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Research Article

Maternal and Neonatal Disorders Attributed to Iron Deficiency in South Asia

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Abstract:

Background: Iron deficiency is a global health concern, affecting populations worldwide and contributing to significant maternal and neonatal health complications. It is associated with adverse outcomes such as maternal mortality, preterm birth, low birth weight, and developmental impairments in neonates. This study aims to compare the prevalence and impact of iron deficiency on maternal and neonatal disorders globally, with a specific focus on South Asia—Nepal, India, Pakistan, and Bangladesh. By highlighting regional disparities and associated risks, the study seeks to provide insights into the burden of iron deficiency in these countries.

Methods: The analysis examines the relationship between iron deficiency and maternal and neonatal health outcomes. Data were sourced from the Global Burden of Disease platform and a comprehensive literature review, with an emphasis on women in the reproductive age range of 15–49 years, as defined by WHO and GBD standards. Studies outside this age range or involving populations beyond South Asia were excluded. The comparative approach highlights variations in prevalence and risks to better understand the unique challenges faced by different regions.

Discussion: Results reveal a disproportionately high burden of iron deficiency in South Asia, with significant disparities among Nepal, India, Pakistan, and Bangladesh. Factors such as cultural practices, healthcare access, and socioeconomic conditions contribute to these variations. The study's analysis of demographic disparities in Disability-Adjusted Life Years (DALYs) offers critical insights for guiding public health interventions.

Purpose: The aim of this study is to gather detailed information about maternal and neonatal disorders attributed to iron deficiency, particularly in South Asian countries—Nepal, India, Pakistan, and Bangladesh. Through a comparison and comprehensive review of existing data, the study seeks to shed light on the regional differences in prevalence and impact, ultimately providing a deeper understanding of how iron deficiency contributes to maternal and neonatal health outcomes in these countries.

Keywords: iron deficiency; maternal and neonatal disorders; south asia

Introduction

Vitamins and minerals are vital for health, affecting cardiovascular, kidney, and metabolic systems. Approximately 2 billion individuals worldwide are believed to suffer from at least one kind of micronutrient deficiency (1). Among these deficiencies, anemia is a major global health challenge, impacting about half a billion women aged (15–49) and 270 million children worldwide. In 2019, the condition affected a substantial portion of women—nearly one-third of non-pregnant women (539 million) and more than one-third of pregnant women (32 million) in their reproductive years (2).

Iron deficiency during pregnancy is one of the leading causes of anemia in infants and young children (3). Recognizing this significant public health issue, in 2012, the World Health Assembly established an ambitious target to reduce anemia in women of reproductive age by 50% by 2025. This initiative has catalyzed increased focus on nutritional intervention programs globally (4). This study specifically focuses on South Asia, including Nepal, India, Pakistan, and Bangladesh, to explore the extent and impact of iron deficiency on maternal and neonatal health.

Iron deficiency anemia of pregnancy is common, especially in South Asia, and is associated with adverse maternal and fetal outcomes. Iron-deficient mothers, irrespective of anemia, are at risk of delivering iron-deficient neonates (5).

The impact of iron deficiency anemia (IDA) extends beyond basic health metrics. Studies show that when the body lacks iron leading to anemia, it can impair both cognitive function and physical development (6). In pregnancy, iron deficiency can lead to placental hypertrophy, and severe maternal iron

deficiency appears to increase the risks of premature delivery, low birth weight, and infant death (7). Furthermore, it may predispose affected individuals to infections and heart failure (8).

Researchers face several key challenges in studying maternal hemoglobin levels and pregnancy outcomes. A major issue is the lack of consistency in defining anemia during pregnancy across different studies. Additionally, the timing of blood tests is critical, as hemoglobin concentrations fluctuate throughout gestation (9).

"While evidence clearly shows that iron deficiency can impair early childhood cognitive development, questions remain about the effectiveness of maternal iron supplementation during pregnancy in preventing these effects. Recent reviews have not demonstrated improvements in neurodevelopmental outcomes. Additionally, maternal ID typically does not affect fetal iron supply, leading to infants born to mothers with iron deficiency anemia (IDA) having normal hemoglobin levels, often unrelated to their mothers' iron status (7).

This study includes research investigating the impact of iron deficiency on maternal and neonatal health outcomes. Only studies focusing on women of reproductive age (15–49 years), as defined by WHO and GBD standards, were included. Research outside this age range or involving populations beyond South Asia was excluded. By analyzing demographic disparities in Disability-Adjusted Life Years (DALYs) using data from the Global Burden of Disease platform, this review highlights regional differences and associated risks.

The findings are expected to provide valuable insights into the burden of maternal iron deficiency and its impact on neonatal health, offering critical information for future research and public health initiatives. These insights aim to support policymakers in prioritizing resources and addressing regional disparities in South Asia.

Methods and analysis

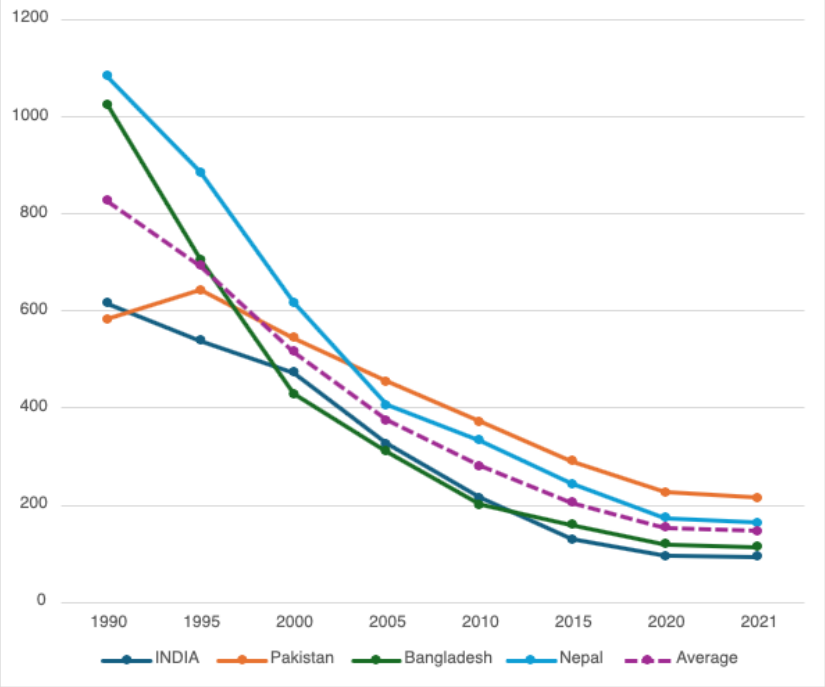
This study analyzed data on Disability-Adjusted Life Years (DALYs) attributed to iron deficiency from the Global Burden of Disease (GBD) database, maintained by the Institute for Health Metrics and Evaluation (IHME, 2024). The analysis focused on women of reproductive age (15–49 years) in South Asia, covering data from 1990 to 2021. This reproductive age range was based on the World Health Organization's definition. Data were exported and converted into Microsoft Excel for visualization, with line chart diagrams used to present trends.

A comprehensive literature search was conducted using PubMed's advanced search functionality. The search strategy combined terms related to iron status (e.g., "iron," "iron deficiency," "anemia") with population-specific terms (e.g., "maternal," "children," "neonate"). Additional literature was sourced from Google Scholar and by manually reviewing reference lists of selected studies to identify relevant articles not indexed in electronic databases.

This review did not involve primary data collection from individuals or clinical settings, as it relied on existing datasets and published literature. Therefore, participant recruitment, eligibility criteria, and informed consent procedures were not applicable.

Results

The review of Disability-Adjusted Life Years (DALY) rates for females in four South Asian countries revealed substantial improvements in population health over the 31-year period covered by the study."



Maternal and neonatal disorders attributed to iron deficiency in four South Asian countries from 1990 to 2021.

In 1990, Nepal and Bangladesh reported high DALY rates of 1083.1 and 1024.1, respectively, compared to India (615.9) and Pakistan (583.1). This suggests to a great degree the difference in countries in healthcare dominance and health problems of population and its amplitude. There is a great standard deviation of 263.6067 in the year 1990 which confirms this wide variation.

Progressive Changes (1990-2010): The first two decades displayed the most significant improvement rate where India's DALY rate decreased by about 65% (from 615.9 to 215.7). Pakistan recorded a comparatively slower decline of 36% (583.1 to 371.3), whereas Bangladesh managed to cut down its DALY rate by an astonishing 80% (decrease from 1024.1 to 201.1) Nepal on the other hand, witnessed a steady decrease of 69% (from 1083.1 to 333.8).

Recent Trends (2010-2021): The rate of improvement continued but showed some moderation. To put the numbers into perspective, India was able to reduce the rates by a further 57% (from 215.7 to 93.4). Pakistan reduced its rates by 42% (371.3 to 214.4). Bangladesh enhanced its percentage by 43% (201.1 to 113.8) whilst Nepal's rate decreased by 51% (333.9 to 164.3)

Discussion:

India: The Indian government started a program in 1970 called National Nutritional Anemia Prevention Program (NNAPP) to prevent anemia (iron deficiency) in the country. The program focused on giving iron and folic acid supplements to: 1) Pregnant women 2) Breastfeeding mothers 3)Young children (1-5 years old). Over time, the program evolved: in 1991, it was renamed the National Nutritional Anaemia Control Programme (NNACP), increasing iron doses and shifting focus toward treating anemia rather than only preventing it. In 2007, the program added liquid iron supplements for young children and expanded to include schoolchildren and teenagers. In 2013, it was renamed the National Iron Plus Initiative (NIPI) and further expanded its reach.

Throughout its evolution, the main goal was to provide iron supplements through health centers while educating people about the importance of preventing and treating anemia. The program also explored new delivery methods, such as fortified salt (10).

Pakistan: Launched in 1993, the Lady Health Workers Program (LHWP) has been central to combating anemia through its community-based healthcare system. The program's success lies in its female health workers, who reach homes in conservative areas where women have limited access to medical facilities. These workers provide anemia monitoring, nutrition education, and iron plus folic acid supplementation to women of reproductive age. The program's effectiveness is enhanced by its reach into rural regions, improved health worker training, and expanded health facilities (11).

Other initiatives include the Weekly Iron Folic Acid Supplementation (WIFS) program which specifically targets adolescent girls aged 10-19 years, providing weekly IFA tablets along with biannual deworming treatment through schools and community outreach (12). This effort is complemented by Pakistan's Anaemia Control Strategy, which is integrated into the National Nutrition Strategy, focusing on pregnant women and children under 5 while incorporating comprehensive screening and treatment protocols (13). The implementation framework includes school-based health programs that combine IFA supplementation with nutrition education, particularly targeting adolescent girls (14). While the program has shown promising results, challenges persist in supply chain management, coverage in remote areas, and compliance monitoring.

Nepal: The National Safe Motherhood Program, established in the 1990s, provides iron-folate supplementation during pregnancy (15). In 2003, the government launched the Iron Intensification Programme (IIP), utilizing Female Community Health Volunteers for community-based distribution of IFA supplements.FA supplement use during pregnancy increased from 23% to 91% between 2001 and 2016, with the percentage of women taking supplements for at least 90 days rising from 6% to 71%.

While anemia rates dropped to 46% by 2016, this progress highlighted the need to address other causes of anemia and improve pre-pregnancy hemoglobin levels, while maintaining successful community-level IFA distribution efforts (16).

Bangladesh: Bangladesh has implemented several major initiatives since the 1990s to address iron deficiency in maternal and neonatal health. The Bangladesh Integrated Nutrition Project (BINP) introduced community-based interventions and established a framework for iron-folate supplementation distribution to pregnant women (17).

In the 2000s, Bangladesh implemented key initiatives to improve maternal and neonatal health, focusing on iron supplementation:

1. National Nutrition Program (NNP): Expanding on the BINP, the NNP provided nationwide iron and folic acid supplementation to pregnant women, integrating nutrition with maternal health services (18).
2. Health, Nutrition, and Population Sector Program (HNPSP): This program combined health and nutrition strategies, strengthening antenatal care and iron supplementation, contributing to a 40% reduction in maternal mortality and 26% reduction in child mortality between 2001 and 2010 (19).

In 2010 Maternal, Neonatal, and Child Health Program integrated iron supplementation with routine care, focusing on the first 1,000 days and engaging community health workers (20).

Country-Specific Achievements: By 2021, India emerged as the best performer with the lowest DALY rate (93.4) demonstrating the most consistent and substantial improvement throughout the study period. Pakistan, while showing improvement, maintained relatively higher DALY rates compared to its neighbors in recent years, with a rate of 214.4 in 2021. Bangladesh demonstrated remarkable progress, transitioning from having the second-highest rate in 1990 to achieving the second-lowest rate by 2021. Nepal, despite starting with the highest DALY rate, showed sustained improvement but remained above the regional average in 2021.

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