intern Med.* 1934;54:256.
9. Alem M, Enawgaw B, Gelaw A, Kenaw T, Seid M, Olkeba Y. Prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Azezo Health Center Gondar town, Northwest Ethiopia. *J Interdiscip. Histopathol.* 2013;1:137-144.
10. Gomes da Costa A, Vargas S, Clode N, Graça LM. Prevalence and risk factors for iron deficiency anemia and iron depletion during pregnancy: A prospective study. *Acta Med. Port.* 2016;29:514-518.
11. Ahmad Hasan Sulthan *et al.* Anemia among female students at university of Sharjah, UAE, prevalence and classification. *J Egypt Public Health Association.* 2007;82:3-4.
12. World health organization. The prevalence of anemia in women: atabulation of available information. Geneva: World health organization. 1992.
13. Mcfee JC. Iron metabolism and iron deficiency during pregnancy. *Clin. Obstet. Gynecol.* 1979;22:799-806.
14. Maninder K, Kochar GK. Burden of Anaemia in Rural and Urban Jat Women in Haryana State, India. *Malaysian Journal of Nutrition.* 2009;15(2):175-184.
15. Kapil U, Pathak P, Tendon M, Singh C, Pradhan R, Dwivedi SN. Micronutrient deficiency disorders among reproductive women in three urban slum communities of Delhi. *Indian paediat.* 1999;36(10):983-989.
16. Saxena V, Srivistav VK, Idris MZ, Mohan U, Bharath V. Nutritional status of rural pregnant women. *Indian Journal of Corn Med.* 2000;3:104-107.
17. National Family Health Survey (NFHS-2), India. 1998-98 Andhra Pradesh, International Institute for Population. Surinder Kaur, Nutrition Foundation of India. 1989.
18. Khan Z, Nawaz M, Khan A, Bacha U. Hemoglobin, red blood cell count, hematocrit and derived parameters for diagnosing anemia in elderly males. *Proceedings of the Pakistan Academy of Sciences.* 2013;50(3):217-226.
19. Chandra J. Megaloblastic anemia: back in focus. *Indian J Pediatr.* 2010;77:795-799.