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Modern Contraception and Anaemia Among Reproductive-age Women in India: Results From a Household Survey

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Objectives: Chronic anaemia is a significant health concern, particularly among women of childbearing age. Factors such as menstrual blood loss, childbirth, inadequate nutrition, closely spaced pregnancies, and recurrent gastrointestinal bleeding increase the risk of anaemia. This study investigated whether current contraceptive methods are associated with anaemia in Indian women of reproductive age.

Methods: Cross-sectional data from the fifth round of the National Family Health Survey, conducted in 2019-2021, were used for this investigation. We included only non-pregnant and non-amenorrhoeic women in our analysis, resulting in a final analytical sample of 673 094 women aged 15-49. Bivariate cross-tabulations and multivariable logistic regression were employed to analyse the data.

Results: The prevalence of anaemia was 57%, and the adjusted regression models found no significant association between the use of any contraceptive methods and women's haemoglobin status. Women using traditional contraceptive methods had 1.08 (95% confidence interval, 1.05 to 1.11) times higher odds of having anaemia. Among the modern methods, other than injectables, all other methods—such as an intrauterine device, barrier use, and sterilisation—were associated with higher odds of anaemia compared to women who used contraceptive pills.

Conclusions: This study explored the relationship between modern contraceptives and haemoglobin levels in India, revealing that injectables were associated with a notable reduction in the odds of anaemia, whereas traditional contraceptives and other modern methods exhibited positive associations with anaemia. These findings prompt policymakers to focus on anaemia reduction and safe contraceptives. More research is needed to inform decisions, given the scant literature.

Key words: Anaemia, Body mass index, Contraception, Haemoglobin, Family planning

INTRODUCTION

Women of childbearing age continue to face a disproportionate risk of developing anaemia, which is a significant public health issue. Approximately one-third of the global population has anaemia, and its impact varies across demographic, socio-cultural, and regional contexts [1]. As of 2019, the global prevalence of anaemia among women of reproductive age was about 29.9%, and among pregnant women, the prevalence was 36.5% [2]. The World Health Organization defines anaemia

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in non-pregnant women is defined by haemoglobin concentration, with levels below 120 g/L classified as anaemia. Haemoglobin concentrations below 80 g/L, between 80-109 g/L, and between 110-119 g/L are categorised as severe, moderate, and mild anaemia, respectively [3]. In 2012, the World Health Assembly set a goal to halve the prevalence of anaemia among women of childbearing age by 2025 [4].

Women of reproductive age are at higher risk of anaemia due to factors such as menstrual blood loss, childbearing, and pregnancy, which increase their risk for maternal illness and death. Additionally, inadequate nutrition, short intervals between pregnancies, and chronic gastrointestinal bleeding also contribute to the risk of anaemia. Recent literature has reported that anaemia during pregnancy can result in multiple adverse health outcomes, including preterm birth, low birth weight, miscarriage, and neonatal mortality. The risk of maternal mortality decreases by one-fourth for every 10-g/L increase in haemoglobin [5]. Twenty percent of maternal fatalities are directly attributable to anaemia, although it is a significant risk factor in nearly half of all maternal deaths.

Since iron deficiency lowers the oxygen-carrying capacity of red blood cells, anaemia in non-pregnant women leads to decreased productivity [6-10]. Although women of reproductive age are severely affected by anaemia, certain behavioural factors can reduce the risk of low haemoglobin levels, with contraception being one such factor. Several studies have documented the beneficial effect of contraception on anaemia, as it limits pregnancy and increases the intervals between pregnancies [11]. In addition to preventing pregnancy, oral contraceptives reduce the duration of menstrual cycles, resulting in lower menstrual iron losses. The risk of anaemia is also differentially modified by the type of contraceptive method used [12,13]. The use of intrauterine devices (IUDs) and hormonal methods might reduce the risk of anaemia by regulating menstrual flow [11]. However, copper IUDs can negatively impact haemoglobin status by increasing menstrual flow [14].

The nutritional status, as measured using parameters such as the body mass index (BMI), is considered a significant predictor of anaemia in reproductive-age women. Studies have shown that with an increase in BMI, the risk of anaemia decreases [15]. However, a few studies have also reported a positive association between BMI and anaemia, meaning that as BMI increases, anaemia also increases [16,17]. These contradictory findings motivated us to explore the association in the Indian context using recently released data.

The use of modern contraceptives among Indian women has increased from 51.2% in 2015-2016 to 58.5% in 2019-2020 [18]. Additionally, the prevalence of obesity in women has risen from 21% to 24% between those 2 survey periods. Despite the increasing prevalence of anaemia, obesity, and the use of modern contraceptives among women in India, no studies have explored the association between modern contraceptive use, nutritional status, and anaemia in women of reproductive age. To underscore the need for context-specific research, it is crucial to recognise that the health landscape is dynamic and influenced by several factors, particularly in a diverse country like India. Simply observing statistical increases in modern contraceptive use, obesity rates, and the prevalence of anaemia does not provide a comprehensive understanding of the underlying dynamics. Therefore, this study aimed to investigate the link between anaemia and the use of modern contraception among women of reproductive age in India, while controlling for the effect of nutritional status (i.e., BMI).

METHODS

Data Source

This study utilised cross-sectional data from the fifth iteration of the National Family Health Survey (NFHS), conducted by the Ministry of Health and Family Welfare (MoHFW) in 2019-2021. The NFHS is a large-scale, nationally representative survey covering more than 99% of India's population. It provides estimates on maternal and child health, women's empowerment, fertility, mortality, nutrition, family planning, and domestic violence. A 2-stage stratified sampling design was used to obtain representative samples from 707 districts, 28 states, and 8 union territories in India. The NFHS-5 interviewed 636 699 households, 724 115 women (15-49 years), and 101 839 men (15-54 years), with response rates of 98%, 97%, and 92%, respectively.

Since the objective of this paper was to analyse the association of modern contraceptive use with anaemia, we included only non-pregnant and non-amenorrhoeic women in our analysis. Additionally, women with missing haemoglobin status were excluded from the sample. The final analytical sample comprised 673 094 women aged 15 years to 49 years.

Outcome and Independent Variables

The primary outcome variable of the study is the anaemic status of women, determined by their haemoglobin concentration levels. Women were categorised as non-anaemic

(≥12 g/dL) or anaemic (<12 g/dL). This classification is binary, with "0" indicating non-anaemic and "1" indicating anaemic. The independent variables are the use of contraceptive methods. This includes the pattern of use (never used, used before last birth, used since last birth, and currently using), type of method (no use, traditional method, and modern methods), and current contraceptive method (pill, IUD, injections, barrier method, female sterilisation, and other). Methods such as the pill, IUDs, injections, barrier methods, sterilisation, female condoms, injectables, diaphragms, spermicidal agents (foam/jelly), and emergency contraception were considered modern contraceptive methods [18]. In contrast, methods such as periodic abstinence or rhythm method (of any kind), withdrawal, and lactational amenorrhoea were considered traditional methods [19].

Covariates

The covariates used in this study were selected based on an extensive review of existing literature [20,21]. The individual socio-demographic factors considered included women's age (less than 25, 25-35, and >35), educational attainment (no education, primary, secondary, and higher), marital status (never married and ever married), and the number of children (no, 1, 2, and 3 or more children). Household factors included region (northern, central, eastern, north-eastern, western, and southern), residence (urban and rural), wealth status (poorest, poorer, middle, richer, and richest), and BMI (underweight, normal, overweight, and obese). BMI is a significant predictor of anaemia; therefore, we adjusted for BMI status in our statistical models when analysing the association between contraceptive method usage and anaemia status.

Statistical Analysis

Using a bivariate percentage distribution based on key predictor and confounding variables, we determined the prevalence of anaemia among women. Differences were assessed using Pearson's chi-square statistic. The association between anaemia and the use of contemporary contraceptives and BMI was examined using a series of binary logistic regression models. The adjusted models (models 1, 2, and 3) controlled for age, wealth, marital status, education, number of living children, residence, region, and BMI. All statistical estimations were performed using Stata version 16 (StataCorp., College Station, TX, USA), with calculations based on appropriate sampling weights provided in the Demographic Health Survey (DHS) guidelines.

Ethics Statement

This study utilised the NFHS-5 India report [22], publicly available dataset with no identifiable information on the survey participants. These datasets can be downloaded from the DHSs website. Ethical approval for the original study was obtained from the International Institute for Population Sciences Ethical Review Board. Additionally, the International Coaching Federation (ICF) International Review Board looked over the survey and gave ethical approval. The respondents provided signed consent after being fully informed about the survey's purpose and procedures.

RESULTS

In Table 1, we see the percentage distribution of women with anaemia aged 15-49 by demographic characteristics for the years 2019-2021. Each age group—15-24, 25-35, and >35—had an almost equal distribution of women with anaemia. Two-thirds of the women with anaemia lived in rural areas. Almost half of the women with anaemia had completed secondary-level education. There was no significant association between marital status and anaemia; however, anaemia was more prevalent among married women (73.2%) than among unmarried women. Anemia had a negative correlation with women's economic status. Regarding biological factors, 59.6% of women with anaemia had a normal BMI, and only 4.9% were obese. Furthermore, anaemia was linked to regional factors: the lowest rate of women with anaemia was found in western India (10.7%), while the highest rate was in central India (21.9%).

Table 2 presents the anaemia status, fertility, and contraceptive use among women of reproductive age. A total of 32.5% of women with anaemia had no children, and only 13.1% had 1 living child. Less than 0.5% of women with anaemia had 3 or more children in the past 5 years, while 78.5% had not given birth in the last 5 years. Additionally, there was a significant difference in the anaemia status of women according to whether they had given birth in the past year. Specifically, 95.4% of women with anaemia had not given birth in the last year. Regarding contraceptive use, half of the women with anaemia were currently using some form of contraception, followed by 39.7% who had never used any contraceptive methods. Only 8.6% of women with anaemia used traditional methods of contraception, while 42.6% used modern methods. Furthermore, 66.5% of women with anaemia preferred female sterilisation over other contraception methods.

Table 1. Association between anaemia and the background characteristics of women of reproductive age in India, 2019-2021

Characteristics	Non-anaemic	Anaemic	*p*-value
Age (y)			0.01
<25	86 567 (31.1)	118 424 (33.0)	
25-35	93 150 (33.4)	117 106 (32.7)	
>35	98 971 (35.5)	122 885 (34.3)	
Place of residence			0.01
Urban	74 893 (26.9)	82 625 (23.0)	
Rural	203 795 (73.1)	275 790 (76.9)	
Educational level			0.01
No education	61 195 (22.0)	88 117 (24.6)	
Primary	32 145 (11.5)	43 069 (12.0)	
Secondary	142 412 (51.1)	182 603 (51.0)	
Higher	42 936 (15.4)	44 626 (12.4)	
Marital status			0.91
Never married	74 678 (26.8)	95 998 (26.8)	
Ever married	204 010 (73.2)	262 417 (73.2)	
Wealth index			0.01
Poorest	49 104 (17.6)	79 935 (22.3)	
Poorer	60 375 (21.7)	81 333 (22.7)	
Middle	59 895 (21.5)	75 186 (21.0)	
Richer	57 385 (20.6)	66 835 (18.6)	
Richest	51 929 (18.6)	55 126 (15.4)	
Body mass index			0.01
Underweight	42 831 (15.4)	72 504 (20.3)	
Normal	165 965 (59.6)	213 464 (59.6)	
Overweight	52 366 (18.8)	54 251 (15.2)	
Obesity	17 186 (6.2)	17 680 (4.9)	
Regions			0.01
Northern	55 540 (19.9)	74 603 (20.8)	
Central	67 807 (24.3)	78 409 (21.9)	
Eastern	35 060 (12.6)	68 240 (19.0)	
North-eastern	45 223 (16.2)	45 926 (12.8)	
Western	26 527 (9.5)	38 532 (10.7)	
Southern	48 531 (17.4)	52 705 (14.7)	

Values are presented as number (%).

Table 2. Associations between anaemia, birth status, and contraceptive usage among Indian women of reproductive age, 2019-2021

Variables	Non-anaemic	Anaemic	*p*-value
No. of living children			0.48
0	91 186 (32.7)	116 669 (32.5)	
1	36 499 (13.1)	46 864 (13.1)	
2	75 581 (27.1)	97 492 (27.2)	
≥3	75 422 (27.1)	97 390 (27.2)	
Births in the last 5 y			0.01
0	223 969 (80.4)	281 390 (78.5)	
1	41 464 (14.9)	56 601 (15.8)	
2	12 124 (4.3)	18 464 (5.1)	
≥3	1131 (0.4)	1960 (0.5)	
Births in the past year			0.01
0	267 704 (96.1)	341 797 (95.4)	
≥1	10 984 (3.9)	16 618 (4.6)	
Pattern of contraceptive use			0.01
Never used	109 201 (39.2)	142 444 (39.7)	
Used before last birth	15 770 (5.7)	19 673 (5.5)	
Used since last birth	10 754 (3.9)	12 694 (3.5)	
Currently using	142 958 (51.3)	183 600 (51.2)	
Current use by method			0.01
No use	135 725 (48.7)	174 811 (48.8)	
Traditional	22 257 (8.09)	30 888 (8.6)	
Modern	120 701 (43.3)	152 712 (42.6)	
Current contraceptive method			0.01
Pill	12 512 (10.5)	15 793 (10.5)	
Intrauterine device	5822 (4.9)	6833 (4.5)	
Injections	1494 (1.2)	1655 (1.1)	
Barrier method	20 010 (16.7)	24 580 (16.3)	
Female sterilisation	78 535 (65.7)	100 488 (66.5)	
Other[1]	1161 (1.0)	1660 (1.1)	
Total observations (n)	637 094		

Values are presented as number (%).
[1]Other includes male sterilisation and emergency contraception.

Figure 1 illustrates the relationship between contraceptive use and haemoglobin status in women aged 15-49. The study found no definitive association between haemoglobin status and current contraceptive use. However, one-way analysis of variance revealed that women using traditional contraceptive methods had lower haemoglobin levels. Haemoglobin levels were significantly associated with contraceptive use patterns only for women who had been using contraception since their last birth. These women were 9% less likely to have anaemia (crude odds ratio [cOR], 0.91; 95% CI, 0.85 to 0.95) compared to those who did not use contraception, and this likelihood decreased to 12% (adjusted odds ratio [aOR], 0.89; 95% CI, 0.85 to 0.93) after adjusting for confounding variables (Supplemental Material 1). Women using injections (cOR, 0.74; 95% CI, 0.66 to 0.82), barrier methods (cOR, 0.86; 95% CI, 0.81 to 0.91), and female sterilisation (cOR, 0.90; 95% CI, 0.86 to 0.94) were less likely to have anaemia than those using pills. Conversely, haemoglobin levels are not significantly affected by IUD use. However, after adjusting for confounding variables, the association with some contraceptives, such as sterilisation, showed significant changes.

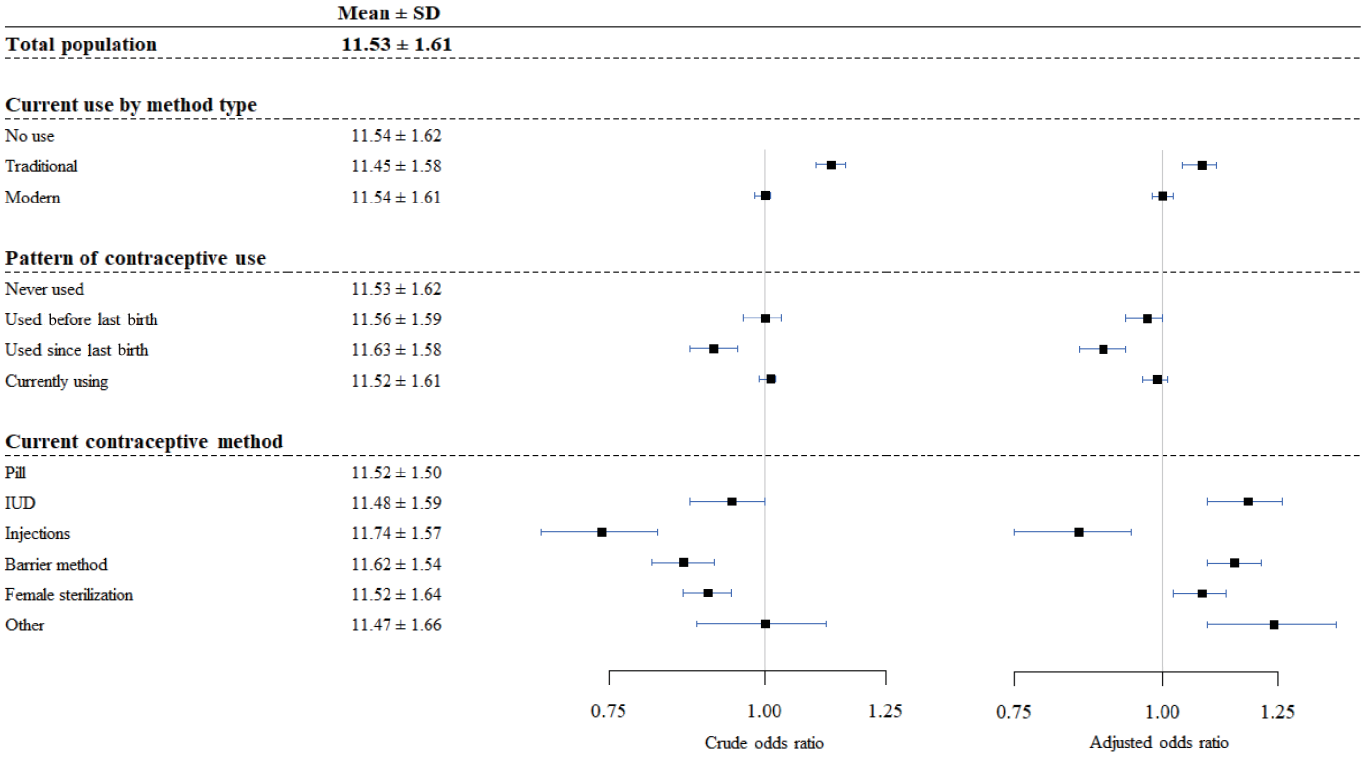

Figure 1. Association between contraceptive usage and anaemia among Indian women of reproductive age, 2019-2021. SD, standard deviation; IUD, intrauterine device.

DISCUSSION

This study utilised large-scale DHS data to investigate the impact of modern contraceptive methods on haemoglobin levels, an indicator of anaemia. The findings indicated that certain modern contraceptive methods, such as injections and female sterilisation, have beneficial effects on anaemia among women of childbearing age in India. However, this benefit was not observed among current users of contraceptive methods. Additionally, our results demonstrated a consistent effect of BMI on haemoglobin levels. The validity of these results is examined below, considering the study's strengths and limitations, as well as comparisons to previous research.

This study demonstrated that, compared to oral contraceptive pills (OCP), the use of injections is associated with a significant 26% reduction in the odds of anaemia. Existing studies also observed a reduction in anaemia levels among women who use injectables [23,24]. The prolonged use of depot medroxyprogesterone acetate, a commonly used injectable contraceptive, tends to increase episodes of amenorrhoea, which may elevate women's haemoglobin levels and prevent iron-deficiency anaemia [24].

Our research found a link between barrier methods and anaemia. However, other studies have not reported this [23,25]. Although this study identified that 66.5% of women with anaemia prefer female sterilisation over other contraceptive methods, we found that women who had undergone sterilisation had a 10% lower risk of anaemia than their peers. This aligns with a study conducted in India, which showed that sterilisation significantly reduced the risk of anaemia [26]. However, it contrasts with previous research that found other contraception methods, excluding sterilisation, were strongly associated with a lower risk of anaemia [20,23,27]. This shift in India is likely due to sterilised women having fewer pregnancies [26]. Sterilisation significantly increases the incidence of numerous reproductive symptoms while decreasing the risk of anaemia, most likely due to the avoidance of pregnancy. However, this association changes when the effect of other covariates is adjusted. Hence, it is very difficult to generalise the association between sterilisation and anaemia. There is still a need for intensive study to test this association due to the scant availability of literature in this domain.

Our study also observed a significant positive association between IUD use and anaemia. Existing research has shown a

complicated interaction between IUDs and anaemia. Hormonal IUDs may induce amenorrhoea and light bleeding, thus reducing the risk of anaemia [28-30]. Conversely, copper IUDs may increase the risk of anaemia by causing heavy bleeding [31,32]. Accordingly, women who have been using contraceptives since their last birth are less likely to have anaemia. Research based on DHS data from 12 low- and middle-income countries (LMICs) found that OCP users had a lower risk of anaemia, which dropped from 32% for at least 6 months to 44% for at least 2 years of usage [33]. A prospective study found that after 12 months of use, haemoglobin levels increased significantly among oral contraceptive and injectable users, but not among IUD users [11]. Recent studies have shed light on the relationship between contraceptive use and anaemia among women, particularly in LMICs. A study by Misunas et al. [34] analysed data from 51 LMICs and revealed that adolescent girls and young women using hormonal contraceptives had lower odds of having anaemia than non-users. This protective effect was observed across different severities of anaemia and was consistent for both short-term and long-term users of hormonal methods. Similarly, Aboagye et al. [35] examined data from 16 countries in sub-Saharan Africa and reported that hormonal contraceptive users were less likely to have anaemia compared to non-users. Gebremedhin and Asefa [20] also found that modern contraceptive use was linked to a 25% reduction in the odds of anaemia among women in sub-Saharan Africa. These findings suggest that hormonal contraceptives may offer non-contraceptive health benefits, including a reduced risk of anaemia, which is crucial for informing public health interventions in regions with high anaemia prevalence among women of reproductive age. The observed increase in haemoglobin could be due to a considerable reduction in cyclic blood loss, contributing to anaemia reduction [36].

Interestingly, there was no significant association in this study between the use of any contraceptive methods and haemoglobin status, even after controlling for other covariates. Despite 50% of women with anaemia using contraception, this research revealed no statistically significant link between contraception use and anaemia. This finding necessitates further investigation. However, our study found that respondents using traditional contraceptive methods had a higher risk of anaemia than those not using any contraception or using modern contraception.

The study's strength lies in its large, nationally representative sample from India. However, several limitations should be considered in future research. First, bias from residual or unobserved confounders cannot be excluded due to the observational design of the study. Additionally, the findings may be influenced by selection bias, as there is no certainty that the attributes of contraceptive users were the same at baseline. Second, the study relies on data from the NFHS-5 survey, which did not provide information about the specific brands of contraceptives used. Thirdly, the cross-sectional design of the data does not allow for the examination of causal associations with the identified determinants. Despite these limitations, the study may assist policymakers in addressing anaemia as a public health issue and in strengthening family planning services to reduce the burden of anaemia in India.

In conclusion, this study explores the intricate relationship between modern contraceptive methods and haemoglobin levels, providing a comprehensive analysis of DHS data in India. The results highlight the positive association of certain contraceptive methods, such as injections, barriers, and female sterilisation, in reducing the risk of anaemia among women of childbearing age. Notably, injectables demonstrate a substantial 26% reduction in the odds of anaemia, aligning with existing studies that show a similar trend. Female sterilisation, despite its prevalence among women with anaemia, exhibits a 10% lower risk, shedding light on the complex dynamics between contraception and anaemia. The study underscores the role of BMI, revealing a significant association with anaemia, with normal and underweight women facing a higher likelihood of having this condition. These findings provide valuable insights for policymakers, emphasising the need to address anaemia as a public health concern and improve family planning services in India.

NOTES

Data Availability

The dataset used in this article is available only upon request on the DHS website at https://dhsprogram.com/what-wedo/survey-Types/dHs.cfm.

Supplemental Materials

Supplemental material is available at https://doi.org/10.3961/jpmph.23.504.

Conflict of Interest

The authors have no conflicts of interest associated with the material presented in this paper.

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Author Contributions

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REFERENCES

1. Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N, Lozano R, et al. A systematic analysis of global anemia burden from 1990 to 2010. Blood 2014;123(5):615-624. https://doi.org/10.1182/blood-2013-06-508325
2. World Health Organization. WHO global anaemia estimates, 2021 edition: global anaemia estimates in women of reproductive age, by pregnancy status, and in children aged 6-59 months [cited 2023 Oct 21]. Available from: https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children
3. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity; 2011 [cited 2023 Oct 21]. Available from: https://www.who.int/publications/i/item/WHO-NMH-NHD-MNM-11.1
4. World Health Organization. Global nutrition targets 2025: anaemia policy brief; 2014 [cited 2023 Oct 21]. Available from: https://www.who.int/publications/i/item/WHO-NMH-NHD-14.4
5. Ezzati M, Lopez AD, Rodgers AA, Murray CJ. Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors; 2004 [cited 2023 Oct 21]. Available from: https://iris.who.int/handle/10665/42770
6. Gilgen DD, Mascie-Taylor CG, Rosetta LL. Intestinal helminth infections, anaemia and labour productivity of female tea pluckers in Bangladesh. Trop Med Int Health 2001;6(6):449-457. https://doi.org/10.1046/j.1365-3156.2001.00729.x
7. Haas JD, Brownlie T 4th. Iron deficiency and reduced work capacity: a critical review of the research to determine a causal relationship. J Nutr 2001;131(2S-2):676S-690S. https://doi.org/10.1093/jn/131.2.676S
8. Scholz BD, Gross R, Schultink W, Sastroamidjojo S. Anaemia is associated with reduced productivity of women workers even in less-physically-strenuous tasks. Br J Nutr 1997;77(1):47-57. https://doi.org/10.1017/S0007114500002877
9. Selvaratnam RR, de Silva LD, Pathmeswaran A, de Silva NR. Nutritional status and productivity of Sri Lankan tea pluckers. Ceylon Med J 2003;48(4):114-118. https://doi.org/10.4038/cmj.v48i4.3326
10. Untoro J, Gross R, Schultink W, Sediaoetama D. The association between BMI and haemoglobin and work productivity among Indonesian female factory workers. Eur J Clin Nutr 1998;52(2):131-135. https://doi.org/10.1038/sj.ejcn.1600527
11. Effects of contraceptives on hemoglobin and ferritin. Task Force for Epidemiological Research on Reproductive Health, United Nations Development Programme/United Nations Population Fund/World Health Organization/World Bank Special Programme of Research, Development and Research Training in Human Reproduction, World Health Organization, Geneva, Switzerland. Contraception 1998;58(5):262-273.
12. Stubblefield PG. Menstrual impact of contraception. Am J Obstet Gynecol 1994;170(5 Pt 2):1513-1522. https://doi.org/10.1016/S0002-9378(94)05013-1
13. Lethaby A, Wise MR, Weterings MA, Bofill Rodriguez M, Brown J. Combined hormonal contraceptives for heavy menstrual bleeding. Cochrane Database Syst Rev 2019;2(2):CD000154. https://doi.org/10.1002/14651858.CD000154.pub3
14. Hubacher D, Chen PL, Park S. Side effects from the copper IUD: do they decrease over time? Contraception 2009;79(5):356-362. https://doi.org/10.1016/j.contraception.2008.11.012
15. Qin Y, Melse-Boonstra A, Pan X, Yuan B, Dai Y, Zhao J, et al. Anemia in relation to body mass index and waist circumference among Chinese women. Nutr J 2013;12:10. https://doi.org/10.1186/1475-2891-12-10
16. Alshwaiyat NM, Ahmad A, Wan Hassan WM, Al-Jamal HA. Association between obesity and iron deficiency (review). Exp

Ther Med 2021;22(5):1268. https://doi.org/10.3892/etm.2021.10703

17. Aigner E, Feldman A, Datz C. Obesity as an emerging risk factor for iron deficiency. Nutrients 2014;6(9):3587-3600. https://doi.org/10.3390/nu6093587
18. Ewerling F, McDougal L, Raj A, Ferreira LZ, Blumenberg C, Parmar D, et al. Modern contraceptive use among women in need of family planning in India: an analysis of the inequalities related to the mix of methods used. Reprod Health 2021;18(1):173. https://doi.org/10.1186/s12978-021-01220-w
19. Ram F, Shekhar C, Chowdhury B. Use of traditional contraceptive methods in India & its socio-demographic determinants. Indian J Med Res 2014;140(Suppl 1):S17-S28.
20. Gebremedhin S, Asefa A. Association between type of contraceptive use and haemoglobin status among women of reproductive age in 24 sub-Saharan Africa countries. BMJ Sex Reprod Health 2018:bmjsrh-2018-200178. https://doi.org/10.1136/bmjsrh-2018-200178
21. Haile ZT, Teweldeberhan AK, Chertok IR. Association between oral contraceptive use and markers of iron deficiency in a cross-sectional study of Tanzanian women. Int J Gynaecol Obstet 2016;132(1):50-54. https://doi.org/10.1016/j.ijgo.2015.06.040
22. International Institute for Population Sciences (IIPS) and ICF. National Family Health Survey (NFHS-5), 2019-21, India. Mumbai: IIPS; 2021.
23. Teshome AA, Berra WG, Huryi AF. Modern contraceptive methods predict hemoglobin levels among women of childbearing age from DHS 2016. Open Access J Contracept 2022;13:1-8. https://doi.org/10.2147/OAJC.S329045
24. Kaunitz AM. Long-acting injectable contraception with depot medroxyprogesterone acetate. Am J Obstet Gynecol 1994;170(5 Pt 2):1543-1549. https://doi.org/10.1016/S0002-9378(94)05017-9
25. Serjeant GR. Sickle haemoglobin and pregnancy. Br Med J (Clin Res Ed) 1983;287(6393):628-630. https://doi.org/10.1136/bmj.287.6393.628
26. de La Rupelle M, Dumas C. Health consequences of sterilizations. WIDER Working Paper 2017/125. Helsinki: United Nations University World Institute for Development Economics Research; 2017. https://doi.org/10.35188/UNU-WIDER/2017/351-6
27. Rahman MA, Rahman MS, Aziz Rahman M, Szymlek-Gay EA, Uddin R, Islam SM. Prevalence of and factors associated with anaemia in women of reproductive age in Bangladesh, Maldives and Nepal: evidence from nationally-representative survey data. PLoS One 2021;16(1):e0245335. https://doi.org/10.1371/journal.pone.0245335
28. Ursin G, Ross RK, Sullivan-Halley J, Hanisch R, Henderson B, Bernstein L. Use of oral contraceptives and risk of breast cancer in young women. Breast Cancer Res Treat 1998;50(2):175-184. https://doi.org/10.1023/A:1006037823178
29. U.S. Food and Drug Administration. Mirena® (levonorgestrel-releasing intrauterine system) [cited 2023 Oct 21]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2008/021225s019lbl.pdf
30. World Health Organization. Family planning: a global handbook for providers: evidence-based guidance developed through worldwide collaboration; 2018 [cited 2023 Oct 21]. Available from: https://iris.who.int/handle/10665/260156
31. Curtis KM, Tepper NK, Jatlaoui TC, Berry-Bibee E, Horton LG, Zapata LB, et al. U.S. medical eligibility criteria for contraceptive use, 2016. MMWR Recomm Rep 2016;65(3):1-103. https://doi.org/10.15585/mmwr.rr6503a1
32. Hakizimana D, Nisingizwe MP, Logan J, Wong R. 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 2019;19(1):1662. https://doi.org/10.1186/s12889-019-8019-z
33. Bellizzi S, Ali MM. Effect of oral contraception on anemia in 12 low- and middle-income countries. Contraception 2018;97(3):236-242. https://doi.org/10.1016/j.contraception.2017.11.001
34. Misunas C, Hindin MJ, Phillips-Howard PA, Sommer M. The association between hormonal contraceptive use and anemia among adolescent girls and young women: an analysis of data from 51 low- and middle-income countries. J Adolesc Health 2024;74(3):563-572. https://doi.org/10.1016/j.jadohealth.2023.09.013
35. Aboagye RG, Okyere J, Seidu AA, Ahinkorah BO, Budu E, Yaya S. Relationship between history of hormonal contraceptive use and anaemia status among women in sub-Saharan Africa: a large population-based study. PLoS One 2023;18(6):e0286392. https://doi.org/10.1371/journal.pone.0286392
36. Bahamondes L, Valeria Bahamondes M, Shulman LP. Non-contraceptive benefits of hormonal and intrauterine reversible contraceptive methods. Hum Reprod Update 2015;21(5):640-651. https://doi.org/10.1093/humupd/dmv023