Anemia and Underweight among Married Women in Yemen; Evidence from Yemen Demographic Health Survey (YDHS-2013)

Manzoor Ahmad Malik; MA, MPS, MPHIL, PhD*[1] & Tukur Dahiru; MA, PhD[2]

[1] Department of Humanities and Social Sciences, Indian Institute of Technology Roorkee; [2] Professor of Public Health, Ahmadu Bello University Zaire, Nigeria.

ABSTRACT

Background: Women in conflict are vulnerable to health and nutrition risks. Anemia and underweight are the common risks faced by women particularly in war torn countries. Yemen is one of the most affected places that has a fragile public health system due to the conflict. Increasing conflict has put women's health and wellbeing at risk and has severely affected their nutritional development. Therefore, this study aims to examine the association between underweight and anemia with different risk factors among married women in Yemen. **Methods**: This study used the data from Yemen demographic health survey-2013 (YDHS-2013) of married women aged 15-59 year. Bivariate and multivariate logistic models were used to study the association between anemia and underweight with various socio-economic and maternal health risk factors. **Results**: A positive and significant association of socio-economic and maternal health risk factors was found with anemia and underweight. Women belonging to more prosperous groups had the lowest odds of underweight [OR=0.30, *P*<0.001)] and anemia [OR=0.61, *P*<0.001). The study also examined some key risk factors like breast feeding, iron supplements and contraceptive use among women and found a positive and significant association of these risk factors with underweight and anemia. **Conclusions**: Nutritional challenges have to be addressed especially in the country like Yemen. The results clearly indicate that women in Yemen are facing acute nutritional risks of underweight and anemia. Therefore, policy interventions are required to address their nutritional needs and also empower them economically to minimize these nutritional risks. Moreover, nutrition related interventions are required to attain the targets for sustainable development goals in Yemen.

Keywords: *Anemia; Underweight; Women health; Breastfeeding; Iron supplementation*

Introduction

Poor nutrition and anemia among reproductive women has a significant impact on their physical and maternal health. Various socio-economic and contextual factors can result in poor nutrition of women and hence significantly affect their health and wellbeing (Creed-Kanashiro *et al*., 2003; Salem *et al*., 2016). Malnutrition among women has a substantial

impact on their own health and their children's health (Dewan, 2008; Müller & Krawinkel, 2005). Despite significant improvements in nutrition and health outcomes, a good proportion of women and children suffer from malnutrition in developing countries (Desyibelew & Dadi, 2019). Women particularly belonging to vulnerable groups are at greater risk of nutritional deficiencies due their conditions and the socio-economic marginalization they face due to contextual factors like conflict (Singh *et al*., 2021). Around a quarter of the world's population is suffering from anemia and a significant part of this population belongs to poor countries (MOPHP *et al*., 2013; Owais *et al*., 2021). Anemia also accounts for 8.8% of total disability according to World Health Organization estimates. Although significant health improvements have been observed in middle east, Yemen has the poorest health system due to persistent conflict and civil wars (Abu-Ismail, 2020; Salisbury, 2017). Anemia is one of the serious problems in Yemen, affecting more than half of the women in this country (MOPHP *et al*., 2013). According to world bank estimates, about 36% of women in Yemen are suffering from anemia with serious health complications (Akabat *et al*., 2017; Salem *et al*., 2016). Moreover, women who are at risk of anemia are not only threaten their own health, but also their children's wellbeing (Gautam *et al*., 2019; Nankinga & Aguta, 2019). Anemia among women is, therefore, a key public health challenge among the reproductive women in Yemen.

Nutritional status is important for women's maternal health and their overall wellbeing, in terms of their pregnancy outcomes and post-delivery care of children during early periods of breastfeeding (Desyibelew & Dadi, 2019; Wells *et al*., 2020). Although this effect is exacerbated by severe malnutrition, many studies have shown that better nutrition among mothers before and during pregnancy is important for healthy pregnancy outcomes (Barker *et al*., 2018; Koletzko *et al*., 2019; Nguyen *et al*., 2017). Mothers with poor nutrition are at risk of delivery complications with a higher probability of

cesarean delivery (Wells *et al*., 2020). It may also hamper the child's growth due to inadequate quantity and quality of nutrients taken by mothers in their maternal diet (Christian & Smith, 2018; Schwarzenberg *et al*., 2018).

Underweight is emerging as a challenge in countries like Yemen, Lebanon, and Syria owing to the persistent conflicts and civil wars. Research studies have shown that food consumption habits are highly affected in conflicts due to micronutrient deficiencies resulting in underweight and anemia among women (Sumbele *et al*., 2020; Young & Ramakrishnan, 2020). These changes are observed mainly among women who are always vulnerable to any socio-economic and political crisis (Bendavid *et al*., 2021).

Underweight has significantly affected the health of women in Yemen due to the ongoing conflict and civil war (Alflah *et al*., 2017). Studies have shown that poor nutrition is a critical nutritional outcome particularly in conflict affected regions. Women do not have physical and economic access to sufficient safe and nutritious food that may fulfil their dietary requirements (Sserwanja *et al*., 2020). Although various reports and international assessments have highlighted these challenges of anemia and underweight (WHO, 2020), very limited studies in Yemen have been conducted to examine the anemia levels and nutrition status of women (Akabat *et al*., 2017; Alflah *et al*., 2017). Therefore, the present study aimed to examine the association between Anemia and underweight with socioeconomic and maternal health characteristics in Yemen based on the Yemen demographic health survey (YDHS-2013), which is the latest available demographic health survey in the country.

Materials and Methods

Study design and participants: This study used the data from 2013 YDHS-2013. YDHS is the second survey conducted in Yemen by a joint collaboration of health ministry in Yemen and USAID. It is one of the main sources of data to

provide an overview of maternal and child health in Yemen (MOPHP *et al*., 2013). Due to the ongoing civil wars, Yemen has faced a challenging health crisis where reliable information on public health is scarce (Ahmadzai *et al*., 2016). Therefore, in this study, the latest survey was used which is the second round of YDHS. The survey was conducted in all the 20 governorates of Yemen with the aim of providing key information and collecting data on various health related outcomes. The survey was conducted based on a stratified two-stage cluster sampling design, consisting of 587 rural and 213 urban clusters. The detailed information about the survey and sampling is given in the final reports of YDHS (MOPHP *et al*., 2013). In this study, 22067 married women with body mass index (BMI) information were examined for underweight, and 7380 women were studied for anemia.

The survey provides a data on wide range of issues varying from fertility, childhood mortality, family planning preferences to maternal and child health of respondents mainly women aged 15-49 years. Only non-pregnant women were included in the study, since pregnancy outcomes nullify the values of BMI data. Moreover, the survey did not collect information on women who gave birth 2 months before the survey; therefore, they were not included in the study.

The study used two outcome variables to examine anemia and underweight among married women in Yemen. Anemia was determined based on the hemoglobin level in the blood test of the respondents who voluntary consented. Mothers with less than 11.0 g of hemoglobin per deciliter were considered as anemic in the study (Nankinga & Aguta, 2019). The study categorized anemia levels into three categories of mild, moderate, and severe to understand further outcomes of anemia among women in Yemen. The detailed classification of anemia levels according to the world health organization (WHO) criteria are given in the supplementary table SI. Finally, for regression model, women with mild, moderate, and severe anemia levels were coded 1 and those

without any anemia were coded 0.

Nutritional status is critical to determine the health and wellbeing of women. The study used standard measures to examine the underweight status of married women in Yemen. Height and weight were used to calculate the BMI of the studied women. BMI of less than 18.5 kg/m^2 indicated undernutrition. It was then categorized into mild, moderate, and severe undernutrition based on the WHO classification (WHO, 2021).

Measurements: A set of common variables were identified including socio-economic and household characteristics to examine anemia and underweight levels among women in Yemen. Therefore, several independent variables like age, mother's education, occupation, partner's education and wealth status, and residence were included in the study. Some key variables were also included such as mass media exposure, 4^+ Antenatal care visits (ANC), delivery type, breast feeding status, and age at the time of marriage. All the variables were coded and later included in the final model. The detailed categorization of the variables is included in the supplementary file.

Data analysis: Bivariate analysis was carried out to study the sample characteristics. Pearson's chi-squared test was used to assess the frequency distribution of main outcome variables with various exposure variables. Finally, a binary regression model was fitted to examine the association between outcome and explanatory variables in the study. Both P-values and confidence intervals were obtained at alpha=0.05 to examine the chance of a statistically significant association between the predictors and outcome variables. All analyses were carried out in STATA-15

Results

Figure 1 shows that the highest level of anemia was in the Abyan region (92.37%), whereas it is lowest in the Ibb region (46.31%), similarly looking at the underweight, it is lowest in the Al-Baidha region, whereas highest in the (40.32%) Al-Hodiedah region of Yemen.

Table 1 shows the prevalence of anemia

among married women in the sample population. About 70% of women were anemic and more than 5% of them were severely anemic. Women at upper age groups were severely anemic and women with poor income status (4.5%) and residing in rural areas (4.1%) were also severely anemic. Working women were found to be more anemic (71%) and severely anemic (4%) in the sample population. About 4% of breastfeeding women were found to be severely anemic compared to 3% of women who were not breastfeeding their children. Also, 73% of women taking iron supplements were anemic and about 4% of them were severely anemic in Yemen. The prevalence of other risk factors can be seen in **Table 1**. A p-value of 0.05 or lower was considered to be statistically significant.

Table 2 shows the prevalence of underweight among married women in Yemen. About 24% of women were thin and nearly 5% of them were severely thin. The results clearly show that women belonging to poor families, low literacy, and rural areas had a higher prevalence of malnutrition. More than 25% of non-working women were thin with BMI of less than 18.5 kg/m^2 and about 5% of them were severely thin. Also, 27% of women who were not taking any contraceptive pills were severely thin compared to 12% of women who were taking contraceptive pills. Among the subjects, 25.7% of women who were not taking any iron supplements were underweight compared to 19% of women who were taking iron supplement. The results were significant at 5% level of significance, which was

measured using chi-square test of significance.

Table 3 presents the results of risk factors associated with anemia and underweight among married women in Yemen. Women at higher ages were less likely to be underweight. Women aged 40-49 had lower odds of being underweight (OR=0.36, *P*<0.001) compared to the 15-19 age group. The results for anemia were opposite but insignificant. Regarding wealth index, women in more prosperous groups had lower odds of being underweight. Women belonging to rich households had the lowest odds of being underweight (OR=0.30, *P*<0.001) compared the ones belonging to poor households. A significant association was also found between anemia and income. Poor women (OR=0.66, *P*<0.001) were at greater odds of having anemia compared to women who belong to rich households (OR=0.61, *P*<0.001). The study also examined some key risk factors like breast feeding, iron supplements, and contraceptive use among women in Yemen. The results showed that women using any contraceptive pills were less likely to be underweight (OR=0.65, *P*<0.001) and have anemia (OR=0.64, *P*<0.001). Breastfeeding women had a greater probability to be underweight (OR=1.32, *P*<0.001) have anemia (OR=1.34 *P*<0.001). In terms of iron supplements, a significant and positive association was found between women taking iron supplements and underweight (OR=1.21, *P*<0.001) and anemia (OR=1.28, *P*<0.001).

Table 1. Prevalence of anemia (%) by risk factors among married women in Yemen.

Variables	Total anemia	Mild anemia	Moderate anemia	Severe anemia	P-value[a]
Age group (year)					0.005
15-19	68.2	38.9	26.8	2.5	
20-29	71.5	38.4	29.7	3.4	
30-39	72.5	37.3	32	3.2	
40-49	68.9	36.1	28.7	4.1	
Residence					0.005
Urban	65.5	40.3	23.7	1.5	
Rural	73.2	36.8	32.3	4.1	
Mother's education					0.015
Illiterate	74.8	36.5	33.8	4.5	
Primary school	67.9	38.4	26.9	2.6	
Junior high school	66.9	39.5	25.3	2	
Higher	67.7	41.2	25.1	1.4	
Mother's occupation					0.045
Not Working	70.5	38	29.4	3.1	
Working	71.5	38.2	28.9	4.4	
Husband's education					0.005
Illiterate	70.6	38.4	29.1	3.2	
Primary school	71.4	34.8	32.5	4.1	
Junior high school	70.6	40.1	28	2.5	
Higher	67.5	41.2	23.8	2.5	
Wealth index					0.031
Poorest	80.1	34.6	39.4	6.1	
Poorer	72.2	35.5	32.5	4.2	
Middle	71.9	40.4	28.7	2.8	
Richer	65.7	36.3	27.2	2.3	
Richest	64.9	42.4	21.2	1.3	
Breast feeding					0.025
No	69.5	37.9	28.6	3.0	
Yes	75	38.4	32.5	4.0	
Contraceptive use					0.005
No	72.2	37.7	30.9	3.6	
Yes	64.4	39.1	23.6	1.6	
Iron supplementation					0.048
No	70.1	37.8	29.2	3.2	
Yes	73.9	39.4	30.8	3.7	

[a]: Chi-square test; Anemia: Hemoglobin < 11 g/dl; Mild anemia: Hemoglobin 10-10.9 g/dl; Moderato anemia: Hemoglobin 7-9.9 g/dl; Severe anemia: Hemoglobin <7 g/dl:

Table 2. Prevalence of underweight by risk factors among married women in Yemen.

Variables	Total underweight	Mild underweight	Moderate underweight	Severe underweight	P-value[a]
Age group (year)					0.034
15-19	36.4	20.5	8.8	7	
20-29	25.4	14.5	6.4	4.5	
30-39	17.3	9.4	4.2	3.7	
40-49	14.5	7.5	3.8	3.2	
Residence					0.042
Urban	17.1	9	4.5	3.5	
Rural	29	16.5	7.1	5.5	
Mother's education					0.005
Illiterate	25.8	14.1	6.6	5.1	
Primary school	24.4	14	5.9	4.5	
Junior high school	27.2	15.3	6.8	5.1	
Higher	16.7	8.9	3.4	4.4	
Mother's occupation					0.012
Not Working	25.5	14.2	6.3	5	
Working	16.1	9.7	3.9	2.4	
Husband's education					0.022
Illiterate	31.1	17.1	7.7	6.3	
Primary school	21.5	11.8	5.6	4	
Junior high school	16.1	10.3	3.7	2.1	
Higher	10.2	5.6	2.5	2.1	
Wealth index					0.013
Poorest	42.2	21.5	11.6	9	
Poorer	30.5	17.6	7.3	5.6	
Middle	23.8	14.7	5.4	3.8	
Richer	18.3	10.4	4.3	3.7	
Richest	14.8	8	3.8	3	
Breast feeding					0.005
No	24.9	13.9	6.1	4.9	
Yes	24.9	14.1	6.4	4.3	
Contraceptive use					0.005
No	28.7	15.9	7.1	5.7	
Yes	12.1	7	3.1	1.9	
Iron supplementation					0.013
No	25.7	14.3	6.4	5	
Yes	18.9	11.2	4.7	3	
Total	24.9	13.9	6.2	4.8	

[a]: Chi-square test; Underweight: BMI <18.5 kg/m^2; Mild Underweight: BMI 17-18.49 kg/m^2; Moderato Underweight: BMI 16-16.99 kg/m^2; Severe Underweight: BMI <16 kg/m^2:

Table 3. Risk factors of underweight (BMI=<18.5) and anemia (<11.0 g/dl) among married women in Yemen.

Variables	Underweight (BMI=<18.5 kg/m^2)		Anemia (<11.0 g/dl)	
	Odds ratio	Confidence intervals 95%	Odds ratio	Confidence intervals 95%
Age group (year)				
15-19	1		1	
20-29	0.75 [a]	[0.68-0.81]	1.07	[0.92-1.25]
30-39	0.48 [a]	[0.42-0.53]	1.14	[0.95-1.37]
40-49	0.36 [a]	[0.32-0.41]	1.09	[1.89-1.34]
Residence				
Urban	1		1	
Rural	0.99	[0.89-1.10]	1.01	[0.85-1.16]
Mother's education				
Illiterate	1		1	
Primary school	1.01	[0.91-1.09]	0.97	[184-1.125]
Junior high school	1.28 [a]	[1.14-1.43]	0.89	[0.74-1.07]
Higher	1.16	[0.96-1.39]	0.95	[0.730-1.24]
Mother's occupation				
Not Working	1		1	
Working	0.91	[0.79-1.06]	0.96	[0.78-1.18]
Husband' education				
Illiterate	1		1	
Primary school	0.75 [a]	[0.69-0.83]	1.03	[1.20-1.45]
Junior high school	0..65 [a]	[0.58-0.73]	1.17b	[1.20-1.45]
Higher	0.52 [a]	[0.43-0.61]	1.03	[1.20-1.45]
Wealth index				
Poorest	1		1	
Poorer	0.62 [a]	[0.56-0.68]	0.66 [a]	[0.55-0.79]
Middle	0.47 [a]	[0.43-0.53]	0.75 [a]	[0.62-0.90]
Richer	0.36 [a]	[0.32-0.40]	0.58 [a]	[0.47-0.71]
Richest	0.30 [a]	[0.26-0.34]	0.61 [a]	[0.48-0.78]
Breast feeding				
No	1		1	
Yes	1.32 [a]	[1.20-1.45]	1.34 [a]	1.15-1.57]
Contraceptive use				
No	1		1	
Yes	0.65 [a]	[0.59-0.72]	0.64 [a]	[0.55-0.73]
Iron supplementation				
No	1		1	
Yes	1.21 [a]	1.07-1.38]	1.28 [a]	[1.06-1.55]

Not being underweight is the reference category for underweight and not having any anemia for anemia ; [a]: Significant at 1%, [b]:Significant at 10%.
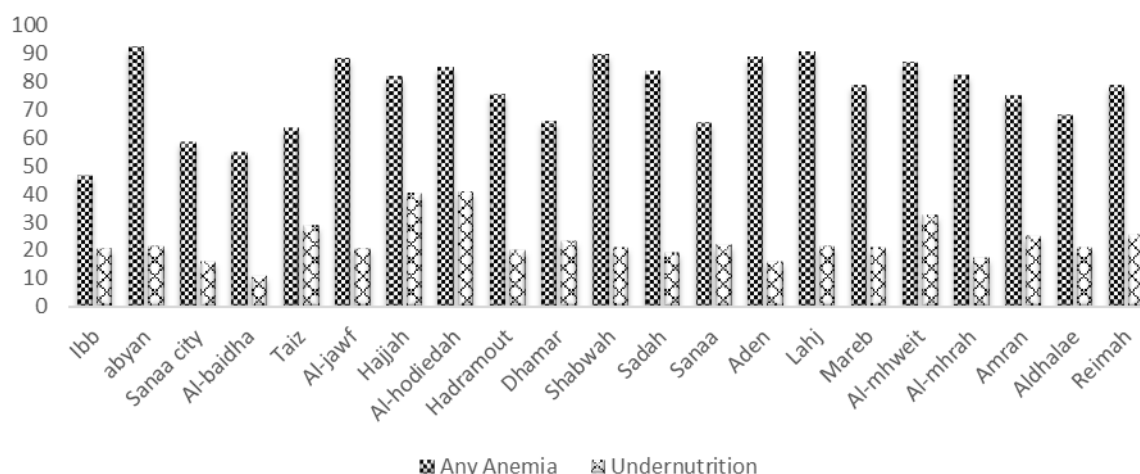
Figure 1. Prevalence of Anemia and underweight among married women in Yemen
Note: Authors own computation from Yemen DHS-2013.

Discussion

Anemia and underweight are the key concerns in public health policy, due to their impact on vulnerable populations like elderly, women, and children. Women particularly belonging the poor countries are likely to suffer more due to their vulnerability to health and wellbeing factors. This study aimed to make a comprehensive approach to examine the prevalence and association of underweight and anemia among the married women in Yemen with some key risk factors.

One of the important goals of sustainable development goals (SDGs) is to end poverty and avert the food security risk with aim of reducing nutrition related challenges (Assembly, 2015; Robert *et al*., 2005).With more than 800 million people undernourished in developing countries, women are the most vulnerable to this nutritional challenge, affecting their health and endangers their life for mortality (Dewan, 2008). Therefore, it is important to understand the underlying causes of underweight and prevailing risk factors undertaken in this study. This study found the strong association between underweight and various socioeconomic and maternal outcomes in Yemen. Although women are less likely to be underweight at older ages, their risk of being under weight is usually higher at early ages. This is in line with many studies, in which married women at early ages are at a greater risk for undernutrition (Kamal

& Islam, 2010; Mtumwa *et al*., 2016). By analyzing the wealth index in the present study, it was found that women were less likely to be undernourished from rich households compared to women belonging to poor households. The study results are line with studies, in which underweight was found to be significantly lower among women belonging to groups with better income (Ali, Ali, *et al.*, 2020; Sserwanja et al., 2020).

Although socio-economic outcomes play an important role, factors like breastfeeding, iron supplementation, and contraceptive use were also examined in this study. The results of the fitted model showed a strong association between underweight and the selected risk factors. It was found that women breastfeeding their children are at greater risk for being undernourished. Studies have reported that breastfeeding can lead to maternal underweight (Dewey *et al*., 2001). The current study showed a positive and significant association between underweight and iron supplement intake, so that underweight women used more iron supplements. Although greater intake of iron supplements is a key factor, underweight in mothers taking iron supplements is indicative of malnutrition due to lack of adequate food and other nutrients in Yemen.

Anemia is a major public health concern in developing countries. It not only affects the health of mothers, but also endangers their wellbeing in

their reproductive ages. Although socio-economic factors affect significantly women's health, factors like lack of iron supplementation and breastfeeding endanger them for being anemic. Anemia is affected by not only the socio-economic status, but also factors like breastfeeding and iron supplementation can affect the nutritional status of women. This study examined the anemia levels of women in Yemen based on various socio-economic and risk factors. This study found a significant association between anemia and income status (Hakizimana *et al.*, 2019). Women belonging to richer households were found to be less likely at risk of anemia compared to women belonging to poor households. A similar relationship was also found between socio-economic factors and anemia levels, but the results were not significant. Examining contraceptive use as a determinant of anemia, the results found that women with contraceptive use were at lower risk of having anemia. These findings are in line with studies conducted in various countries (Gebremedhin & Enquselassie, 2011; Hakizimana *et al.*, 2019; Mawani *et al.*, 2016). This study also tested the breastfeeding status of women with anemia levels. It was found that women breastfeeding their children were likely to be more anemic. The results were in line with the earlier studies conducted in both Yemen and other developing countries (Alflah *et al.*, 2017; Ali, Abbasi, *et al.*, 2020; Hakizimana *et al.*, 2019; Nankinga & Aguta, 2019). While examining the anemia levels, it was also found that women with anemia were more likely to take more iron supplements due to their poor nutrition and dietary intakes (Teshale *et al.*, 2020).

This study provides a thorough analysis of nutritional risk among married women in Yemen. There are some key strengths that make the study novel. First, the study has a representative sample size. Second, this study highlights the key problems of nutritional challenges that must be addressed by policy makers. Finally, this study seems the first to analyze anemia and underweight among women in Yemen. This study has few limitations and one of the limitations the cross-sectional nature of the study. Also, the data available for 2013, do not give the current scenario of nutritional status in Yemen. A key limitation of this study was the use of BMI as a measure of nutritional status for women, which does not predict the true nutritional status of women particularly under the age of 18 year. The study only focused on married women, so the results may not be generalized for women having other marital status in Yemen.

Conclusion

Yemen is suffering from one of the worst humanitarian crisis with an already fragile public health system. Women and children are at risk of nutritional challenges due to lack of optimal socio-economic conditions, fragile health environment, and poor contextual factors like conflict. Therefore, this study investigated the risk factors of anemia and underweight to examine the nutritional challenge of married women in Yemen. According to the results, an association was found with the risk factors such as income, occupation, and other risk factors like breastfeeding, contraceptive use, and iron supplementation. Nutritional challenges of women in Yemen need urgent attention worldwide. Therefore, interventions are required to address the nutritional needs of women and empower them economically to reduce the risk of anemia and underweight. Nutrition related intervention care is also needed to lower the nutritional risk and attain the SDGs in Yemen.

Funding

Authors' contributions

Both the authors contributed equally in preparing this manuscript.

Conflict of Interest

No conflict declared or whatsoever in carrying out this study.

Declaration of interest statement

We know of no conflicts of interest associated with this publication, and there has been no significant financial support for this work that

could have influenced its outcome

References

Abu-Ismail, K. (2020). Note on Poverty and Conflict in Arab States. UNESCWA Report. Available online: https://www.un. org/ development/ desa/dspd/wp-content/uploads/ sites/ 22/2020/03/ Abu-Ismail-paper.pdf (accessed on 7 November 2021).

Ahmadzai, TK, **Maburutse, Z, Miller, L, & Ratnayake, R** (2016). Protecting public health in Yemen. *Lancet*, *388* (**10061**), 2739.

Akabat, MY, Al-Shammakh, AA, Mehrass, AA, Al-Adhroey, AH, & Ali, AD (2017). Prevalence and associated factors of anemia among pregnant women residing at high altitude in Yemen. *American journal health research*, *5*(**4**), 93–98.

Alflah, YM, Wahdan, IH, Hasab, AA, & Tayel, DI (2017). Prevalence and Determinants of Anemia in Pregnancy, Sana'a, Yemen. *International journal of public health science*, *6*(**3**), 213–220.

Ali, SA, Abbasi, Z, Shahid, B, Moin, G, Hambidge, KM, Krebs, NF, Westcott, JE, McClure, EM, Goldenberg, RL, & Saleem, S (2020). Prevalence and determinants of anemia among women of reproductive age in Thatta Pakistan: Findings from a cross-sectional study. *Plose one*, *15*(**9**), e0239320.

Ali, SA, Ali, SA, Razzaq, S, Tikmani, SS, Allana, A, Rizvi, N & Saleem, S (2020). Determinants of under-nutrition among women of reproductive age in Sindh, Pakistan: Findings from Pakistan Demographic and Health Survey, 2012-2013. *Population medicine*, *2*(August). https://doi.org/10.18332/popmed/125364

Assembly, G. (2015). Sustainable development goals. *SDGs Transform our world*, *2030*.

Barker, M, Dombrowski, SU, Colbourn, T, Fall, CH, Kriznik, NM, Lawrence, WT, Norris, SA, Ngaiza, G, Patel, D, & Skordis-Worrall, J (2018). Intervention strategies to improve nutrition and health behaviours before conception. *The Lancet*, *391*(**10132**): 1853–1864.

Bendavid, E, Boerma, T, Akseer, N, Langer, A, Malembaka, EB, Okiro, EA, Wise, PH, Heft-

Neal, S, Black, RE, & Bhutta, ZA (2021). The effects of armed conflict on the health of women and children. *The Lancet*. **397(10273)**:522-32.

Christian, P & Smith, ER (2018). Adolescent undernutrition: Global burden, physiology, and nutritional risks. *Annals of Nutrition and metabolism*, *72*(**4**): 316–328.

Creed-Kanashiro, HM, Bartolini, RM, Fukumoto, MN, Uribe, TG, Robert, RC, & Bentley, ME (2003). Formative research to develop a nutrition education intervention to improve dietary iron intake among women and adolescent girls through community kitchens in Lima, Peru. *Journal of nutrition*, *133*(**11**): 3987S-3991S.

Desyibelew, HD & Dadi, AF (2019). Burden and determinants of malnutrition among pregnant women in Africa: A systematic review and meta-analysis. *Plos one*, *14*(**9**): e0221712.

Dewan, M (2008). Malnutrition in women. *Studies on home and community science*, *2*(**1**): 7–10.

Dewey, KG, Cohen, RJ, Brown, KH, & Rivera, LL (2001). Effects of exclusive breastfeeding for four versus six months on maternal nutritional status and infant motor development: Results of two randomized trials in Honduras. *Journal of nutrition*, *131*(**2**): 262–267.

Gautam, S, Min, H, Kim, H, & Jeong, HS (2019). Determining factors for the prevalence of anemia in women of reproductive age in Nepal: Evidence from recent national survey data. *Plos one*, *14*(**6**): e0218288.

Gebremedhin, S, & Enquselassie, F (2011). Correlates of anemia among women of reproductive age in Ethiopia: Evidence from Ethiopian DHS 2005. *Ethiopian journal of health development*, *25*(**1**): 22–30.

Hakizimana, D, Nisingizwe, MP, Logan, J, & Wong, R (2019). Identifying risk factors of anemia among women of reproductive age in Rwanda – a cross-sectional study using secondary data from the Rwanda demographic and health survey 2014/2015. *BMC public health*, *19*(**1**): 1662.

Kamal, SM, & Islam, A (2010). Socio-economic Correlates of Malnutrition among Married

Women in Bangladesh. *Malaysian journal of nutrition*, *16*(**3**).

Koletzko, B, Godfrey, KM, Poston, L, Szajewska, H, Van Goudoever, JB, De Waard, M, Brands, B, Grivell, RM., Deussen, AR, & Dodd, JM. (2019). Nutrition during pregnancy, lactation and early childhood and its implications for maternal and long-term child health: The early nutrition project recommendations. *Annals of nutrition and metabolism*, *74*(**2**): 93–106.

Mawani, M, Ali, SA, Bano, G, & Ali, SA (2016). Iron deficiency anemia among women of reproductive age, an important public health problem: Situation analysis. *Reproductive system & sexual disorders: current research*, *5*(**3**): 1.

Ministry of Public Health & Population, Central Statistical Organization, The Pan Arab Program for Family Health (PAPFAM), ICF International. Yemen National Health and demographic survey 2013. Rockville: PAPFAM; 2015.

Mtumwa, A, Paul, E, & Vuai, S (2016). Determinants of undernutrition among women of reproductive age in Tanzania mainland. *South African journal of clinical nutrition*, *29*(**2**): 75–81.

Müller, O, & Krawinkel, M (2005). Malnutrition and health in developing countries. *Canadian medical association journal*, *173*(**3**): 279–286.

Nankinga, O, & Aguta, D (2019). Determinants of Anemia among women in Uganda: Further analysis of the Uganda demographic and health surveys. *BMC public health*, *19*(**1**): 1757.

Nguyen, PH, Sanghvi, T, Kim, SS, Tran, LM, Afsana, K, Mahmud, Z, Aktar, B, & Menon, P (2017). Factors influencing maternal nutrition practices in a large scale maternal, newborn and child health program in Bangladesh. *Plos one*, *12*(**7**): e0179873.

Owais, A, Merritt, C, Lee, C, & Bhutta, ZA (2021). Anemia among Women of Reproductive Age: An Overview of Global Burden, Trends, Determinants, and Drivers of Progress in Low- and Middle-Income Countries. *Nutrients*, *13*(**8**): 2745.

Robert, KW, Parris, TM, & Leiserowitz, AA (2005). What is sustainable development? Goals, indicators, values, and practice. *Environment: science and policy for sustainable development*, *47*(**3**): 8–21.

Salem, MEA, Mahrous, OA, El Shazly, HM, Ibrahem, RA, & Al-oshari, SH (2016). Epidemiology of iron-deficiency anemia among pregnant women in menoufia governorate, Egypt and Taiz Governorate, Yemen: Acomparative study. *Menoufia medical journal*, *29*(**4**): 1005.

Salisbury, P (2017). Bickering While Yemen Burns: Poverty, War, and Political Indifference. *Policy paper*, *2*: 35–55.

Schwarzenberg, SJ, Georgieff, MK, Daniels, S, Corkins, M, Golden, NH, Kim, JH, Lindsey, C, & Magge, SN (2018). Advocacy for improving nutrition in the first 1000 days to support childhood development and adult health. *Pediatrics*, *141*(**2**).

Singh, NS, Ataullahjan, A, Ndiaye, K, Das, JK, Wise, PH., Altare, C, Ahmed, Z, Sami, S, Akik, C, & Tappis, H (2021). Delivering health interventions to women, children, and adolescents in conflict settings: What have we learned from ten country case studies? *Lancet*.**397(10273)**:533-42

Sserwanja, Q, Mukunya, D, Habumugisha, T, Mutisya, LM, Tuke, R, & Olal, E (2020). Factors associated with undernutrition among 20 to 49 year old women in Uganda: A secondary analysis of the Uganda demographic health survey 2016. *BMC public health*, *20*(**1**), 1–10.

Sumbele, IUN, Asoba, GN, Teh, RN., Metuge, S, Anchang-Kimbi, JK, & Nkuo-Akenji, T.(2020). Burden of moderate to severe anaemia and severe stunting in children< 3 years in conflict-hit Mount Cameroon: A community based descriptive cross-sectional study. *BMC pediatrics*, *20*(**1**)**:** 1–13.

Teshale, AB, Tesema, GA, Worku, MG.,Yeshaw, Y, & Tessema, ZT (2020). Anemia and its associated factors among women of reproductive age in eastern Africa: A multilevel mixed-effects generalized linear model. *Plos one*, *15*(**9**): e0238957.

Wells, JC, Sawaya, AL, Wibaek, R, Mwangome, M, Poullas, MS., Yajnik, CS, & Demaio, A

(2020). The double burden of malnutrition: Aetiological pathways and consequences for health. *Lancet*, *395***(10217)**: 75–88.

World Health Organization. (2020). *The state of food security and nutrition in the world 2020: Transforming food systems for affordable healthy diets* (Vol. 2020). Food & Agriculture Organization.

World Health Organization. (2021). *Malnutrition in women*. https:// www.who.int/data/maternal-newborn-child-adolescent-ageing/advisory-groups/gama/gama-related-resources/nlis

Young, MF, & Ramakrishnan, U (2020). Maternal undernutrition before and during pregnancy and offspring health and development. *Annals of nutrition and metabolism*, *76***(3)**: 41–53.