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Anemia And the Adequacy of Prenatal Care According to Kessner/ Institute of Medicine Index

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Introduction

Anemia is a major preventable nutritional deficiency in the world, about one third of the global population (over 2 billion) is anemic. (1) Iron deficiency is the most common cause in pregnancy. (2)

The prevalence of anemia was highest in south Asia and central and west Africa(3) From statistical point of view regarding anemia, WHO global database on anemia 2021 estimate the prevalence of anemia to be 29.9% of women in reproductive age in 2019 worldwide.(4) Furthermore, Anemia contributes to maternal death indirectly by 15-20%.(5) Prevalence of anemia during pregnancy in developing countries is relatively high (33% - 75%) (2,6), while 15% of pregnant women are anemic in developed countries (2,6-9)

Yemen is one of the developing countries and studies from South Yemen reports a relatively higher results. In a study conducted in al Huta Lahej governorate showed that 204 (94%) of the study group were found to have Hb level below 11g/dl.(10). Another study about the prevalence and risk factors of anemia among pregnant women in Al-Mukala 2001 showed that 81% of pregnant women were anemic.(11) And a prospective study was carried out in Al sadaqa teaching hospital during Oct2002-March2003 over 500 full term pregnant women, found that the prevalence of anemia was 83.4%,significantly due to poor iron supplement and other bad habits.(12)

The predisposing factors for anemia include grand multiparty, low socioeconomic status, inadequate dietary intake, mal absorption of iron, folic and vitamin B 12, chronic infection, bleeding source, late prenatal care, Malaria and tropical diseases, HIV infection and inadequate spacing of pregnancies (9).also increased demands of essential micronutrients iron, folic acid and vitamin B12.

Anemia is regarded as a major risk factor for unfavorable pregnancy outcomes for both; the mother and the fetus. Anemia has been associated with preterm delivery and low birth weight infants (13) and maternal and prenatal mortality (14). Fetal mortality has consistently been associated with maternal mortality (15).. Anemia is associated with poor cognitive development in children, and work capacity in adults, influencing country development.(4)

Specialized and systematic care during pregnancy is important for the healthier pregnancy and optimum pregnancy outcomes. Regular ANC attendance is believed to guarantee healthier pregnancies and uneventful deliveries, and women who miss visits are considered at risk of poor pregnancy outcomes. (16–19)

Accurate assessment of prenatal care utilization is the critical first step in the development of public health programs to improve prenatal care accessibility and ultimately to improve birth outcomes. (20)

Therefore, in order to prevent all of the mentioned sequel and from point of public health measures, antenatal care would strongly decrease the incidence of these sequel by educating the pregnant women

regarding anemia, its causes, ways and measures of prevention **(**by providing nutritional education with the emphasis on the locally and affordable food stuffs and administration of iron, folic acid supplements**)**. It's believed that not only Antenatal care **(**ANC**)** will combat these problems but also will participate in the development of the country by means of ensuring the mothers with healthy and productive life and enable them to deliver healthy newborns. **(**21**)**

Worldwide there are several studies which deal with anemia in pregnancy or prenatal care but few study the relation between them. In Yemen anemia and prenatal care where studied separately and no reports about the effect of prenatal care or its quality on the prevalence of anemia in pregnancy.

The interest of this study was to assess the prevalence of anemia and the quality of prenatal care among pregnant women attending ANC centers for at least one visit, and to measure the influence of quality of care on the prevalence of anemia.

2. Objectives

General

To determine the prevalence of anemia & its relation to the adequacy of prenatal care among pregnant women admitted to Al-Sadaka Teaching Hospital.

Specific

1- To identify the sociodemographic, medical & obstetric characteristics of the studied population **(**age, education, parity, etc.**)**.

2- To study the relation between the maternal anemia and the prenatal care.

3- To determine the quality of prenatal care through the studied population.

Methodology

Study Setting

A retrospective hospital based cross-sectional study was conducted in Al- Sadaka Teaching Hospital from 1st January to 28th february 2018. The study population included all pregnant women admitted to the hospital during the study period. Al-Sadaka Teaching Hospital is a referral hospital in the region that provides preventive, curative, and diagnostic services to Aden city and its surroundings and serves as a referral center to the south of Yemen.

Data Collection

Data about socioeconomic, demographic medical and obstetrical characteristics of pregnant women were collected from medical records and filled in to a questionnaire, and a blood hemogram were registered. In this study the hemoglobin **(**HGB**)** value was determined at admission and the severity of anemia was noted based on the HGB value according to the WHO definition as HGB < 11 g/dl, Mild, moderate and severe anemia was defined as HGB measurements between 10-10.9 g/dl, 7- 9.9g/dl and less than 7 g/dl, respectively. Information about antenatal care **(** first visit, number of visits**)** were collected from medical file, the quality of antenatal care was defined according to Kessner index.

Quality of prenatal care according to kessner index

A classification of prenatal care was developed by the Institute of Medicine in 1973 David Kessner was the first author of the Institute of Medicine**(**IOM**)**. The Kessner Index- the principal adequacy of prenatal care utilization index includes information about both the timing of prenatal care initiation and quantity of prenatal care visits after initiation. It was published in 1973 as part of an IOM-supported study of infant mortality in New York City.**(**22**)** The Kessner Index combines two continuous numeric measures **(** month prenatal care begins and number of visits, adjusting for length of gestation**)** and rigidly links them into a very easy to understand index with three levels of adequacy **(**Adequate, Intermediate، and Inadequate**)**.**(**20**)** To be rated Adequate on the Kessner Index, one must start prenatal care in the first trimester and have nine prenatal care visits for a normal-length pregnancy.

Prenatal care and Antenatal care are the same and used interchangeably in this article

Booking or first visit

Was defined as Early booking; if in the first trimester or late if after the first trimester

Exclusion criteria

Incomplete files about preenatal care visits & blood HGB were omitted, Also pregnancies with multiple pregnancy and chronic medical diseases were excluded from the study.

Data Analysis

Data was entered and statistical analysis was performed using SPSS version 20, software. The frequency distributions of the variables were worked out. Frequency tables and charts were used to present the summarized

Ethical Consideration

Ethical approval was obtained from the authority of the hospital.

Results

This study enrolled a total number of 503 pregnant women admitted to the hospital for different indications, the majority of them 365 **(**72.6% **)** were in the age group of 20-34 years. The two extremes have near equal distribution.

More than half have primary school education 269 **(**53.3%**)** and most of them were house wife 476 **(**94.6%**)**.

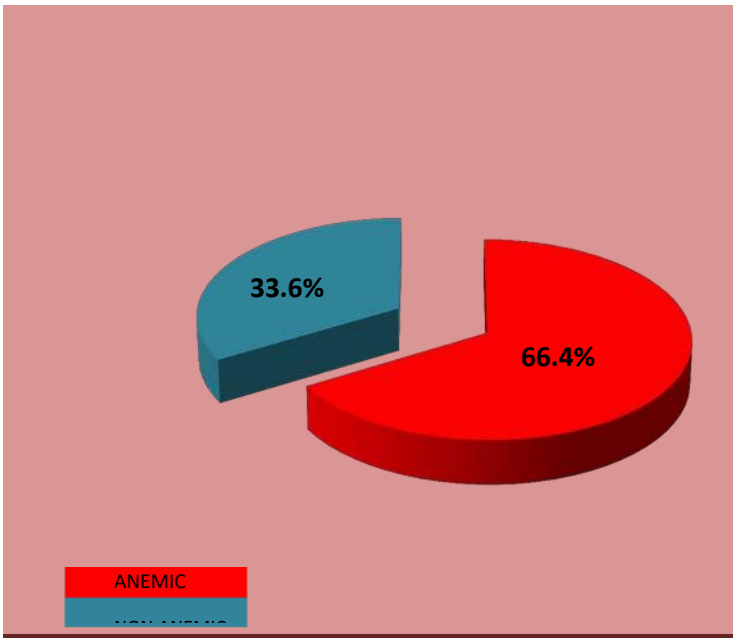
The obstetric characteristics of the study population were of a pleuripara 1-3 previous pregnancies 256 **(**50.9%**)**.

The majority of them were admitted to the hospital during this current pregnancy in their third trimester of pregnancy 438 **(**96%**)**. Table **(**1**)**.

Anemia was highly prevalent among the studied population It affects 334 patients **(**66.4%**)**.Graph no. 1.

Table (1): Distribution according to Socio demographic and Obstetric Characteristics:

		NO.	Percentage %
Age groups	< 20 years	66	13.1
	20-34 years	365	72.6
	≥35	72	14.3
Education level	Illiteracy	177	35.2
	Primary school	269	53.4
	Secondary school	38	7.6
	Higher level	19	3.8
Occupation	House wife	476	94.6
	Employed	27	5.4
Parity	Primigravida **(**P= 0**)**	180	35.8
	Pleuripara1-3 Multipara	256	50.9
	4-5 Grand multipara	45	8.9
Duration of pregnancy	1st trimester	22	4.4
	2nd trimester	3	0.6
	3rd trimester	17	3.4
		483	96
Total		**503**	**100**



GRAPH. 1. FREQUENCY OF ANEMIA

In terms of severity a total number of 189 (37.6%) have moderate anemia and 135 (26.8%) have mild anemia and only 10 (2%). with severe anemia.

More than half of the patients use iron supplements during this current pregnancy (53.5%). the iron used were prophylactic in 225 of users (83.6%) and therapeutic for 44 patients (16.4%). Although only 10 patients have severe anemia there was 47 (9.3%) patients give a history of blood transfusion.

Regarding to antenatal care in this study we find that about 495 (98.4%) of the patients under study were attend to antenatal care during pregnancy with a minimum of at least one visit, with the majority of them started their booking visit early in the first trimester before the 12th week of pregnancy 301 (60.8%). And 194 (39.2) have late booking. Table (3).

Although most of our studied population have attended to antenatal care in their first trimester; a round half of ANC was classified as inadequate care 253 (50.3%) And more than a third 31.2% have intermediate ANC, according to kessner index, ((Kessner index define the quality of ANC according to number of visits for each trimester)). Table (3).

Table (2) Distribution of prevalence of Anemia according to a level of Hemoglobin, Iron use and type, and Blood transfusion during pregnancy

			NO	Percentage %
Hemoglobin Level	Severe anemia	<7 gm	10	2
	Moderate anemia	7-9.9 gm	189	37.6
	Mild anemia	10-10.9 gm	135	26.8
	No anemia	≥11 gm	169	33.6
Total			**503**	**100**
Iron use		Yes	269	53.5
		No	234	46.5
Total			**503**	**100**
Type of iron use		Prophylactic	225	83.6
		Therapeutic	44	16.4
Total			**269**	**100**
Blood transfusion		Yes	47	9.3
		No	456	90.7
Total			**503**	**100**

Table (3): Distribution according to Antenatal care:

		NO.	Percentage
Attendance to Antenatal care	Yes	495	98.4
	No	8	1.6
Total		**503**	**100**
Timing of 1st Antenatal care	Early < 12weeks	301	60.8
	Late > 12 weeks	194	39.2
Total		**495**	**100**
Adequacy of Antenatal care	Adequate	93	18.5
	Intermediate	157	31.2
	Inadequate	253	50.3
Total		**503**	**100**

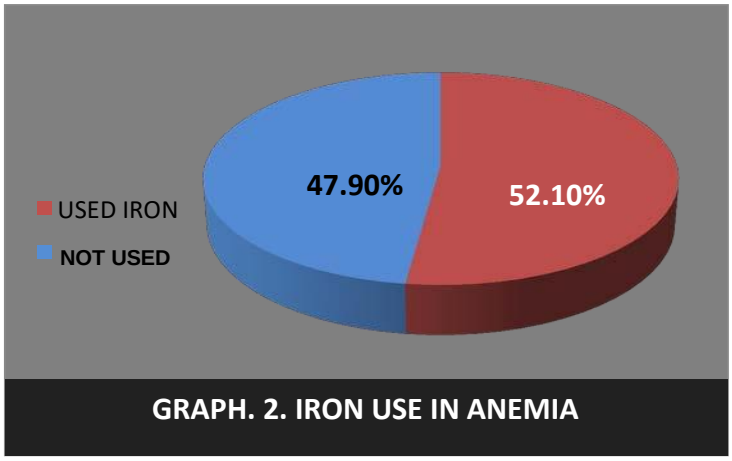
The iron supplement was taken only by a little more than half of anemic patients 174 **(**52.1%**)** in this study. Graph.2.

The distribution of anemic patients according to severity of anemia and gestational age at admission, shows that patients in the first trimester have equal distribution of all degrees of anemia, while those in the third trimester have more prevalent anemia of moderate degree 178 **(**56.3%**)**. in general anemia of moderate degree was observed more in this study 189 **(**56.6%**)**, & the distribution according to severity of anemia was: moderate, mild and severe, 189 **(**56.6%**)**, 135 **(**40.4%**)**, and 10 **(**3%**)** respectively. Table **(**5**)**

There are 334 patients with anemia in this study the majority of them have at least one visit to ANC centers 327 **(**97.9%**)**. Graph **(**3**)**.

Most of patients with early ANC have their booking visit in the first trimester 224 **(**74.4%**)** were anemic, while most of those with late booking were non-anemic 91 **(**46.9%**)**. Table **(**5**)**

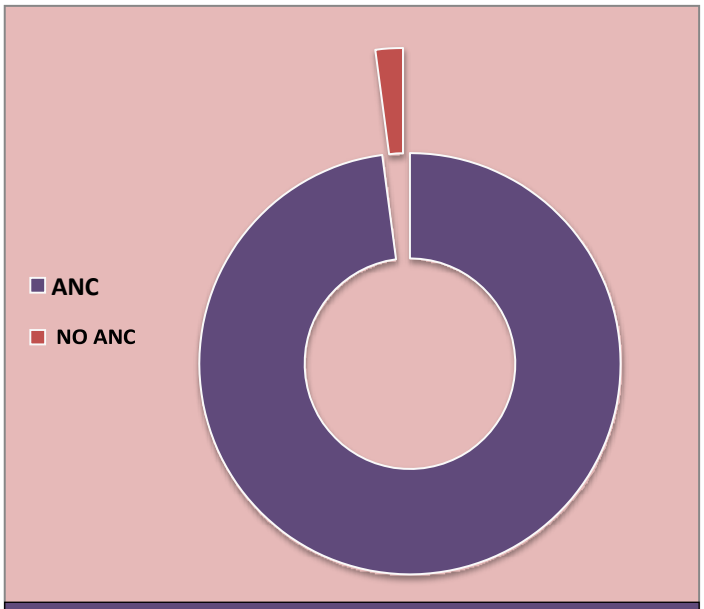
In relation of anemia to ANC, among admitted patients there are 8 patients who never attend to ANC during this pregnancy, 7 **(**87.5%**)** of them have anemia and only one patient has no anemia. Moderate anemia was the most common type among nonusers of ANC, late booking and early booking respectively **(**71.4%, 57.2% & 55.8%**)**. Table **(**6**)**.



GRAPH. 2. IRON USE IN ANEMIA

Table (4) Distribution of anemic patients according to degree of Anemia & Gestational age :

Gestational Age	First trimester		Second trimester		Third trimester		Total	
Degree of Anemia	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**
Mild Anemia	1	33.3	5	11.8	129	40.8	135	40.4
Moderate Anemia	1	33.3	10	29.4	178	56.3	189	56.6
Severe Anemia	1	33.3	0	0	9	2.9	10	3
Total	**3**	**100**	**15**	**100**	**316**	**100**	**334**	**100**



GRAPH. 3. ANTENATAL CARE IN ANEMIC PATIENTS

Regarding the frequency of anemia and quality of antenatal care, anemia was more prevalent among patients with inadequate care 178 **(**53.3%**)** with moderate type being the most common 113 **(**63.5%**)**,

patients with adequate & intermediate ANC have nearly equal distribution of mild and moderate anemia. Table **(**7**)**.

Graph.4. Shows the distribution of anemia patients according to the degree of anemia and adequacy of ANC.

Graph. 5. Shows that more than half of anemia patients have inadequate ANC 53.3% , and a third of them have intermediate care 30.8%.

In Table **(**8**)**. We have the full distribution of study population in relation to anemia and adequacy of ANC and gestational age at admission to the hospital. Patients admitted in first trimester have anemia and similar level of care while those in 2nd trimester 15 of 17 patients were anemic **(**88.2%**)** and 10 of them **(**58.8%**)** with inadequate ANC, the anemia patients who were in their third trimester of pregnancy at admission were 316 **(**94.6%**)**, and the majority of them 167 **(**93.8%**)** have inadequate care,

Graph. 6.represents the quality of ANC among anemic patients and their gestational age at admission to the hospital.

Table (5) Distribution of patients according to Anemia & timing of ANC :

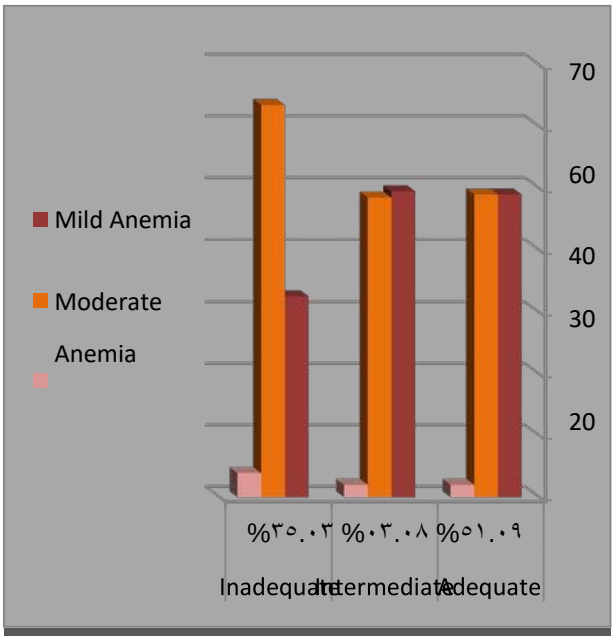
	Early ANC		Late ANC		Total	
	NO.	%	NO.	%	NO.	%
Anemic	224	74.4	103	53.1	327	66.1
Non anemic	77	25.6	91	46.9	168	33.9
Total	**301**	**100**	**194**	**100**	**495**	**100**

Table (6) Distribution of anemic patients according to degree of Anemia & 1st Antenatal visit:

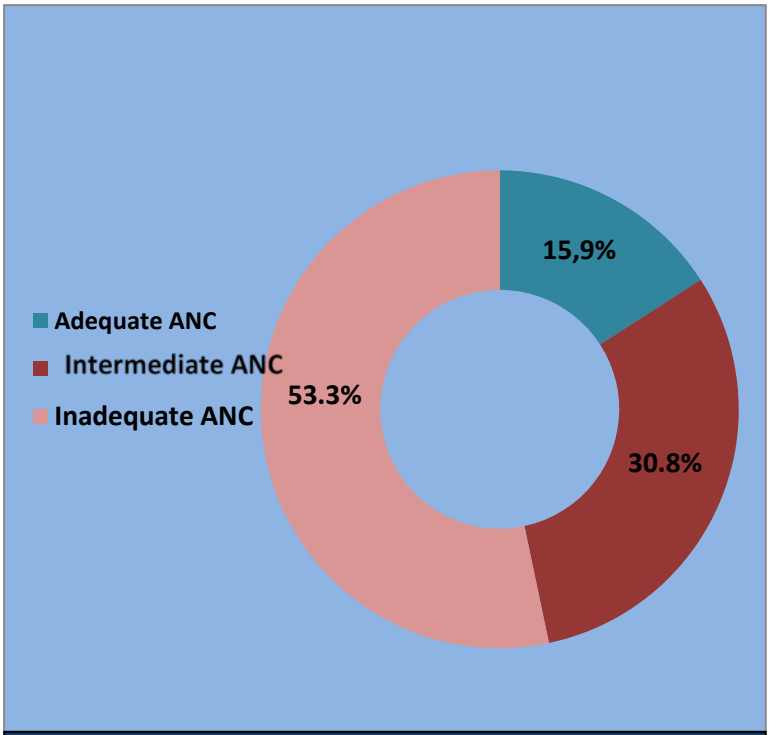
Degree of anemia	No ANC		Timing of ANC: Early ANC		Late ANC		Total	
	NO.	%	NO.	%	NO.	%	NO.	%
Mild Anemia	2	28.6	93	41.5	40	39	135	40.7
Moderate Anemia	5	71.4	125	55.8	59	57.2	189	56.3
Severe Anemia	0	0	6	2.7	4	3.9	10	3
Total	**7**	**100**	**224**	**100**	**103**	**100**	**334**	**100**

Table (7) Distribution of anemic patients according to degree of Anemia & Adequacy of antenatal care:

Degree of Anemia	Adequacy of ANC: Adequate ANC		Intermediate ANC		Inadequate ANC		Total	
	NO.	%	NO.	%	NO.	%	NO	%
Mild Anemia	26	49	51	49.5	58	32.6	135	40.4
Moderate Anemia	26	49	50	48.5	113	63.5	189	56.6
Severe Anemia	1	2	2	2	7	3.9	10	3



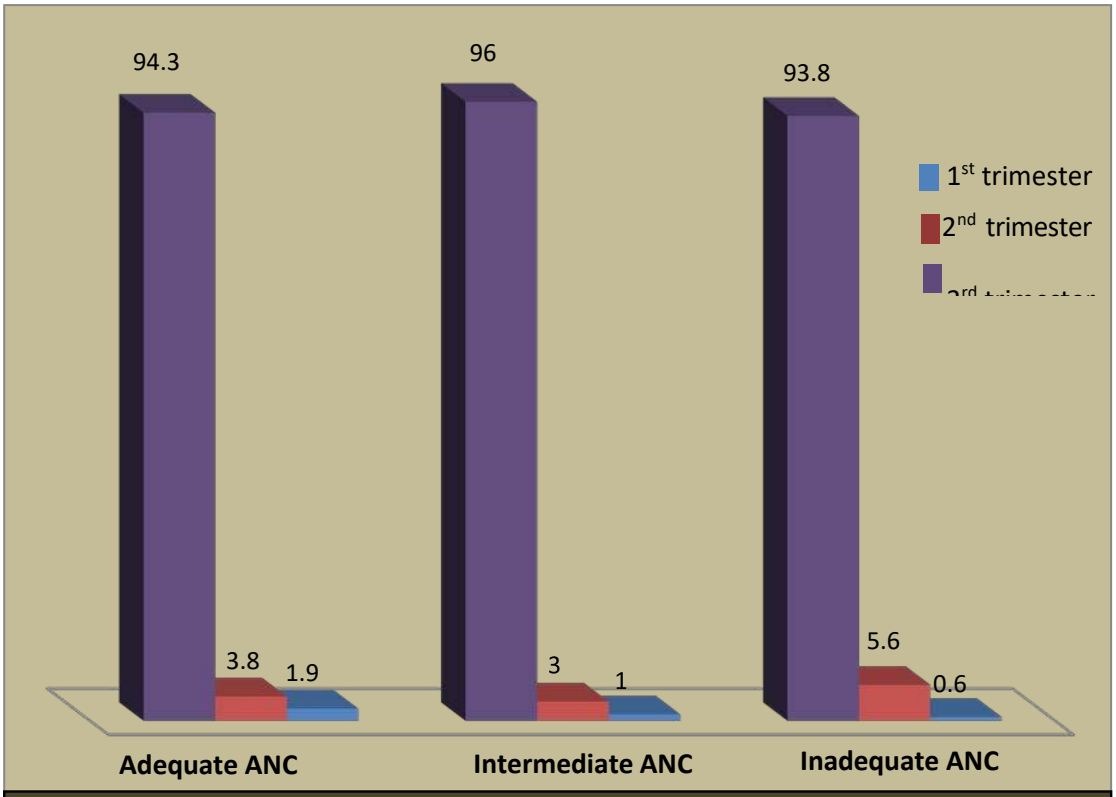
GRAPH.4. DISTRIBUTION ACCORDING TO SEVERITY OF ANEMIA AND ADEQUACY OF



GRAPH. 5. DISTRIBUTION OF ANEMIA PATIENTS ACCORDING TO ADEQUACY OF ANC.

Table (8) Distribution of anemic patients according to Anemia, gestation and adequacy of ANC according to kessner index

Trimester	Adequate ANC				Intermediate ANC				Inadequate ANC				TOTAL			
	Anemic		Non anemic		Anemic		Non anemic		Anemic		Non anemic		Anemic		Non anemic	
	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	NO	%
1st trimester	1	1.9	0	0	1	1	0	0	1	0.6	0	0	3	0.9	0	0
2nd trimester	2	3.8	0	0	3	3	2	0.7	10	5.6	0	0	15	4.5	2	1.2
3rd trimester	50	94.3	40	100	99	96	52	99.3	167	93.8	75	100	316	94.6	167	98.8
Total	**53**	**100**	**40**	**100**	**103**	**100**	**54**	**100**	**178**	**100**	**75**	**100**	**334**	**100**	**169**	**100**



GRAPH. 6. DISTRIBUTION OF ANEMIA PATIENTS ACCORDING TO ADEQUACY OF ANC AND GESTATIONAL AGE

Discussion

Anemia is an indicator of both poor nutrition and poor health. Failure to reduce anemia may result in millions of women experiencing impaired health and quality of life, and may impair children development and learning. (23)

In most developing countries anemia in pregnancy makes an important contribution to maternal mortality and morbidity (24, 9).

The role of early and quality antenatal care (ANC) in preventing maternal anemia cannot be overemphasized. (25) Good nutritional awareness and practices or quality prenatal services and utilization among well motivated and highly aware women are expected to reduce the prevalence of anemia in pregnancy in any society.(26)

Anemia is highly prevalent in this study (66.4%), but relatively lower than previous studies done in South Yemen (10-12). Similar findings were reported in eastern Sudan (62.6%), South Ethiopia and China (70%); (27-29).

However, the prevalence of anemia reported in pregnant women showed variability in different countries. studies conducted in south East Ethiopia (Harar), Gondar Nigeria and Thailand showed prevalence of anemia as 27.9%, 23.2% , 23.2%, 14%, respectively (30-33). which were much lower from the report obtained in this study. India reported a higher result than this study, a study carried out among 7 states by Nutritional Foundation of India observed the overall prevalence of anemia among pregnant women as 84% another two studies in India also reported the same prevalence 84%. (34-36). Similar high prevalence of anemia in pregnancyalso reported in studies from Tanzania, Sudan and Nigeria.(27, 37-41)

Socioeconomic, demographic and clinical characteristics of pregnant woman may affect the magnitude of anemia (42). Anemia was associated with aspects of lower socioeconomic class, low level of education, rural residence, not working low reported income. Other clinical characteristics such as gravidity, regular ingestion of iron supplements, trimester of pregnancy, and other factors are shown to be risk factors for anemia (42-46).

The majority of the study subjects were in the third trimester of pregnancy 96%, unemployed & housewife 94.6% and more than half of them with low educational level 53.3%, and about half of them 50.9% have one to three previous pregnancies (pleuripara), these considered as risk factors for anemia in pregnancy Similar to study from India. (35)

According to the WHO classification of severity of anemia in pregnancy, moderate anemia (HGB 7-9.9g/dl) was more frequent in more than third 37.6% of pregnant women under study and more than half 56.6%, followed by mild anemia 40.4% and severe anemia 3% in anemic patients attending ANC

during current pregnancy. studies in Ethiopia indicated that moderate anemia constitutes a significant portion of anemia in pregnant women attending ANC clinics.

Other studies in Ethiopia, reported a mild anemia ranging from 23% to 81%, and moderate anemia from 17.9% to 74.3%. This finding is comparable with studies in other countries, (28,35,37,47-50).

In this study it was identified that anemia was significantly higher in the third trimester of pregnancy 316 (94.4%). This is comparable with other studies conducted in sub–Saharan Africa, in Ethiopia and Nigeria (47,48, 51). Similar reports have also been found in other studies (6, 52).

The majority of anemia patients have received ANC services for at least one visit during this pregnancy 97.9%. And 68.5% started their first booking early in the first trimester and 31.5% late after the first trimester. Which mean that anemia is highly prevalent among pregnant women attending prenatal care in Yemen due to lack of nutritional support at ANC in addition to low quality level of services.

Most of patients in this study have access to ANC services and have anemia also, which is related to other sociodemographic factors mainly the poverty, nutritional deficiency and inaccessibility to iron supplements at ANC centers as Yemen is one of the poor countries in the world. After the war in 2015 the lack of free iron supplements and nutritional support to pregnant women attending ANC centers was more intense. As shown in this study only 53.5% of pregnant women take iron tablets during pregnancy and the remainder 46.5% ignore iron intake despite that most of them attend to ANC centers 98.4%.

Similar findings were reported in many studies in the surrounding developing countries. Anemia prevalence in pregnant women attending ANC clinics in different studies from Ethiopia, ranged from 53 to 62.7% (37,53,54) and in the Boditii health center at Southern Ethiopia eastern Sudan 62.6%. (28)

According to WHO recommendations; every pregnant mother should start ANC booking during the first trimester of pregnancy [55,56].

This study finding showed that the majority of women 301 (60.8%) made early booking for ANC visit Whereas 194 (39.2%) were booked late. More recent Demographic and Health Survey (DHS) data illustrate that 16% of women started ANC in the first trimester in Nigeria (2008), 47% in Congo-Brazzaville (2005) and 55% in Ghana (2008) (57–62). A higher prevalence reported in Indonesia 80%.(63) The prevalence of timely booking for antenatal care in the current study is relatively higher than that reported in other studies. Ethiopia demographic health survey 2014 revealed 17%، south Eastern Tanzania 29%, South Western Nigeria17.4%, and Uganda 27.9%. (58, 64-67)

The Kessner Index has been widely adopted for public health research, planning، and resource allocation. The Kessner Index has also been widely used to assess the association between prenatal care and birth outcomes. (68-71)

The quality of prenatal care of our studied population were classified according to initially published kessner index algorithm.

Three-Factor Health Services Index Controlled for Gestation and Based on Number of Prenatal Visits, Interval to First Prenatal Visit‹ and Type of Hospital Service
Medical Care Index **(**Gestational Weeks**)** & Number of Prenatal Visits
A Adequate 13 or less and 1 or more or not stated 14-17 and 2 or more 18-21 and 3 or more 22-25 and 4 or more 26-29 and 5 or more 30-31 and 6 or more 32-33 and 7 or more 34-35 and 8 or more 36 or more and 9 or more **B Inadequate** 14-21C and 0 or not stated 22-29 and 1 or less or not stated 30-31 and 2 or less or not stated 32-33 and 3 or less or not stated 34 or more and 4 or less or not stated **Intermediate All combinations other than specified above**
A in addition to the specific number of visits indicated for adequate care, the interval to the first prenatal visit had to be 13 weeks or less **(**first trimester**),** and the delivery must have taken place on a private obstetrical service. B in addition to the specific number of visits indicated for inadequate care, all women who started their prenatal care during the third trimester
(28 weeks or later**)** were considered inadequate. C For this gestation group, care was considered inadequate if the time of the first visit was not stated. Source. Reprinted with permission from Infant Death: An Analysis by Maternal Risk and Health Care

Although most of women under study receive their ANC care early in the first trimester. Among anemia patients there are 53.3% classified as having inadequate prenatal care which is due to insufficient number of visits for each trimester as described by kessner index. Although Kessner et al. called their index the "Adequacy of Prenatal Care Index," their measure indicates nothing about the content or clinical adequacy of prenatal care; it is a utilization index only.

Suboptimal and low quality of care at ANC centers, poor counseling regarding risk factors and prevention of anemia in pregnancy and lack of folic, iron and nutritional supplementation are contributing factors.

Our results support the findings of others, regarding the urgent need for improvement of quality care of prenatal care program(24,72,73).

Conclusion

The high prevalence of anemia, despite the attendance and easy access to ANC care, indicates the level of ignorance and indifference to health needs and low quality of care. Therefore, increased health education on risk factors and interventions to prevent the prevalence and severity of anemia among pregnant women should be a priority for mothers attending ANC. (28)

Recommendations:

Prevention of disease, promotion of health, and provision of obstetrical care with iron and folic supplementation for all pregnant women attending antenatal care are important determinants influencing the quality of ANC.

Periodic monitoring and evaluation of the program (ANC) is imperative. Researchers are also recommended to conduct larger studies to evaluate the health situation at the level of maternity care and to formulate strategies to reduce its adverse health consequences in order to improve maternal health and reduce poor perinatal outcome.

Further actions are required to reach the World Health Assembly target of a 50% reduction of anemia in women of reproductive age by 2025. (74.75) The World Health Organization (WHO) has published revised guidelines that support policies for the prevention and control of anemia. (76)

References

1. Dc Mayer EM, Tegman A. Prevalence of Anemia in the World. World Health Organ Qlty 1998; 38 : 302-31

2. Nbuke RB, letsky EA: Etiology of anemia in pregnancy in south Malawi.Am.J. Clini.Nutr.2000; 72:247 – 256.

3. Stevens G, Finucane M, De-Regil L, Paciorek C, Flaxman S, Branca F et al. Nutrition Impact Model Study Group (Anaemia). 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: e16-e25. doi: 10.1016/S2214-109X(13)70001-9.

4. World Health Organization, the Global Health Observatory, WHO global anemia estimated 2021 edition.

5. Stoltsfus R.J. Iron deficiency: global reference and consequences Food. Nutr. Bull.2003; 24**(**4**)**:99-103.

6. World Health Organization. The prevalence of anemia in women: a tabulation of available information. Geneva Switzerland: WHO: 1992; WHO/NCH/MSM/ 92-2.

7. Untro J, Cross R, Schultire W, Sidiaoetama D. The association between BMI and hemoglobin and work productivity among Indonesian female factors workers. Eureapian.J. Clini.Nutr.1998; 52: 131-133.

8. World Health Organization**(**WHO**)** prevention and management of severe anemia in pregnancy: report of technical working group. Geneva – Sweizerland: WHO 1993:WHO /FNE/MSM/ 93.5.

9. Vanden brock NR, Progrsion SI, Mahango CJ, et al. Anemia in pregnancy in southern Malawi: prevalence and risk factor.BIOG. 2000; 107: 437-435.

10. Al-Nakeeb Iman anemia during pregnancy in Alhuta center of Lahej governorate.from 6th- July 1988 to 18th october 1988.

11. Bin Breik As, Bahaj AI. Prevalence and risk factors of anemia among pregnant women Mukalla 2001.

12. Fadhel Muna Mohammed. Maternal anemia in relation to neonatal birth weight in Al Wahda teaching hospital. ADEN GOVERNORATE October 2002-March 2003.

13. Barbin et al. consequence of maternal Anemia on outcome of pregnancy in malaria endemic areas in Papua New Guinea. Am.Trop.med parasitol 1990; 84 : 11-24.

14. Rasmusens. First and second trimester hemoglobin levels in relation to birth weight and gestational age. Act A Obstet. Gyneacol. Scand. 1993; 72: 246 -251.

15. Ryoh D. Nutritional and maternal mortality in developing world. Am. J. Clini. Nutr.2000, 72: 212 - 240.

16. Villar J, Ba'aqeel H, Piaggio G, Lumbiganon P, Miguel BJ, Farnot U. WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care. Lancets. 2001;357:1551–64. https://doi.org/10.1016/ S0140-6736**(**00**)**04722-X.

17. World Health Organization. Trends in maternal mortality: 1990 to 2008. Geneva: Estimates developed by WHO, UNICEF, UNFPA and The World Bank; 2010.

18. Magoma et al. BMC pregnancy and childbirth 2010;10:13. http://www. biomedcentral.com/1471-2393/10/13.

19. Central statistical authority (Ethiopia), ICF international 2014. Mini-Ethiopia Demographic and Health Survey, 2014. Addis Ababa: Ethiopia and Calverton; Central Statistical Aauthority (Ethiopia) and ICF international; 2014. p. 37–42.

20. Kotelchuck Milton, An Evaluation of the Kessner Adequacy of Prenatal Care Index and a Proposed Adequacy of Prenatal Care Utilization Index. American Journal of Public Health, September 1994, Vol. 84, No. 9:1414-20.

21. DC DUTA'S TEXTBOOK OF OBTETRICS enlarged & revised reprinted of 7th edition(Chapt.19, p.260).

22. Kessner DM, Singer J, Kalk CE, Schlesinger ER. Infant Death: An Analysis by Matemal Risk and Health Care. Washington, DC: Institute of Medicine and National Academy of Sciences; 1973:chap 2.

23. Nutritional anemia. Report of a WHO Group of Experts. Geneva, World Health Organization, 1972 (WHO Technical Report Series, No. 503.

24. The prevalence of anemia in women: a tabulation of available information. Geneva, World Health Organization، 1992 unpublished document WHO/MCH/MSM/92.2; available upon request from Division of Reproductive Health, World Health Organization, 1211 Geneva 27, Switzerland.

25. Idowu OA, Mafiana CF, Dapo S. Anaemia in pregnancy: A survey of pregnant women in Abeokuta, Nigeria. Afr Health Sci 2005;5:295-9 .

26. Ikeanyi E M, Ibrahim A I. Does antenatal care attendance prevent anemia in pregnancy at term?. Niger J Clin Pract 2015;18:323-7

27. Adam I, Khamis AH, Elbashir MI. Prevalence and risk factors for anaemia in pregnant women of eastern Sudan. Trans R Soc Trop Med Hyg 2005;99:739-43.

28. Dereje lelissa et al. Prevalence of Anemia Among Women Receiving Antenatal Care at Boditii Health Center, Souther Ethiopia. Clinical Medicine Research.Vol. 4, No. 3, 2015, pp. 79-86. Doi: 10.11648/j.cmr.20150403. 14

29. Xing Y, Yan H, Dang S, Zhuoma B, Zhou X, et al. Hemoglobin levels and anemia evaluation during pregnancy. in the highlands of Tibet: a hospital-based study.BMC Public Health 2009, 9: 336.

30. Filagot Kefiyalew, Endalew Zemene, Yaregal Asres and Lealem Gedefaw. Anemia among pregnant women in Southeast Ethiopia: prevalence, severity and associated risk Factors. BMC Research Notes 2014, 7:771.

31. Alem M, Enawgaw B, Gelaw A, Kena 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 Interdiscipl Histopathol 2013, 1:137–144.

32. Oboro VO, Tabowei TO, Jemikalajah J. Prevalence and risk factors for anaemia in pregnancy in South Southern Nigeria. J Obstet Gynaecol 2002, 22: 610- 613.

33. Sukrat B, Suwathanapisate P, Siritawee S, Poungthong T، Phupongpankul K. The prevalence of iron deficiency anemia in pregnant women in Nakhonsawan, Thailand. J Med Assoc Thai 2010, 93: 765-770.

34. Agarwal KN, Agarwal DK. Prevalence of anemia in pregnant and lactating women in India. Indian J Med Res 2006;124:173-84.

35. Kastrui B. Hunshikatti, Pranita R. Viveki Prevalence of Anemia and Its Predictors in Pregnant Women Attending Antenatal Clinic: A Hospital Based Cross-Sectional Study. IOSR Journal of Nursing and Health Science **(**IOSR-JNHS**)** e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 4, Issue 1 Ver. II **(**Jan.-Feb. 2015**)**, PP 12-17 www.iosrjournals.org

36. Toteja GS, Singh P, Dhillon BS, Saxena BN. Micronutrient deficiency disorders in 16 districts of India –Part 1 Report of ICMR task force study. District Nutrition Project. Ansari nagar, New Delhi: Indian Council of Medical Research; 2001.

37. Desalegn S. Prevalence of anaemia in pregnancy in Jima town, southwestern Ethiopia. Ethiop Med J 1993;31:251-8.

38. Kidanto HL, Morgen I, Lindmark G, Massawe S, Nystrom L. Risk for preterm delivery and low birth weight are independently increased by severity of maternal anaemia. S Afr Med J 2006;99:98-102.

39. Massawe S, Urassa E, Lindmark G, Moller B, Nystrom L. Anaemia in pregnancy: A major health problem with implications for maternal health care. Afr J Health Sci 1996;3:126-32.

40. Haggaz AD, Radi EA, Adam I. Anaemia and low birth weight in Western Sudan. Trans R Soc Trop Med Hyg 2010;104: 234-6.

41. Uneke CJ, Duhlinska DD, Igbinedion EB. Prevalence and public health significance of HIV infection and anaemia among pregnant women attending antenatal clinics in south eastern Nigeria. J Health Popul Nutr 2007;25:328-35.

42. Elashirya, El ghazali S, Habil I. Prevalence and determinants of anaemia in third trimester pregnancy in fayoum governorate-Egypt. Acta Medica Mediterranea, 2014, 30: 1045.

43. Jin L, Yeung LF, , Cogswell ME, Ye R, Berry RJ, Liu J, Hu DJ, Zhu L. Prevalence of anaemia among pregnant women in south-east China, 1993-2005. Public Health Nutr 201013**(**10**)**: 1511-8.

44. Ahmad N, Kalakoti P, Bano R, Aarif SMM. The prevalence of anaemia and associated factors in pregnant women in a rural Indian community. AMJ 2010; 3:276-80.

45. Belachew T, Legesse Y. Risk factors for anemia among pregnant women attending antenatal clinic at Jimma University Hospital, southwest Ethiopia. Ethiop Med J 2006, 44: 211-220.

46. Federal Ministry of Health. Planning and Programming Department Health and health related indicators. Addis Ababa: Planning and Programming Department, Federal Ministry of Health, Government of Ethiopia, Ethiopia. 2004, 54: 58.

47. Alemayehu Hailu Jufar, Tewabech Zewde Prevalence of Anemia among Pregnant Women Attending Antenatal Care at Tikur Anbessa Specialized Hospital, Addis Ababa Ethiopia. Hematol Thromb Dis 2014, 2:1

48. Olujimi A. Olatunbosun, Aniekan M. Abasiattai, Emem A. Bassey, Robert S. James, Godwin Ibanga, and AnyiekereMorgan. Prevalence of Anaemia among Pregnant Women at Booking in the University of Uyo Teaching Hospital, Uyo‹ Nigeria. BioMed Research International Volume 2014‹

49. N. Nuru Yesuf and Z. Agegniche Prevalence and associated factors of anemia among pregnant women attending antenatal care at Felegehiwot Referral Hospital, Bahirdar City: Institutional based cross-sectional study International Journal of Africa Nursing Sciences International Journal of Africa Nursing Sciences 15 **(**2021**)** 100345

50. Sharma P.1, Nagar R. Hematological profile of anemic pregnant women attending antenatal hospital IOSR Journal of Nursing and Health Science **(**IOSR-JNHS**)** e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 1, Issue 4 **(**May – Jun. 2013**)**, PP 11-15 www.iosrjournals.org

51. Niguse O, Mossie A, Gobena T: Magnitude of anemia and associated risk factors among pregnant women attending antenatal care in shalla woreda, west arsi zone, oromia region‹ Ethiopia. Ethiop J Health Sci 2013, 23:165–173.

52. Adesina Olubukola, Akinyemi Odunayo , Oladokun Adesina Anemia in pregnancy at two levels of health care in Ibadan‹ south west Nigeria Annals of African Medicine, Vol. 10, No. 4, October-December, 2011, pp. 272-277.

53. Million Getachew, Delenesaw Yewhalaw, Ketema Tafess‹ Yehenew Getachew and Ahmed Zeynudin Anaemia and associated risk factors among pregnant women in Gilgel Gibedam area, Southwest Ethiopia. Parasites & Vectors 2012‹ 5:296.

54. Yonas T: Prevalence of anaemia among ANC attendants of Assendabo Teaching Health Center. Jimma, Ethiopia: MSc thesis. Jimma Institute of Health Sciences; 1996.

55. llen D, Ammann A, Bailey H, Allen D, Ammann A, et al.:Revised Recommendation for HIV Screening of Pregnant Women: Prenatal Counseling and Guidelines for Consultation. Atlanta, Georgia; 2001.

56. Irene M, Jenny H: Chang and Adaptation in Pregnancy. In Mayles Text Book For Midwives. Edited by Diane M, Margaret A. Churchill Livingstone: Elsevier2009:210 ؛.

57. Banta D. What is the efcacy/efectiveness of antenatal are and the fnancial and organizational implications? Copenhagen: WHO Regional office for Europe [Health, Evidence Network report; 2003.

58. Adekanle DA, Isawumi AI. Late antenatal care booking and its predictors among pregnant women in south western Nigeria. Online J Health Allied Sci. 2008;7**(**1**)**:4–8.

59. Pell C, Menaca A, Were F, Afrah N, Chatio S, et al. Factors afecting antenatal care attendance: results from qualitative studies in Ghana, Kenya and Malawi. PLoS ONE. 2013;8**(**1**)**:e53747. http://www.plosone.org.

60. Seljeskog L, Sundby J, Chimango J. Factors infuencing women's choice of place of delivery in rural Malawi-an explorative study. Afr J Reprod Health . 2006.٥٧–٦٦**(**٣**)**٠١؛

61. WHO. Antenatal care in developing countries: promises, achievements and missed opportunities. An analysis of trends, levels and differentials ،1990 .١٠٠٢–Geneva: WHO; 2003.

62. Feleke G, Yohannes D, Bitiya A. Timing of frst antenatal care attendance and associated factors among pregnant women in Arba Minch Town and Arba Minch District, Gamo Gofa Zone, South Ethiopia. J Env

63. Statistics Indonesia **(**Badan Pusat Statistik—BPS, National Population and Family Planning Board **(**BKKBN, Kementerian Kesehatan **(**kemenkes- MOH, ICF international. Indonesia Demographic and Health Survey 2012. Jakarta:BPS,BKKBN.Kemenkes, and ICF international; 2013.

64. Centra statistical authority **(**Ethiopia**)**,ICFinternational 2014, MiniEthiopia Demographic and Health Survey,2014. Addia Ababa:Ethiopia and Calverton; central statistical Authority **(**Ethiopia**)** and ICF international:2014.p.37-42.

65. Gross et al. Timing of antenatal care for adolescent and adult pregnant women in south eastern Tanzania. BMC Pregnancy Childbirth. 2012;12:16. http://www.biomedcentral.com/1471-2393/12/16/prepub.

66. Kisuule, et al. Timing and reasons for coming late for the frst antenatal care visit by pregnant women at Mulago hospital, Kampala Uganda. BMC Pregnancy Childbirth. 2013;13:121. https://doi.org/10.1186/1471-2393-13-121.

67. Gidey et al. Timing of first focused antenatal care booking and associated factors among pregnant mothers who attend antenatal care in Central Zone, Tigray, Ethiopia. BMC Res Notes 2017; 10: 608. DOI 10.1186/ s 13104-017-2938-5

68. Gortmaker SL. The effects of prenatal care upon the health of the newborn. Am J Public Health. 1979;69:653-660.

69. Quick JD, Greenlick MR, Roghmann KJ. Prenatal care and pregnancy outcome in an HMO and general population: a multivariate cohort analysis. Am J Public Health. 1981;71:381-390.

70. Showstack JA, Budetti PP, Minkler D. Factors associated with birthweight: an exploration of the roles of prenatal care and length of gestation.Am JPublic Health. 1984;74:1003-1008.

71. Murray JL, Bemfield M. The differential effect of prenatal care on the incidence of low birthweight among whites and blacks in a prepaid health care plan. N Engl J Med.1988;319:1385-1391.

72. URASSA P. DAVID , Quality assessment of the antenatal program for anemia in rural Tanzania; International Journal for Quality in Health Care 2002; Volume 14, Number 6: pp. 441–448

73. Van den Broek NR,Ntonya C, Mhango E, White SA. Diagnosing Record 1996; 71: 97–104. anemia in pregnancy in rural clinics: assessing the potential of the Hemoglobin Colour Scale. Bull World Health Organ 1999; 77: Urassa EJN, Massawe S, Lindmark G, Nystrom L. Maternal 15–21.

74. Resolution WHA65.6. Comprehensive implementation plan on maternal ، infant and young child nutrition. In: Sixty-fifth World Health Assembly Geneva, 21–26 May 2012. Resolutions and decisions, annexes. Geneva :World Health Organization; 2012:12–13 **(**http://www.who.int/nutrition/ topics/WHA65.6_resolution_en.pdf?ua=1, accessed 6 October 2014**)**.

75. World Health Organization. Global targets 2025. To improve maternal ، infant and young child nutrition **(**www.who.int/nutrition/topics/nutrition_ globaltargets2025/en/, accessed 6 October 2014**)**

76. World Health Organization. WHO guidelines on nutrition **(**http://www.who. int/publications/guidelines/nutrition/en/, accessed 21 October 2014**)**.