Extended Abstract

Geographical Patterns and Determinants of Maternal High-Risk Fertility Behavior in India

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Introduction

Maternal high-risk fertility behavior (HRFB), broadly in the form of too early or too late childbearing age, closely spaced birth and too many births, is one of the bio-demographic risk factors that could affect health of child and mother. Both extremes of the reproductive age are considered at risk for adverse pregnancy outcomes. Teenage mothers have a higher risk of preterm birth, low birth weight, and postnatal mortality [1]. On the other hand, advanced maternal age has a positive association with preterm delivery, low birth weight, perinatal death, and cesarean section [2-4]. Similarly, short birth interval and high parity carries the risk of numerous unfavorable child and maternal health outcomes [5,6]. These risk factors also adversely affect the survival chances of a mother and her child [7,8]

The incidence of early marriage followed by early childbearing is widespread in India. The 2016 National Family and Health Survey (NFHS) revealed that 27% of girls are married before their eighteenth birthday, and 31% of the married Indian women gave birth by the age of 18 years [9]. Additionally, India has a high level of parity and an average inter pregnancy interval of 16.7 months was observed in India during 2015-16 with no change in the past 10 years [9,10]. Average inter pregnancy interval in India is much shorter than in countries with similar or lower levels of socio-economic development [11-13]

Although there are studies that have explored single risk factors such as teenage pregnancy, high birth order and short birth interval in India, the authors could not find any study that have considered all the components of HRFB as defined by Demographic Health Survey (age of mother less than 18 or more than 35, more than three births and birth interval less than 24 months) [14]. Therefore, this study aims to examine the socio-demographic determinants and geographical patterns of maternal HRFB using data from the Indian version of Demographic Health Survey referred to as NFHS. This study could help policymakers to identify hot spot areas and vulnerable subgroups of women and design health interventions accordingly.

Materials and Methods

The study uses latest available data from the fourth round of National Family Health Survey (NFHS-4) conducted during 2015-16. NFHH-4 provides information on maternal and child health, family planning, other reproductive health indicators as well as sexual behavior for India's 36 states and Union territories and 640 districts. A total of 699,686 eligible women age

15–49 were interviewed with a response rate of 97% [9]. A total of 184,640 women who gave birth in the preceding 5 years before the survey is included in the final analysis.

The outcome variable of this study is maternal HRFB, defined as the presence of any of the following four conditions (coded as 1 and otherwise 0); (i) mother aged less than 18 years at the time of delivery; (ii) mother aged over 34 years at the time of delivery; (iii) the latest child born less than 24 months after the previous birth; and (iv) the latest child of order three or higher. The definition of HRFB adopted by the DHS was applied. From NFHS-4 dataset socio-demographic characteristics of women such as age at marriage, educational level, social group, religion, wealth index, media exposure, number of household members, pregnancy wantedness and children sex composition are taken as independent variables.

We first estimated prevalence of HRFB by selected socio-demographic characteristics and constructed a district level map of HRFB prevalence. We then measure spatial autocorrelation using the Moran's I index to assess whether HRFB among reproductive-age women is dispersed, clustered, or randomly distributed in India. This index measures the correlation coefficient between values observed in a district with the mean value of adjacent districts and ranges from 0 (no autocorrelation) to 1 (complete autocorrelation). When the z-score or p-value indicates statistical significance, a positive Moran's I index value indicates a tendency toward clustering while a negative Moran's I index value indicates a tendency toward dispersion [15]. Based on this, a decision is made about whether to reject the null hypothesis that HRFB among women is randomly distributed across the country.

Hot spot analysis using the Getis-Ord Gi statistics is used to measure the degree of clustering, which may be high or low. The higher (or lower) the z-score, the stronger the intensity of the clustering. A z-score near zero indicates no apparent clustering within the study area. A positive z-score indicates clustering of high values (a hot spot) and a negative z-score indicates clustering of low values (a cold spot) [16]. This statistic produces a hot and/or cold spot map using HRFB prevalence as the input. All spatial analyses and map construction are done using ArcGIS 10 software.

The study implements a multilevel logistic regression analysis to identify the predictors of HRFB considering individual women as level 1, communities/PSUs (Primary Sampling Units) as level 2 and districts as level 3. Four models are fitted for the analysis. The first model is an empty model without predictors, and it focused on decomposing the total variance into the community (PSU) and the district components, which is useful to measure the extent of cluster variation. The second and third model are adjusted for individual and community level variables, respectively. The fourth model is a full model and adjusted for both individual and community level variables simultaneously. The results of regression analysis are presented as Odds ratio, p-value, and 95% confidence interval. The measures of variation (random-effects) were reported as Intra community correlation coefficient (ICC) which measures variation in HRFB across clusters and quantifies the degree of heterogeneity of HRFB between clusters. Proportional Change in Variance (PCV), expresses the change in the community level variance between the empty model (Model 1) and the consecutive models [17]. Prior to multivariate analysis, Multicollinearity was examined using variance inflation factor (VIF). All statistical analyses are done using the Stata statistical software, version 14.

Results

Preliminary analysis of the data revealed that more than one third of reproductive-age women are exposed to HRFB in India. HRFB prevalence within states varies from 14.59% (95% CI 13.00-16.34) in Kerala to 49.20% (95% CI 47.04-51.36) in Nagaland. The district level HRFB prevalence map provided a more systematic picture of regional differentials which was further confirmed by a strong and significant Moran index of spatial autocorrelation (I = 0.473). The more intense clustering of high (hot spot) proportion of women who had HRFB is observed in central, eastern and north-eastern region of the country. We expect the results of regression analysis to reveal some important predictors of HRFB among women.

Preliminary findings conclude that the efforts should be made to reduce HRFB among women with a focus on hotspot areas and underprivileged subgroups of women in India.

References

1. Gibbs, C. M., Wendt, A., Peters, S., & Hogue, C. J. (2012). The impact of early age at first childbirth on maternal and infant health. *Paediatric and perinatal epidemiology*, *26*, 259-284.
2. Kenny, L. C., Lavender, T., McNamee, R., O'Neill, S. M., Mills, T., & Khashan, A. S. (2013). Advanced maternal age and adverse pregnancy outcome: evidence from a large contemporary cohort. *PloS one*, *8*(2), e56583.
3. Laopaiboon, M., Lumbiganon, P., Intarut, N., Mori, R., Ganchimeg, T., Vogel, J. P., ... & WHO Multicountry Survey on Maternal Newborn Health Research Network. (2014). Advanced maternal age and pregnancy outcomes: a multicountry assessment. *BJOG: An International Journal of Obstetrics & Gynaecology*, *121*, 49-56.
4. Jolly, M., Sebire, N., Harris, J., Robinson, S., & Regan, L. (2000). The risks associated with pregnancy in women aged 35 years or older. *Human reproduction*, *15*(11), 2433-2437.
5. Sonneveldt, E., Plosky, W. D., & Stover, J. (2013). Linking high parity and maternal and child mortality: what is the impact of lower health services coverage among higher order births?. *BMC Public Health*, *13*(3), 1-8.
6. Conde-Agudelo, A., Rosas-Bermudez, A., Castaño, F., & Norton, M. H. (2012). Effects of birth spacing on maternal, perinatal, infant, and child health: a systematic review of causal mechanisms. *Studies in family planning*, *43*(2), 93-114.
7. Arps, S. L. (2007). *High fertility in a high-risk environment: A biocultural study of maternal health in Honduran Miskito communities* (Doctoral dissertation, The Ohio State University).
8. Amir-ud-Din, R., Naz, L., Rubi, A., Usman, M., & Ghimire, U. (2021). Impact of high-risk fertility behaviours on underfive mortality in Asia and Africa: evidence from Demographic and Health Surveys. *BMC pregnancy and childbirth*, *21*(1), 1-14.
9. International Institute for Population Sciences (IIPS) and ICF. (2017). National Family Health Survey (NFHS-4), 2015–16: India.

10. International Institute for Population Sciences, ORC Macro (2007) National Family Health
Survey India, 2005–06 NFHS-3. Mumbai: IIPS.
11. Cecatti, J. G., Correa-Silva, E. P., Milanez, H., Morais, S. S., & Souza, J. P. (2008). The associations between inter-pregnancy interval and maternal and neonatal outcomes in Brazil. *Maternal and child health journal*, *12*(2), 275-281.
12. Mahande, M. J., & Obure, J. (2016). Effect of interpregnancy interval on adverse pregnancy outcomes in northern Tanzania: a registry-based retrospective cohort study. *BMC pregnancy and childbirth*, *16*(1), 1-9.
13. Mignini, L. E., Carroli, G., Betran, A. P., Fescina, R., Cuesta, C., Campodonico, L., ... & Khan, K. S. (2016). Interpregnancy interval and perinatal outcomes across Latin America from 1990 to 2009: a large multi-country study. *BJOG: An International Journal of Obstetrics & Gynaecology*, *123*(5), 730-737.
14. Guide to DHS Statistics DHS-7. Available at. https://dhsprogram.com/data/Guide-to-DHS-Statistics/index.htm#t=High-Risk_Fertility_Behavior.htm
15. Esri. How Spatial Autocorrelation (Global Moran's I) works. Available at https://pro.arcgis.com/en/pro-app/tool-reference/spatial-statistics/h-how-spatial-autocorrelation-moran-s-i-spatial-st.htm
16. Esri. High/Low Clustering (Getis-Ord General G). Available at. http://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-statistics-toolbox/high-low-clustering.htm
17. Merlo, J., Yang, M., Chaix, B., Lynch, J., & Råstam, L. (2005). A brief conceptual tutorial on multilevel analysis in social epidemiology: investigating contextual phenomena in different groups of people. *Journal of Epidemiology & Community Health*, *59*(9), 729-736.