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[ORIGINAL RESEARCH ARTICLE]

## Prevalence and Determinants of Anaemia among Women aged 15-49 in Nepal: A Trend Analysis from Nepal Demographic and Health Surveys from 2006 to 2016

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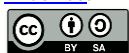
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### Abstract

Anaemia remains one of the major health problems throughout the world and is most common in underdeveloped or developing countries like Nepal. Most of the studies have presented and analysed the situation on a particular time basis that could be by chance. The paper intended to assess the trends of anaemia prevalence amongst reproductive-age women throughout the decade using nationally representative data. The study used the data from recent three Nepal Demographic and Health Surveys (NDHS) 2006, 2011, and 2016. More than one third (36%, 35%, and 41% in NDHS 2006/2011/2016 respectively) of women of reproductive age were anaemic. Data showed inconsistent trends of anaemia prevalence among the surveys years. The situation of anaemia has not been improved. It was even worse in the latest NDHS 2016. Policymakers should reconsider, re-evaluate, and revise the intervention programmes applied to reduce anaemia.

**Keywords:** Haemoglobin level; nutritional status; prevalence of anaemia; status of women; women of reproductive age

## Prevalence and Determinants of Anaemia among Women aged 15-49 in Nepal

### Introduction

Anaemia is one of the major public health problems globally and the second leading cause of disability among pregnant women (World Health Organization, 2016). Poor maternal health is also associated with low birth outcomes including maternal morbidity and mortality (Okawa et al., 2019). Anaemia is defined as less than 12.0g/dl for non-pregnant and 11.0g/dl haemoglobin level for pregnant women (Ministry of Health et al., 2017) however definition varies in terms of severity, sex, living condition, and status of women including age (Ford et al., 2020; Miles et al., 2019). Lower concentration of the haemoglobin in the blood affects the circulation of oxygen throughout the body including the brain which limits the maternal and birth outcomes, leads to high morbidity and mortality among mothers and neonates, reduces the working ability and productivity including learning capacity (Harding et al., 2017). Anaemia depresses the immune system and increases the chances of morbidity both in mothers as well as neonates (Abusharib, 2019). It further influences cognitive and intellectual development, socio-economic growth, gross domestic products, and ultimately delay achieving developmental targets including Sustainable developing Development Goals [SDG](Department of Health Services, 2019).

Anaemia prevalence is common around the globe but most prevalent in developing countries. Prevalence of anaemia was recorded higher in the South Asian and African continent than in other countries throughout the world (Ajepe et al., 2020). Global estimation indicated that three out of ten (29%) of non-pregnant women and more than one third (38%) were anaemic (Herzog et al., 2019; Kay et al., 2019). It is estimated that nearly half a billion of women from reproductive age are affected by anaemia (Wemakor, 2019). Nearly four out of ten (38.5%) women of reproductive age [WRA] were anaemic in Nepal. SDG number two has a specific target of reducing anaemia prevalence among WRA by less than one per cent by 2030 (National Planning Commission, 2015).

There are numerous and complex factors that can cause anaemia. Low intake of iron-rich foods together with poor bioavailability, chronic infection, malaria and intestinal helminths, and higher requirement related to menstruation lead to iron deficiency (Ampiah et al., 2019; Jammok et al., 2020). Educational status, age, access to healthcare, socio-economic status, frequency of pregnancy, availability and consumption of nutrients/diet, and place of residence are identified as associated factors for being anaemic (Sharma et al., 2020). Anaemia affects individuals in the different periods of the life cycle but is most common in lactating mothers, pregnant women and adolescent girls as well (Ayensu et al., 2020; Williams et al., 2020). Nearly one-fifth of the total maternal deaths are resulted directly due to anaemia. Moreover, another 20 per cent of deaths are caused due to anaemia related causes such as sepsis, haemorrhage or other indirect causes of anaemia (Neogi et al., 2019). Besides these, anaemia is responsible for serious health consequences during and after pregnancy not only for mothers but for babies too (Grover et al., 2020).

Various programmes are being implemented to reduce the prevalence of anaemia in Nepal. Deworming programme, outreach clinic at the community level, iron supply free of cost are some examples. Despite these efforts by the government, the proportion of anaemic women have not decreased as per the anticipation throughout the decade in Nepal (Ford et al., 2020). Many studies have been conducted in the field of nutritional status of women including anaemia but we could not find any study focusing on trend analysis of anaemia among WRA (15 to 49 years). Therefore, the study aimed to assess the trend of anaemia prevalence among WRA (15-49 years).

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### Methods

#### *Data sources and characters*

The study uses secondary data from Nepal Demographic and Health Survey [NDHS] conducted in 2006, 2011, and 2016. The NDHS was the national representative periodic survey conducted every five years. The main objectives of the NDHSs were to provide, update to date, reliable, and accurate information about demographic and health-related data which would be essential for policymaking, programme planning, formulation of monitoring and evaluation tools for improving maternal and child healthcare services in Nepal (Gautam et al., 2019; Ministry of Health et al., 2017).

The sample was taken from two stages. First, it involved selecting cluster based on probability proportional to size from the national sample frame on the basis of the latest national census and households survey 2001 for NDHS 2006 and NDHS 2011, and of national census 2011 for NDHS 2016 (Ministry of Health et al., 2017; Ministry of Health and Population (MOHP) [Nepal] et al., 2007, 2012). Second, systematic sampling was followed from the list of households as created in NDHS clusters. The sample was taken in two stages for NDHS 2006 and NDHS 2011 (Ministry of Health and Population (MOHP) [Nepal] et al., 2007, 2012) but NDHS 2016 used two stages in *Gaupalika* (rural areas) and three stages in *Nagarpalika* (urban areas) (Ministry of Health et al., 2017). Some changes were made in NDHS 2016 such as provinces replacing developmental regions, rural-urban setting, municipal boundaries due to how the political map has been changed.

#### *Measures*

Non-pregnant women who had less than 12.0 g/dl (gram per decilitre) haemoglobin level and pregnant women who had less than 11.0 g/dl haemoglobin level were considered anaemic and analysed accordingly. For non-pregnant women, 10.0 to 11.9, 7.0 to 9.9, and less than 7.0 g/dl haemoglobin levels were classified as 'mild', 'moderate', and 'severe' anaemia respectively. Similarly, haemoglobin levels of 10.0 to 10.9, 7.0 to 9.9, and less than 7.0 g/dl were categorized as 'mild', 'moderate', and 'severe' anaemia respectively for pregnant women (Ministry of Health et al., 2017). A survey questionnaire was used for collecting the household's and individual's information. Haemoglobin was analysed using a HemoCue analyser which was a portable battery-operated device. Some variables like age, age at marriage, number of children, literacy status, religion, dwelling status/setting, employment status, wealth category, autonomy on decision making, smoking habit, and media exposure were analysed as per the study objective and the literature available for interpretation. The age of women was further classified into three categories as less than 25 years, 25 to 34 years, and more than 35 years.

There were three issues assessed for women's autonomy in decision making mostly in household: first, autonomy on their own healthcare; second, autonomy on household major goods/asset purchases; and third, autonomy on visiting their relatives or family. Women's autonomy on all these three issues was considered as 'high autonomy', autonomy on any two of these was considered as 'moderate autonomy' and none of these as 'no autonomy'. In the case of wealth status, wealth quintiles I and II have been merged as 'poor' quintiles III as 'middle' and quintiles IV and V as 'rich' categories. Similarly, exposure to mass/public media at least once a week was considered as 'high exposure' less than once a week as 'low exposure' and no access to mass media as 'no exposure' for newspaper, radio, and TV.

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### *Statistical analysis*

For the analysis of the data, IBM SPSS Statistics 22 was used. Prevalence of anaemia is defined as the per cent of women who had anaemia (less than 12.0g/dl and 11.0g/dl haemoglobin levels for non-pregnant and pregnant women respectively). Descriptive (frequencies and percentage), bivariate (cross-section with chi-square test), and multivariate analysis (binary logistic regression) were performed to present the data and results. We performed univariate analysis and bivariate analysis separately but for multivariate analysis, all data have been merged and analysed accordingly. The acceptable margin of error was set at five per cent and confidence intervals were set at 95 per cent with *p*-values which considered less than 0.05 as significant for differences.

### *Ethical consideration*

Nepal Health Research Council [NHRC], Kathmandu, and IFC International Review Board, Maryland reviewed and approved the survey protocol (Ministry of Health et al., 2017; Ministry of Health and Population (MOHP) [Nepal] et al., 2007, 2012). Respondents were informed about study objectives and requested for voluntary participation. Written consent was taken prior to the interview as well as haemoglobin testing and in the case of minor [age between 15 to 17 years], the consent was taken from parents or the adults who were responsible to take care of them. Data and samples were taken from the individuals who agreed to participate. Women were referred to concerned health facilities for follow-up care if less than 9.0g/dl and 7.0g/dl haemoglobin levels were observed for pregnant and non-pregnant women respectively. The survey followed the ethical guidelines for health-related research made by NHRC (Nepal Health Research Council, 2011).

## **Results**

### *Socio-demographic characteristics of WRA*

The study included 10647, 6088, and 6414 sample from NDHS 2006, NDHS 2011, and NDHS 2016 respectively. Therefore, a total of 23149 data were analysed to find out the determinants of anaemia in women. There was a higher number of samples in NDHS 2006 compared to other NDHSs. The educational status of women has been gradually increasing towards secondary and higher education while the proportion of illiterate women was gradually decreasing [Table 1]. In the same way, the urban population was also in increasing trend consequently rural population in decreasing trend. Interestingly, proportion of currently working women was in decreasing trend despite different governmental efforts to empower women including various reservation facilities in the formal sectors. The proportion of women with high autonomy increased in NDHS 2011 compared to 2006 but declined in 2016. Exposure to the radio at least once a week was decreasing whereas exposure to TV at least once a week was in increasing trend. Data also showed that women are interested to watch TV compared to listening to the radio during the last decade.

**Table 1**

*General characteristics (%) of participants (WRA)*

Variables	Category	NDHS 2006	NDHS 2011	NDHS 2016	Pooled
Anaemia level	Severe	0.4	0.3	0.3	0.4
	Moderate	6.4	5.7	7.0	6.4
	Mild	29.4	28.9	33.5	30.4
	Not anaemic	63.8	65.0	59.2	62.8

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Age group	< 25 years	41.1	39.8	37.7	39.4
	25-34	28.8	30.3	30.6	30.0
	≥ 35 years	30.1	29.9	31.7	30.6
Age at marriage, cohabitation	Less than 15	4.0	8.1	11.1	8.0
	15-17	11.9	28.5	43.4	28.8
	18-20	7.9	18.8	28.8	19.1
	21 and above	76.2	44.6	16.7	44.2
Number of children borne	None	27.6	29.8	28.6	28.7
	One	12.6	13.4	16.1	14.2
	Two	17.1	19.7	21.7	19.6
	Three	14.4	15.2	14.9	14.9
	Four	10.3	9.7	8.8	9.6
	Five or more	18.0	12.1	9.8	13.0
Education	No education	53.1	39.8	33.3	41.4
	Primary	17.6	17.4	16.7	17.2
	Secondary or above	29.3	42.8	50.0	41.3
Religion	Hindu	85.1	84.2	85.8	85.1
	Buddhist	8.6	8.8	5.1	7.4
	Islam	3.6	3.7	5.0	4.1
	Kirat/Christian	2.6	3.3	4.1	3.4
Place of residence	Urban	15.6	14.4	62.8	31.9
	Rural	84.4	85.6	37.2	68.1
Currently working	No	28.9	40.0	43.1	37.8
	Yes	71.1	60.0	56.9	62.2
Wealth index	Poor	37.4	35.6	36.6	36.5
	Middle	20.5	20.5	20.2	20.4
	Rich	42.1	43.9	43.3	43.1
Women's autonomy in household decision	No autonomy	45.1	42.0	44.3	43.8
	Moderate autonomy	22.9	23.5	26.7	24.5
	High autonomy	32.0	34.5	28.9	31.8
Smoking	No	80.4	86.7	91.6	86.6
	Yes	19.6	13.3	8.4	13.4
Exposure to newspaper	No exposure	68.5	65.1	69.6	67.7
	Low exposure	21.2	22.3	21.7	21.8
	High exposure	10.3	12.6	8.7	10.5
Exposure to radio	No exposure	10.4	18.8	43.2	24.9
	Low exposure	29.1	37.0	29.1	31.9
	High exposure	60.5	44.2	27.7	43.2
Exposure to TV	No exposure	28.4	25.5	28.8	27.5
	Low exposure	33.5	27.1	20.9	26.8
	High exposure	38.1	47.4	50.3	45.7
<b>Total</b>	<b>Number (%)</b>	<b>10647(100)</b>	<b>6088(100)</b>	<b>6414(100)</b>	<b>23149(100)</b>

***Prevalence of anaemia among WRA***

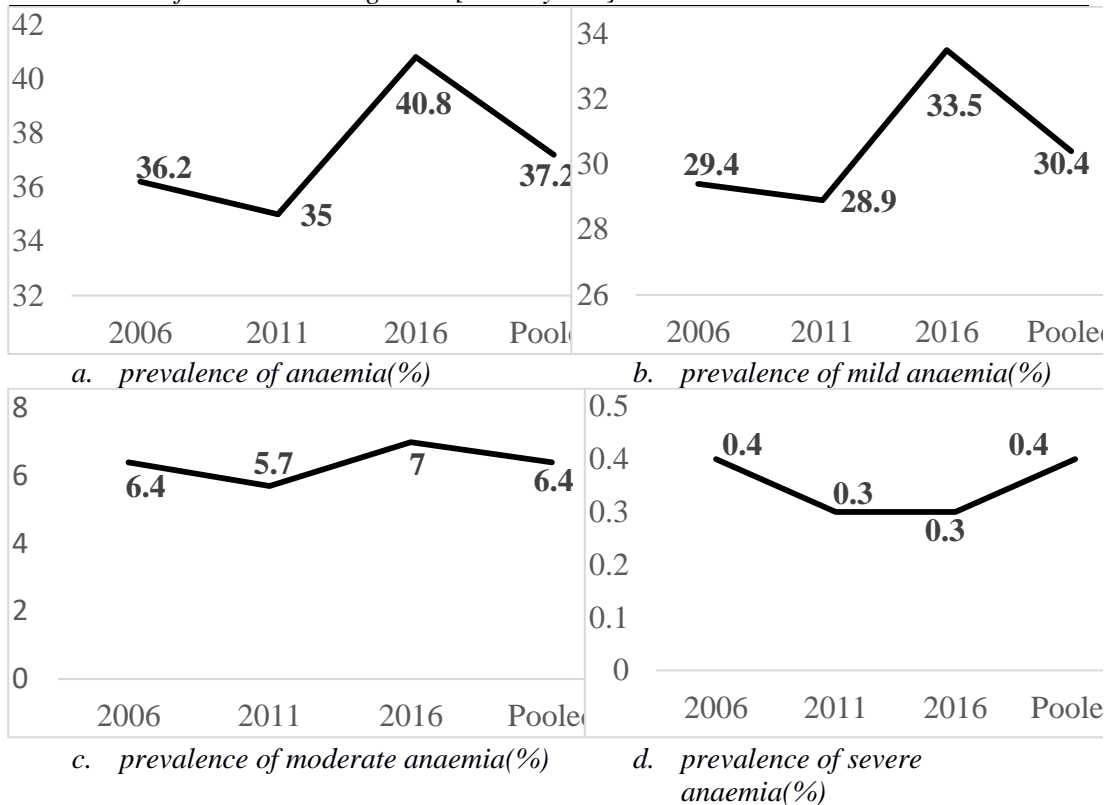
During the decade of 2006 to 2016, there was a minor change in the proportion of women having severe anaemia from 0.4 to 0.3 per cent. However, the proportion of

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women having moderate anaemia was in increasing trend i.e. seven per cent in 2016 compared to 2006 (6.4%). Similarly, the rate of mild anaemia was also increasing i.e.33.5 in 2016 from 29.4 per cent in 2006 [Figure 1]. Surprisingly, despite various efforts by the government and other sectors to control anaemia, 41 per cent of the women had some kind of anaemia in the survey of 2016 which was a five per cent increment over the period of 10 years.

**Figure 1**

*Prevalence of anaemia among WRA [15-49 years]*



### **Association of background characteristics of women and prevalence of anaemia**

Despite several programmes which have been launched to promote women's health status, it is depressing to note that the prevalence of anaemia, remained static or even worse throughout the decade. The NDHS 2016 recorded 41 per cent anaemic women, compared to 36 per cent in NDHS 2006. The proportion of anaemic women was in increasing trend in all age groups of the women during the decade of 2006 to 2016. Prevalence of anaemia had a significant association with age group and age at marriage in the years 2006 and 2016 [Table 2]. Interestingly, women having a primary level of education had a low level of anaemia prevalence compared to women having no education or higher than primary education. In regards to religion, Muslim women had a higher anaemia prevalence compared to women of other religions ( $p < 0.001$ ).

Rural women were more prone to be anaemic compared to the women who lived in urban areas. Similarly, the working condition of women was also significantly associated with the prevalence of anaemia. The women who had paid jobs were less vulnerable to have anaemia compared to jobless women ( $p < 0.001$ ). Similarly, women having middle-level wealth status were more anaemic than poor and rich women

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( $p < 0.01$ ). But, the prevalence of anaemia was in increasing trend among the women who had rich wealth status ( $p < 0.01$ ). Women's autonomy was significantly associated with the prevalence of anaemia in NDHS 2006 and 2011 ( $p < 0.001$ ) but not in the NDHS 2016.

**Table 2**

*Prevalence of anaemia in women by background characteristic*

Variables and category	NDHS 2006			NDHS 2011			NDHS 2016		
	No(%)	Yes(%)	Total	No(%)	Yes(%)	Total	No(%)	Yes(%)	Total
<b>Age group</b>	***			**			***		
Less than 25 years	61.5	38.5	4392	62.3	37.7	2476	56.4	43.6	2443
25-34	65.6	34.4	3069	66.9	33.1	1774	58.7	41.3	1971
35 or above	65.2	34.8	3186	66.9	33.1	1838	63.2	36.8	2000
<b>Age at marriage, cohabitation</b>	***			NS			*		
Less than 15	70.5	29.5	345	64.1	35.9	414	58.0	42.0	582
15-17	69.4	30.6	1010	66.2	33.8	1368	58.4	41.6	2192
18-20	74.8	25.2	683	68.3	31.7	879	59.2	40.8	1439
21 and above	61.1	38.9	6487	64.2	35.8	2115	64.1	35.9	874
<b>Number of children borne</b>	NS			NS			NS		
None	63.6	36.4	2957	63.8	36.2	1828	58.2	41.8	1842
One	64.6	35.4	1350	65.4	34.6	850	61.1	38.9	1026
Two	63.1	36.9	1815	66.0	34.0	1168	60.3	39.7	1406
Three	65.2	34.8	1522	65.5	34.5	920	58.0	42.0	954
Four	63.8	36.2	1093	66.0	34.0	575	60.5	39.5	566
Five or more	63.0	37.0	1909	64.8	35.2	747	57.6	42.4	620
<b>Education</b>	***			**			NS		
No education	60.7	39.3	5637	62.6	37.4	2403	58.4	41.6	2144
Primary	67.7	32.3	1876	68.1	31.9	1068	61.5	38.5	1069
Secondary or above	66.9	33.1	3134	66.0	34.0	2617	59.0	41.0	3201
<b>Religion</b>	***			***			***		
Hindu	63.0	37.0	9070	64.9	35.1	5160	58.6	41.4	5500
Buddhist	70.8	29.2	927	71.4	28.6	511	70.8	29.2	347
Islam	56.0	44.0	376	45.5	54.5	202	48.3	51.7	312
Kirat/Christian	77.1	22.9	275	70.7	29.3	216	69.9	30.1	256
<b>Place of residence</b>	***			***			*		
Urban	71.0	29.0	1640	72.4	27.6	836	60.4	39.6	4029
Rural	62.5	37.5	9008	63.8	36.2	5252	57.3	42.7	2385
<b>Currently working</b>	***			***			***		
No	60.4	39.6	3065	61.8	38.2	2360	56.4	43.6	2737
Yes	65.1	34.9	7582	67.1	32.9	3727	61.4	38.6	3677
<b>Wealth index</b>	***			**			***		
Poor	63.2	36.8	4001	65.0	35.0	2175	62.8	37.2	2318
Middle	57.7	42.3	2184	61.4	38.6	1265	51.0	49.0	1317



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Rich	67.2	32.8	4461	66.7	33.3	2647	60.2	39.8	2779
<b>Women's autonomy in household decision ***</b>				***			NS		
No autonomy	60.1	39.9	4811	61.8	38.2	2607	57.7	42.3	2820
Moderate autonomy	68.0	32.0	2433	67.8	32.2	1435	60.2	39.8	1716
High autonomy	66.0	34.0	3403	67.1	32.9	2046	60.6	39.4	1878
<b>Smoking ***</b>	***			***			***		
No	62.0	38.0	8560	64.1	35.9	5244	58.1	41.9	5841
Yes	71.2	28.8	2088	70.4	29.6	844	71.1	28.9	573
<b>Exposure to newspaper ***</b>	***			***			*		
No exposure	60.7	39.3	7280	63.7	36.3	3933	58.3	41.7	4466
Low exposure	69.0	31.0	2271	63.6	36.4	1390	60.9	39.1	1413
High exposure	73.5	26.5	1090	74.4	25.6	765	63.2	36.8	535
<b>Exposure to radio ***</b>	***			**			***		
No exposure	53.4	46.6	1092	60.6	39.4	1102	55.4	44.6	2828
Low exposure	64.1	35.9	3101	65.0	35.0	2254	62.6	37.4	1820
High exposure	65.4	34.6	6453	66.8	33.2	2732	61.9	38.1	1766
<b>Exposure to TV ***</b>	***			**			NS		
No exposure	59.4	40.6	3014	62.8	37.2	1523	60.0	40.0	1860
Low exposure	63.9	36.1	3576	63.3	36.7	1686	58.2	41.8	1325
High exposure	66.9	33.1	4057	67.2	32.8	2879	59.2	40.8	3229
<b>Total</b>	<b>63.8</b>	<b>36.2</b>	<b>10647</b>	<b>65.0</b>	<b>35.0</b>	<b>6088</b>	<b>59.2</b>	<b>40.8</b>	<b>6414</b>

Note: \*\*\* = Significant in chi-square test at  $p < 0.001$ ; \*\*= $p < 0.01$  and \*= $p < 0.05$ ; NS = Not Significant

Interestingly, women who had smoking habits were less vulnerable to have anaemia. All three NDHS showed that the trends of anaemia prevalence were more among women who did not smoke compared to smokers ( $p < 0.001$ ). Exposure to mass media was also significantly associated with the prevalence of anaemia. Women having high exposure to newspapers were less prone to be anaemic than the women having low or no exposure to newspaper. In the same way, women who had no exposure to the radio were more prone to be anaemic compared to those who listened to the radio ( $p < 0.01$ ). Surprisingly, anaemia prevalence was in increasing trend among women who watched TV less than once a week i.e. 36, 37, and 42 per cent in the NDHS 2006, 2011, and 2016 respectively.

***Predictors of anaemia prevalence among the WRA***

Women who participated in NDHS 2016 were almost 24 per cent more likely to have anaemia compared to women in NDHS 2006 (aOR = 1.24,  $p < 0.001$ ). So the data showed the worsening condition of women in terms of anaemia prevalence in 2016 than 2006. The higher the age of women, the lower was the chances of anaemia. Women aged

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more than 24 years were 13 to 14 per cent less likely to have anaemia than the women aged less than 25 years ( $p < 0.01$ ).

Women who had primary level education were significantly less likely to have anaemia compared to those who had no formal education (aOR = 0.79,  $p < 0.001$ ). In the same way, Buddhist, Kirat and Christian women were 28 to 34 per cent less likely to be anaemic compared to those who belonged to the Hindu ( $p < 0.001$ ) religion. Likewise, rural women were more likely to have anaemia compared to urban women (aOR = 1.13,  $p < 0.05$ ) [Table 3].

**Table 3**

*Adjusted odd ratio (aOR) and 95% confidence interval (CI) for having anaemia among women aged 15-49 years*

Selected predictors	Model I			Model II		
	aOR	95% CI		aOR	95% CI	
		Lower	Upper		Lower	Upper
<b>Year</b>						
NDHS 2006 (ref.)	1.00			1.00		
NDHS 2011	0.95	0.887	1.012	1.004	0.917	1.100
NDHS 2016	1.21***	1.137	1.291	1.236***	1.105	1.383
<b>Age group</b>						
Less than 25 years (ref.)				1.00		
25-34				0.860**	0.786	0.942
35 or above				0.872**	0.788	0.964
<b>Age at marriage, cohabitation</b>						
Less than 15 (ref.)				1.00		
15-17				0.935	0.817	1.070
18-20				0.960	0.831	1.110
21 and above				1.086	0.949	1.242
<b>Education</b>						
No education (ref.)				1.00		
Primary				0.791***	0.716	0.874
Secondary or above				0.993	0.889	1.110
<b>Religion</b>						
Hindu (ref.)				1.00		
Buddhist				0.717***	0.621	0.827
Islam				0.936	0.797	1.099
Kirat/Christian				0.661***	0.532	0.822
<b>Place of residence</b>						
Urban (ref.)				1.00		
Rural				1.127*	1.029	1.234
<b>Currently working</b>						
No (ref.)				1.00		
Yes				0.939	0.870	1.013
<b>Wealth index</b>						
Poor (ref.)				1.00		
Middle				1.108*	1.009	1.218
Rich				0.907*	0.822	1.000
<b>Women's autonomy in household decision</b>						
No autonomy (ref.)				1.00		
Moderate autonomy				0.893*	0.818	0.975

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High autonomy		0.936	0.860	1.018
<b>Smoking</b>				
No (ref.)		1.00		
Yes		0.708***	0.643	0.781
<b>Exposure to newspaper</b>				
No exposure (ref.)		1.00		
Low exposure		0.975	0.877	1.084
High exposure		0.821*	0.702	0.959
<b>Exposure to radio</b>				
No exposure (ref.)		1.00		
Low exposure		0.851**	0.774	0.936
High exposure		0.831***	0.754	0.915
<b>Exposure to TV</b>				
No exposure (ref.)		1.00		
Low exposure		1.055	0.963	1.155
High exposure		0.976	0.883	1.079
<b>Constant</b>	<b>0.567***</b>	<b>0.644***</b>		
<b>Cox &amp; Snell R Square</b>	<b>0.002</b>	<b>0.046</b>		
<b>-2 Log likelihood</b>	<b>30493.9</b>	<b>20199.6</b>		

Note: \* = significant at  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ ; ref= reference category

Similarly, women having middle-level wealth status were 11 per cent more likely to have anaemia but women having rich wealth status were nine per cent less likely to be anaemic compared to poor women ( $p < 0.05$ ). Women with a moderate level of autonomy in household's decision making were less likely to have anaemia compared to those with no autonomy in household decision making (aOR = 0.89,  $p < 0.05$ ). Interestingly, women who used to smoke tended to be less likely to have anaemia than who did not smoke (aOR = 0.71,  $p < 0.001$ ).

Adequate, accurate, relevant, and timely information are vital for decision making for health-related behaviour change (Kreps et al., 2017). Mostly health related information can be obtained from mass media. Exposure to mass media especially exposure to radio was the significant predictor for anaemia prevalence [Table 3]. Data showed that the women who had low or high-level exposure to radio were 15 to 17 per cent less likely to have anaemia compared to those who had no exposure ( $p < 0.01$ ).

### Discussion

Some results appeared similar in bivariate and multivariate analysis. Background characteristics of women especially age, age at marriage (in NDHS 2006 and NDHS 2016), education (in NDHS 2006 and NDHS 2011), religion, place of living, women's employment, wealth status, women's autonomy in decision making (in NDHS 2006 and NDHS 2011), smoking habit, exposure to media (except exposure to TV in NDHS 2016), were significantly associated with the prevalence of anaemia. Age of women, place of living, wealth status, smoking habit, exposure to radio were significant predictors for having anaemia. Similarly, the educational level of women, religion, women's autonomy in household decision making, and exposure to newspapers were also predictors to some extent.

Comparing our results with other past studies, considerable variations can be observed in terms of some similarities and some differences. A study showed similar results that women residing in rural areas were eight per cent more likely to have anaemia compared to those who lived in urban areas and non-Hindu women were less

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likely to have anaemia compared to Hindu women (Harding et al., 2017). A hospital-based study in Jumla [Karnali], Nepal also presented similar results that women aged less than 20 years were observed to be more likely to have anaemia compared to women aged more than 20 years (Sharma et al., 2020). Another study from India also showed nearly comparable results that illiterate women were more than literate, rural women more than urban, Hindu women more than women of other religions, and poor women more than rich were more likely to be anaemic (Bharati et al., 2019).

An Ethiopian study showed different results that higher the age, higher chances of anaemia prevalence. Women aged 36-45 years tended to be 4.5 times more likely to have anaemia compared to women aged 15-35 years. But the study also showed similar results that rural women and illiterate women were observed as more likely to have anaemia (Hailu et al., 2019). A cross-sectional study conducted in Ghana showed that more than half (56%) women were anaemic and most common (73%) among adolescents aged 15-19 years (Tibambuya et al., 2019). Some similar and some different results were observed in Congo that women aged less than 20 years compared to women more than 20 years and urban women than rural were more likely to have anaemia (Kandala et al., 2019).

Contradictory to the findings of this study, a study in Jordan showed that women who resided in urban areas were 17 per cent more likely to have anaemia compared to those who lived in rural areas (Arabyat et al., 2019). Likewise, a different result was observed in the study from 30 Sub-Saharan African Countries that women who lived in semi-urban or urban areas had significantly higher odds (1.18 to 1.43) of concurrent overweight or obesity and anaemia compared to those women who lived in rural areas (Rhodes et al., 2020). However similar result was noticed that smoker women were less likely to have anaemia prevalence (Arabyat et al., 2019). A cross-sectional study showed different results that women aged 20 to 29 years were more anaemic than women aged less than 20 years and more than 29 years. In the same way, women having school level education were more anaemic than those women who had no formal schooling or graduated women (Kumari et al., 2019). Both results were different from the result of our study.

Likewise, women aged less than 40 years were less likely to be anaemic compared to women aged 40 or more (Kofie et al., 2019). Another study from Ethiopia showed contradictory results that women aged 20 or more years who were attending antenatal care in public hospitals were more likely to have anaemia compared to women aged less than 20 years (Gudeta et al., 2019) but another study in Ethiopia supports the results that rural women attending the hospital were six times more likely of having anaemia compared to those who lived in urban area [aOR = 6, 95%CI = 1.3 -27.6,  $p < 0.05$ ] (Berhe et al., 2019). Younger aged [15-24] women had higher chances of having anaemia than women aged 35-49 years. Two-third (67%) of the pregnant women resided in rural areas than those women who lived in urban areas (49%) were anaemic in Ghana (Ayensu et al., 2020).

More than one third (36%) of the rural WRA were anaemic compared to 27 per cent of urban women, 42 per cent poorest compared to 27 per cent richest women ( $p < 0.001$ ) in Uganda which is similar to the findings of our study but younger women were comparatively less anaemic than adult women which is the different result (Nankinga & Aguta, 2019). Surprisingly, smokers and past smokers were less likely to have anaemia prevalence compared to non-smoker in Japan (Hisa et al., 2019) which is similar with the results of this study. A study from Pakistan also showed similar results that two-third of total illiterate pregnant women were anaemic compared to literate women (55%) and women with secondary or higher education (47%). In the same way,

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63 per cent of total rural pregnant women were anaemic compared to 53 per cent of urban women (Ullah et al., 2018).

Various studies support our findings that younger age, rural residency, non-smoker are some predictors for having a higher prevalence of anaemia among reproductive-aged women (Gautam et al., 2019). Prevalence of anaemia varies in different places and persons with a particular condition but is most common in younger, poor and pregnant women (Tulu et al., 2019). Another study showed age and ethnicity of women were the significant predictors of anaemia prevalence (Aljaadi et al., 2019). Rural women who went for antenatal appointments were noticed more likely to have anaemia than those who resided in urban areas in Ethiopia (Belay et al., 2019; Samuel et al., 2020).

It was noticed that media exposure was significantly associated with the prevalence of anaemia. High exposure to media was associated with lower chances of anaemia. An experimental study conducted in Jordan using a health information package programme showed 24 and 54 per cent of the pregnant women were non-anaemic respectively in control and experimental groups (Abujilban et al., 2018). In the same way, a quasi-experimental study conducted in Indonesia showed that health education and counselling through pictorial handbooks had a positive impact on pregnant women (Nahrisah et al., 2020). So, exposure to communication and information about health-related issues may be a vital tool to reduce anaemia prevalence among the WRA.

Wealth status was noticed as a significant predictor for anaemia prevalence in this study. Women with middle-level wealth status were almost 11 per cent more likely to have anaemia prevalence but women having rich wealth status were as nearly as nine per cent less likely to have anaemia compared to the women who had poor wealth status. Similar to this finding, a study from Rwanda showed that women belonging to middle and rich wealth status were 17 and 26 per cent less likely to be anaemic compared to poor women respectively (Hakizimana et al., 2019). Women having formal education tended to be less likely to have anaemia prevalence in Ethiopia compared to those women who had no formal education which was similar to this study (Samuel et al., 2020).

### **Strengths and limitations of the study**

The study has several strengths in terms of sample size, sampling procedure, and data from three different surveys on a periodic basis. It uses secondary data from recent three NDHSs data. The data were representative of the whole nation in all NDHSs. The data were merged for multivariate analysis. We analysed the data in three ways, univariate and bivariate analysis separately for all three NDHSs and multivariate analysis in a combined way. The study also had some limitations. The nature of data was quantitative, so qualitative aspects and issues of women were missed. The study uses a cross-sectional design; therefore, it is difficult to detect root cause analysis beyond cause and effect relationships. We included the wealth status of women by assessing proxy measures of household assets and consumption patterns. Some patterns of data have been changed in previous and recent NDHS such as boundaries and numbers of rural and urban areas, and number of sample taken from the areas. We assessed limited variables based on the literature available and the objectives of the study.

### **Conclusion**

Although the prevalence of severe anaemia remained static, the prevalence of mild and moderate anaemia stepped up making the situation worse throughout the decade (2006 to 2016). Overall, 41 per cent of WRA were anaemic in 2016 compared to

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36% in 2006. Socio-demographic characteristics such as age group of women, religion, place of residence, working status, wealth index, smoking habit, exposure to newspapers and radio were significantly associated with the prevalence of anaemia among the WRA. Nearly similar results were observed in the multivariate analysis. It showed that the age group of women, place of residence, wealth index, smoking habit, and exposure to radio were significant predictors for having anaemia. Policymakers need to re-evaluate and amend the existing policies and programmes since these programmes seemed not so effective in reducing the prevalence of anaemia. Moreover, policies and programmes need to target comparatively more vulnerable populations.

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