

# Assessment of anaemia and nutritional status of antenatal women attending a tertiary care hospital

Kanupriya Arora, Anupama Bahadur, Divya Mishra, Rajlaxmi Mundhra

Department of Obstetrics and Gynecology, All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India

## ABSTRACT

**Aim:** The aim of this study was to assess and grade anaemia in antenatal women at a tertiary care hospital. **Materials and Methods:** This cross-sectional study was conducted on 151 participants over 4 months at All India Institute of Medical Sciences (AIIMS), Rishikesh, a tertiary care hospital in Uttarakhand, India. Extensive work on quantifying daily nutritional intake and requirement was done to estimate antenatal women's nutritional status suffering from anaemia. **Results:** The proportion of anaemia among pregnant women was 37.09%, with mean haemoglobin of 11 g/dl, mode and median of 11.3 g/dl with higher and moderate anaemia than mild. It was in direct proportion with the number of abortions, gravid status and trimester of pregnancy. There was a protein deficit of 30–60% in 73.2% of the anaemic patients. Iron tablets were taken regularly by 85.5% of anaemic patients and 87.1% of non-anaemic patients. None of the anaemic patients met their 100% calorie requirement. The least calorie deficit was found to be 14.4%. A calorie deficit of 30–60% was found in 75% of the anaemic patients. Patients with severe anaemia had a calorie deficit of 40–60%. **Discussion:** Poverty, ignorance and non-availability of resources are the key factors underlying this condition. The lacunae in the delivery chain of beneficence to antenatal women offered by the government need to be looked at. Family planning has a pivotal role in controlling anaemia, as a high frequency of abortions and pregnancies were associated with anaemia.

**Keywords:** Anemia, nutrition, pregnancy

## Introduction

Gestation, a physiological state, is an anabolic process that demands higher input to meet the needs of the growing foetus and supporting tissue. This mismatch between resources and consumption adds to nutritional deficiencies in mothers. It is not very unlikely that the mother had a scarcity of resources before conception. Iron deficiency anaemia (IDA) is the most prevalent form and ranked as the third leading cause of disability adjusted life years lost for females aged 15–44 years by the World Health Organisation.<sup>[1]</sup> Physiological changes like hemodilution, intended for saving quality blood losses at the time of delivery, also lead to anaemia. It is after consideration of these physiological factors that

haemoglobin concentration less than 11 gm/dl and hematocrit less than 33 gm% has been defined as anaemia by WHO. Furthermore, for diagnosis of anaemia during the second trimester of pregnancy, the haemoglobin cut-off reduces to 10.5.<sup>[2]</sup> Anaemia in pregnant women remains unacceptably high in developing countries as compared to developed countries. Our country is under a heavy burden of this disease, with 50.4% of pregnant women suffering from anaemia as per NFHS-4. There is an 80% contribution to maternal deaths due to anaemia in South Asian countries, which constitutes half of the global maternal deaths.<sup>[3]</sup>

Severe anaemia has innumerable maternal and foetal complications like low birth weight, premature delivery, intrauterine growth restriction, increased risk of birth asphyxia, low APGAR score at birth, increased perinatal and maternal mortality. Those with moderate anaemia experience decreased working efficiency and are prone to infections. Eclampsia, antepartum and postpartum haemorrhage are frequently associated. As nutritional deficiency

**Address for correspondence:** Dr. Anupama Bahadur,  
Department of Obstetrics and Gynecology, All India Institute of  
Medical Sciences, Rishikesh, Uttarakhand, India.  
E-mail: anupama.bahadur@gmail.com

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is the most common cause of anaemia, that is, iron deficiency anaemia, exploring this root cause becomes essential. The purpose of this study was in the same context to estimate the nutritional deficit in antenatal women with anaemia. The idea was to quantify the calorie and protein intake for estimating the deficit and correlating it with the severity of anaemia. The degree of the disease has been assessed, too, along with various socio-demographic parameters.

Treating anaemia has significant health implications in pregnancy and would go a long way in improving the maternal and foetal outcome. As shown in a recent meta-analysis, the risk of maternal mortality decreases by 20% for every 1 g/dl increase in the haemoglobin concentration.<sup>[4]</sup>

## Materials and Methods

This study was carried out with an objective to assess anaemia among antenatal women attending All India Institute of Medical Sciences (AIIMS), Rishikesh, which is a tertiary care hospital in Uttarakhand, India. We also aimed to determine the nutritional status of these antenatal women. Our secondary objectives were to grade anaemia in these women according to severity, to relate their nutritional status with their anaemic condition and to correlate the extent of anaemia with socio-demographic parameters. For this purpose, we conducted a hospital-based, cross-sectional study from November 2017 to March 2018. We screened all antenatal women attending the hospital, identified those with anaemia and did their dietary work-up. According to the National Family Health Survey-4 (NFHS-4), the prevalence of anaemia in pregnant women in the State of Uttarakhand is 46.5%. Assuming similar expected results for the present study, considering 95% confidence interval and absolute precision of 7%, a sample size of 195 was determined using single population proportion formula (Fischer *et al.*,<sup>[5]</sup> 1998;  $n = Z^2pq/d^2$ ).

A review of antenatal care register showed that about 30 pregnant women attended antenatal clinic at AIIMS, Rishikesh, every week. Accordingly, the study was designed to be carried out for 5 months, during which period an estimated 600 women were expected to visit for antenatal care. A systematic random sampling method with a sampling interval of three was used to select the study participants. The first pregnant woman included in the sample was chosen randomly. After that, every third woman coming for antenatal care was screened for the study, until the desired sample size was attained. After taking informed written consent, we included women less than 38 years of age with confirmed pregnancy test of any trimester. Pregnant women who had received recent blood transfusion or who were in sick health condition were excluded. Out of the desired sample of 195, only 151 women fulfilled the criteria during our study period and gave consent for participation.

In our study, anaemia was classified as per World Health Organisation (WHO) as the value of haemoglobin <11 g/dl.<sup>[6]</sup> Mild, moderate and severe forms of anaemia have been defined

by WHO as haemoglobin concentrations of 10.0–10.9, 7.0–9.9 and <7 g/dl, respectively. For second trimester, the haemoglobin cut-off has been reduced to 10.5 g/dl.

Diagnosis of pregnancy was made by urine pregnancy test that detects hCG levels; further confirmation was done by ultrasonography. Gestational age was assessed from the last menstrual period. The participants were interviewed with the help of a pre-designed questionnaire comprising patient particulars, relevant menstrual history, obstetric history, drug history, dietary habits, anthropometric measurements and level of education to obtain the desired data.

Dietary history was taken with the help of 24-hour recall method. The nutritive value of food was calculated based on data provided by the National Institute of Nutrition, ICMR. The daily energy requirement and energy deficit were calculated based on the basal metabolic rate (BMR) of patients, using the Harris–Benedict equation and daily activities, and additional 350 calories were added, to account for the increased requirement during pregnancy. The height and weight were measured using a weighing scale and portable stadiometer, respectively. The diagnosis of anaemia was made by observing haemoglobin values recorded by an automated analyser, which works on the principle of cyanmethaemoglobin method.

## Results

In this cross-sectional study carried out at a tertiary care centre for a duration of 5 months, out of the 151 study participants, 56 were found to be anaemic, resulting in a proportion of 37.09%, which is much below the NFHS-4 reported proportion of 46.5%. The likely explanation is that these women were chosen from the fraction of antenatal women seeking tertiary centre care.

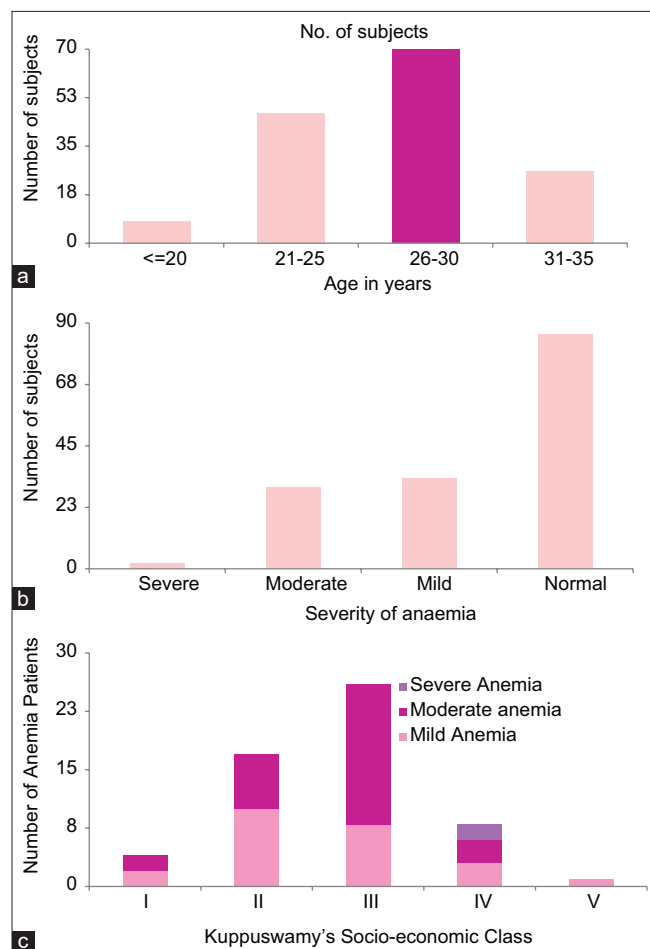
The age-wise distribution of our study subjects is shown in the Figure 1a. The most common age group presentation was 26–30 years, which constituted 47% of the study sample, followed by 21–25 years (31%), 31–35 years (17%) and <21 years (5%).

The haemoglobin concentration of women in our study ranged from 3.8 to 14 g/dl with a mean of 11 g/dl, median of 11.3 g/dl and mode of 11.3 g/dl. On grading anaemia according to the WHO guidelines and considering the reduced cut-off of 10.5 for haemoglobin in second trimester, it was found that majority of the women had mild and moderate anaemia. Mild anaemia constituted 42.8%, moderate 53.6% and severe 3.6% of the total anaemic population, as shown in Figure 1b.

Socio-economic classification was done using Kuppuswami 2018 scale, which revealed that majority of anaemia patients belonged to class III [Figure 1c]. When analysed on the basis of proportion in each class, anaemia prevalence was 100% in class V, 48.1% in class III, 44.4% in class I, 36.4% in class IV and 26.1% in class II [Table 1].

We also analysed the prevalence of various degrees of anaemia separately in women in different age groups as well as all the three trimesters of pregnancy in our study population, as shown in Table 2. Anaemia was the most prevalent in the age group of 26–30 years, which was also the most common age group to present in our study. Least prevalence of anaemia was in the age group of 31–35 years, but comprised only of mild and moderate cases. Severe cases were distributed in central age groups. Distribution of anaemia among each trimester was such that proportion of anaemia increased with increasing period of gestation, that is, 21.2% were anaemic in first trimester, 29.1% in second, and 52.4% in third. All severe cases belonged to third trimester.

Score	Socio-economic class	No. of subjects	Anaemic subjects	Proportion of anaemic subjects
26-29	Upper (I)	9	4	44.4%
16-25	Upper Middle (II)	65	17	26.1%
11-15	Lower Middle (III)	54	26	48.1%
5-10	Upper Lower (IV)	22	8	36.4%
<5	Lower (V)	1	1	100%

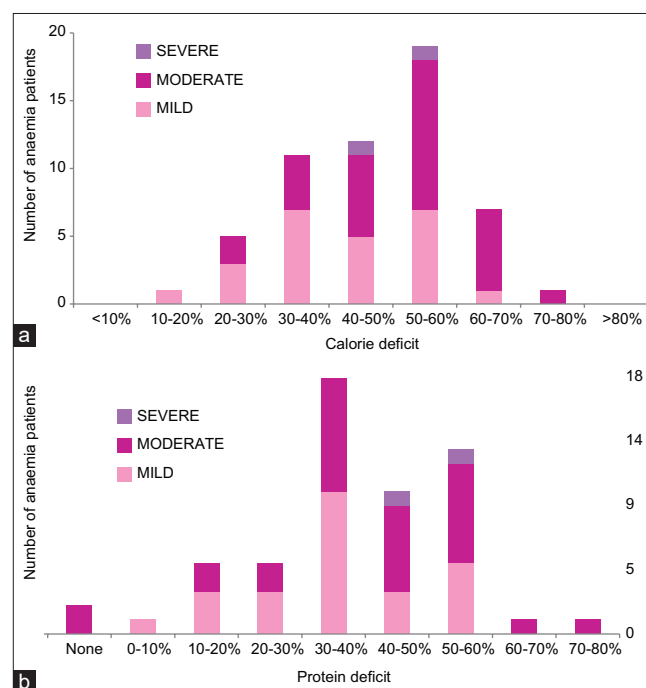


**Figure 1:** (a) Distribution of antenatal subjects in age groups; (b) Distribution of subjects according to anaemia severity; (c) Distribution of anaemic antenatal subjects across different socio-economic classes

When the prevalence of anaemia was assessed taking into consideration the gravidity of these women, it was observed that fourth gravida women had highest proportion of anaemia, meaning, 70.5% of fourth gravida females were anaemic [Table 3]. This was followed by fifth gravida, third gravida, second gravid and primigravida in that order. The proportion of severe anaemia also increased with increasing gravidity. Similarly, the proportion of anaemic women was higher in women with history of more abortions. Two-thirds of women with history of three abortions were found to be anaemic.

We did a detailed analysis of the daily nutritional intake and requirement in these anaemic women in terms of calorie and protein intake. It was observed that none of the anaemic women met their 100% calorie requirement. The minimum calorie deficit observed was 14.4%. About one-third of the anaemic patients in our study lay in the 50–60% calorie deficit category. The maximum calorie deficit obtained in this study was 70.9%, which was a case of moderate anaemia with haemoglobin concentration of 9.1 g/dl. All the severely anaemic women fell in the 40–60% calorie deficit category. Similarly, about one-third of the anaemic antenatal women had a protein deficit of 30–40% in their diet. Only about 3.5% of the anaemic women in our study met their total portion requirement [Figure 2a and 2b].

We also studied the iron supplementation in these antenatal women. Most of these women took oral iron preparations, with two women requiring injectable iron. Some of these patients started taking iron in the beginning of pregnancy, but discontinued it later due to intolerance. The iron supplementation in these women with the degree of their anaemia is shown in Table 4.



**Figure 2:** (a) Degree of calorie deficit in antenatal women with various degrees of anaemia; (b) Degree of protein deficit in antenatal women with various degrees of anaemia

**Table 2: Distribution of various degrees of anaemia in different age groups and trimesters of pregnancy**

Total (n=151)	Age group	Trimester	% anaemia	Anaemic	Mild Anaemia	Moderate Anaemia	Severe Anaemia
3	<20		33.33%	1	0	1	0
		3		1	0	1	0
		2		0	0	0	0
52	20-25	1	32.7%	0	0	0	0
		3		17	6	10	1
		2		7	2	4	1
70	26-30	1	42.8%	4	1	3	0
		3		30	14	15	1
		2		21	13	7	1
26	31-35	1	30.8%	8	4	4	0
		3		8	4	2	0
		2		4	2	1	0
		1		2	1	1	0

**Table 3: Distribution of various degrees of anaemia according to trimester, gravidity and number of abortions**

	Total number of subjects	% Anaemia	Mild anaemia	Moderate anaemia	Severe anaemia	No Anaemia
Trimester						
1 <sup>st</sup> trimester	33	21.2	2	5	0	26
2 <sup>nd</sup> trimester	55	29.1	5	11	0	39
3 <sup>rd</sup> trimester	63	52.4	17	14	2	30
Gravida						
1	43	27.9	7	5	0	31
2	47	31.9	6	9	0	32
3	41	36.5	6	9	0	26
4	17	70.5	5	6	1	5
>4	3	66.7	0	1	1	1
Number of abortions						
0	89	30.3	13	13	1	62
1	46	47.8	10	11	1	24
2	13	38.4	1	4	0	8
3	3	66.7	0	2	0	1

**Table 4: Iron supplementation and anaemia severity in antenatal subjects**

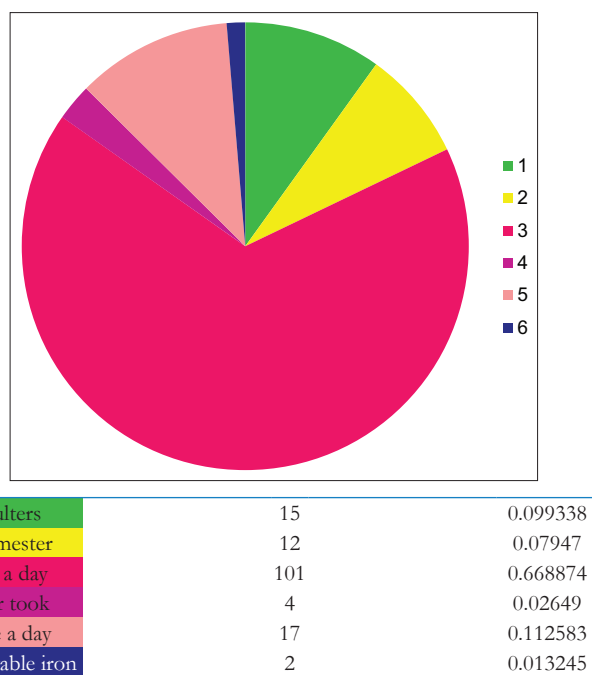
	Total patients (n=151)	Anaemic patients	Mild Anaemia	Moderate Anaemia	Severe Anaemia	No Anaemia
Defaulters	15	6	2	4	0	9
1 <sup>st</sup> trimester	12	1	0	1	0	11
Once a day	101	31	17	14	0	70
Never took	4	2	0	1	1	2
Twice a day	17	13	3	10	0	4
Injectable iron	2	2	1	0	1	0

We also compared the compliance to iron in the anaemic antenatal patients with that in the non-anaemic women in our study. It was found to be comparable in both the groups of women, with 85.5% compliant anaemic and 87.1% non-anaemic women who took iron supplements regularly during their antenatal period. The proportion of defaulters was 10.9% among the anaemic women and 10.5% among the non-anaemic patients. The proportion of women who never took iron supplements

was 3.63% in anaemic patients and 2.85% in non-anaemic women [Figure 3].

## Discussion

This study model was cross-sectional and was suitable to meet our objectives.



**Figure 3:** Compliance and preparation of iron supplementation

The present study revealed anaemia in pregnant women to be 37.09%, which is lower than the prevalence reported in Uttarakhand by NFHS-4 (46.7%). This study was conducted at a tertiary care centre located in Uttarakhand, which caters to the parent state and extends its services to neighbouring states like Uttar Pradesh, Haryana, Himachal Pradesh and many others. Our results were better compared to other tertiary hospitals,<sup>[7]</sup> which may be due to higher basal haemoglobin levels in hilly areas and a comparatively lesser antenatal load on hospital and special antenatal OPD. A significant patient–doctor time results in quality care. Uttarakhand has the lowest MMR in India. The first annual health survey declared Uttarakhand the safest state for a child to be born. This fact is evident in our study, as a satisfactory number (86.33%) of antenatal women consume iron tablets, which is considerably better than previous data of state (38.5%)<sup>[8]</sup> and National figure of 57.6%.<sup>[9]</sup> Our study also signifies the improvement in calorie intake for anaemia correction and improvement in family planning methods as Family planning has a pivotal role in controlling anaemia, (as a high frequency of abortions and pregnancies were associated with anaemia).

The severity of anaemia observed in this study—moderate, greater than mild, greater than severe—is supported by a similar study.<sup>[6,18]</sup> Contrary to expected result supported by good compliance to iron supplementation, antenatal women are not just not mildly affected by anaemia, but the most commonly occurring type was moderate anaemia. The fact that the study was conducted in a tertiary setup should not be neglected. Moreover, the operational definition defined anaemia as <11 g/dl in the first and third trimester, but 10.5 g/dl in the second trimester. This lower cut-off for second trimester shifted many otherwise mild anaemia cases into a normal pool.

An increasing trend of proportion and severity of anaemia with increasing trimester can be explained by greater haemodilution and increasing foetal demands. Women with higher abortions have a greater risk of being anaemic with increasing severity due to blood loss. Each abortion is associated with a blood loss of 14–512 ml, with a median loss of 74 ml, and the amount is significantly correlated to the period of gestation.<sup>[10]</sup> The lesser prevalence of anaemia in women with two abortions than those with one abortion can be attributed to lesser number of multigravida in the latter category. The proportion of mild anaemia decreased and moderate anaemia increased with increasing number of abortions. Such a trend was not seen for severe cases of anaemia; they were equally distributed between one and two abortion category. Based on this data, no conclusion should be drawn regarding the relation of anaemia severity with the number of abortions, due to a lesser number of cases of severely anaemic women, that is, two in the present study.

Similarly, rising trend of anaemia was observed with increasing gravidity as with abortion, which was observed until the fourth pregnancy. Findings were relatable with those in other parts of the world.<sup>[11]</sup> After fourth gravida, a slight fall in the proportion of anaemia, should not be considered significant owing to lesser number of subjects in this category. However, the proportion of severe anaemia continued to rise.

With increasing maternal age proportion, moderate anaemia decreased but the overall prevalence of anaemia was maximum in 26–30-year age group, which was also the most commonly presenting age group in our study. The age group of 21–30 years had the highest anaemia proportion, which was in agreement with the studies done in other parts of the country.<sup>[12]</sup> Socio-economic status was inversely related to anaemia prevalence, which aligned with other workers' findings.<sup>[13]</sup> It can be explained by a better knowledge of foods' nutritive value and better affordability, accessibility of quantity and quality of food items, hygiene, medication with increasing literacy and socio-economic status.

In our study, calorie deficit was present in 100% of the anaemic women, indicating the significant role of diet in anaemia causation. An improvement in dietary habits of these women can decrease the prevalence of anaemia in antenatal women. The importance of nutrition in preventing anaemia has been advocated by numerous studies.<sup>[14]</sup> The calorie requirement has been calculated using the basal metabolic rate derived using the Harris–Benedict equation, which gives more accurate values compared to another formula.<sup>[15]</sup> The analysis of protein deficit in our study showed that a meagre proportion of 3.4% of anaemic women fulfilled their protein demand, and rest could not. The significance of proteins in the diet can be well understood as haemoglobin comprises two subunits—haem and globin. Of these, haem is made by protoporphyrin ring and iron, whereas globin is the amino acid chain. Emphasis on iron supplementation with the help of various health programmes and other government policies has resulted in many antenatal women taking iron tablets (86.33%), which has come a long way

since the reported figure of 48.31% in Dehradun in 2012<sup>[16]</sup> and 77.78% in Maharashtra in 2015.<sup>[17]</sup> The group of women with anaemia had 0.4% of defaulters and 0.78% of these antenatal women were not receiving iron, unlike the women who did not have anaemia.

Normocytic hypochromic and microcytic hypochromic pictures of anaemia were predominant in our study as iron deficiency remains the most common cause.<sup>[7]</sup> Folic acid supplementation is equally essential as necessitated by the observation of macrocytic picture in the peripheral smear of the severely anaemic women.<sup>[18]</sup> The history of folic acid intake could not be elicited reliably in our study due to unawareness in 66.4% of patients. In a recent study on 1227 women admitted for delivery in a tertiary institute in Jaipur, almost 64.72% of pregnant women were found to be suffering from anaemia. This highlights the importance of nutritional supplementation right from the conception period.<sup>[19]</sup>

We acknowledge a few limitations of our vastly informative study. Nutritional assessment should have been done for the non-anaemic women also, as it would have given a scale of comparison and scope for calculation of odds of anaemia occurrence. For more details of anaemia causation in antenatal women in Uttarakhand, a cohort study can be planned in future. Conducting it in high altitudes and tribal areas will be more beneficial than in hospital-based settings, as these regions need to be explored and checked for under-reporting.

## Conclusions

It was concluded that poverty, ignorance and non-availability of resources are the key factors underlying this condition. The lacunae in the delivery chain of beneficence to antenatal women offered by the government need to be looked at. Family planning has a pivotal role in controlling anaemia, as a high frequency of abortions and pregnancies were associated with anaemia. Moreover, the outlying population could not be reached as they probably do not visit the tertiary setting.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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