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Preconception care in South Asia: awareness, risk factors and interventions – a scoping review

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ABSTRACT

Objectives To review the prevalence of risk factors in preconception care of women of reproductive age and those actively planning pregnancy, the effectiveness of specific interventions and the awareness of preconception care and barriers to its delivery in South Asia.

Design A scoping review was performed.

Data sources A systematic search strategy was performed on PubMed and Scopus databases.

Eligibility criteria We included all studies on preconception risk factors, awareness and barriers to preconception care in South Asia. The search was limited to papers published between 2019 and 2024 in the English language alone.

Data extraction and synthesis We extracted the authors' names, year of the study, study design, number of participants, risk factors, interventions, awareness levels, barriers to utilisation, and main findings of the study. We presented the findings through narrative synthesis.

Results We found 45 studies that met our inclusion criteria. The findings reveal that both undernutrition and overnutrition are prevalent risk factors in preconception women. Micronutrient deficiencies, specifically iron, iodine, zinc, vitamin A, and vitamin D, are common. In addition, behavioural and social risk factors such as tobacco use, alcohol consumption and intimate partner violence further increase the health risks faced by women in the preconception stage. Interventions focused solely on nutritional supplementation were found to have a modest impact on pregnancy outcomes. In contrast, integrated care packages that address multiple aspects of preconception health—nutritional, behavioural and social—may yield more substantial benefits. Several sociocultural and systemic barriers are potential limiting factors in the widespread utilisation of preconception care services.

Conclusions Future studies must focus on designing a comprehensive care package for preconception that extends beyond nutritional interventions and study their implementation at the community level.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Preconception care (PCC) is recognised as a critical intervention to improve maternal and neonatal health outcomes. In South Asian countries, PCC remains grossly underaddressed and poorly integrated into routine healthcare services. Most of the existing literature focuses on interventions in the antenatal period, with limited attention given to the preconception period. The paucity of a comprehensive understanding of the existing PCC strategies prompted the need for this scoping review.

WHAT THIS STUDY ADDS

⇒ This study maps the existing evidence on PCC in South Asia, highlighting key risk factors, intervention strategies and gaps in service delivery. It reveals a greater focus on maternal nutrition with limited attention to psychosocial and environmental risk factors. The findings underscore the need for context-specific, comprehensive PCC models with a multi-pronged approach tailored to the region's unique health system including the management of pre-existing health conditions.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Future research can address neglected aspects of PCC, such as psychosocial and environmental determinants. It highlights the need to embed PCC within existing primary healthcare systems, moving beyond maternal nutrition alone. The findings can support policy-makers in developing region-specific guidelines and integrated PCC programmes to improve maternal and child health outcomes.

BACKGROUND

Preconception care (PCC) comprises a set of preventive and management interventions that aim to identify and modify risks to a woman's health or pregnancy outcome by interventions before or early in pregnancy.[1] These health promotion interventions can be implemented before the first pregnancy, starting from adolescence, or between two pregnancies. Preconception interventions focus on improving nutrition, identifying and treating medical conditions, modifying risky behaviours, addressing psychosocial factors and eliminating common environmental risks.[2] PCC includes, but is not limited to, clinical visits before pregnancy. It involves an

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increased knowledge and changes in attitudes and behaviours related to reproductive choices. Moreover, PCC is not limited to just the woman; it should also involve the partner and other family members who can influence behavioural changes.[3] The components of PCC, where there is evidence to support their benefit for pregnancy outcomes, have been summarised in a systematic review by Korenbrot *et al* and included 19 such research trials.[4] The identified interventions included comprehensive health screening, folic acid supplementation, and nutritional counselling for women with metabolic problems such as diabetes and hypertension.[4]

Several medical, nutritional and behavioural risk factors in women can affect pregnancy outcomes.[5–9] Addressing these risks before pregnancy is an essential component of PCC. These include stopping smoking and alcohol use; supplementing thyroxine in women with clinical or subclinical hypothyroidism; managing obesity to achieve a healthy weight; optimising control and medications for diabetes, hypertension, asthma, anaemia, seizure disorders, and other medical conditions; correcting folate and other micronutrient deficiencies; screening and managing hepatitis B, HIV/AIDS and sexually transmitted infections.[9]

There is a dearth of studies that evaluate the effectiveness of a multicomponent PCC package of services. Though there are guidelines for care for women with specific medical conditions such as diabetes, hypothyroidism and epilepsy before conception, there is no comprehensive PCC package that incorporates nutritional, medical and behavioural considerations. A recent systematic review of clinical practice guidelines on PCC identified 11 guidelines from the USA, UK, Canada, Australia and India. This review demonstrated that the level of evidence was highest for the prevention of neural tube defects through folic acid supplementation and the prevention of HIV transmission by providing antiretroviral medications.[10] PCC is not addressed within health programmes in most low-income and middle-income countries. Across the eight South Asian countries, PCC practices are poorly documented. This is despite the high prevalence of malnutrition, anaemia, consanguineous marriages, poverty, socioeconomic challenges and limited access to good quality healthcare.[11–20] We conducted this scoping review to explore what is known about PCC in South Asia, focusing on the prevalence of risk factors, evidence of the effectiveness of specific preconception interventions and existing good practices in the delivery of PCC.

METHODS

We conducted a scoping review according to the Joanna Briggs Institute guidelines. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses scoping review checklist has been included in online supplemental file 2.

Eligibility criteria

For this review, South Asia was defined according to the World Bank regional classification, which includes Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. We included primary studies using any methodology, and scoping and systematic reviews on PCC conducted in one or more South Asian countries (ie, India, Sri Lanka, Pakistan, Bangladesh, Nepal, Bhutan, Maldives and Afghanistan). For the purpose of this review, we defined PCC using the definition described by the Preconception Care Work Group and Select Panel on Preconception Care Centers for Disease Control and Prevention (CDC) in 2006 : 'Preconception care is defined as a set of interventions that aim to identify and modify biomedical, behavioural and social risk factors to a woman's health or pregnancy outcomes, through prevention and management.'[21] It encompasses nutritional status, chronic disease management, mental health, genetic and hereditary conditions, infectious diseases, substance use, environmental exposures and sociocultural determinants to optimise maternal and fetal health outcomes.

We included papers that provided the prevalence of preconception risk factors, evidence of effectiveness for any PCC intervention or implementation of PCC strategies. We included research studies of any design, theoretical papers, clinical guidelines, commentaries and opinion pieces to gain a broad understanding of existing PCC strategies in South Asia. Only articles published in English were considered for inclusion. The review was restricted to studies published within the last 5 years (2019–2024). We excluded preprints. The studies included women in the reproductive age (15–49 years), newly married women, women actively planning pregnancy, as well as adolescent girls (13–18 years).

Information sources

We searched the PubMed and Scopus databases for peer-reviewed publications. The search dates were as follows: PubMed (5 July 2024) and Scopus (6 July 2024). The complete search strategy for each database, along with filters used, has been provided in online supplemental file 3. The search strategies were refined through team discussion.

Search strategy

We applied the following search strategy for the PubMed search.

((anaemia* OR "folic acid" OR iron OR "neural tube defect*" OR ("blood pressure" OR hypertension*) OR (contraception* OR "contraceptive technique*" OR "family planning service*") OR ("Diabetes mellitus" OR "glycaemic control") OR "gestational diabetes mellitus" OR ("domestic violence" OR "intimate partner violence") OR (maltreatment OR abuse*) OR environment OR (exercise OR "physical activity" OR yoga) OR (meditation OR mindfulness) OR ("family history" OR "hereditary disease*") OR "genetic disease*" OR "gene

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mutation*" OR "obstetric history*" OR "genetic counselling" OR "genital mutilation" OR "health history" OR (immunization OR vaccination) OR ("job related stress" OR "workplace stress") OR "occupational hazard*" OR (radiation OR "x ray exposure") OR (knowledge OR awareness) OR sleep OR relaxation* OR ("mental health" OR "psychological illness*" OR depression OR anxiety OR "psychological disorder*" OR "psychiatric illness*") OR "self-harm" OR antidepressants OR (nutrition OR vitamins OR micronutrient) OR ("eating disorder*" OR "anorexia nervosa" OR "bulimia nervosa") OR "partner health" OR HIV OR "Sexually transmitted disease*" OR "Hepatitis B" OR "prescription drug*" OR "nonprescription drug*" OR smoking* OR alcohol OR "substance abuse" OR "recreational drugs" OR ("thyroid disorder*" OR hyperthyroidism OR hypothyroidism) OR ("autoimmune disorder*" OR "Systemic lupus erythematosus" OR "rheumatoid arthritis*") OR asthma OR ("weight management" OR underweight OR overweight OR obese*) OR (epilepsy OR "seizure disorder*") OR tuberculosis OR "infectious disease*" OR "hemoglobinopathy*" OR "beta thalassemia" OR haemophilia OR "thromboembolic disorder*" OR "congenital malformation*" OR macrosomia OR "still birth" OR "preterm birth" OR "low birth weight" OR "developmental delay*" OR "foetal abnormality*" OR "neonatal abnormality*" OR "chromosomal abnormality*" OR "teratogen exposure*" OR ("pregnancy loss" OR miscarriage) OR malignancy OR "non-malignant disorder*" OR infertility OR "fertility clinics" OR "sociocultural factor*")) AND (preconception OR prenatal OR prepregnancy OR "before pregnancy" OR "before conception") AND ("South Asia" OR India* OR Bangladesh* OR Bhutan* OR Nepal* OR Pakistan* OR "Sri Lanka*" OR Maldives* OR Afghanistan*)

We used a slightly modified strategy for Scopus.

The search was limited to publications from 2019 to 2024, English language, human studies including females, full text availability and excluded preprints.

Selection of sources of evidence

Two researchers, AG and VG, screened the titles and abstracts of all the papers using the eligibility criteria for inclusion. We used the Rayyan software[22] for screening the titles and abstracts and removing duplicates. We exported the included papers to an Excel spreadsheet and then downloaded the full papers. AG and VG read all the full papers and extracted the required data. Whenever AG and VG had a discrepancy in data extraction, they discussed and reconciled by arriving at a consensus.

Data charting and items

AG and VG completed the data charting independently on an Excel spreadsheet after deciding which variables to extract. We extracted the following information: the country of origin of the study, study design, research participants, research objective, type of preconception risk factor studied, type of preconception intervention examined and the main findings of the study.

Critical appraisal

As our main aim was only to understand the status of research and practice in PCC in South Asian countries and not to combine the findings into a comprehensive evidence base, we did not critically appraise each study.

Synthesis of results

Both AG and VG read the emerging themes. The papers were classified into studies of preconception risk factors—nutritional factors, preconception body mass index (BMI), tobacco use and intimate partner violence (IPV)—and studies of preconception interventions, including folic acid, iron and iodine supplementation, micronutrient supplementation, contraception and barriers and facilitators to the utilisation of PCC.

Patient and public involvement

This study is a scoping review of existing literature and did not involve patients or human participants in its design, conduct, reporting or dissemination plans.

RESULTS

Selection of sources of evidence

Of the 341 titles and abstracts screened, we excluded 288 as they did not belong to the South Asian region or did not relate to PCC. Of the remaining 53 eligible papers, we excluded an additional 8 after reading the full texts, as they were not conducted in South Asia or did not have a PCC component. We, therefore, included a total of 45 papers, describing 29 studies (figure 1).

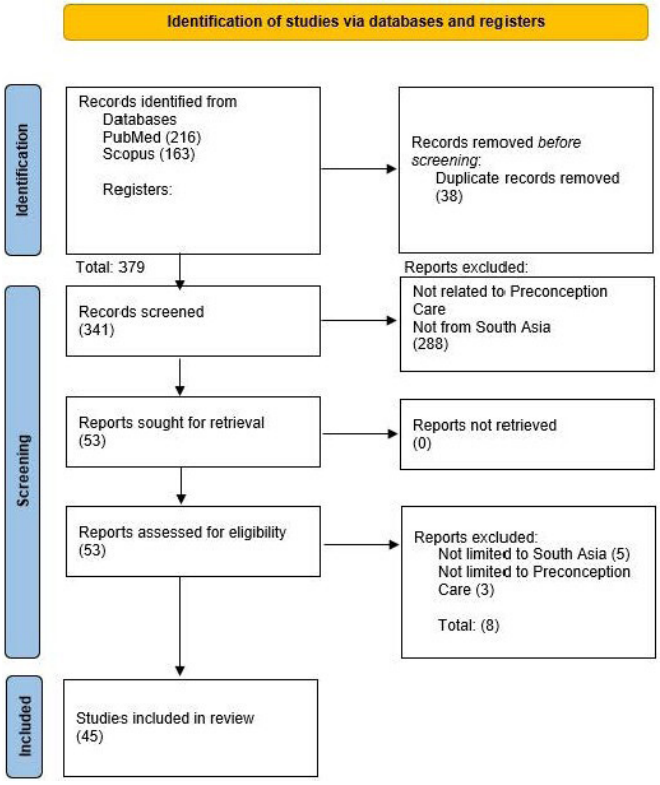


Figure 1 Sources of information, screening, inclusion and review.

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22 studies were from India, five were from Pakistan and two were from Bangladesh and Nepal. The remaining 15 were multicountry studies, including South Asian countries along with countries from other regions. The methodologies used varied with seventeen randomised controlled trials, seventeen cross-sectional studies, three systematic reviews, four qualitative studies, three cohort studies, one mixed-method study and one implementation research. The sample size for these studies is highly varied, ranging from 25 to 65 238, depending on the type of study, qualitative or quantitative, cross-sectional or longitudinal and the eligibility criteria for each. The study design, study location, demography of participants, number of participants, objective, intervention applied and main findings of each study have been presented in a detailed manner in online supplemental file 1.

Preconception risk factors

Of the 45 included papers, 19 described preconception risk factors. These included multiple risk factors such as dietary risk factors (n=9), iron deficiency (n=1), iodine deficiency (n=1), preconception BMI (n=7), tobacco use (n=4), alcohol use (n=2), mental illness (n=1), IPV (n=2) and genetic abnormalities (n=1).

Table 1 highlights nutrition-related PCC risk factors studied, the study location, study designs, number of participants and key findings. The identified studies in table 1 focus on nutritional risk factors such as food insecurity (n=2), nutritional deficiencies (n=3), and preconception BMI and its effects (n=7). These factors were associated with pregnancy complications, including gestational diabetes, hypertension and adverse birth outcomes.[23–31] Micronutrient deficiencies, including iron (38.0%), vitamin A (31.8%), vitamin D (33%–81.1%), vitamin B_{12} (32.1%) and iodine (15.3%) were notably high among women and adolescent girls, emphasising the need for targeted interventions.[23 32 33]

Table 2 describes additional PCC risk factors studied, the study location, study designs, number of participants and key findings. Additional risk factors include IPV (n=2), tobacco use (n=4), alcohol use (n=3) and unintended pregnancies (n=2).[34–39] A study also looked at mental illness and exposure to psychotropic medications with unplanned pregnancy.[40] This was a study based in Karnataka, India. Karnataka has one of India's best-developed perinatal mental health services, through National Institute of Mental Health and Neurosciences. The study revealed that women with certain characteristics were more likely to seek PCC counselling than others, such as those with an advanced educational background or a history of prolonged or severe mental illness.[40] Additionally, PCC was more frequently utilised by women managing medical comorbidities and those undergoing fertility treatments.[40] Women with previous PCC experience demonstrated a higher likelihood of seeking such care for subsequent pregnancies.[40]

A cross-sectional study based in the Nashik district of Maharashtra, India, focused on married women of reproductive age and compared the risk factors for adverse pregnancy outcomes between those belonging to tribal versus non-tribal groups. Women from tribal areas exhibited a higher number of risk factors, such as malnutrition, lack of education, environmental and social challenges, on preconception health.[38 39]

Preconception interventions and their impact on pregnancy outcomes

We identified 21 papers describing preconception interventions. These included studies of preconception nutritional supplementation, contraception, cervical cerclage for cervical incompetence and studies of multi-intervention PCC packages.

10 of these papers were from The Women First Preconception Maternal Nutrition Randomised Controlled Trial, a multicountry trial conducted in India, Pakistan and Guatemala. In this trial, women were randomised to three arms: (1) Arm 1: small-dose lipid-based micronutrient supplementation given from 3 months before pregnancy, (2) Arm 2: supplementation given from 12 weeks to the end of pregnancy or (3) Arm 3: no supplementation.[41] Additional protein energy supplementation was given to women with a BMI less than 20 kg/m^2 at the time of randomisation for arm 1, from the second trimester to arm 2 and to those who failed to meet the guidelines for gestational weight gain for arm 1 and arm 2 in the second and third trimesters.[41] The study identifier, study design, number of participants and findings of these nutrition intervention studies are shown in table 3. Preconception lipid-based micronutrient supplementation showed benefits in fetal growth outcomes such as length-for-age and weight-for-age, particularly in specific subgroups like nulliparous women without anaemia carrying male fetuses.[41 42] However, the interventions often did not significantly impact long-term growth markers such as stunting at 24 months or neurodevelopment outcomes.[43 44] Variations were observed across study sites, such as differences in the impact on placental development and nutritional markers like zinc and iodine levels.[45 46] India and Pakistan showed higher levels of hypozincaemia compared with Guatemala at 12 weeks (26%, 65%, 23%), 34 weeks (48%, 74%, 36%) and 3 months post partum (91%, 92%, 79%), respectively.[45] Guatemala (30% vs 44%) and India (26% vs 47%) showed that the intervention arm 1 helped improve iodine levels compared with arm 2. However, in Pakistan, the intervention did not make much difference (44% vs 39%).[46]

A comprehensive 2022 systematic review by Partap *et al* examined 58 global studies, including seven from South Asian nations (India, Bangladesh, Pakistan, Nepal). In contrast, their analysis revealed that while preconception nutritional interventions demonstrated modest efficacy in mitigating adverse early outcomes—specifically low birth weight, small for gestational age and preterm birth—the cumulative evidence regarding these interventions was insufficient to draw definitive conclusions about their effectiveness.[47] This is supported by the findings of

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Table 1 Preconception risk factors related to nutrition

Risk factor	Author and year	Study design	Study location	No of participants	Key findings
Nutritional risk factors					
Dietary diversity and food insecurity	Baxter *et al*, 2021	Cross-Sectional	Pakistan, rural	25 447	Pakistani adolescent girls lacked dietary diversity, which compromised the quality of their food intake.[23 24]
	Diamond-Smith *et al*, 2020	Cross-Sectional	Nepal, both rural and urban	200	Preconception food insecurity was as high as 46% in Nepal, thus leading to poor dietary quality.[25]
	Deshpande *et al*, 2023	Clinical Data	India, urban	600	Women's prepregnancy BMI and gestational weight gain were positively correlated with gestational diabetes.[26]
	Arora and Aeri, 2023	Cohort Study	India, urban	312	Women who had higher prepregnancy BMI gained more weight during pregnancy.[27]
	Naik *et al*, 2021	Cross-Sectional Study	India, both rural and urban	3950	Prepregnancy overweight and obesity prevalence was very high (37.3%). Prepregnancy overweight and obesity were associated with a greater chance of pregnancy-induced hypertension and gestational diabetes.[28]
	Bhardwaj *et al*, 2021	Cross-Sectional Study	India, both rural and urban	1000	Mothers who were overweight and obese prior to pregnancy had a greater chance of hypertension, gestational diabetes, macrosomia, large for gestational age and congenital anomalies.[29]
	Gudipally *et al*, 2023	Cohort Study	India, periurban region	980	Overweight and obese women had a greater risk of caesarean delivery, miscarriages and fetal demise.[30]
	Arora *et al*, 2021	Cross-Sectional Study	India, urban	186	The prevalence of antenatal depression was higher (50%, 48.3%, 51%) at baseline, midterm and end points among overweight and obese women.[31]
Micronutrient deficiencies					
Iron, vitamin A and vitamin D deficiency	Baxter *et al*, 2021	Cross-Sectional Study	Pakistan, rural	25 447	Young Pakistani women have a high prevalence of iron deficiency (53%), vitamin A deficiency (32%) and vitamin D deficiency (81%).[23]
Multiple micronutrient deficiencies	Patil *et al*, 2024	Cohort Study	India, rural	1520	Multiple micronutrient deficiencies, such as vitamin B_{12} (32.1%), folate (11.8%) and vitamin D (33%) were common among adolescent girls in Maharashtra, India.[32]
Iodine deficiency	Vijay *et al*, 2020	Cross-Sectional Study	India, rural	1912	In Rajasthan, a considerable prevalence of goitre (15%) suggests moderate iodine deficiency among adolescent girls.[33]

BMI, body mass index.

the SARAS project, conducted in Mumbai, India, where 2291 non-pregnant women who were planning a pregnancy were given a nutrient-rich snack as a part of the intervention.[48] A freshly prepared daily snack, starting 3 months before conception and continuing throughout pregnancy, was given to the participating women in the intervention group.[48] These snacks were made in a trial kitchen using locally available, micronutrient-dense vegetarian ingredients such as green leafy vegetables, fruits and milk.[48] In contrast, the control group was provided with snacks of relatively low micronutrient value, like potatoes and onions. Participants were instructed to consume one snack at least every other day, 3 months before conception and throughout pregnancy. Snack consumption was monitored and meticulously documented.[48] Women who conceived continued receiving the intervention until childbirth.[48] As per the Indian government protocols, all participants were also given daily supplements of iron (100 mg) and folic acid (500 µg) after the confirmation of pregnancy.

The study observed no significant differences in cardiometabolic outcomes among children born to

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Table 2 Additional preconception risk factors

Risk factor	Author and year	Study design	Study location	No of participants	Key findings
Intimate partner violence (IPV)	Jahirul Islam *et al*, 2021	Cross-Sectional Study	Bangladesh, rural	426	Research found IPV rates varied across pregnancy stages: physical IPV occurred in 52.8% of women before pregnancy, dropping to 35.2% during pregnancy and 32.2% post partum. Psychological IPV was most common but also declined from prepregnancy (67.4%) through pregnancy (65%) to post partum (60.8%). Sexual IPV showed the lowest prevalence, decreasing from 21.1% before pregnancy to 18.5% during pregnancy and 15.5% after delivery.[34]
Tobacco use	Aziz Ali *et al*, 2021	Cross-Sectional Study	Pakistan, both rural and urban	2095	71.5% of preconception women in Pakistan reported using chewed tobacco.[35]
Tobacco and alcohol use	Biradar and Halli, 2023	Cross-sectional study	India (taken from National Family Health Survey four data)	65 238	4.3% of preconception women in this study were using alcohol and tobacco. Older women from rural, poorer and uneducated backgrounds had a higher use of alcohol and tobacco.[36]
Fragile X premutation allele	Meraj *et al*, 2022	Cross-Sectional Study	Pakistan, both rural and urban	808	In women seeking preconception care counselling in the primary health centres of the Khyber Pakhtunkhwa region of Pakistan between April 2018 and December 2020, those with a family history of intellectual disability or autism spectrum disorder showed a prevalence of carriers of the premutation of fragile X of 0.7%.[93]
Unintended pregnancies	Khan and Islam, 2022	Cross-Sectional Study	Bangladesh		In this study, 20% of live births were unintended pregnancies. Having an unwanted pregnancy was not associated with a change in contraceptive use prepregnancy and postpregnancy.[37]
Mental illnesses	Nanjundaswamy *et al*, 2022	Cross-sectional study	Karnataka, India	766	Out of the total 766 women who had sought perinatal psychiatry services from 2014 to 2017, 23.37% consulted for conception counselling. Out of 179 seeking conception counselling, 104 participants opted for preconception counselling, whereas the remaining 75 had unplanned pregnancy exposure to psychotropic medications.[40]
Multiple risk factors	Doke *et al*, 2022	Cross-Sectional Study	India, both rural and urban	7875	60% of the women had several risk factors, the most common being lack of education and malnutrition.[38]

Continued

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Table 2 Continued

Risk factor	Author and year	Study design	Study location	No of participants	Key findings
	Doke *et al*, 2021	Cross-Sectional Study	India, both rural and urban	9307	Heavy physical labour (18.7%), consanguinity (18.5%), tobacco consumption (5.6%), alcohol consumption (0.5%), domestic violence (0.8%) and pesticide exposure (2.3%) emerged as common risk factors.[39]

mothers in the intervention and control groups.[48] However, subgroup analysis revealed that there were notable interaction effects between intervention allocation and child sex for multiple adiposity measurements, including BMI, skinfold thickness, and both fat mass and percentage.[48] Girls in the intervention group exhibited significantly elevated adiposity metrics compared with controls.[48] Among girls, the intervention was associated with a 2% increase in BMI (95% CI 1% to 4%; p=0.01), a 10% higher fat mass index (95% CI 3% to 18%; p=0.004), and 7% greater body fat percentage (95% CI 1% to 13%; p=0.01).[48] There were also trials of multi-intervention care packages of PCC, shown in table 3.

Table 4 summarises key studies and guidelines on PCC, highlighting a range of targeted interventions and their diverse impacts on maternal and neonatal health. These studies, using randomised controlled trials (n=2), systematic review (n=1), implementation research (n=1) and observational studies (n=3) and recommended guidelines (n=2), explore interventions such as nutritional supplementation, management of pre-existing conditions, family planning, and psychosocial support.[49–53] While some interventions demonstrated benefits, including modest reductions in low birth weight, improvements in cognitive scores of the children, increased antenatal care utilisation, and enhanced family dynamics, others showed limited or no effect on long-term outcomes.[25 49 50 54]

Sumadhur was a 4-month weekly group intervention in Nepal targeting families (wives, husbands and mothers-in-law) that combines education and interactive activities addressing nutrition, prenatal care, gender inequality, family planning, and household relationships.[53] An 18-month study of 200 newly married women recruited from 2018 to 2020 revealed significant benefits: traditionally homebound women gained permission to attend through family involvement; maternal nutrition education proved particularly effective; and interpersonal family dynamics improved substantially. Women reported better nutritional care. Notably, the practice of women eating leftover meals at last decreased dramatically from 43% to just 3%.[53]

In a study among married women in India, health, nutrition, psychosocial care and support, and WaSH interventions were delivered to the intervention group during preconception, pregnancy and early childhood.[49] Interventions given only during the preconception period did not result in a significant difference in low birth weight (RR (relative risk) 0.85) or stunting at 24 months.[49] However, continued care through the preconception period to early childhood led to significant reductions in low birth weight (RR 0.76) and stunting at 24 months (RR 0.49).[49] These findings highlight the potential of targeted interventions while acknowledging the complexity of achieving consistent improvements across all health outcomes through PCC.

Awareness, attitudes, behaviours related to PCC, barriers and facilitators to their utilisation

We identified two studies describing the barriers and facilitators to utilisation of PCC and three focused on awareness, attitudes and behaviours related to PCC.

There were several sociocultural barriers to using PCC services in this region. Patriarchal social norms, low status of women in society, lack of reproductive autonomy, lack of awareness and utilisation of contraceptive services and financial constraints greatly limited the use of PCC.[55–58] The dimensions of PCC studied and their key findings are summarised in online supplemental file 1. Early marriage emerges as a significant negative factor, reducing awareness and autonomy, while higher education, income and greater spousal age differences are associated with better knowledge and practices.[59] The studies also highlight opportunities for improvement, such as integrating PCC into existing health systems and leveraging local governance structures to enhance accessibility.[55] These findings underscore the urgent need for targeted interventions addressing systemic, sociocultural and educational barriers to improve the adoption and effectiveness of PCC.

DISCUSSION

Our review highlights that several important risk factors are prevalent in women of reproductive age in South Asia, including malnutrition, obesity, micronutrient deficiencies, high consumption of tobacco, IPV and high prevalence of unplanned, unintended pregnancies. However, preconception nutritional interventions mainly addressed undernutrition and micronutrient malnutrition, with few studies describing interventions targeting other risk factors such as overweight and obesity, psychological care or pre-existing medical conditions.

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Table 3 Effect of preconception nutrition interventions on pregnancy outcomes

Study identifier	Author/year	Study design	No of participants	Main findings
Women First Preconception Maternal Nutrition Trial.NCT01883193	Dhaded *et al*., 2020	Randomised controlled trial	961	Preconception nutritional supplementation led to a significant improvement in fetal growth, measured by length for age, weight for age and weight-to-length ratio for age.[41]
	Hambidge *et al*, 2019			Parity, anaemia and the sex of the fetus significantly modified the impact of preconception nutritional supplementation on fetal growth. Nulliparous women without anaemia and carrying a male fetus experienced a greater effect.[42]
	Fernandes *et al*, 2023			Preconception nutrition supplementation did not influence neurodevelopment in cognitive, language, gross motor or fine motor domains. There were no differences in visual or auditory evoked response potentials.[43]
	Young *et al*, 2021			Preconception nutritional supplementation did not impact vitamin B levels in human milk. However, site-specific differences were seen between India, Pakistan and Guatemala.[94]
	Krebs *et al*, 2022			Preconception nutrition had no significant impact on stunting at 24 months of age. Being born small was the most important predictor of stunting at 24 months.[44]
	Castillo-Castrjon *et al*, 2021			Among Pakistani women, preconception nutritional supplementation led to larger placental surface area, larger length for age at birth, increase in the placental rpS6(T37/46) ratio, decrease in the AMPKA(T172) ratio, increased placental IGF1 mRNA expression and increased placental PAPP-A levels.[95]
	Krebs *et al*, 2021			There was no difference in length for age or weight for age at 6 months between preconception and pregnancy nutritional supplementation. However, preconception nutritional supplementation was superior to no supplementation. There was no significant impact of preconception nutrition on other growth measures.[96]
	Hambidge *et al*, 2019			There was no difference between preconception nutrition supplementation and supplementation during pregnancy concerning length for age, stunting, small for gestational age (SGA) or preterm births (PTB). However, length for age was better and stunting was lower in the preconception nutrition arm compared with no intervention.[97]
	Kemp *et al*, 2024			There was no difference in serum zinc concentrations between the groups at 12 weeks of pregnancy and 3 months postpartum. Zinc deficiency at 34 weeks was associated with lower length for age and weight for age at birth.[45]
	Young *et al*, 2020			The serum I/Cr ratio was higher in the preconception arm compared with the pregnancy supplementation arm at 12 weeks, but at 34 weeks, the mean values did not differ significantly. The serum I/Cr ratio at 12 weeks was associated with birth length and head circumference.[46]
	Partap *et al*, 2022	Systematic review		A review of 58 studies showed that the evidence was largely inconclusive about the effects of any intervention on low birth weight, SGA and PTB. However, there was a minor effect of reduction of early adverse outcomes.[47]
Mumbai Maternal Nutrition Project (Project 'SARAS'; (ISRCTN)62 811 278).	Sahariah *et al*, 2022	Randomised controlled trial	2291	15% of children were stunted, 34% were wasted and 3% were overweight. Providing women with micronutrient-rich foods from before pregnancy through delivery did not affect their children's body composition or cardiometabolic risk markers. However, subgroup analysis revealed that when supplementation began more than 3 months before conception, it was associated with increased adiposity in female children.[48]

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Table 4 Effect of multi-intervention preconception care packages and other non-nutritional interventions on pregnancy outcomes

Author, year	Study design	Preconception interventions	Findings
Jacob *et al*, 2020	FIGO Position Paper Guidelines	BMI assessment and management, exercise, managing diabetes, HTN and PCOS (Polycystic Ovary Syndrome), folic acid supplementation, assessing nutritional deficiencies and managing diet and health of the partner.[98]	Guidelines on providing preconception care
Singh *et al*, 2024	Indian Academy of Paediatrics Consensus Guidelines	Screen for diabetes, iodine intake, screen for and manage hypothyroidism, measure and manage BMI, iron folic acid intake, calcium supplementation, screen and manage STIs, immunisation, address substance use, and mental health.[99]	Guidelines on providing preconception care
Taneja *et al*, 2022	Randomised controlled trial	Health, nutrition, psychosocial and water, sanitation and hygiene (WaSH) interventions	Preconception care had a modest effect on reducing low birth weight. However, it did not lead to a reduction in stunting at 24 months of age.[49]
Upadhyay *et al*, 2024	Randomised controlled trial	Health, nutrition, psychosocial and WaSH interventions	Compared with the controls at age 24 months, children in the preconception intervention groups had higher cognitive scores but had similar language, motor and socioemotional scores as controls. Those receiving pregnancy and early childhood interventions had higher cognitive, language, motor and socioemotional scores than did controls.[50]
Lassi *et al*, 2020	Systematic review	Delaying the age at first pregnancy, contraception promotion, optimisation of the interpregnancy interval and periconception iron and folic acid supplementation.	The 45 studies that were reviewed showed an increased uptake of contraception with health education interventions. Periconceptional supplementation with iron and folic acid reduced neural tube defects and anaemia.[52]
Doke *et al*, 2024	Implementation research	Clinical examination, lab tests, deworming, anaemia management, folic acid supplementation, contraception and family planning. (Nashik Model)	Reduction in preterm birth and low birth weight in the intervention clusters compared with the control.[51]
Nuruzzaman Khan *et al*, 2024	Cross-sectional study	Preconception care and health education	Receiving preconception care and health education was associated with increased utilisation of antenatal care. This was worsened by having an unwanted or mistimed pregnancy.[54]
Diamond-Smith *et al*, 2022	Mixed-methods study	Fourth-month weekly group intervention for families—nutrition, anaemia, gender equality, contraception, family planning, relationship dynamics	Participant families were satisfied with the care package, which improved food distribution, enhanced respect for women's decision-making and positively affected family dynamics.[53]
Yanamandra *et al*, 2023	Cross-sectional study	Preconception laparoscopic cervical cerclage for women with cervical insufficiency.	About 4% were delivered between 28 and 33 weeks due to premature rupture of membranes. 13% had delivery between 34 and 36 weeks. 82% delivered after 37 weeks. For all those who carried pregnancy beyond the first trimester, there was a 100% live birth and neonatal survival.[100]

BMI, body mass index; FIGO, International Federation of Gynecology and Obstetrics; HTN, hypertension; PCOS, Polycystic Ovary Syndrome; STIs, sexually transmitted infections.

A critical insight from this analysis is the imperative for targeted nutritional strategies specifically designed for reproductive-aged women in South Asia, a region facing a complex 'triple burden' of nutritional challenges—simultaneously battling undernutrition, rising rates of overweight and obesity, and widespread micronutrient deficiencies across populations.[60 61] A recent scoping review showed that the prevalence of stunting (13%), thinness (10.8%) and micronutrient deficiencies like iron (52.5%), iodine (17%), vitamin A (19%) and vitamin D (61%) deficiencies is quite prevalent in South Asia.[16 62–65] It is well established that women's nutritional status during this critical period before conception can significantly influence placental function and the subsequent

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growth and development of the fetus.[66 67] Animal studies have shown that maternal nutritional status during implantation influences fetal growth and development, including neural development.[68] Micronutrient malnutrition during the preconception period has also been shown to have adverse pregnancy outcomes.[69] Higher rates of anaemia were found to be linked to factors such as younger age, residing in rural areas, lower education levels, lower socioeconomic status, grand multigravida (>4), birth interval of less than 2 years and food insecurity at the household level in South Asia.[63 70] Anaemia in the preconception period is known to cause low birth weight and small for gestational age babies.[71]

Underweight is more frequently observed among economically disadvantaged groups, especially in rural areas and among younger women between the ages of 15 and 19. In contrast, overweight was more prevalent among wealthier households and older women.[72 73] Therefore, the PCC programme must be tailored to the age group and their specific nutritional needs. The increasing prevalence of overweight and obesity among adolescent girls and young women is a reason for concern.[74] Prepregnancy overweight and obesity are well-established risk factors for gestational diabetes, hypertension during pregnancy, induction of labour, caesarean section, prematurity and macrosomia.[75] Similar associations are also reported in South Asian studies, as seen in this review.[26 28–30]

Preconception folic acid supplementation and its impact on reducing neural tube defects is the only intervention with strong evidence.[76] The evidence supporting other nutrient supplementation in the preconception and early pregnancy period is weak and of poor quality.[77] The evidence of WaSH interventions alone in studies has yet to report major differences in long-term outcomes. However, even in major cities across South Asia, people face disparities in WaSH access due to factors like housing quality, economic status, education, socio-religious background and occupation.[78 79] The large multicountry randomised controlled trial, the Women First Preconception Maternal Nutrition Intervention trial, showed an overall modest impact on preventing adverse early pregnancy outcomes. One potential reason that nutritional supplementation interventions alone do not significantly affect pregnancy outcomes is the complex interplay of multiple other determinants influencing these outcomes. The overall poor health status, poor access to health services and multiple other sociocultural determinants in the lives of these women influence the impact of these nutritional interventions.

Key factors contributing to higher rates of unintended pregnancies (11.9%–28.4%) in South Asia include young maternal age, lower income levels and limited contraceptive use, with the youngest and most economically disadvantaged women at a notably higher risk.[80] Enhancing women's autonomy in reproductive decision-making has been associated with improved contraceptive use.[74] Sexual and emotional IPV was found to be associated with higher odds of unmet family planning needs in India.[81] Women subjected to physical IPV have significantly reduced odds of using condoms compared with those who did not experience violence.[82] On the other hand, women who justified intimate partner IPV showed significantly lower odds of using maternal health services.[83] Given the complexity of the biological, psychological and social factors that influence a woman's health before and during pregnancy, multiintervention PCC packages are likely to be favourable. The Nashik Model is slowly gaining traction in India and is being adopted by other states to improve PCC.[49]

The nutritional landscape in South Asia reveals clear demographic patterns, with underweight more common among rural, economically disadvantaged and younger women (15–19), while overweight affects wealthier, older populations.[63 64] This necessitates age-specific and targeted PCC approaches. While evidence strongly supports periconceptional folic acid for preventing neural tube defects, other nutritional interventions show limited effectiveness, likely due to the complex interplay of factors affecting pregnancy outcomes.[71 72] These include poor health infrastructure, limited WASH access (even in urban areas), and sociocultural determinants.[67 68] The region's high unintended pregnancy rates (11.9%–28.4%) stem from factors including young maternal age, poverty and limited contraception access, with IPV further complicating reproductive health by reducing contraceptive use and maternal health service utilisation.[73 74] Given these multifaceted challenges, comprehensive intervention packages like India's Nashik Model are emerging as promising approaches to improve preconception health outcomes.[27]

The USA has been proactive in recommending PCC through the CDC, the American College of Obstetricians and Gynaecologists and the Committee on Gynecologic Practice (American Society for Reproductive Medicine).[84] The recommendations made in 2019 and reaffirmed in 2024 are comprehensive and start with the question about the woman's plan for a pregnancy within the next 12 months.[84] The Before, Between and Beyond Pregnancy resource guide for clinicians was developed through a collaboration among academic institutions, with support from Health Resources and Services Administration and contributions from the CDC's Select Panel on Preconception Care. It provides a strategic framework for advancing preconception healthcare practices in the USA.[85] The UK has multiple resources available to healthcare providers to provide PCC, including guidelines and recommendations.[86] An audit done in the UK and Ireland has identified a significant number of resources, mostly directed at healthcare providers.[86] A unique and interesting feature of the audit was the inclusion of a Patient and Public Involvement and Engagement panel, which acts as an advisory panel comprising 23 adults aged 18–45 years.[86] The newly established UNICEF recommendations released in April 2025 outline five key action areas for preconception nutrition: establishing clear definitions of the preconception period and target populations;

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creating universal registration systems for preconception women with standardised nutrition intervention packages adaptable across diverse healthcare platforms; developing innovative outreach strategies to reach vulnerable women through non-traditional channels; incorporating preconception nutrition metrics into monitoring systems while addressing research gaps; and conducting rigorous implementation research to determine optimal intervention approaches for women's nutritional health before, between and beyond pregnancies.[87] A systematic review in 2022 highlighted that PCC improves women's knowledge and mitigates risk factors, but evidence of effectiveness in men remains scarce.[88]

China successfully initiated a free, nationwide programme in 2010 that has been called the National Free Preconception Health Examination Project and has been labelled a welfare initiative.[89] While maternal and infant mortality had declined steadily, birth defect rates had not, thus prompting the Chinese government to initiate this free programme.[89] The programme covers more than 80% of couples planning a pregnancy within the next 6 months.[89] In addition to the routine evaluation that is available to all, specialised tests for thalassaemia and favism are offered to couples from high-risk areas.[89] The significant lowering of birth defects from 5.6% to 2.5% is a great validation of the programme.[90] In addition, folic acid supplementation reduced the risk of abortions, preterm births and autism spectrum disorders.[91] A descriptive study from Southern Mexico has demonstrated that knowledge levels regarding PCC are relatively low.[92] Moreover, the adoption of PCC practices is closely associated with education and socioeconomic status, particularly among populations already at high risk for adverse maternal and child outcomes.[92]

This review indicated that two community-based trials of PCC implementation have shown significant effects from a multifaceted PCC intervention that includes health, nutrition, psychosocial support, water, sanitation and hygiene initiatives on pregnancy outcomes. Consequently, future research should concentrate on optimising the PCC package, the methods of delivering it, and the modalities for its implementation. This review has also shown that there are predominantly social and cultural barriers to utilising such PCC packages. Implementing sustained and well-designed behaviour change communication campaigns can help overcome these barriers.

Though the need for robust, comprehensive, cost-effective, culturally appropriate and proven PCC programmes is felt and acknowledged by the maternal healthcare community, there still exists a large gap in implementing guidelines where they exist and in developing where they are lacking. A recent systematic review highlights the mixed association between preconception nutrition status and contextual factors, such as sociodemographic aspects and health-related indicators, underscoring the need for tailored interventions and longitudinal studies to evaluate their impact on birth outcomes.[61]

There are certain limitations to this study. Publication bias cannot be ruled out for this review. We restricted our search to two main databases, namely PubMed and Scopus. Therefore, there is a possibility that we could have missed studies in journals that are not indexed in these databases. We restricted the review to include only papers published in English. Grey literature was not included. Due to vast variations in study designs and as our main goal was only to scope the area of PCC in South Asia, we did not perform a critical appraisal of all included papers.

CONCLUSIONS

This scoping review has explored the landscape of preconception risk factors and interventions in South Asia. There is a dual burden of undernutrition, overweight and obesity in the preconception period along with multiple micronutrient malnutrition. In addition, the other common PCC risk factors in South Asia include tobacco use and IPV. The high prevalence of medical conditions like pre-diabetes, diabetes and thyroid disorders in women of reproductive age in South Asian countries is well established. Preconception interventions limited to nutrition alone seem to have only a modest impact. On the other hand, multi-intervention PCC packages seem to have a more significant effect on preventing early adverse pregnancy outcomes. Future studies are needed to investigate the implementation of these PCC packages in terms of effectiveness, feasibility, scalability and sustainability at the community level. Such packages might significantly benefit from incorporating the management of pre-existing conditions, such as diabetes, seizures, asthma, thyroid disorders and hypertension, along with the focus on maternal nutrition. Developing and incorporating well-structured, robust, locally relevant and accessible PCC programmes could strengthen the healthcare system and may be considered as a future standard of care.

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