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IP Journal of Nutrition, Metabolism and Health Science

Journal homepage: https://www.jnmhs.com/

Original Research Article

Nutritional supplementation and its role in Indian women's health: An expert perspective study

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Abstract

Background: Although there are several studies regarding nutritional supplements, there is a dearth of specific data regarding multivitamin use among experts in Indian contexts. So, this study gathers expert perspectives on women's awareness and nutritional supplementation needs across different life stages, with a focus on pregnancy, lactation, polycystic ovary syndrome (PCOS) management, and the use of myo-inositol (MI) and D-chiro-inositol (DCI) in Indian settings.
Materials and Methods: This cross-sectional study was conducted among Indian experts using a 23-item questionnaire designed to assess nutritional practices. The questions covered topics such as patient awareness, protein requirements, pregnancy care, PCOS management, and supplement adherence. The effectiveness of MI–DCI supplementation was also evaluated. Descriptive statistics were used to analyse the data.
Results: The study included 63 experts, of whom 92% reported that pregnant and lactating women most commonly require protein supplementation. Among them, 38% recommended protein supplementation to 51–75% of their patients. Low haemoglobin levels (Hb <9%) were observed in 11–20% of women, as reported by approximately 48% of clinicians. Additionally, 59% and 48% of experts reported low vitamin B12 and vitamin D3 levels, respectively, in 11–25% of women. An obvious improvement with the use of MI–DCI (in a 40:1 ratio) for PCOS management was noted by 37% of clinicians. About 56% identified enhanced ovarian function as the main benefit when the combination was used along with hormonal therapy. Around 68% of respondents reported that this combination improved ovulation, folliculogenesis, and oocyte quality during IVF, and nearly 75% preferred prescribing it 2–3 months before IVF.
Conclusion: The study findings are consistent with existing literature on micronutrient deficiencies in Indian women and support the clinical efficacy of the 40:1 MI–DCI ratio in enhancing ovarian function and improving reproductive outcomes in women with PCOS.

Keywords: Nutrition, Supplementation, Pregnancy, Polycystic ovary syndrome, Myo-inositol, D-chiro-inositol

Received: 01-06-2024; **Accepted:** 03-07-2025; **Available Online**: 25-07-2025

1. Introduction

Despite significant progress in reducing global poverty and food insecurity over the past five decades, the rates of maternal and child undernutrition in low- and middle-income countries (LMICs) remain unacceptably high, with over 20% of women typically affected.[1] Maternal undernutrition is a key contributor to fetal growth restriction, which significantly increases the risk of neonatal mortality and, among surviving infants, raises the likelihood of stunting by the age of two. Additionally, inadequate breastfeeding practices further elevate the risk of mortality during the first two years of life.[2]

According to the 2023 report by the Food and Agriculture Organization (FAO), India has the third-highest rate of severe undernutrition among women in South Asia.[3] Maternal and child malnutrition represent some of the most severe health challenges in India, contributing to 15% of the country's total disease burden.[4] It is the leading cause of death among children under five, responsible for 68.2% of under-five mortality, and the primary contributor to health loss across all age groups, accounting for 17.3% of total disability-adjusted life years (DALYs).[4] Widespread undernourishment and high rates of anaemia are prevalent among Indian women of reproductive age, with nearly one in four having a BMI below 18.5 kg/m².[5] To address the burden of undernutrition in pregnant women, providing nutritional supplements is considered a scalable and effective intervention. This approach has been shown to positively influence a wide range of maternal and child health outcomes.[6]

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DOI: https://doi.org/10.18231/j.ijnmhs.2025.013

Polycystic ovary syndrome (PCOS) affects approximately 6–13% of women of reproductive age, yet up to 70% of cases remain undiagnosed globally. It is the most common cause of anovulation and one of the leading contributors to infertility. Beyond reproductive problems, PCOS is linked to a range of long-term health complications that impact both physical and emotional well-being.[7] In India, the estimated prevalence of PCOS ranges from 3.7% to 22.5%.[8]

Combined hormonal contraceptives have long been used to treat PCOS with generally good outcomes; however, their use is limited by an increased risk of venous thromboembolism and other side effects. Metformin, another commonly used treatment, is often poorly tolerated due to gastrointestinal side effects, leading to low adherence. To enhance safety and avoid hormonal therapies, insulin-sensitizing agents such as inositols are being explored. These agents help restore ovulation and reduce androgen levels, particularly when used in conjunction with lifestyle modifications and weight loss.[9] Simultaneous correction of myo-inositol (MI) and D-chiro-inositol (DCI) deficiencies may improve metabolic, menstrual, ovulatory, and hyperandrogenic symptoms in PCOS. Therefore, combined MI and DCI therapy represents a rational and effective treatment option, either alone or in combination with other therapies.[10]

The present study aims to explore experts' perspectives on women's awareness and needs regarding nutritional supplementation across different life stages, with a particular focus on pregnancy, lactation, PCOS management, and MI–DCI supplementation.

2. Materials and Methods

This cross-sectional study was conducted between June 2024 and December 2024 among clinicians in major Indian cities. The questionnaire booklet named NOURISH (Nutritional Supplementation and its role on Indian women's Health: An Expert Perspective Study) was sent to the doctors who were willing to participate. The comprehensive 23-item questionnaire explored various aspects, including patient awareness of nutritional supplementation, protein needs across different groups of women, and nutritional management during pregnancy and lactation. It also addressed PCOS prevalence and management, common nutritional deficiencies, factors influencing adherence to supplements, and the effectiveness of specific interventions, particularly the MI–DCI combination.

An invitation was sent to leading Gynaecologists in the month of March 2024 for participation in this Indian survey. Clinicians were instructed to complete the questionnaire independently, without consulting colleagues. Written informed consent was obtained from all participants prior to the study. Any unanswered questions were considered as not attempted.

The data were analysed using descriptive statistics, with categorical variables expressed as percentages to illustrate their distribution. Each variable's frequency and corresponding percentage were reported to provide a comprehensive overview. To visually represent the distribution of categorical variables, pie and bar charts were generated using Microsoft Excel 2013 (version 2409, build 16.0.18025.20030).

3. Results

The study included 63 experts. According to 46% of clinicians, only 21–30% of women are aware of the role of nutrition supplementation and its health benefits. Most clinicians (65.08%) reported that 26 to 50% of women in their practice require protein supplementation. Around 48% indicated that 26 to 50% of their patients presenting to the outpatient settings are pregnant women. According to 46% of respondents, the most common age group of pregnant women in their practice is 26 to 30 years. A majority of clinicians (42.86%) reported that 11 to 20% of pregnant women in their practice are malnourished. More than half (52.38%) agreed that a lack of nutrition may lead to birth defects.

A significant number of clinicians (80.95%) reported that they advise protein supplementation along with multivitamins and minerals from the second trimester through to six months of lactation. Half of the clinicians (50.79%) stated that 26 to 50% of pregnant women are compliant with nutritional supplementation. Approximately 65% identified a lack of patient education as the primary factor contributing to non-adherence to nutritional supplementation. According to 57% of respondents, fewer than 10% of women in their practice present with peripheral neuropathy.

Most experts (92.06%) reported that pregnant and lactating women are the groups most commonly requiring protein supplementation (**Figure 1**). About 38% indicated that they advise protein supplementation to 51 to 75% of pregnant and lactating women in their practice (**Table 1**). According to 48% of participants, 11 to 20% of women have low haemoglobin levels (Hb <9%). Nearly 59% reported that 11 to 25% of women have low vitamin B12 levels, and 48% observed low vitamin D3 levels in 11 to 25% of women (**Table 2**).

The majority of clinicians (58.73%) reported that 21–30% of women in their clinical practice are diagnosed with PCOS. A significant number of clinicians (76.19%) indicated that PCOS is typically diagnosed in women aged 18–30 years. Approximately 41% reported that 21–30% of obese women in their practice are diagnosed with PCOS. According to 38% of experts, only 11–20% of women are aware of PCOS and its complications.

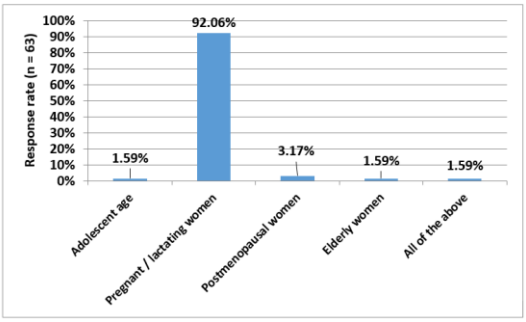

Figure 1: Distribution of responses to clinicians' opinions on the category of women most commonly requiring protein supplementation

Table 1: Distribution of responses to the proportion of pregnant/lactating women advised protein supplementation

Proportion of women advised protein supplementation (%)	Response rate (n = 63)
<10	2 (3.17%)
11-25	4 (6.35%)
26-50	18 (28.57%)
51-75	24 (38.1%)
>75	14 (22.22%)
100	1 (1.59%)

Table 2: Distribution of responses to clinicians' observations on nutrient deficiencies among women in clinical practice

Category (%)	Response rate (n = 63)		
	Low hemoglobin (Hb <9%)	Low-vitamin B12	Low-vitamin D3
<10	10 (15.87%)	15 (23.81%)	13 (20.63%)
11-20	30 (47.62%)	37 (58.73%)	30 (47.62%)
21-30	23 (36.51%)	11 (17.46%)	20 (31.75%)

Approximately 37% of clinicians observed a clear improvement with the use of MI-DCI in a 40:1 ratio for PCOS treatment (**Figure 2**). More than half (55.56%) believed that the main advantage of combining MI-DCI with hormonal therapy is the improvement in ovarian function (**Table 3**). A significant proportion (68.25%) reported that the MI-DCI combination offers multiple benefits, such as promoting ovulation, enhancing folliculogenesis, and improving oocyte quality when used along with IVF treatment (**Figure 3**). Around 75% preferred prescribing MI-DCI for 2–3 months before IVF treatment (**Table 4**).

Table 3: Distribution of responses to clinicians' perspectives on the advantages of combining MI-DCI with hormonal therapy in PCOS management

Reported advantages	Response rate (n = 63)
Regularization of the menstrual cycle	10 (15.87%)
Improves ovarian function	35 (55.56%)
Prevent complications related to PCOS	16 (25.4%)
All of the above	2 (3.17%)

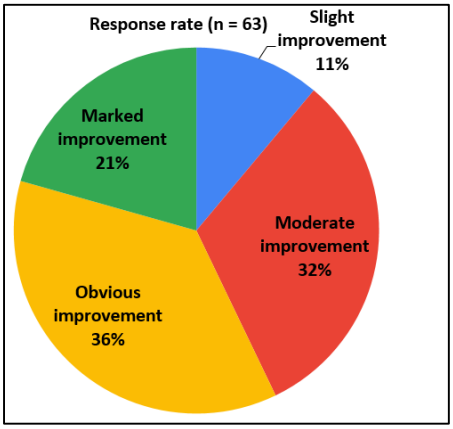

Figure 2: Distribution of responses to clinicians' opinions on the effectiveness of MI-DCI (40:1 ratio) in PCOS treatment

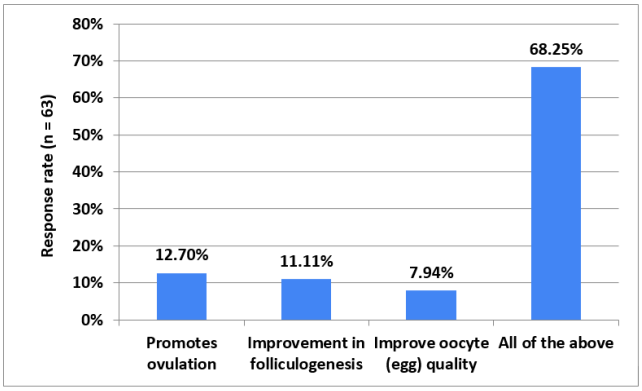

Figure 3: Distribution of responses to clinicians' perspectives on the advantages MI-DCI combination in IVF treatment

Table 4: Distribution of responses to clinicians' preferences on the timing of MI-DCI prescription in IVF treatment

Timing of MI-DCI prescription	Response rate (n = 63)
2-3 months before IVF	47 (74.6%)
1 month before IVF	8 (12.7%)
2 weeks before IVF	4 (6.35%)
During IVF	2 (3.17%)

4. Discussion

The current study highlights the importance of improving patient awareness and adherence to targeted nutritional supplementation, as well as incorporating MI–DCI therapy to enhance reproductive health outcomes in women, particularly those with PCOS or during pregnancy and lactation.

In this study, the majority of clinicians identified pregnant and lactating women as the group most commonly requiring protein supplementation, with many recommending it to 51–75% of women in this category. This finding underscores the widespread recognition of increased nutritional demands and the proactive management of dietary insufficiencies during these critical life stages. According to the World Health Organization (WHO), providing balanced protein-energy supplementation to undernourished pregnant women, where protein contributes less than 25% of total energy intake, has been shown to support healthy gestational weight gain and improve overall pregnancy outcomes.[11]

A review of 20 studies by Liberato et al. underscored the significance of total dietary protein content in influencing fetal growth. The findings suggest that balanced protein-energy supplementation—providing up to 20% of total energy as protein—can be beneficial for pregnant women with energy or protein deficiencies. Such supplementation has been shown to enhance fetal growth, increase birth weight by 95–324 grams, improve birth length by 4.6–6.1 mm, and reduce the incidence of low birth weight by 6%.[12]

Murphy et al., using data from 528 pregnant women in the National Health and Nutrition Examination Surveys (NHANES) 2003–2012, assessed usual protein intake and its adequacy across pregnancy trimesters. Mean protein intake ranged from 82 to 88 grams per day, or approximately 1.30 to 1.35 g/kg of body weight per day, with intake lowest in the later trimesters. While only 4.5% of women in the first trimester consumed less than the recommended amount, this figure increased to over 12% in the second and third trimesters. About two-thirds of the protein consumed came from animal sources. These findings highlight that a notable proportion of pregnant women may not meet protein requirements during later stages of pregnancy, underlining the importance of promoting adequate and diverse protein intake during this critical period.[13]

The prevalence of micronutrient deficiencies reported by clinicians is concerning, with the majority observing that 11–20% of women have low haemoglobin levels (Hb <9%). This aligns with the high burden of anaemia among women of reproductive age in India. Anaemia remains a major public health concern, affecting over half of women aged 15–49 years.[14] Analysis of data from the National Family Health Surveys (NFHS-4: 2015–16 and NFHS-5: 2019–21) revealed a concerning rise in anaemia among women of reproductive age, with the nationwide prevalence increasing from 53% to 57%. Between 2015 and 2021, over 60% of districts reported an increase in anaemia rates, with 29 out of 112 districts witnessing a surge of at least 10%. Pooled regression analysis identified several key risk factors for anaemia: women with three to four children (AOR: 1.13, 95% CI: 1.08–1.17), breastfeeding women (AOR: 1.17, 95% CI: 1.13–1.20), women from Scheduled Tribes (AOR: 1.39, 95% CI: 1.35–1.44), those from the poorest households (AOR: 1.27, 95% CI: 1.22–1.33), and women who consume fish only occasionally (AOR: 1.14, 95% CI: 1.12–1.17) were more likely to be anaemic.[15]

Similarly, the reported prevalence of vitamin B12 and vitamin D3 deficiencies in the current survey, where the majority of clinicians observed rates between 11% and 25%, highlights the multifaceted nutritional challenges faced by women in India. A study from South India involving 120 pregnant women revealed a high prevalence of vitamin B12 deficiency in rural areas. Vitamin B12 deficiency, defined as levels below 200 pg/mL, was observed in 55% of participants, while 17.5% were found to be anaemic (haemoglobin ≤10.5 g/dL).[16] Pandey et al. also reported a high prevalence of vitamin B12 deficiency among pregnant women in North India, which may contribute to an increased risk of neural tube defects, adverse birth outcomes, and neurological deficits in their children.[17]

In rural areas of India, the study titled ‘Srinivaspura Aging Neurosenescence and Cognition (SANSCOG)’ noted that vitamin D deficiency was significantly more prevalent among women. Among women aged 75 years and older, the prevalence of vitamin D deficiency was especially high, affecting 94% of the women.[18] At a tertiary care center in South India, a study involving 160 antenatal women revealed that only 18 participants (11.3%) had sufficient vitamin D levels (>30 ng/mL). Vitamin D insufficiency (20–29 ng/mL) was observed in 45 women (28.1%), while 97 women (60.6%) were found to have vitamin D deficiency (<20 ng/mL). Around 88% of the participants had either deficiency or insufficiency of vitamin D.[19]

The study findings demonstrate strong clinical support for MI–DCI supplementation in PCOS management, with the majority of clinicians reporting “obvious improvement” when using the 40:1 ratio formulation. Most clinicians specifically noted enhanced ovarian function when MI–DCI was combined with hormonal therapy. Additionally, many observed multiple reproductive benefits from this combination during IVF treatment, including improved ovulation, folliculogenesis, and oocyte quality. The widespread preference for prescribing MI–DCI 2–3 months prior to IVF further underscores the recognized importance of preconception nutritional optimization in clinical practice.

A randomized controlled trial by Nordio et al. found that a 40:1 MI–DCI ratio was the most effective formulation for restoring ovulation and normalizing key clinical parameters in individuals with PCOS. Other ratios tested (1:3.5, 2.5:1,

5:1, 20:1, and 80:1) were less effective.[20] An animal model study by Bevilacqua et al. reported that mice treated with the 40:1 MI–DCI formulation experienced normal delivery times post-mating, reduced theca/granulosa cell layer (TGR) thickness, and a faster recovery of fertility.[21] Another study by Colak et al. suggested that in normal-weight individuals with PCOS who do not exhibit insulin resistance, an MI–DCI (40:1) formulation may be considered a first-line treatment option.[22]

Colazingari et al. demonstrated that combined therapy with MI–DCI improved oocyte and embryo quality, as well as pregnancy rates, in women with PCOS undergoing *in vitro* fertilization and embryo transfer.[23] A randomized controlled trial by Kachhawa et al., involving 70 women with PCOS and delayed menstrual cycles, evaluated the use of MI–DCI in combination with hormonal contraceptives. The study found that the MI–DCI combination significantly improved insulin resistance and helped regularize menstrual cycles.[24] Benelli et al. investigated the effects of combined MI–DCI therapy in young, overweight women with PCOS and found it effective in improving both endocrine and metabolic parameters.[25] A randomized controlled trial by Mohammadi suggested that myo-inositol supplementation in poor ovarian responders significantly improved assisted reproductive technology outcomes, including higher fertilization rates and ovarian sensitivity index, while reducing the required doses of gonadotropins.[26] Additionally, D-chiro-inositol has been shown to enhance ovarian activity and increase the frequency of menstruation in women with PCOS.[27,28]

The study provides valuable insights into clinical perspectives on nutritional supplementation for women across various life stages in India, particularly highlighting the widespread recognition of protein supplementation needs during pregnancy and lactation, as well as the documented effectiveness of MI–DCI in PCOS management. The major strength of the study is the use of a carefully designed and validated questionnaire-based survey, which enabled expert insights grounded in evidence-based practices. However, the study has certain limitations. The small sample size may limit the generalizability of the results. Additionally, since the conclusions are based on expert opinion, there is potential for bias. Further research involving larger sample sizes and randomized controlled methodologies is needed to validate these findings.

5. Conclusion

The study findings align with established literature regarding micronutrient deficiencies among Indian women and demonstrate strong clinical support for specific nutritional interventions, particularly the 40:1 ratio of MI-DCI for improving ovarian function, ovulation, and reproductive outcomes in women with PCOS. These findings suggest potential avenues for developing standardized nutritional protocols in women's healthcare across India.

6. Source of Funding

None.

7. Conflict of Interest

None.

8. Acknowledgement

We would like to thank all the Gynaecologists who participated in this study.

9. Ethical clearance

The study was conducted after receiving approval from Bangalore Ethics, an Independent Ethics Committee, which is recognized by the Indian regulatory authority, the Drug Controller General of India.

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Cite this article: Manjula S, Kumar MK. Nutritional supplementation and its role in Indian women's health: An expert perspective study. *IP J Nutr Metab Health Sci*. 2025;8(2):60–65