## Introduction

India has achieved a significant improvement in maternal services (WHO, 2018; Banerjee & Biswas, 2019). During the last decade, the proportion of births assisted by skilled health personnel has increased from 46.6% in 2005-06 to 81.4% in 2015-16 (IIPS & ICF, 2017). Despite this increased coverage, the maternal mortality ratio still stands at 113 per 100000 live births (RGI, 2020), far behind the global target of <70 per 100000 live births (UN, 2015). Globally, an estimated number of 2,95,000 maternal deaths occurred in 2017 (WHO, 2019). Over the past few decades, providing high and equitable coverage of maternal and child health services has been a top priority for all the countries in the developing world (Elmusharaf et al., 2015; Lassi et al., 2016). However, one needs to understand that merely ensuring coverage of services will not lead us to the global aim of achieving a maternal mortality ratio of less than 70 per 100000 live births and neonatal mortality as low as 12 per 1000 live births by 2030 (UN, 2015). These services must be of good quality providing an effective, safe, and good experience to the patient. Studies have shown that quality maternal and newborn care delivered in a timely fashion could avert 71% of neonatal deaths, 33% of stillbirths, and 54% of maternal deaths in low-and-middle-income countries (Bhutta et al., 2014). However, in developing countries, large-scale programs aimed at increasing the coverage of maternal health services have failed due to poor quality of care (Lim, 2010). The quality of care provided is substandard, despite increased coverage of these populations (Detrick, 2016). The development of suitable measurement tools is necessary to fill the gaps in the measurement of care quality and improve reproductive health outcomes. Therefore, this study is crucial as it attempts to develop a single composite index to measure maternal and newborn services quality and understand its determinants.

## Data and Methods

The study uses the secondary data available from the fourth round of the Indian National Family Health Survey (IIPS & ICF, 2017), conducted during 2015-16. Of particular interest to this study, we have obtained information on the maternal and newborn services rendered by the mother and her newborn. This paper analyzed information on a weighted sample of 184,641 women in the age group 15-49 years who had a live birth preceding five years to the survey date. This study incorporates the process indicators of MNC to find out whether these services follow the protocols and standards outlined in the Integrated Management of Pregnancy and Childbirth (IMPAC) guidelines given by WHO in 2007 [WHO, 2007]. Based on these guidelines, we examined the woman's questionnaire for NFHS-4 for the presence of

questions that could provide us with indicators of our interest. Finally, 34 indicators corresponded to all the components of the continuum of MNC were used for making a composite index for quality in maternal and newborn care (QMNCI).

*Description of variables*

*Outcome variable*

This study's outcome variable is named "Quality in maternal and newborn care index "(QMNCI), a weighted variable representing the quality in maternal and newborn care generated by using the technique of principal component analysis.

*Predictor variable*

For this study, Mother's education (No schooling, <5 years completed, 7-9 years completed, 10-11 years completed, and 12 or more years completed), Religion (Hindu, Muslim, Others), Caste (SC, ST, OBC, Others), Wealth index (Poorest, Poorer, Middle, Richer, Richest), Place of residence (Urban, Rural), and Birth order (1,2, 3, 4 or above), are considered as predictor variables.

*Statistical Methods*

We used the PCA technique to compute the quality in maternal and newborn care index (QMNCI) and calculate the variable weights. Further, we used proportional odds logistic regression to identify significant relationships of various socio-economic and demographic factors with QMNCI. We divided the quality in maternal and newborn care in three categories namely Poor, Average, and Good.

## Results

### Bivariate Associations

Results revealed that 0.226 (95% CI 0.212, 0.240) is the mean QMNCI score of women in India. A woman with no schooling had a mean QMNCI score of -1.527 (95% CI -1.555,-1.500), the score increased with an increase in the number of years of education for the woman with a woman having education of more than 12 years having a mean QMNCI score of 1.437 (95% CI 1.414, 1.460). Similarly, the mean QMNCI score was highest for women belong to the "Other" category of religion, which consists of Christian, Sikh, Jains, and others (mean QMNCI score=1.186 (95% CI 1.129, 1.243)). On the other hand, women who belonged to the Muslim religion had a mean QMNCI score of -0.295 (95% CI -0.329, -0.260). The mean QMNCI score was highest for women who did not belong to either any of the caste/tribe or were backward (mean QMNCI score=0.673 (95% CI 0.649, 0.698)), the mean QMNCI scores of women belonging to ST, SC, and OBC were -0.075 (95% CI -0.121,

-0.030), 0.165 (95% CI 0.134, 0.197) and 0.071 (95% CI 0.049, 0.092) respectively. The women belonging to the country's southern region had the highest mean QMNCI score of 1.916 (95% CI 1.893, 1.939), followed by the western region, which had a mean QMNCI score of 1.081 (95% CI 1.050, 1.112). Women belonging to the central and eastern regions had a negative mean QMNCI score of -0.872 (95% CI -0.900, -0.845) and -0.545 (95% CI -0.575, -0.516), respectively. The women belonging to the lowest wealth quintile had a mean QMNCI score of -1.725 (95% CI -1.755, -1.695), the score increased as the woman goes up in the wealth quintile, with a woman in the highest quintile having a mean QMNCI score of 1.574 (95% CI 1.550, 1.598). Rural women had a negative mean QMNCI score of -0.105 (95% CI -0.123, -0.088). On the other hand, it was 1.011 (95% CI 0989, 1.032) for urban women. Women with one child had a mean QMNCI score of 0.985 (95% CI 0.964, 1.006), and those with four or above children had a mean QMNCI score of -1.753 (95% CI -1.789, -1.716). Results reveal that Goa, Punjab, Tamil Nadu, Andhra Pradesh, and Kerala have the highest mean QMNCI score. Nagaland, Bihar, Arunachal Pradesh, Uttar Pradesh, and Jharkhand were the laggards and had the lowest QMNCI score among all the states. The mean QMNCI score for Goa is 3.114 (95% CI 2.815, 3.412), and that of Nagaland is -3.495 (95% CI -3.830, -3.161). Among the union territories, Pudducherry has the highest mean QMNCI score of 2.955 (95% CI 2.680, 3.230). The mean QMNCI score at the national level is 0.226 (95% CI 0.212, 0.240).

**Multivariate Associations**

Results show that women's educational status, wealth quintile, religion, place of residence, the region of residence, and parity were significant determinants of quality in maternal and newborn care. The odds of receiving good quality in maternal and newborn care were 1.68 times (OR 1.68; 95% CI 1.617, 1.745) among women who had 12 or more years of schooling than uneducated women. Women in the highest quintile of wealth had 192% higher (OR 2.925; 95% CI 2.793, 3.061) odds of receiving "good" quality maternal and newborn care than those in the lowest wealth quintile. Women living in the country's southern region had 114% higher (OR 2.142; 95% CI 2.063, 2.223) than the women living in the country's north region. The likelihood of Muslim women receiving good quality was 0.759 times than the Hindu women (OR 0.759; 95% CI 0.735, 0.783). The likelihood of receiving good quality in maternal and newborn care decreased with increasing parity of women. Women with four or more children had 46% lower (OR 0.531; 95% CI 0.295, 0.324) odds than those having one child.

## Conclusion

This study creates a single Quality Index (QMNCI), representing maternal and neonatal health care quality. The analysis shows the variation in index scores across some of India's known equity markers, including wealth, urban, rural status, caste, religion, and educational attainment. The study provides valuable insights into the current state of quality of care and the areas to work. The study does not only help in showing the current status of quality in maternal and newborn care, but it also indicates as to which groups are receiving excellent quality services and also helps the government to identify the laggards and make focused policies for them.

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