**RESEARCH STUDY**
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# The Effect of Knowledge, Education, Income, and Marriage Age on Iron Deficiency Anemia in Pregnant Women in Taiz City-Yemen

## *Pengaruh Pengetahuan, Pendidikan, Pendapatan, dan Usia Pernikahan terhadap Kejadian Anemia Defisiensi Besi pada Ibu Hamil di Kota Taiz-Yaman*

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**ABSTRACT**

**Background:** Iron Deficiency Anemia (IDA) is one of the most common types of nutritional anemia in pregnant women and is the most dangerous to the mother and fetus; This is because the need for iron for both the mother and the fetus increases gradually during pregnancy and reaches its highest levels at the end of pregnancy.

**Objectives:** The study aimed to identify the effect of education, income, and age of marriage on the anemia of pregnant women in Taiz City-Yemen.

**Methods:** The study was carried out utilizing a quantitative design (Descriptive study). From 3rd November 2023, until 30th January 2024. A simple random selection procedure is used to choose six of Taiz City's 10 primary healthcare facilities.101 pregnant women between the ages of 18 and 42 took part in the study.

**Results:** The findings showed that the low knowledge levels (0-35%) had low Hb levels (9.3 mg/dL) when compared with higher knowledge levels (> 50%) with Hb levels (9.92 mg/dL). Furthermore, those Lower marriage age (<20 Years) had low Hb levels (9.46 gm/dL) when compared to marriage age (>25) with Hb levels (10.81 mg/dL). On the other hand, lower education levels were associated with low Hb levels (8.18 mg/dL) when compared to higher education levels.

**Conclusions:** Findings demonstrated that lower knowledge levels, younger marriage age, lower education, and lower income were associated with lower hemoglobin levels. These factors were linked to a higher prevalence of anemia. Improved education and income levels can lead to better knowledge and management of anemia.

## INTRODUCTION

Knowing her nutritional needs during pregnancy was one of a pregnant woman's most important responsibilities, as ideal nutrition during this period requires adjustments compared to normal life stages. A lack of essential nutrients, particularly vitamins, and minerals, can increase the likelihood of giving birth to low-weight infants, raise the risk of birth defects, weakened resistance to infection, and hinder the ability to maintain a healthy pregnancy, emphasizing the importance of providing good and appropriate food throughout pregnancy[1]. But also providing it during the pre-pregnancy period ensured to a large extent that the pregnant woman passed this critical period with the least amount of hardship and fatigue, and also largely guarantees the birth of a healthy, full-weight child[2,3].

Anemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development[4,5], furthermore, Sifakis S & Pharmakids G reported that anemia was one of the most frequent complications related to pregnancy, which related to decrease in the oxygen-carrying capacity of the blood and was best characterized by a reduction in hemoglobin concentration[6]. Anemia arises when hemoglobin levels decline below the normative range for

an individual's age, sex, and environment[7], It was frequently categorized as mild, moderate, severe, and extremely severe. The basic cause Classification of anemia defined three primary etiological categories of anemia: malnutrition, marrow disorders, and hemolytic diseases[8]. Iron deficiency anemia was the most common kind of anemia, accounting for 76%, followed by folate deficiency at 20% and combined iron and folate insufficiency at 20%. Additionally, hookworm infestation, malaria, and HIV infections significantly contributed to the incidence of severe anemia in pregnant women[9]. The World Health Organization (WHO) defined anemia in pregnancy as a hemoglobin concentration below 110 g/L at any stage of gestation. Nevertheless, the World Health Organization's recommendations on prenatal care and the guidelines from the U.S. Centers for Disease Control and Prevention advocated for trimester-specific thresholds for anemia (first trimester: <110 g/L; second trimester: <105 g/L; and third trimester: <110 g/L)[10].

Reports of food shortages and high rates of illiteracy, particularly among females, place Yemen among the world's least developed nations and poorest Middle Eastern nations[5]. Contrary to the Yemeni government statistic of 164 maternal mortality ratio, UNFPA recorded it as 385 in 2019[2]. Yemen was classified as a low-income nation, with 80% of its population residing below the poverty threshold and nearly half lacking sufficient access to nutritional food[11]. Yemen was one of the countries adversely impacted by the Arab Spring events of 2011 and had descended into prolonged conflict[2]. The conflict and siege in Yemen severely affected the health of women and children[5]. Evidence indicated that the health impacts of conflict on women and children had been ignored[12]. Taiz City, being heavily affected by these conditions, may experience higher rates of IDA, and also because there was limited localized data on how knowledge about IDA among pregnant women in Taiz had been understudied in previous research. This study was important to explore how local factors, such as education and income, and early marriage were contributing to iron deficiency anemia among pregnant women, so, it will give vital data for bettering Yemen's mother and child health results. According to the information mentioned before, our study aimed to know the knowledge, education, income, and marriage age on the prevalence of IDA in pregnant women.

**METHODS**

The study was carried out utilizing a quantitative design, conducted from 3rd November 2021, until 30th January 2022 (Quantitative Descriptive). A simple random selection procedure was used to choose six of Taiz City's 10 primary healthcare facilities. During 3 months in the Taiz-Yemen districts of Al-Mudaffer and Al-Qahera, 101 pregnant women between the ages of 18 and 42 took part in the study. The inclusion criteria were women residing in Taiz city, women of reproductive age, women who got married at varying ages, women without any other health problems, and willingness to participate in the study. While exclusion criteria were non-pregnant women, women with chronic conditions or health issues affecting iron absorption, women currently undergoing

iron supplementation or other treatments for IDA, and any participant unwilling to provide informed consent. The Hb levels were evaluated by using secondary data from pregnant women for their last visit to primary healthcare facilities. A practical purposive sampling strategy was applied when visiting antenatal care facilities for therapeutic or preventative purposes.

In order to accomplish the objectives of this study, researchers employed the Arabic version of the questionnaire, which has three components, to conduct interviews to gather sample data using constructive questions. Data analysis was performed using SPSS version 24.0. Descriptive statistics were used to describe the characteristics of the study subjects. Differences in means and percentages were calculated using an ANOVA test at p-value≤0.05.

Our research received ethical approval before its commencement. The study was approved on September 28th, 2021, under approval number "322-USMH-2021," ensuring compliance with ethical standards. The approval was granted by the Faculty of Medical & Health Sciences at Al-Saeed University, which oversees the ethical conduct of research involving human subjects.

In this study, the variables were operationally defined to ensure clarity and consistency in measurement. Knowledge was assessed based on participants' responses to a standardized questionnaire, categorized as A from (0-35%), B from (35-50%), or C (>50%) based on their scores. Education level was determined by the highest grade or degree attained, classified as uneducated, just reading and writing, or having a university qualification. Income was measured as the household's monthly earnings and categorized into (<50K) R.Y., intermediate (50-100K) R.Y., or high (>100K) R.Y., according to local economic standards. Marriage age was recorded as the age at first marriage and classified into less than 20 years or from 20 to 25 years.

A structured questionnaire was utilized as the primary data collection tool in this study. The questionnaire consisted of sections designed to gather demographic information and socioeconomic status, including knowledge about anemia, educational background, income level, and age at marriage. The questionnaire was pretested on a small sample to ensure clarity, reliability, and validity before being administered to the study participants.

**RESULTS AND DISCUSSIONS**

Table 1, showed the age average of pregnant women under study was (25.9±5.58 years), the proportion of women with university qualifications was 49.5%, while 38.6% were only reading and writing also uneducated women constituted 11.9%, and it was observed that 89.1% were housewives while 9.9% of them had jobs while only 1% of female students, and it turned out that the percentage of their income was 46.5% of their income level <50 thousand and the same percentage exactly was the proportion of income they had between 50 to 100 thousand while 6.9%, their income level was >100 thousand, and the results indicated that the average length of the study samples (1.57±0.039 m), and it was noted that the average weight before pregnancy for the study samples (54.11±12.14 kg),

while the average weight during pregnancy was (59.07±10.74 kg). It found that the average of H for study samples was (9.87±wereee8), where the results indicated that the average age of marriage was (20.27±4.14 years), also; it noted that the average weight of the last child of the study samples was (1.79±1.38 kg) where the results indicated that the average. The average percentage of total knowledge reached (44.77±7.95).

**Table 1.** Mean and SD of characteristics of pregnant women in Taiz, Yemen

| Variable | Mean | ±SD |
|---|---|---|
| Age (year) | 25.90 | 5.58 |
| Height (m) | 1.57 | 0.039 |
| Weight before Pregnancy (kg) | 54.11 | 12.14 |
| Weight during Pregnancy (kg) | 59.07 | 10.74 |
| Hb Level | 9.87 | 2.68 |
| Age of Marriage (year) | 20.27 | 4.14 |
| Pregnant Month (month) | 4.82 | 1.86 |
| Last Baby Weight (kg) | 1.79 | 1.38 |
| Total Knowledge (%) | 44.77 | 7.95 |

HB: Hemoglobin

**Table 2.** Frequency distribution of Socioeconomic characteristics of pregnant women in Taiz, Yemen

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| **Education** | | |
| Uneducated | 12 | 11.9 |
| Just Read and Write | 39 | 38.6 |
| Has a University Qualification | 50 | 49.5 |
| **Job** | | |
| Employee | 10 | 9.9 |
| Housewife | 90 | 89.1 |
| Student | 1 | 1 |
| **Income (R.Y)** | | |
| <50K | 47 | 46.54 |
| 50-100K | 47 | 46.54 |
| >100K | 7 | 6.92 |

1 USD=1535 YR

Table 2, showed the educational background of the participants, revealing that 11.9% were uneducated, while 38.6% were literate but had not pursued formal education beyond basic reading and writing skills. The majority, 49.5%, had attained a university-level qualification. Regarding employment status, 89.1% of the participants were housewives, 9.9% were employed, and only 1% were students. In terms of household income, nearly half (46.54%) of the participants reported earning <50K R.Y, while an equal proportion (46.54%) reported an intermediate income ranging between 50K and 100K R.Y. A small minority (6.92%) reported a high income exceeding 100,000 R.Y.

**Table 3.** Frequency distribution of Socioeconomic characteristics and their effects on Hb levels among Pregnant Women

| Variable | Frequency (n) | Percentage (%) | Hb Level Mean | ±SD | p-value |
|---|---|---|---|---|---|
| **Knowledge** | | | | | |
| A (0-35%) | 11 | 10.90 | 9.3 | 3.29 | |
| B (35-50%) | 63 | 62.37 | 9.94 | 2.39 | <0.001* |
| C (>50%) | 27 | 26.73 | 9.92 | 3.08 | |
| **Education** | | | | | |
| Uneducated | 12 | 11.88 | 8.18 | 4.07 | |
| Just Read and write | 39 | 38.61 | 10.20 | 1.88 | <0.001* |
| Has a University Qualification | 50 | 49.51 | 10.03 | 2.71 | |
| **Income (R.Y)** | | | | | |
| <50K | 47 | 46.54 | 9.17 | 3.36 | |
| 50-100K | 47 | 46.54 | 10.49 | 1.80 | <0.001* |
| >100K | 7 | 6.92 | 10.41 | 0.83 | |
| **Age of Marriage (year)** | | | | | |
| <20 | 53 | 52.48 | 9.46 | 2.90 | |
| 20-25 | 40 | 39.60 | 10.23 | 2.53 | <0.001* |
| >25 | 8 | 7.92 | 10.81 | 0.80 | |

HB Level: Hemoglobin Level, *) ANOVA test, significant at p-value≤0.05

Knowledge processing was identified as one of the most significant factors impacting social and economic sustainability[12]. Table 3 clarified that the study samples were divided into three groups (A, B, and C), whereas group (A) had % of their knowledge ranging from 0-35%, the results indicated that their number reached 11 out of 101 samples where their average of Hb level was (9.30±3.29) compared to (9.94±2.39), at a rate of (62.37%) of the samples under study from group (B), whereas the average of Hb at group (C) was (9.92±3.08). Concerning the total knowledge of the study samples according to the divided groups (A, B, and C), their proportions (were 31.5±3.32), (42.90±4.25) and (54.56±3.62) respectively. This aligns with the findings from other studies that emphasized and demonstrated that nutrition education and an iron-rich dietary plan during pregnancy resulted in enhanced hemoglobin levels, maternal weight gain, and elevated intake of iron-rich foods[13]. The research conducted in Ethiopia demonstrated a significant enhancement in the nutritional knowledge of pregnant women following the implementation of nutrition education and targeted dietary practices[14].

The marriage age in group A was (19±3.82 years) while in group B was (20.25±3.86 years) and in group C the average age was (20.81±4.88 years). From these results, we conclude that the younger the age of marriage leads to lower the knowledge, these results coincided with what was mentioned in the current study identified a relationship between the prevalence of anemia and several factors, including gestational age, gravidity, child spacing, milk consumption, the timing of tea consumption, the timing of coffee consumption, the timing of cola consumption, chicken intake, liver intake, and level of knowledge[3], also the researchers Baksono & Elga, 2018 mentioned that knowledge of anemia is a thing that a person knows about Hb levels are less than normal. Knowledge of anemia included the understanding, causes, signs and symptoms, and consequences of anemia, benefits and instructions in taking supplements, and the selection of foods rich in iron[15]. Knowledge was influenced by several factors: education, age, occupation and income, information exposure, experience, and social culture, also Justina et al., 2018 found that the high prevalence of anemia in the research region may be attributed to the inadequate awareness among pregnant women regarding the preventive and control methods for anemia; such knowledge might facilitate comprehension of the issue and promote behavioral change[16]. Conversely, insufficient knowledge or misinformation inhibited the community's willingness and practical engagement in interventions; studies indicate that a lack of understanding regarding the causes, management, and prevention of anemia adversely affected the condition.

The level of education attained by women may influence fertility by affecting their health and physical capacity for childbirth, the health of their children, the desired number of children, and their ability to manage reproductive methods[17]. Study samples were collected according to the level of their education (those who are not educated, who can read and write and has academic qualifications), their number reached 12, 39 and 50, respectively, and the difference between the groups was in terms of average percentage of Hb level (8.18±4.07, 10.20±1.88 and 10.03±2.71), respectively, and the average percentage of total knowledge was large for those with academic qualifications as it was estimated at (47.49±7.44), and in the samples who were only reading and writing, their average ratios were average, which is (41.91±6.90) compared to those who were not educated, so the average total knowledge was estimated at (40.92±8.50), and through these results we concluded that each increased in the level of education will lead to increase of knowledge and the average of Hb level, these results were mentioned in the prevalence of anemia decreased with an increase in the level of education, Pregnant women with no formal education were associated with a significantly higher prevalence of IDA[16,18,19]. Another study was conducted by Alem and Adugnaw Zeleke.2023 Women with higher education tend to have more income, better knowledge, and healthier behaviors, which can protect against anemia. They were more likely to eat nutritious food, make informed health decisions, and maintain good hygiene[20].

Income is the sum of all the wages, salaries, profits, interest payments, rents, and other forms of earnings received in a given period of time[21]. The study samples were classified according to income level, where the results showed that 47, 47, and 7 had their incomes <50 K R.Y and from 50-100K thousand R.Y and K100K R.Y, respectively, and where they were knowledge by the level of Hb, and the average of Hb level was (9.17±3.36, 10.49±1.80 and 10.41±0.83) respectively, also observed that the total knowledge percentage varied according to the level of income, so if their income was <50K the average percentage of total knowledge they had was 42.07±7.78, while in samples whose income level was from 50-100K, they had 46.57±7.59, while in samples whose income level was >100K, the average percentage of knowledge they reached was 50.86±4.39. It was found from the results that the level of individual income, has a significant impact on the level of total knowledge, furthermore, lower income led to lower total knowledge, and in the knowledge of hemoglobin, the results agreed that the prevalence of anemia increased with the decrease in the level of income, the highest prevalence of anemia (49.9%) was among pregnant women who had poor incomes[3] also It was shown that a decline in socioeconomic status correlated with the increase of the prevalence of anemia. Consequently, a decrease was linked to an elevated chance of anemia development during pregnancy[9,16,21].

Hemoglobin levels were crucial in assessing anemia risk during pregnancy, highlighting the need for antenatal iron supplementation. WHO recommends a daily intake of 30-60 mg of iron and 0.4 mg of folic acid during pregnancy to prevent anemia and related complications. In another study conducted by Adugnaw Zeleke Alem, 2023 both education and wealth status were linked to anemia risk. Women with lower education and wealth levels were more likely to be anemic, aligning

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Ali et al. | Amerta Nutrition Vol. 8 Issue 3SP (December 2024). 1-6

5

with studies from other LMICs. Educated women tended to have healthier lifestyles and better access to healthcare, while wealthier women had greater financial capacity for healthcare services, reducing anemia risk. In addition, wealthier women can afford better healthcare services and nutritious food, contributing to lower anemia rates[20].

The age at which a woman enters her first nuptial life is directly related to the number of children she will have because it affects the length of time she will be at risk of becoming pregnant[22]. Indicates the age of marriage at the age of <20 years for the study samples was 52.48% of the total sample. Their range of level was 9.46±2.90, and the total knowledge was 43.76±7.83. The results showed that the study samples who married at an age between 20-25 reached 39.60% of the total samples, where their knowledge of hemoglobin level was 10.23±2.53, and the total knowledge was 45.66±6.98. It was observed that the study samples who were married at the age of >25 years reached 7.92%, where their average knowledge average of Hb level was 10.81±0.80 and their average total knowledge was 47.06±12.48, and through these results, it was found that the age of marriage affected the average percentage of total knowledge, as the most affected groups were those who were<20 years old, this result was consistent with the percentage of pregnant women suffering from anemia was a maximum 93.8% in the age group less than 20 years old[23]. Similarly, Increased maternal age at pregnancy had been linked to a significant decrease in anemia in India, while adolescent pregnancies were consistently linked to increased odds of anemia when compared to women aged 20-49 years. The findings suggested that interventions aimed at enhancing maternal nutrition, including balanced energy protein supplementation, as well as efforts to reduce adolescent pregnancy rates, could significantly decrease anemia prevalence among women of reproductive age[24].

Another study conducted by Fentanesh Nibret Tiruneh, 2021 that early marriage and childbearing were major contributors to anemia among female adolescents, as they increased health risks, including pregnancy-related complications and reduced educational and healthcare access. These practices were common in Ethiopia, especially in rural areas, and were influenced by socio-cultural norms. Communities with higher rates of early marriage tended to have more cases of anemia. Delaying marriage and childbearing could reduce anemia rates by improving education, contraceptive use, and autonomy for young women. Anemia prevention programs should focus on addressing these practices and enhancing healthcare access[25].

The research's strength laid in its multidimensional approach, which examined various socio-demographic factors and provided a comprehensive understanding of the contributors to iron deficiency anemia. However, a potential weakness was the challenge of isolating these factors' individual impacts, as they were often interrelated. Additionally, the study faced limitations in data collection due to cultural sensibilities.

## CONCLUSIONS

The study demonstrated a clear association between anemia in pregnant women and their overall knowledge levels. Socioeconomic factors, particularly individual income, were shown to significantly influence knowledge, with lower income correlating with reduced purchasing power and, consequently, a higher incidence of anemia. Additionally, the prevalence of anemia was found to decline as educational attainment increased, indicating the protective effect of education on maternal health. Furthermore, younger age of marriage was linked to both diminished overall knowledge and lower awareness of hemoglobin levels, further underscoring the importance of educational and socioeconomic interventions in mitigating anemia risk during pregnancy.

## AUTHOR CONTRIBUTIONS

LASA: conceptualization, methodology, data curation, formal analysis, roles/writing-original draft, writing-review & editing; HTSM: conceptualization, methodology, data curation, formal analysis, roles/writing-original draft, writing-review & editing; HHMA: data collection, writing-original draft; FGA: data collection, writing-original draft; AAA: data collection, writing-original draft; SAAA: data collection, writing-original draft; SAALH: data collection, writing-original draft; SADA: data collection, writing-original draft; TMAQ: data collection, writing-original draft; RAST: project administration, visualization, software; HTJ: supervision, and validation; WF: supervision, and validation; HT: supervision, and validation, LA: language validation and translation.

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