## Original Research Article

# Understanding the linkages between sustainable development goal 3 and other sustainable development goals in India

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## ABSTRACT

**Background:** Despite sustainable development goals (SDG) accounting for numerous goals and targets, all of them are interconnected.
**Methods:** Using NITI (National institution for transforming India) Aayog's SDG indexes and indicators, the current study examines the interlinkage between SDG 3 indicators-neonatal mortality rate (NMR) and under-five mortality rate (U5MR) and other SDGs indicators in India.
**Results:** Spearman's correlation suggests SDG 3 has a synergetic relationship with SDG 7 (Affordable and clean energy), SDG 1 (No poverty), and SDG 5 (Gender equality). On the other hand, significant negative correlations have been seen between zero hunger (SDG 2), quality education (SDG 4), no poverty (SDG 1), and industry, innovation, and infrastructure (SDG 9) with neonatal, and U5MR. It suggested that reducing poverty, improving quality education, and taking action to address climate change are statistically linked with progress in SDG 3.
**Conclusions:** The study confirms the relevance of interactions between the SDGs. The study suggested more research and interlinked policies will be needed to achieve SDG 3 by 2030.

**Keywords:** SDG 3, NMR, U5MR, NITI Aayog, India

## INTRODUCTION

In 2016, the United Nations adopted the 2030 agenda for sustainable development, which covers all dimensions of development and encourages creative thinking to address sustainability challenges.[1] SDG 3 calls for an end to preventable deaths of newborns and children under five. By 2030, all countries should have reduced at least 12 neonatal deaths and under-five mortality to at least 25 under-five deaths per 1,000 live births. Despite the many goals and targets, they are interconnected and require multidimensional policy interventions. Previous studies have focused on the quality of interlinkages between SDGs, but conflicting intersections may occur.[2-5] Frameworks have been used to rate the relationships between SDG targets across and within the goals.[6]

Understanding these relationships is essential to show the interconnections between SDG 3 and other goals and identify co-benefits. It's crucial to consider potential connections and dependencies among the objectives within and between goals.[5,7]

The success of achieving the SDG agenda depends on utilizing the identified interactions among the goals to avoid incoherent policies and diverging outcomes.[3] Previous research has focused on the interlinkages between the SDGs and targets, with limited attention to SDG 3's relation to other goals.[5,7,8] Achieving one SDG target may be necessary to attain another. Understanding the interlinkages among the goals and targets for integrated governance and policy coherence is crucial to attaining equitable and sustainable health outcomes and improving

well-being.[9,10] The study examines the linkage between SDG 3 indicators (U5MR and NMR) and other SDGs in India to uphold health as a fundamental component of progress and achieve SDGs.

## METHODS

This study was a state panel study based on all 28 states and 8 union territories of India.

### Data source

For the present study, data on the SDG Index and SDG indicators launched by NITI Aayog, in collaboration with the ministry of statistics and programme implementation (MoSPI), the United Nations in India, and the Global Green Growth Institute, were used. The SDG Index is a useful tool that allows States/UTs to identify priority areas that require action, stimulate peer learning, uncover data gaps, and encourage healthy competition. NITI Aayog has done considerable monitoring work at the national level and collaborates closely with states and UTs to push SDG monitoring at the state and district levels from 2018 to 2020.

### Statistical analysis

Spearman's correlation analysis has been performed to link the other SDG goals and SDG 3. It is the best method of measuring the relationship between two variables and can be described using a monotonic function.

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

Where $\rho$ is Spearman's rank correlation coefficient, di is the difference between the two ranks of each observation, and n is the number of observations.

At the multivariate level, multivariable linear regression analysis has been used to identify the predictors of the SDG 3 Index, Neonatal Mortality, and U5MR in India. The model used for the present analysis is given by-

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i$$

Where $Y_i$ denotes SDG 3 index, neonatal mortality, and U5MR, and $X_i$'s were all the SDG indicators identified using Mosley Chen framework.[11]

## RESULTS

The Spearman correlation results depict that SDG 7 (Affordable and clean energy) was statistically linked with progress in SDG 3 ($\rho$=0.67) in India (Table 1). Other SDGs like SDG 1 (No poverty), SDG 5 (Gender equality), SDG 4 (Quality education), and SDG 11 (Sustainable cities and communities) were also significantly correlated with SDG 3. It has been seen that SDG 2 (zero hunger) plays an essential role in reducing the NMR ($\rho$=-0.64) and the U5MR ($\rho$=-0.63).

Findings indicate a reduction in NMR, and the U5MR was statistically linked with quality education (SDG 4), no poverty (SDG 1), and industry, innovation, and infrastructure (SDG 9). The findings also reveal that other SDGs, such as SDG 8 (Decent work and economic growth), SDG 10 (Reduce inequalities), SDG 13 (Climate action), and SDG 5 (Gender equality), are significantly correlated with NMR and U5MR.

Table 2 shows that gender equality (SDG 5) and affordable and clean energy (SDG 7) positively impacted sustainable goal 3. Whereas zero hunger (SDG 2), affordable and clean energy (SDG 7), industry, innovation, and infrastructure (SDG 9), and reduced inequalities (SDG 10) were significant predictors of reducing NMR and U5MRs. A significant association has been seen between climate change and NMR.

**Table 1: Correlation coefficients between SDG 3 index, NMR, and U5MR with other SDG goals indexes in India, 2018-2020.**

| Rank | SDG 3 index with other SDG goals indexes ($\rho$) | | NMR with other SDG goals indexes ($\rho$) | | U5MR with other SDG goals indexes ($\rho$) | | N |
|---|---|---|---|---|---|---|---|
| 1 | SDG 7: Affordable and clean energy | 0.67* | SDG 2: Zero hunger | -0.64* | SDG 2: Zero hunger | -0.63* | 66 |
| 2 | SDG 1: No poverty | 0.61* | SDG 4: Quality education | -0.62* | SDG 4: Quality education | -0.59* | 66 |
| 3 | SDG 5: Gender equality | 0.51* | SDG 1: No poverty | -0.56* | SDG 1: No poverty | -0.56* | 66 |
| 4 | SDG 4: Quality education | 0.40* | SDG 9: Industry, innovation, and infrastructure | -0.52* | SDG 9: Industry, innovation, and infrastructure | -0.5* | 66 |
| 5 | SDG 9: Industry, innovation, and infrastructure | 0.40* | SDG 7: Affordable and clean energy | -0.38* | SDG 16: Peace, justice, and strong institutions | -0.39* | 66 |
| 6 | SDG 2: Zero hunger | 0.40* | SDG 16: Peace, justice, and strong institutions | -0.36* | SDG 7: Affordable and clean energy | -0.39* | 66 |
| 7 | SDG 16: Peace, justice, and strong institutions | 0.39* | SDG 8: Decent work and economic growth | -0.32* | SDG 8: Decent work and economic growth | -0.27* | 66 |
| 8 | SDG 11: Sustainable cities and communities | 0.38* | SDG 10: Reduce inequalities | -0.29* | SDG 13: Climate action | -0.27* | 66 |

Continued.

| Rank | SDG 3 index with other SDG goals indexes (ρ) | | NMR with other SDG goals indexes (ρ) | | U5MR with other SDG goals indexes (ρ) | | N |
|---|---|---|---|---|---|---|---|
| 9 | SDG 13: Climate action | 0.38* | SDG 13: Climate action | -0.27* | SDG 10: Reduce inequalities | -0.26* | 66 |
| 10 | SDG 12: Responsible consumption and production | 0.31* | SDG 5: Gender equality | -0.19 | SDG 5: Gender equality | -0.26* | 66 |
| 11 | SDG 15: Life on land | -0.28* | SDG 12: Responsible consumption and Production | -0.09 | SDG 15: Life on land | 0.11 | 66 |
| 12 | SDG 6: Clean water and sanitation | 0.20 | SDG 11: Sustainable cities and communities | -0.04 | SDG 12: Responsible consumption and production | -0.08 | 66 |
| 13 | SDG 8: Decent work and economic growth | 0.18 | SDG 15: Life on land | 0.03 | SDG 11: Sustainable cities and communities | -0.05 | 66 |
| 14 | SDG 10: Reduce inequalities | 0.06 | SDG 6: Clean water and sanitation | 0.004 | SDG 6: Clean water and sanitation | -0.03 | 66 |

*0.05>p significant, N: Number of observations, ρ: Correlation coefficient value, NMR: Neonatal mortality rate, U5MR: Under-five mortality rate.

**Table 2: Results of multivariable linear regression analysis of SDG 3 index, NMR, and U5MR by other SDG indexes in India, 2018-2020.**

| SDG goals indexes | | Sustainable goal 3 index | NMR | U5MR |
|---|---|---|---|---|
| | | Coefficient (95%CI) | Coefficient (95%CI) | Coefficient (95%CI) |
| 1 | No poverty | 0.18 (-0.12, 0.49) | -0.10 (-0.26,0.05) | -0.15 (-0.36, 0.07) |
| 2 | Zero hunger | -0.12 (-0.43, 0.2) | -0.20* (-0.36,-0.04) | -0.26* (-0.48, -0.04) |
| 4 | Quality education | 0.09 (-0.22, 0.4) | -0.07 (-0.23,0.08) | -0.06 (-0.27, 0.16) |
| 5 | Gender equality | 0.56* (0.16, 0.95) | -0.08 (-0.28, 0.12) | -0.23 (-0.5, 0.05) |
| 6 | Clean water and sanitation | -0.06 (-0.28, 0.17) | -0.003 (-0.12, 0.11) | -0.04 (-0.2, 0.12) |
| 7 | Affordable and clean energy | 0.39* (0.19, 0.58) | -0.12* (-0.21, -0.02) | -0.17* (-0.3, -0.03) |
| 8 | Decent work and economic growth | -0.14 (-0.53, 0.24) | 0.02 (-0.18, 0.21) | 0.11 (-0.15, 0.38) |
| 9 | Industry, innovation, and infra | 0.15 (-0.05, 0.35) | -0.16* (-0.26, -0.05) | -0.21* (-0.35, -0.07) |
| 10 | Reduce inequalities | 0.2 (-0.06, 0.46) | -0.15* (-0.28, -0.02) | -0.22* (-0.4, -0.05) |
| 11 | Sustainable cities and communities | -0.13 (-0.35, 0.08) | 0.12 (0.01, 0.23) | 0.21* (0.06, 0.36) |
| 12 | Responsible consumption and production | -0.12 (-0.37, 0.13) | 0.05 (-0.08, 0.18) | 0.11 (-0.06, 0.29) |
| 13 | Climate action | 0.03 (-0.21, 0.26) | 0.12* (0.01, 0.24) | 0.16 (0, 0.32) |
| 15 | Life on land | -0.01 (-0.21, 0.19) | -0.04 (-0.14, 0.06) | -0.004 (-0.14, 0.13) |
| 16 | Peace, justice, and strong institutions | 0.16 (-0.21, 0.53) | -0.08 (-0.27, 0.11) | -0.18 (-0.43, 0.08) |
| **Number** | | 66 | 66 | 66 |

*0.05>p significant.

**Table 3: Results of multivariable linear regression analysis of NMRs and U5MRs by SDG indicators in India, 2018-2020.**

| SDG indicators | | | Coefficient (95% CI) | Coefficient (95% CI) |
|---|---|---|---|---|
| **SDG 1** | 1.2.1 | Percentage of the population living below the national poverty line | 0.43* (0.03, 0.82) | 0.62* (0.03, 1.21) |
| | 1.2.2 | Headcount ratio as per the multidimensional poverty index | -0.08 (-0.36, 0.2) | -0.07 (-0.49, 0.34) |
| | 1.3.1(a) | The proportion of the population (out of the total eligible population) receiving social protection benefits under maternity benefit | 0.05 (-0.01, 0.11) | 0.06 (-0.03, 0.15) |
| | 1.3.1 (b) | Percentage of households with any usual member covered by a health scheme | 0.36* (0.05, 0.66) | 0.37 (-0.08, 0.83) |
| | 1.4.2 | Percentage of households living in kutcha houses | -0.002 (-0.5, 0.5) | -0.61 (-1.36, 0.14) |
| **SDG 2** | 2.2.1 | Percentage of children under five years who are stunted | 0.02 (-0.4, 0.44) | 0.13 (-0.5, 0.75) |
| | 2.2.2 | Percentage of children under five years who | -0.13 (-0.46, 0.21) | -0.22 (-0.72, 0.28) |

| SDG indicators | | | Coefficient (95% CI) | Coefficient (95% CI) |
|---|---|---|---|---|
| | | are underweight | | |
| | 2.2.3 (a) | Percentage of pregnant women aged 15-49 years who are anemic | -0.2 (-0.5, 0.11) | -0.05 (-0.5, 0.4) |
| | 2.2.3. (b) | Percentage of children aged 6-59 months who are anemic (Hb<11.0 g/dl) | 0.22 (-0.04, 0.48) | 0.22 (-0.17, 0.61) |
| SDG 4 | 4.6.1 | Percentage of persons fifteen years and above who are literate | -0.64* (-0.91, -0.38) | -0.63* (-1.03, -0.24) |
| SDG 5 | 5.1.1 | Sex ratio at birth | -0.03 (-0.08, 0.02) | -0.03 (-0.1, 0.05) |
| | 5.2.1 (a) | Married women aged 15-49 who have ever experienced spousal violence | -0.04 (-0.13, 0.04) | -0.04 (-0.16, 0.09) |
| | 5.2.1 (b) | Rate of crimes against women | 0.04 (0, 0.07) | 0.09* (0.03, 0.14) |
| SDG 7 | 7.1.2 | Households using clean cooking fuel | -0.08* (-0.14, -0.02) | -0.11* (-0.2, -0.01) |
| | 7.1.1 | Percentage of households electrified | 0.06 (-0.25, 0.36) | 0.01 (-0.45, 0.46) |
| **Number** | | | 62 | 62 |

SDG indicators have been identified using Mosley et al study.[11] *0.05>p significant.

Table 3 shows the results of multivariable linear regression of NMRs and U5MRs by SDG indicators in India, 2018-2020. It has been found that in India, the proportion of the population which lives below the national poverty, the percentage of persons 15 years and above who are literate, and households using clean cooking fuel were significant predictors of neonatal and U5MRs. Targets of U5MR could be achieved by decreasing the rate of crime against women.

## DISCUSSION

This study attempted to introduce the linkages of SDG 3 child health indicators with other SDGs in India. The findings highlighted that SDG 3 is interconnected with SDG 1, SDG2, SDG 4, SDG 5, SDG 7, and SDG 9. Earlier literature supported the same path.[3,12,13] The study highlights SDG 2 (Zero hunger)'s a crucial role in reducing neonatal and U5MRs. It is more likely that improving nutrition will result in preventing neonatal mortality and under-five mortalities.[14] The results indicate that quality education (SDG 4), no poverty (SDG 1), industry, innovation, and infrastructure (SDG 9), and decent work and economic growth (SDG 8) are also linked with a reduction in these mortality rates. Increased individual health and well-being and their contribution to economic growth are closely related. Public health spending may rise as a result of economic expansion.[3] Furthermore, the article suggests that gender equality (SDG 5) and affordable and clean energy (SDG 7) positively impact SDG 3. SDG 5, which aims to ensure universal access to sexual and reproductive health care and reproductive rights, as well as to put an end to all forms of violence against women and girls (5.2) and harmful behaviors (5.3), are connected to SDG 3.[15]

The study's multivariable linear regression analysis demonstrates that poverty, literacy rates, and households using clean cooking fuel are significant predictors of neonatal and U5MRs in India. Improving access to clean cooking fuel practices was suggested to reduce air pollution, improve public health, and prevent neonatal and under-five mortalities.[2,3] Targets of NMR, and U5MR,

could be achieved by reducing the percentage of the population living below the national poverty line and increasing the percentage of persons fifteen years and above, who are literate.[16] The present article suggests that achieving targets for U5MRs requires addressing the issue of crime against women. As a result of better child health, families and communities will have access to modern energy, educate girls and women, end extreme poverty, and eradicate all kinds of violence.

The findings suggest that a comprehensive approach is necessary to address the health challenges in India, which involves focusing on multiple SDGs simultaneously. The study provides valuable insights for policymakers and stakeholders to design and implement effective strategies to achieve the SDGs and improve health outcomes in India.

### *Limitations*

One of the limitations of the present study was unavailability of suitable data for selected indicators. It has been noticed that there remains a significant data gap in assessing country-level SDG indicators in India. In this scenario, proxy indicators have been used instead of the indicators suggested by the SDG indicator framework. So due to the non-availability of data, all the SDG indicators could not be linked with SDG 3 indicators.

## CONCLUSION

The article discusses the interlinkages between different SDGs and their impact on the health and well-being of the population in India. The present study found significant correlations between SDG 3 and other SDGs, particularly SDG 7, which was strongly linked to progress in SDG 3. Several SDGs impacted neonatal and U5MRs, gender equality and a decreasing crime against women could help achieve targets for U5MRs. Achieving targets for NMR and U5MR in India requires reducing poverty, improving quality education, and taking action to address climate change are statistically linked with progress in SDG 3. With increased collaboration between health and non-health sectors, the benefits of improved health and well-

being in reducing poverty, promoting equality, and achieving sustainable development can be realized.

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