



(RESEARCH ARTICLE)



## Assessment of nutritional status, use of nutritional supplements and their adherence during pregnancy

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### Abstract

**Objective:** The objective of the present study was to assess the nutritional status during pregnancy, survey the prescribed nutritional supplements, and monitor the adherence to prescribed nutritional supplements & to assess the attitude/experience of subjects towards supplement use.

**Methods:** This was a prospective study. A data collection form was used to collect demographic data, Biochemical, clinical, obstetrics, nutritional supplements and dietary data. The adherence to the supplements by using 24-h recall method was noted, and the attitude towards supplement use was assessed.

**Results:** The study was conducted over a period of six months in a tertiary care hospital in Pimpri- Chinchwad which comprised of 193 subjects. There was not much difference in the mean age of the pregnant women attending antenatal care at the hospital, which figured up to 29.93 years. The nutritional status of the study population was assessed and was classified on the basis of BMI and MUAC. BMI measurements revealed that out of 193 subjects studied, 5(2.5%) were underweight, 78(40%) had normal nutritional status, 75(38.8%) were overweight, and 35(18%) were obese. MUAC measurements show 19(9.8%) had moderate malnutrition (MUAC190-230mm), and 174(90.1%) had normal nutritional status (MUAC>230mm). FIGO analysis showed that an average of 47.33 out of 193 required assessment of nutritional status in detail. Out of the 193 subjects studied, combination therapy with Calcium & Vitamin D3 193(100%) was the most commonly prescribed nutritional supplement, followed by combination of Folic acid & iron 151(78.23%), and monotherapy with iron & folic acid respectively 42(21.7%) Adherence to the oral nutritional supplements was measured by a 24-h recall method, 11(6%) of the population reported skipping the prescribed supplements on the previous day. Out of 193 participants surveyed, 67(34.7%) reported they tend to skip the nutritional supplements sometimes. Reported barriers to adherence were forgetfulness (55%), followed by metallic taste (26%), fear of ADRs (9%), gastric ADRs (5%), and inconvenience in taking them along with other medications (5%).

**Conclusion:** The findings of our study reveal that many pregnant women continue to have compromised nutritional status, despite the fact that there exist recommendations and ways for treating under nutrition, lack of sufficient dietary intake of the nutrients, weight management during pregnancy for avoiding post-pregnancy complications.

**Keywords:** Pregnancy; Nutritional status; Adherence; Nutritional supplements

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## 1. Introduction

Pregnancy is defined as a state which is dynamic, anabolic and is characterized by small changes whose purpose is to allow the growth & development of the fetus. These changes affect the metabolism of all nutrients. Assessment of anthropometric parameters during pregnancy to assess the nutritional status is a widely used method which requires few resources. NACS recommends using the ABCD (Anthropometric, Biochemical, and Clinical & Dietary) approach to assess the nutritional status [1].

Adequate nutrition during pregnancy is essential for maternal health and positive health outcomes. Traditional diets may be suboptimal in low-income countries and other individual & socio-cultural factors like food aversions & eating down (eating less) in pregnancy can further reduce the intake. Nutritional supplements can be used to fill this gap & can improve outcomes during pregnancy [2].

A recent study in the US reported that a significant number of pregnant women do not meet the adequate recommendations for various nutrients from food. These nutrients include folic acid, vitamin D, iron & calcium [3].

Literature reviews on the use of nutritional supplements during pregnancy supports routine use of folic acid and individualized approach for vitamins & minerals. Use of folate supplement is recommended during the prenatal phase for the first 12 weeks of pregnancy to reduce the risk of neural tube defects. [NTD] WHO recommends a daily dose of 400 micrograms of folate [4].

Vitamin D deficiency in pregnancy can result in adverse maternal outcomes like preterm delivery, gestational diabetes mellitus, recurrent pregnancy loss and postpartum depression. Also, babies born to mothers who are having vitamin D deficiency were found to have lower birth weight. Vitamin D supplements alone or in combination with calcium reduces the risk of pre-eclampsia. For pregnant and lactating women, a daily dose of 2000 IU is recommended [5].

As per WHO, the recommended daily dose of elemental oral calcium is 1.5-2.0g during pregnancy, which has been shown to reduce the risk for preeclampsia [6]. For iron, a daily dose of 30-60mg is recommended during pregnancy as per WHO. This is known to reduce the risk of low birth weight, anemia, preterm delivery and puerperal sepsis [7].

Literature reviews provide strong evidence that links inadequate nutrition and development to obesity in later life, TYPE-2 Diabetes, CVDs and atopic diseases [8]. Therefore, assessment of nutrition during pregnancy and maintaining its adequate level is essential during pregnancy. Despite the daily supplementation recommendations of iron, folic acid and vitamins by WHO, still the coverage in most countries is low. A very small proportion of women follow the recommendations of nutritional supplementation [9]. Forgetfulness, side effects, and metallic after taste are reported to be the barriers to adherence to the supplements [10] [11] [12].

The objective of this study is to assess nutritional status during pregnancy, to study what supplements are being used by the pregnant women during pregnancy and review the adherence to these supplements and identify the barriers to adherence.

There is a need to evaluate the nutritional status of the pregnant women as well as their compliance to the recommended supplements.

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## 2. Material and methods

The Ethical approval and permission was obtained from the ethics committee of the tertiary care hospital of Pimpri Chinchwad, Pune. This was a prospective, observational study that involved pregnant women who attended antenatal care hospital in Pimpri-Chinchwad over past 6 months. The data were collected by all four members of the said group. Ethical approval for this study was granted by the Hospital Ethics Committee with the proposal number of ABMH/Academics/EC/13/2022.

During the study period, 193 pregnant women were enrolled based on the inclusion criteria, and prospective data were collected. The inclusion criteria included: All pregnant women over 21years of age, furthermore, only those subjects who understood the purpose of the study & were ready to provide information regarding their health status & those who signed an ICF were only included. The following patients were excluded from the study: Pregnant women below the age of 21, the patients who underwent chemotherapy and radiation therapy & subjects not ready to participate in the study.

Sociodemographic data, medical and medication history, family history social history Clinical data (RBC count, Hb MCV & blood group), Obstetrics data ( Trimester, GP data, Age at first pregnancy, number of children under 5) and supplements prescribed during ANC visits, Dietary data( Food choice, most common food consumed using Food frequency questionnaire) were collected from the self-designed patient profile form. FIGO nutrition checklist for Pre-pregnant/ Early pregnant women was used as a scale to assess the nutritional intake was insufficient. Attitude towards supplement use was assessed by using 4-point likert scale. On a scale of four, how strongly agree subject agrees or disagrees towards following statements

- Supplements are good for my health
- I like the taste of supplements
- I need support to take supplements
- Forgetfulness regarding their consumption

The main variable measured in the study was the BMI & MUAC. The collected data was entered into a Microsoft Excel file.

Data were evaluated in terms of numbers, percentages, tables, figures, and graphical representation. Descriptive statistics were used to analyze the result which was then compared to those documented in the literature review.

### 3. Results

The Sociodemographic characteristics of the respondent is presented in Table 1. Data from Table 1 suggests that in the age group 21-30 years, maximum pregnancies were recorded (61.13%). The mean age of the participants was  $29.9323 \pm 4.6$  years. Out of 193 participants, 93 (48%) were housewives/Homemakers whereas 100(51.81%) had a working profession. From the total study participants, 127(65%) had tertiary education, followed by 62(32.1%) who had secondary education, &4(2.07%) had low educational status (Primary education) [Table 1 summarizes the socio-demographic characteristics of respondents]

**Table 1** Sociodemographic analysis

Variables	Category	Frequency	Percentage
Age	21-30	118	61.13
	31-40	74	38.34
	>40	1	0.518
	Total	193	100
Educationalbackground	Primary	4	2.072
	Secondary	62	32.12
	Tertiary	127	65.80
	Total	193	100
Occupation	Working	100	51.81
	Homemaker	93	48.18
	Total	193	100

The data regarding the nutritional status according to MUAC is given in Table 2 .On the basis of MUAC (mid-upper arm circumference)measurements, out of 193 subject's in the study, 0(0%) had SAM, 19(9.84%) had moderate malnutrition &174(90.15%) had normal nutritional status.

**Table 2** MUAC & Nutritional status

MUAC cutoff	Nutritional status	Number (n)	Percentage (%)
<190 mm	SAM (Severe acute malnutrition)	0	0
190-230mm	MAM (Moderate acute malnutrition)	19	9.84
>230mm	Normal nutritional status	174	90.15

The data regarding the nutritional status according to BMI is presented in Table 3. Out of the total study population, 5(2.59%) women were underweight (BMI<18.5Kg/m<sup>2</sup>), 78(40.4%) women were healthy (BMI 18.5-24.9kg/m<sup>2</sup>), followed by 75(38.80%) who were overweight (BMI 25-29.99kg/m<sup>2</sup>) & 35(18.13%) women who were obese (BMI>30 kg/m<sup>2</sup>).

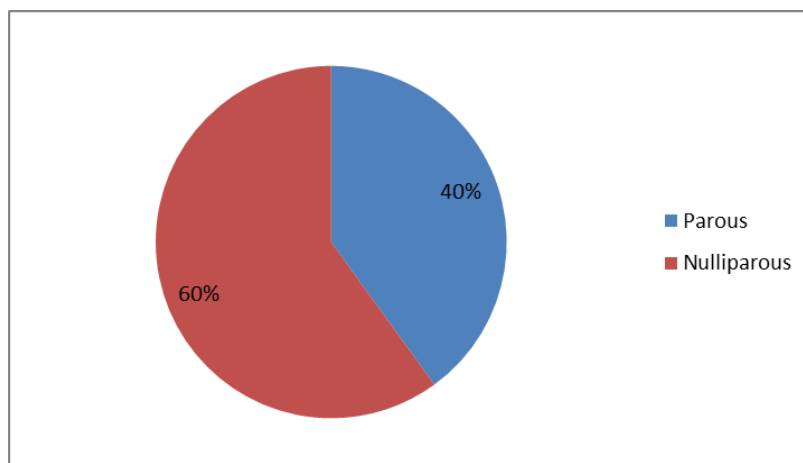
**Table 3** Interpretation of health status according to BMI

BMI (Kg/m <sup>2</sup> )	Health status	Number	%
<18.5	Underweight	5	2.59
18.5- 24.9	Healthy	78	40.40
25.0- 29.9	Overweight	75	38.80
>30	Obese	35	18.13

The distribution of participants on the basis of trimesters is presented in Table 4. Out of 193 participants, 66(34.19%) were into the first trimester of pregnancy, 57(29.50%) were into the second trimester of pregnancy, followed by 70(36.26%) in the third trimester. Out of the study population enrolled, 78(40.4%) were parous & 115(59.5%) were nulliparous [Fig.1].

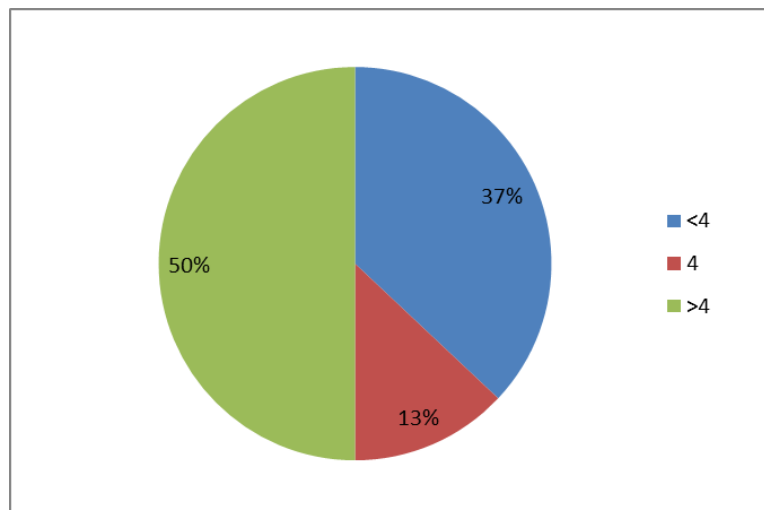
**Table 4** Distribution on the basis of trimesters

Trimester	Number	Percentage
First	66	34.19
Second	57	29.50
Third	70	36.26



**Figure 1** Distribution on the basis of parity

The distribution of the subjects on the basis of prenatal visits have been presented in Fig.2.1.Out of the 193 patients, majority 96(49.7%) attended ANC more than 4 times, 71(36.7%) less than 4 & about 26(13.4%) attended ANC for 4 times. [Fig.2]



**Figure 2** Distribution on the basis of number of prenatal visits

The biochemical data of the subjects have been represented in Table 5. According to this data we found that the rate of red blood cells of pregnant women, the hemoglobin & MCV are standard. From the table we see that normal distribution because the median is above average, except for RBCs & Hemoglobin.

**Table 5** Biochemical data

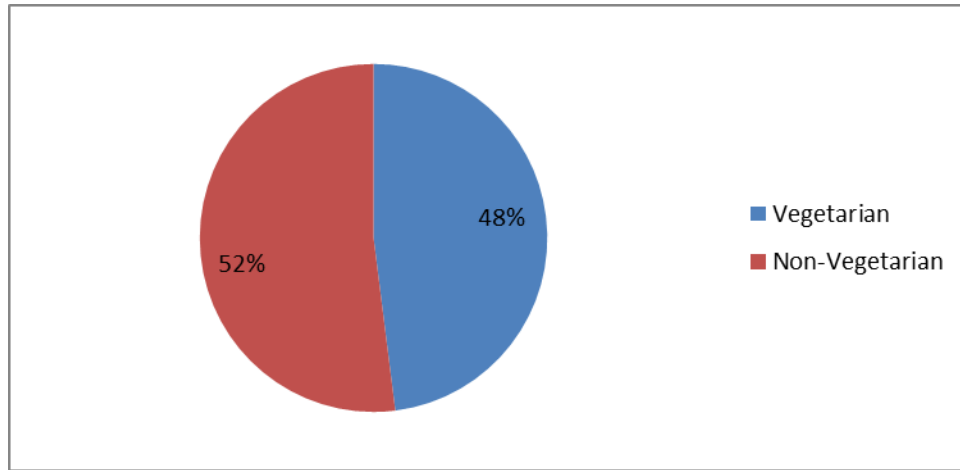
Parameters	Standard Values	Mean +SD	Maximum	Median	Mode
RBCs*10 <sup>6</sup> /mm <sup>3</sup>	4.00 – 5.50	4.01 + 0.45	3.91	2.92	5.42
Hb(g/dl)	11.5 – 13.5	11.59+ 0.97	11.8	7.9	13.5
MCV(fl)	76.00 – 96.00	81.48 + 11.57	82	75.7	99

As per WHO definition, Hb below 11 g / dL and MCV below 85 fl is considered as anemia. [WHO, 2001]. In our study it was found that 20% of women have anemia, 73% of the women had iron deficiency anemia whereas 6.2% had Folate deficiency anemia.

**Table 6** Incidence of anemia

Parameter	Range	N	%
Hb (g/dl)	<11	39	20%
	>11	132	80%
	Total	193	
MCV (fL)	Iron deficiency anemia <85	141	73%
	Normal pregnancy 85 -95	40	20%
	Anemia, folate deficiency >95	12	6.2%
	Total	193	

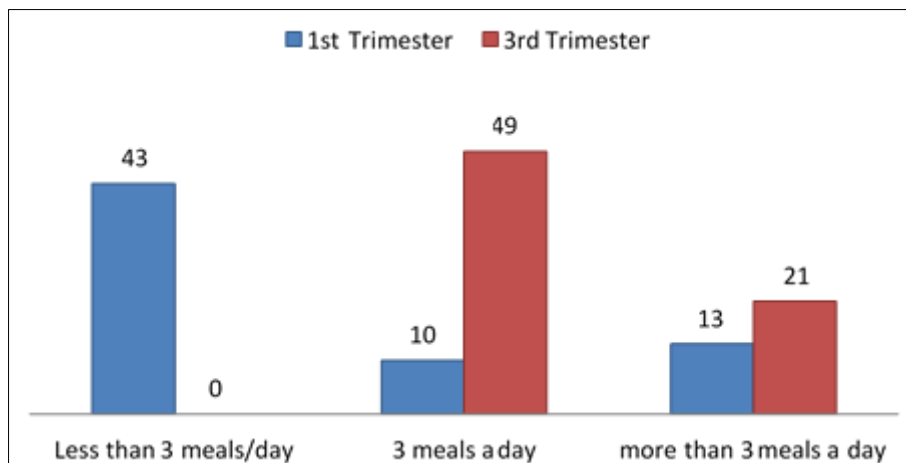
The special food requirements (Vegetarian, Non-vegetarian, and vegan) have been represented in Fig.4.1. There was a nearly equal distribution of participants on the basis of food choices, 52% followed a vegetarian diet whereas 48% preferred a non-vegetarian diet.



**Figure 3** Dietary choices of the participants

A qualitative analysis of dietary data by using food-group questionnaire has been represented in the figures below. Cereals (33%) were the most common food item consumed during breakfast, followed by dairy products (29%). Vegetables (86%) were highly consumed during lunch, followed by pulses (10%).

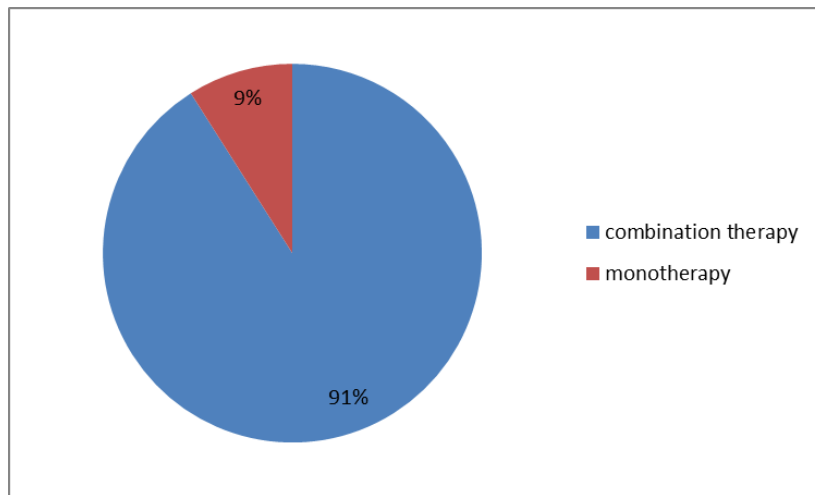
The consumption of different foods was found to depend on the term of pregnancy. Women who were in the first trimester of pregnancy had a reduced percentage of consumption of different foods from those who were in the third trimester. This was due to vomiting, nausea and food aversions that appeared in early pregnancy. Out of the 66(34.1%) women in their first pregnancy, 43(65.1%) consumed less than 3 meals a day as compared to 70(36.2%) of women in their third trimester, in which no one reported consuming less than 3 meals a day, 49(70%) of them reported consumption of 3 or more than 3 meals a day.[Fig.4]



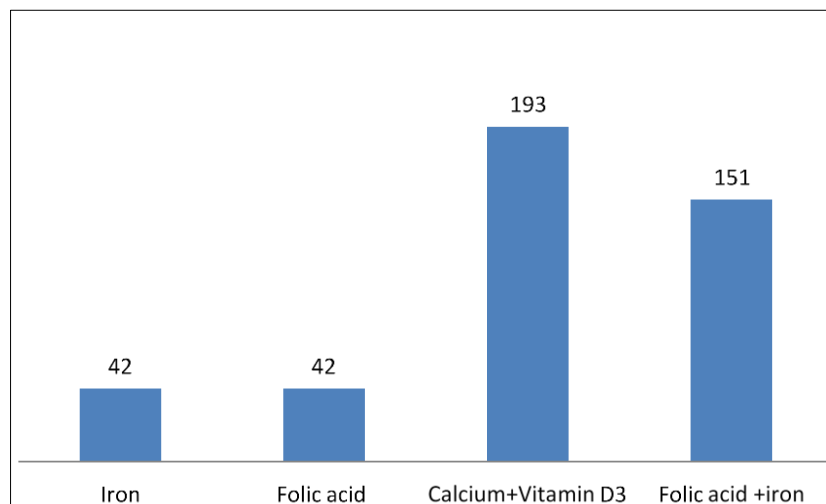
**Figure 4** Number of meals consumed in a day

Out of the 193 subjects surveyed, an average of 47.33 participants answered ‘no’ to either of the questions of FIGO, & thus their nutritional status needs to be assessed in detail.

The data regarding the Supplements prescribed according to composition is represented in Fig 5 & Fig.6. 91% of the population was on nutritional combination therapy as compared to the rest 9% who received monotherapy.



**Figure 5** Nutritional supplements prescribed as monotherapy vs. combination therapy



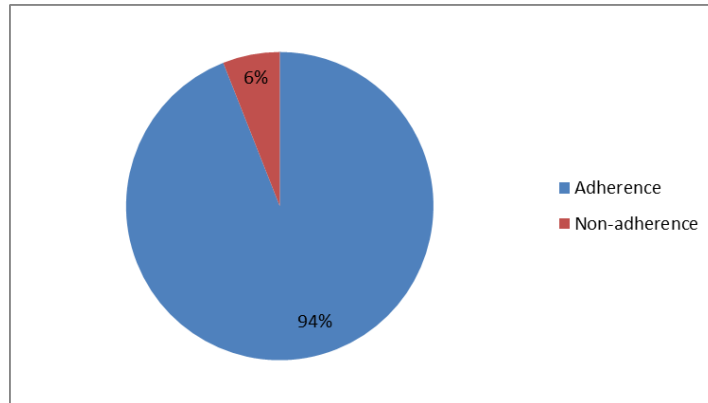
**Figure 6** Types of nutritional supplements being used

The number & percentage of women taking folic acid, vitamin D, iron & calcium supplements based on trimester of pregnancy is represented in Table 7. It was found that during the First trimester, combination of Calcium & vitamin D3 was the mostly prescribed supplement, followed by combination of iron & folic, followed by monotherapy with folic acid & iron. Similar results were found during second & third trimester.

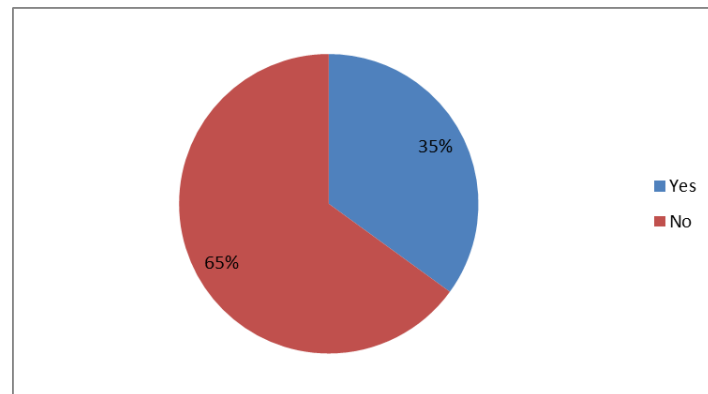
**Table 7** Distribution of supplements according to trimesters

Dietary supplement	Trimester		
	First n=66 (34.1%)	Second n=57 (29.5%)	Third n=70 (36.2%)
Iron+Folic acid	44(66.6%)	50(87.7%)	57(81.4%)
Calcium+Vitamin D3	66(100%)	57(100%)	70(100%)
Folic acid	22(33.3%)	7(12.2%)	14(20%)
Vitamin C	1 (1.5%)	0	1(1.4%)
Iron	22(33.3%)	7(12.2%)	13(18.5%)

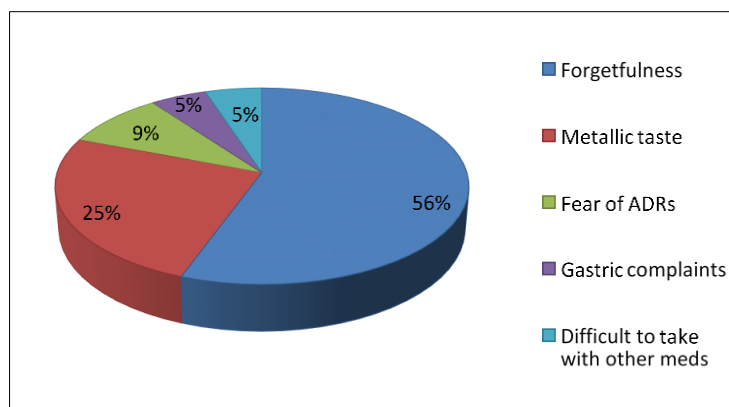
The adherence towards supplement use was assessed by the self reported intake of the subjects by using the 24-h recall method. Out of 193 subjects interviewed, 11(6%) reported that they skipped the prescribed supplement a day before.[Fig.7]. 67(34.7%) reported they tend to skip the nutritional supplements sometimes. The non-adherent subjects & barriers to adherence have been represented in Fig.8 & Fig.9. It was found that forgetfulness (55%) was the most common barrier, followed by metallic taste (26%), fear of ADRs (9%), gastric side effects (5%), inconvenience in taking them along with medications (5%).



**Figure 7** Assessment of adherence by using 24-h recall method



**Figure 8** Whether you skip supplements or not



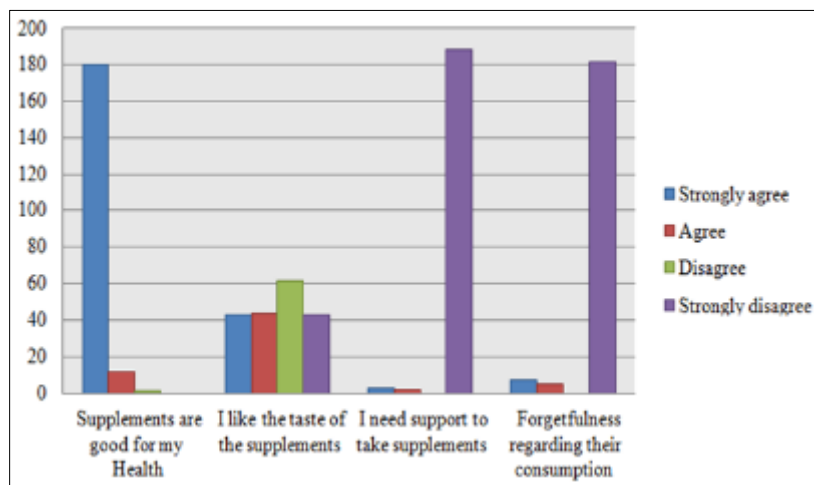
**Figure 9** Barriers to adherence



For the statement “The supplements are good for my health” only 1 person disagreed. For the statement, “I like the taste of supplements”, 43(22%) strongly agreed & 43(22%) strongly disagreed and 44(22.7%) partially agreed, and 62(32.1%) partially disagreed to the statement. For the statement, “Forgetfulness regarding the consumption” 7(3.6%) out of 193 strongly agreed, 181(93.7%) strongly disagreed, and 5(2.5%) partially agreed to the statement. For the statement, “Need support for consumption of the supplements”, 3(1.5%) strongly agreed, 188(97.4%) strongly disagreed & 2(1%) partially agreed to the statement. [Table 8 & Fig.10]

**Table 8** Knowledge/attitude towards supplement use

Statement	Strongly Agree	Partially agree	Partially disagree	Strongly Disagree
The supplements are good for my health	180	12	1	0
I like the taste of supplements	43	44	62	43
Need support for consumption of these supplements	3	2	0	188
Forgetfulness regarding the consumption	7	5	0	181



**Figure 10** Knowledge/attitude towards supplement use

#### 4. Discussion

Pregnancy is considered to be the most nutritionally demanding time in a woman’s life. The physiological changes during pregnancy stimulates the nutrient homeostasis regardless the nutritional status of the pregnant women. The utilization and turnover rate of most of the nutrients is increased in pregnancy & thus there is an increase in the nutritional demands [13]. The concept of woman’s health during pregnancy is crucial for both the woman & the neonate. Lack of optimal nutrition during pregnancy can pose a real health threat, especially into developing countries. Maternal under nutrition can lead to PTB, LBW or unsuccessful birth outcomes [14]. Over the years, the prevalence of obesity during pregnancy is increasing rapidly. A high BMI is closely related to GDM, gestational HTN, C-section, PTB, still birth, neonatal death [15]. Therefore, the assessment of nutritional status before & during pregnancy is crucial. The purpose of this study was to assess the nutritional status, the nutritional supplements, adherence to the supplements and assess the attitude/experience towards supplement use among the pregnant women visiting ANC clinic at a tertiary care hospital, in Pimpri- Chinchwad.

The total study subjects were 193, among these most of the pregnant women were in the age group of 21-30years. Majority of the study population had tertiary education & a working profession, & were into the third trimester of pregnancy. Most of the pregnant women were nulliparous. Nearly 20% of the enrolled participants were anemic, in a study conducted by Ravishankar et al, the incidence of anemia was 62.23% [16]

Out of the 193 patients, majority 96(49.7%) attended ANC more than 4 times, 71(36.7%) less than 4 & about 26(13.4%) attended ANC for 4 times. In comparison WHO reports that globally 62% of the pregnant women received the WHO

recommended minimum 4 antenatal visits during the period 2010 -2016 [17]. Studies show that a lower stillbirth rate was found in women with a minimum of 8 antenatal care visits, based on which the recommended number of ANC visits has been increased to 8 from 4. During 2006 to 2016, In India, the number of pregnant women receiving the earlier recommended minimum 4 antenatal contacts has increased from 37.0 to 51.2% [18].

The current study found a very minimal participants as underweight (BMI<18.5), while significant number of them were either obese (18%) or overweight (38%). In a similar study conducted by Fatma M et al., 2011, observed 34% of the population as obese & 31% as overweight. It further showed that the risk of elective C-section increased in obese women & miscarriages were more common among obese women compared to the normal weight [19].

A well balanced diet is a cornerstone for good health. Specific dietary choices like vegan or vegetarian diets are associated with mineral & microelement deficiencies and unfavorable outcomes during pregnancy. A vegan diet can lead to inadequate intake of zinc, iron and DHA, as well as increased risk of inadequate brain development & preeclampsia, whereas a vegetarian diet can result in iron and vitamin B12 deficiency [20]. In our study, there was a nearly equal preference for vegetarian & non-vegetarian diet.

As discussed traditional diets can be suboptimal & to meet the increased nutritional demands, nutritional supplements are essential during pregnancy. It was observed that majority of the participants were on combination nutritional therapy. The combinations prescribed were iron & folic acid, calcium with vitamin D3. In a similar study conducted by Amybranum, in the U.S., 55-60% of women in their first trimester reported taking a folic acid- or iron-containing supplement compared with 76-78% in their second trimester and 89% in their third trimester [21].

It was assessed that almost all participants received combination of calcium & vitamin D3, followed by a combination of iron and folic acid, and monotherapy with folic acid and iron. Monotherapy with folic acid was high during first trimester as compared to second and third trimester. In our study only minimal participants (6%) were found to be non-adherent, 24-hour recall method was used for assessing adherence. In a previous study conducted by Birhanu Jikamo in Southern Ethiopia, 30.41% were non adherent to iron/folate supplementation [22]. Nearly 35% of the participants reported they tend to skip supplements sometimes, to identify the barriers, the participants were supposed to state the reason why they tend to skip the supplements, it was found that majority of them reported forgetfulness as the most common barrier, followed by metallic taste, fear of ADRs, gastric ADRs, inconvenience in taking them along with other medications. In a similar study, Judith Tessema reported the common barriers to be adverse effects, and poor communication from health care providers about the benefits of use [23].

To assess the attitude & experience of the participants towards supplement use, 4 - point Likert scale was used. Majority of the study participants agreed to the statements that supplements are good for their health, majority of the participants disliked the taste of the supplements, and disagreed to the statement that they need support for consuming supplements. Minimal participants agreed that they tend to forget consuming supplements sometimes. A similar study conducted to assess the experience of participants towards use of ONS reported that majority of the par (n = 78) agreed to a very large or large extent with the statements "I like the taste of the ONS" (76%), "The ONS are good for my health" (88%) & Less than one-fifth of the patients (17%) agreed to a very large or large extent with the statement "Support from others helps me drink ONS." [24].

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## 5. Conclusion

Above half of the population was obese/overweight, & a minor population was undernourished in this study, a healthy nutrition should be considered as a major public health problem in this study area. Our study also identified prevalence of anemia, HTN, DM during pregnancy; it also aimed to assess the adherence of pregnant women towards supplement use and to identify the barriers for adherence. The experience of the women towards the use of supplement was also assessed. The Nutritional status, barriers reported, & the analysis of FIGO questionnaire helped in identifying problem areas when it comes to maintaining an optimal nutritional status, so that the healthcare providers and health organizations should give special focus on these factors. Counseling services for pregnant women might also help to improve their nutritional status. Interventions that would target maternal nutritional education, child spacing, and adherence to supplements are recommended. Comprehensive improvements in nutrition & health status during pregnancy will contribute for improved prenatal survival, optimal fetal growth, favorable obstetrical outcomes, & potential for a better long-term health in both mother and the offspring.

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

All authors declare that they have no conflicts of interest.

### *Statement of ethical approval*

The Ethical approval and permission was obtained from the ethics committee of Aditya Birla memorial hospital, Pimpri Chinchwad, Pune with the proposal number of ABMH/Academics/EC/13/2022.

### *Statement of informed consent*

Informed consent was obtained from all the subjects.

### *Authors' contributions*

The authors confirm their contribution to the paper as follows: KS and VS designed and conceptualized the study whereas data collection was done by KS, VS, NG, and OB. KS and VS analyzed and interpreted the data and wrote the manuscript, with the input from OB and NG. All authors reviewed the results and approved the final version of the manuscript.

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