Assessment of Knowledge Regarding Iron Deficiency Anemia and Urinary Tract Infections during Pregnancy among Pregnant Women Attending Antenatal Clinic in Omdurman Maternity Hospital-Sudan in 2019

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Abstract

Introduction: Anemia is the most frequent derailment of physiology in the world throughout the life of a woman it's one of the world's leading cause of disability and thus one of the most serious global public health issues. After anemia, urinary tract infections are the second common complications in pregnant women, which if not controlled well, can adversely affect the health of infant or the pregnant mother. Detection and treatment of iron deficiency anemia and urinary tract infections remains an important clinical problem due to the potential risk to the mother and the fetus. So engagement of women in tackling this problem is crucial.

Objectives: The aim was to assess the level of knowledge of iron deficiency and urinary tract during pregnancy among pregnant women in Omdurman Maternity Hospital of Khartoum State, Sudan.

Methods: This was a descriptive cross-sectional facilitated basic study conducted in Omdurman Maternity Hospital in Khartoum State, Sudan by using a close ended questionnaire that showed the demographic data and knowledge of participants regarding iron deficiency anemia and urinary tract infections during pregnancy. Data was collected between Jan-Feb, 2019 from 384 participants and their data with high confidentiality was analyzed by SPSS.

Results: Of the 384 participants, the majority of participants had poor knowledge regarding iron deficiency anemia (76.8%) and urinary tract infections (59.9%) during pregnancy. The study also revealed significant association between the level of knowledge about iron deficiency anemia and educational level (p < 0.001), residency (p = 0.006) and occupation (p < 0.001). It also revealed significant association between level of knowledge regarding urinary tract infections and age (p = 0.002), educational level (p < 0.001) and occupation (p = 0.002).

Conclusion: The majority of participants had poor knowledge regarding iron deficiency anemia and urinary tract infections during pregnancy and this knowledge is strongly affected by age, educational level, residency and occupation.

Keywords: Iron; Deficiency; Anemia; Urinary; Infections; Pregnancy

Abbreviations

AIDS: Acquired Immunodeficiency Syndrome; Hb: Hemoglobin; ID: Iron Deficiency; IDA: Iron Deficiency Anemia; IV: Intravenous; LBW: Low Birth Weight; MCH: Maternal and Child Health; RDW: Red Cell Distribution Width; US: Urinary System; UTI: Urinary Tract Infections

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Introduction

Anemia is the most frequent derailment of physiology in the world throughout the life of a woman. It is a serious condition in industrialized and semi-industrialized countries and it becomes a very serious condition in poor resources countries. Anemia is a major public health problem, causing an unfavorable status in respect to upcoming pregnancy. Among fertile, non-pregnant women, approximately 40% have low iron reserves [1].

Iron deficiency is the most widespread nutritional deficiency in the world and it accounts for 75% of all types of anemia in pregnancy. In more than 80% of countries in the world, the prevalence of anemia in pregnancy is > 20%. The prevalence of anemia in pregnancy varies considerably because of the differences in social conditions, lifestyles and health seeking behaviors across different cultures. Anemia can affect pregnant women all over in the world (the global prevalence in pregnancy is estimated to be approximately 41.8%) with rates of prevalence that range from 35 to 60% for Africa, Asia and Latin America and it is reported to be < 20% in industrialized countries. The lowest estimated prevalence of anemia is of 5.7% in the USA and the highest is of 75% in Gambia and 65-75% in India [1].

The most common causes of anemia are poor nutrition, deficiencies of iron, micronutrients deficiencies including folic acid, vitamin A and vitamin B12, diseases such as malaria, hookworm infestation and schistosomiasis, HIV infection and genetically inherited hemoglobinopathies, such as thalassemia. There is also a possible association between Helicobacter species infection and anemia as reported in a study of Kibru in 2014 [1].

Throughout pregnancy, iron deficiency anemia adversely affects the maternal and fetal well-being, and is linked to increased morbidity and fetal death. Affected mothers frequently experience breathing difficulties, fainting, tiredness, palpitations, and sleep difficulties. They also have an increased risk of developing perinatal infection, pre-eclampsia, and bleeding. Post-partum cognitive impairment and behavioral difficulties were also reported. Adverse perinatal outcomes include intrauterine growth retardation, prematurity, and low birth weight, all with significant mortality risks, particularly in the developing world. Iron deficiency during the first trimester, has a more negative impact on fetal growth than anemia developing later in pregnancy. This is also true for risk of premature labor [2].

Poor socio-economic status contributes significantly to all aspects of these inter-linked problems that are more commonly encountered in the developing world. Any successful public prevention or treatment program should put into consideration all these contributing and correlating factors [2].

Lowered iron stores of the newborn child may persist for up to one year and result in iron deficiency anemia. Such a state should be identified and treated promptly because of the possible long term consequences. Iron is essential for neural metabolism and functioning. Iron deficiency anemia results in changes in energy metabolism within the brain with defects in neurotransmitter function and myelination. Therefore, infants and young children with iron deficiency anemia are at risk of developmental difficulties involving cognitive, social-emotional, and adaptive functions. Other studies have documented delays in both language and motor development. Breastfeeding is usually protective, but not if the mother is iron deficient. It has been noted that iron levels in breast milk fall as lactation progresses over time. Careful monitoring and adequate supplementation is therefore needed for infants at risk [2].

After anemia, UTIs are the second common complications in pregnant women, which if not controlled well, can adversely affect the health of infant or the pregnant mother. UTIs and its associated complications are the cause of nearly 150 million deaths per year worldwide. The disease can be developed in 40% - 50% of women and 5% of men [3].

Various microorganisms are able to invade the urinary tract and can be involved in the pathogenesis of urinary tract infection (UTI). As one of the most common recurrent acquired infections, UTI has a conspicuous role in increasing the number of stillbirth deliveries [3].

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Pregnancy increases the risk of UTIs. At around 6th week of pregnancy, due to the physiological changes of pregnancy the ureters begin to dilate. This is also known as "hydronephrosis of pregnancy", which peaks at 22 - 26 weeks and continues to persist until delivery. Both progesterone and estrogens levels increase during pregnancy and these will lead to decreased ureteral and bladder tone. Increased plasma volume during pregnancy leads to decrease urine concentration and increased bladder volume. The combination of all these factors lead to urinary stasis and uretero-vesical reflux. Glycosuria in pregnancy is also another well-known factor which predisposes mothers to UTI [4].

Pregnancy UTI is classified into two categories of symptomatic and asymptomatic: A) The involvement of the lower urinary tract, leading to asymptomatic bacteriuria is the most common cause of UTI during pregnancy: B) The involvement of the upper urinary tract can lead to symptomatic bacteriuria and is characterized by acute Pyelonephritis. Based on performed researches, the prevalence of symptomatic urinary tract infection in pregnant women has been 17.9% and asymptomatic form in 13%. If asymptomatic infection is not treated, it leads to some clinical manifestations in mother and newborn [3].

Acute pyelonephritis complicates approximately 1 - 2% of pregnancies and is one of the leading causes of non-obstetric antepartum hospitalization. Earlier epidemiological data showed an incidence as high as 10%, but with improved antenatal surveillance, the incidence of acute pyelonephritis has decreased in recent years. However, the development of antibiotic resistance and other factors have now affected the diagnosis, clinical course, and treatment. In pyelonephritis, infection usually ascends from the bladder, due to vesicoureteral reflux in pregnancy. Other risk factors include previous episodes of pyelonephritis, abnormalities or stones of the urinary tract, and other conditions such as diabetes mellitus, sickle cell disease, and AIDS [5].

Several studies have demonstrated maternal and fetal morbidity associated with pyelonephritis. Fever in the first trimester during organogenesis has been associated with teratogenicity, miscarriage, and preterm delivery. Increased Uterine activity occurs due to the presence of endotoxin and also due to the fever. The presence of endotoxin is also said to cause hemolytic anemia in one third of these patients [5].

All pregnant mothers should be screened for UTI because untreated UTI will lead to pre-term premature rupture of membrane, maternal chorioamnionitis, intrauterine growth retardation and low birth weight baby. Early treatment with antibiotics has significantly reduced the above complications. Urine culture and sensitivity remain the gold standard in diagnosing UTI. If patients' condition is not improving despite adequate and appropriate use of antimicrobials, further investigations for underlying predisposing factors are necessary. Prophylactic antibiotic is indicated for recurrent UTI [4].

Anemia is one of the world's leading cause of disability and thus one of the most serious global public health issues. In fact, it involves issues of morbidity and mortality, but it can be mostly the basis of the inability of the woman to react to a postpartum blood loss thus leading to serious consequences [1]. The incidence of anemia in pregnancy ranges widely from 40-80% in the developing countries compared to 10 - 20% in the developed countries and it's responsible for 20% of maternal death in developing countries [6].

Prenatal IDA in the third trimester is associated with mental development of the child. However, prenatal supplementation with sufficient iron protects child development even when the woman's IDA was not properly corrected in pregnancy [7].

Studies have indicated that 25% - 40% of untreated pregnant women with asymptomatic bacteriuria will eventually develop to acute pyelonephritis as the most common cause of redelivery hospitalization. Furthermore, even if pyelonephritis is treated immediately, the condition significantly increases mortality and the number of infants with low-birth weights [3].

Detection and treatment of IDA and UTI remains an important clinical problem due to the potential risk to the mother and the fetus. And hence the objective of this study was to assess the level of knowledge regarding IDA and UTI complications during pregnancy among

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pregnant women. This might give an insight into how we can improve pregnant women's awareness about the steps that should be taken in order to protect their infants and ensure a healthy pregnancy.

Materials and Methods

Study design

Descriptive, cross-sectional, facility based study.

Study area

There were three public maternity hospitals in Khartoum State. This study was done in Omdurman Maternity hospital by simple randomized selection.

Location

This hospital is in Almawrda, Omdurman locality, Khartoum State. It's the largest maternity hospital in Sudan, and it was found 1957. Number of Staff work on it = 560. There were 467 beds in the hospital.

Rate of pregnant women per day

There were about 70 - 80 cases per day at antenatal care unit. Inpatients: approximately wards were full every day.

Study population

Inclusion criteria

- Pregnant women of all age.

- Pregnant women of any gestational stage attending antenatal care unit.

Exclusion criteria

- Non-pregnant women.

- Pregnant women in labor.

Sampling method

Sample size

$n = z^2 \, q \, p/e^2$

$q = (1-p)$

n = Minimum sample size required,

z = Probability that e is not exceeded,

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p = Expected prevalence (estimated as 0.5),

q = 1-p,

e = Maximum acceptable random sampling error,

According to the equation above the estimated sample size = 384.

Sampling technique

Systemic random sampling.

Data collection

Techniques

Data was collected using a structured pre-coded interview questionnaire which contained socio-demographic data and knowledge about IDA and UTI during pregnancy and it was translated to arabic. The questionnaire was pre-tested in some pregnant women in another hospital called Saad Abu Alela to test the efficacy and flexibility of it. The data was collected between January and February 2019.

Tool

Questionnaires includes close ended question.

Variables

Age, gestational stage, socioeconomic status, level of awareness and knowledge, level of education.

Data analysis

- Data entry: Entered and coded by researcher.

- Data analysis: Data was analyzed using SPSS.

- Data display: In charts, figures, tables and chi-squares.

Ethical concern

- Ethical approval will be taken from Department of Community Medicine, University of Khartoum.

- Permission was taken from hospitals administrator.

- Consent was obtained from the subject as written consent in the questionnaire.

- No information that can lead to identification of a specific subject was taken.

Limitations

The research took longer period than expected due to the revolutionary events that were taking place in the country

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Results

Socio-demographic characteristics of the study population

The study included 384 participants giving response rate of 100%. The maximum age was 45 years and the minimum age was 16 years with the mean of ages of approximately 27.07 years.

Regarding educational level most of the respondents (31%) had secondary education only.

Age	Frequency	Percentage
Below 20 years	60	15.6
21 to 40 years	319	83.1
40 years and above	5	1.3
Educational level	**Frequency**	**Percentage**
Illiterate	29	7.6
Khalwa (religious teaching facility)	5	1.3
Primary	52	13.5
Middle	76	19.8
Secondary	127	33.1
University/Above	95	24.7
Residency	**Frequency**	**Percentage**
City Inside Khartoum State	342	89.1
City Outside Khartoum State	16	4.2
Village Inside Khartoum State	24	6.3
Village Outside Khartoum State	2	.5
Occupation	**Frequency**	**Percentage**
Working	29	7.6
Not working	355	92.4

Table 1: *Distribution of socio-demographical characteristics of the respondents (n = 384).*

Knowledge of participants regarding iron deficiency anemia

Regarding having information about iron deficiency anemia,110(28.6%) of participants have information, and 274 (71.3%) don't have any information about the disease. Those who have information have been further investigated about IDA.

The total score of knowledge was 21 every right answer was given 1. Those who scored from 0 to 7 were considered to have poor knowledge, those with a score of 8 to 14 considered to have medium knowledge, and those with a score of 15 and above considered to have good knowledge. The mean value was 3.8 with Std. deviation of 6.8. The majority of women had poor knowledge.

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Level of knowledge	Frequency	Percentage
Poor knowledge	295	76.8
Medium knowledge	52	13.5
Good knowledge	37	9.6
Total	384	100.0

Table 2: Distribution of knowledge about IDA during pregnancy among pregnant women at Omdurman maternity hospital 2018 - 2019 (n = 384).

When asked about the risk factors for having IDA during pregnancy most of the participants chose the increased body demand for iron during pregnancy and the least chosen risk factor was consuming milk along with iron supplement.
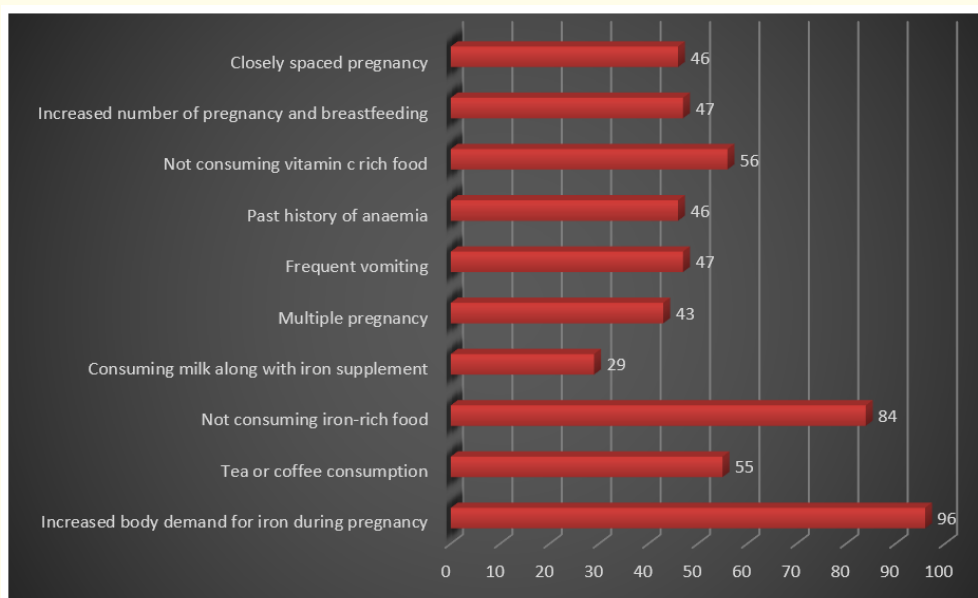

Figure 1: Distribution of knowledge about IDA risk factors during pregnancy among pregnant women in Omdurman maternity hospital, in 2018-2019. (n=110).

The most known symptom of IDA was fatigue and tiredness and the most unknown symptom was difficulty in concentration.

Figure 2: Distribution of knowledge about IDA symptoms during pregnancy among pregnant women in Omdurman maternity hospital, in 2018-2019. (n=110)

Participants were asked if they know what are the risks of having IDA during pregnancy on the fetus ,74(67%) know about the risks ,36(33%) don't know. Those who know the risks were further asked to identify these risks. Most of the participants identified lowered iron stores in newborn as the risk of having IDA during pregnancy, and the least known risk was the delay in motor development.

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Figure 3: *Distribution of knowledge about IDA risks on the fetus during pregnancy among pregnant women in Omdurman maternity hospital, in 2018-2019. (n=74)*

The influence of educational level on knowledge about IDA during pregnancy

There was significant association between the educational level and level of knowledge (p = 0.001).

Level of Education	Anemia Knowledge Level			Total
	Poor Knowledge	Medium Knowledge	Good Knowledge	
Illiterate	26	1	2	29
Khalwa (religious teaching facility)	3	2	0	5
Primary	50	1	1	52
Middle	68	7	1	76
Secondary	94	15	18	127
University / Above	54	26	15	95
Total	295	52	37	384

Table 3: *The association between knowledge score of IDA and the educational level among pregnant women in Omdurman maternity hospital 2018 - 2019 (n = 384).*

The influence of residency on the level of knowledge about IDA during pregnancy

There was a significant association between residency and level of knowledge (p = 0.006).

Residency	Anemia Knowledge Level			Total
	Poor Knowledge	Medium Knowledge	Good Knowledge	
City Inside Khartoum State	256	49	37	342
City Outside Khartoum State	13	3	0	16
Village Inside Khartoum State	24	0	0	24
Village Outside Khartoum State	2	0	0	2
Total	295	52	37	384

Table 4: *The association between knowledge score of IDA and the residency among pregnant women in Omdurman maternity hospital 2018-2019 (n = 384).*

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The influence of occupation on the level of knowledge about IDA during pregnancy

There was a significant association between occupation and level of knowledge (p = 0.001).

Work	Anemia Knowledge Level			Total
	Poor Knowledge	Medium Knowledge	Good Knowledge	
Working	16	7	6	29
Not Working	279	45	31	355
Total	295	52	37	384

Table 5: The association between knowledge score of IDA and the occupation among pregnant women in Omdurman maternity hospital 2018-2019 (n = 384).

Knowledge of participants regarding urinary tract infections

The participants were asked if they have any information about UTI, 169 (44%) answered yes to the question and those have been further investigated about the disease. 215 (56%) answered.

Total score of knowledge was considered 100%, those who scored from less than 25% were considered to have poor knowledge, those who scored from 25% to 75% were considered to have moderate knowledge and those who scored above 75% were considered to have high level of knowledge.

Level of knowledge	Frequency	Percent
Poor	230	59.9
Moderate	152	39.6
High	2	.5
Total	384	100.0

Table 6: Distribution of level of knowledge about UTI during pregnancy among pregnant women at Omdurman maternity hospital 2018-2019 (n = 384).

When the participants were asked about UTI symptoms most of them chose burning sensation during urination (77.5%) and least frequent answer was bloody urine (24.3%).

Symptoms	Yes		No		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Nausea, vomiting and fever	80	47.3	89	52.7	169	100%
Back pain	112	66.3	112	66.3	169	100%
Chills	57	33.7	36	72.0	169	100%
Frequent urge to urinate	107	63.3	62	36.7	169	100%
Burning sensation during urination	131	77.5	38	22.5	169	100%
Urinary incontinence	51	30.2	118	69.8	169	100%
Bloody urine	14	24.3	118	75.7	169	100%

Table 7: Distribution of knowledge about UTI symptoms during pregnancy among pregnant women in Omdurman maternity hospital, in 2018 - 2019 (n = 169).

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When participants were asked if they know that pregnant women have higher risk for developing UTI 143 (84.6%) answered yes and 26 (15.4%) answered no. Those who answered yes have been further asked about the reason for that and most of them 44 (30.7%) chose the growing weight of the uterus during pregnancy.

Risk Factors During Pregnancy	Yes		No		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Growing weight of the uterus during pregnancy increases the risk of UTI	44	30.7	99	69.3	143	100%
Hormonal changes during pregnancy increases risk of UTI	36	25.2	107	74.8	143	100%

Table 8: Distribution of knowledge about UTI risk factors during pregnancy among pregnant women in Omdurman maternity hospital, in 2018 - 2019 (n = 143).

Regarding UTI causes most of the participants chose renal stones 60 (35.5%) which is a wrong answer as it's considered a risk factor of UTI not a cause, the least frequent cause chosen was fungi.

Symptoms	Yes		No		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Bacteria	41	24.3	128	75.7	169	100%
Fungi	24	14.2	145	85.8	169	100%
Renal stones	60	35.5	109	64.5	169	100%

Table 9: Distribution of knowledge about UTI causes during pregnancy among pregnant women in Omdurman maternity hospital, in 2018-2019 (n = 169).

When participants were asked if they know that having UTI during pregnancy have serious risks on the fetus most of them answered 97 (57.4%) answered yes and 72 (42.6%) answered no, those who answered yes were further asked about the impact of UTI on the fetus and the most chosen impact 41 (42.3%) was early labor.

Symptoms	Yes		No		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Early labor	41	42.3	56	57.7	97	100%
Low birth weight of the newborn	35	36.1	62	63.9	97	100%

Table 10: Distribution of knowledge about UTI risks on the fetus during pregnancy among pregnant women in Omdurman maternity hospital, in 2018-2019 (n = 97).

Participants practice toward UTI was assessed they were asked if they perform routine urine tests during pregnancy and most of them 164 (97%) answered yes and then they were asked if they have ever been diagnosed with UTI and those who answered yes 111 (65.7%) their practice was further assessed.

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Variable	Frequency	Percentage
Perform urine tests routinely during pregnancy		
Yes	164	97%
No	5	3%
Total	169	100.0
Did you get UTI before		
Yes	111	65.7%
No	58	34.3%
Total	169	100.0
Did you get treatment (n = 111)		
Yes	94	84.7%
No	17	15.3%
Total	111	100.0
How have you been diagnosed with UTI (n = 111)		
By the doctor	108	97.3%
Due to symptoms	3	2.7%
Total	111	100.0

Table 11: Assessment of practice toward UTI among pregnant women in Omdurman maternity hospital, in 2018-2019 (n = 169).

The influence of age on the level of knowledge

There was a significant association between age and level of knowledge (p = 0.002).

Age	Knowledge			Total
	Poor	**Moderate**	**High**	
16 - 19	27	3	0	30
20 - 29	135	93	0	228
30 - 39	64	51	2	117
40 - 49	4	5	0	9
Total	230	152	2	384

Table 12: The association between knowledge score of UTI and age among pregnant women in Omdurman maternity hospital 2018-2019 (n = 384).

The influence of educational level on the level of knowledge

There was a significant association between level of knowledge and educational level (p = 0.001).

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Educational Level	Knowledge			Total
	Poor	Moderate	High	
Illiterate	27	2	0	29
Khalwa (religious teaching facility)	3	2	0	5
Primary	40	12	0	52
Middle	53	24	0	77
Secondary	72	52	2	126
University / Above	35	60	0	95
Total	230	152	2	384

Table 13: *The association between knowledge score of UTI and the educational level among pregnant women in Omdurman maternity hospital 2018 - 2019 (n = 384).*

The influence of occupation on the level of knowledge

There was a significant association between occupation level of knowledge (p = 0.002).

Occupation	Knowledge			Total
	Poor	Moderate	High	
Not Working	220	133	2	355
Working	10	19	0	29
Total	230	152	2	384

Table 14: *The association between knowledge score of UTI and the occupation among pregnant women in Omdurman maternity hospital 2018-2019 (n = 384).*

The influence of residency on the level of knowledge

There is no significant association between residency and level of knowledge (p = 0.225).

Discussion

Iron deficiency anemia discussion

This study showed that the mean age + Sd is 27.7 + 5.95 which is close to a study done by H. Ahamed N., *et al.* 2018 [8] in Egypt. While it's in contrast with a study conducted by Karim., *et al.* 2016 [9] which showed that the Mean age ± SD of the studied females was 16.3 ± 0.860.

Most of the participants in this study had secondary education (33%) followed by graduate level or above (24.7) and the least observed educational levels were illiterate (7.6) and khalwa (1.5) this finding is supported by the fact that most of these participants are living inside Khartoum state which is the capital of Sudan. This is consistent with a study conducted by Ghimire and Pandey, 2013 [6] which found that the majority of women had secondary or above education and the least of them were illiterate.

This study is also against a study that was done in Karnataka by Yadav., *et al.* 2014 [10] which reported that majority 148 (37.0%) of the women had secondary level education and only 33(8.3%) had graduate level education.

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In addition it disagree with H. Ahmed., *et al.* 2018 [8] which observed that slightly less than two fifth of the studied women (39%) were illiterate and about only one tenth of them (10.8) had high education. These results may be explained due to low socioeconomic level, cultural factors and more than four fifth of them were from rural area.

Regarding level of knowledge in the present study more than three fifth of the participants (76.8) had poor knowledge score about IDA during pregnancy and only less than one fifth (9.6) of them had good knowledge score. This is supported by a study done in Egypt by H. Ahmed., *et al.* 2018 [8] which reported that three fifth of participant women (60%) had poor knowledge scores and fewer than one fifth (18.8) of them had good knowledge scores.

These results are also consistent with Ghimire and Pandey, 2013 [6] who reported that more than half of the studied women didn't have acceptable knowledge about anemia prevention Moreover, the current study is in the same line with M'Cormack and Drolet, 2012 [11] who illustrated that the studied participants 'knowledge about anemia was generally poor.

On the other hand, these results are in contrast with a study made in Tanzania by Margwe, 2015 [12] who found that more than one third of participants had high knowledge.

Regarding the risk factors of IDA this study reported that more than two thirds (76.4) could define not consuming adequate iron-rich food as a risk factor and this is consistent with a study done in Kerala, India by Jose., *et al.* 2016 [13] (68%) but it disagrees with other studies including M'Cormak and Drolet, 2012 [11] (38%) and Ghimire and Pandey, 2013 [6] (98%).

On the other hand, half of participants (50%) knew that tea or coffee reduces iron absorption this finding agrees with a study done by Angadi and Ranjitha, 2016 [14] (43%). But it disagrees with a study done in Palestine by Karim., *et al.* 2016 [9] (25%).

In the current study more than half of participants (50.9) answered that not consuming vitamin C rich food is risk factor for IDA this is consistent with other studies including Angadi and Ranjita, 2016 [14] (74.1%) and Karim., *et al.* 2016 [9] (64.1%).

This finding disagrees with a study done by Jose., *et al.* 2016 [13] (28.1%).

Regarding symptoms of anemia in our study more than two thirds of participants (79.1%) identified fatigue as a symptom which is inconsistent with some other studies including Jose., *et al.* 2016 [13] in which it was (53.5%) and Angadi and Ranjitha, 2016 [14] (31%). Also, more than two thirds of population identified pale skin (65.5%) which disagree with Jose., *et al*. 2016 [13] study in which it was (45.4%). And more than two thirds (62.7%) identified breathlessness which is inconsistent with a study done by Angadi and Ranjitha, 2016 [14] (3%).

Regarding IDA complications on the fetus more than one fifth of participants (25.3%) knew about the presence of those complications and this is well consistent with a study done in Sierra Leone by M' Cormak and Drolet, 2012 [11] which mentioned that only 3% of women knew about those complications.

Regarding the association between educational level and level of knowledge this study reported significant association with the highest percentage of good knowledge (15.8%) and the lowest percentage of poor knowledge (56.8%) level being among university students or above.

A study done in Nepal by Ghimire and Pandey, 2013 [6] has consistent results with the current study with the highest percentage (56.2%) of adequate level of knowledge and the lowest percentage (43.9%) of inadequate level of knowledge being among secondary school level or above.

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This study also agrees with a study done by Yadav., *et al.* 2014 [10] which reported that majority of correct answer was given by women who was educated up to higher secondary and graduate. In addition to that another study done by Margwe, 2015 [12] stated that generally, the respondents with secondary education (38%) and those of higher level of education (100%) had higher level of knowledge and awareness on anemia.

Discussion

The results of this study shows that the majority of participants were housewives 355 (92.4%) and only 29 (7.6%) were working this is consistent with a study by Adhikari and Dhakal, 2015 [15] in Nepal which reported that most of respondents 174 (70.73%) were house workers. This result is also similar to two other studies done in Egypt conducted by Ahmed, 2015 [16] and El Sayed, 2019 [17] which found that most of participants (69.1%) and (75.2.%) were housewives.

In the current study the mean of knowledge regarding UTI symptoms was 37.2, UTI causes 41.6 and UTI complications during pregnancy was 39.2. This finding is inconsistent with a study conducted by Adhikari and Dhakal, 2015 [15] which found that the mean of knowledge regarding UTI symptoms was 4.93, UTI causes 7.9 and UTI complications 4.64.

In this study participants were asked if they have any information about UTI most of them 215 (56%) answered no, this is probably due to the fact that most of participants had secondary education only and due to the lack of a proper health education about UTI. This is inconsistent with some other studies including a study done by Mangai., *et al*. 2019 [18] which reported that 80.3% of participants had knowledge about UTI and a study conducted by Pierre and Clemetine,2018 [19] which found that the percentage of pregnant women who knows something about UTI is high 75.8%.

Regarding the level of knowledge, the current study found that more than half of participants had poor knowledge (59.9%) followed by moderate knowledge (39.6%) and only (0.5%) had high knowledge. This finding can be explained by the fact that most of participants were housewives and had secondary education only, also by the absence of adequate health education regarding health issues during pregnancy.

This finding can be supported by a study done by Ahmed, 2015 [16] in Egypt which reported that most of women had low score levels of knowledge before the intervention. It's also similar to a study conducted by El Sayed 2019 [17] which found that more than half of women (69.5%) had unsatisfactory level of knowledge.

On the other hand, this finding disagrees with a study conducted by Adhikari and Dhakal, 2015 [15] which found that most of participants had an average level of knowledge (65.05%) followed by poor knowledge (24.39%) and then good knowledge (10.56%). It's also inconsistent with a study done by Bhat., *et al.* 2017 [20] which reported that the majority of participants had an average knowledge (77.3%) followed by poor knowledge (22.7%) and there were no participants with good knowledge (0%).

In the current study there was a significant association between age and level of knowledge showing a positive relationship this can be explained by the higher experience among the older women. This is similar to a study conducted by Adhikari and Dhakal, 2015 [15] which reported the presence of a significant association between age and level of knowledge.

This study showed a significant association between level of knowledge and educational level with the least percentage of poor knowledge and the highest percentage of moderate knowledge among those who had university and above education. This is consistent with a study conducted by Pierre and Clementine, 2018 [19] which reported that huge number of pregnant women who did not show effective knowledge about UTIs were found in the group of women who did not have any educational background.

In this study it was found that most of participants (65.7%) experienced UTI before this finding is inconsistent with a study done by Mangai., *et al*. 2019 [18] in Nigeria which reported that most of the respondents (62.5%) have never experienced UTI before.

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Conclusion

The majority of participants had poor knowledge regarding IDA during pregnancy especially about IDA risks on the fetus. The study highlights the educational level, residency and occupation as they play important factors in the knowledge of respondents.

Based on this study it was concluded that most of the respondents had poor knowledge on UTI, the most knowledgeable area was UTI symptoms and the least knowledgeable area was on the area of causes of the UTI.

It was also concluded that age, educational level and occupation strongly affect participant's level of knowledge.

Recommendations

The study recommends raising pregnant women perception regarding IDA and UTI during antenatal visits through educational program. Media should aim to improve the knowledge of pregnant women regarding IDA risks on the fetus and UTI causes during pregnancy.

All women of childbearing age in Sudan should receive basic nutritional education regarding food sources of iron and how food choices affect iron absorption and counseling should be provided to pregnant women in the antenatal care centers regarding IDA and UTI complications during pregnancy.

Integrating antenatal care in school education especially in areas where there are high adolescents and teenagers' marriage is also a fundamental necessity that is highly recommended by this study.

Further researches should be conducted throughout Sudan to assess the knowledge of IDA and UTI during pregnancy among pregnant women, also focus group discussions are recommended.

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Conflict of Interest

There was no conflict of interest in this study.

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