Strategies to Improve Child Immunization via Antenatal Care Visits in India: A Propensity Score Matching Analysis

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1. Motivation

Indian Ministry of Health has a defined schedule for the free immunization for children 0 to 6 years of age. In spite of the "extensive free" immunization campaigns, still children belongs to a specific segment of the population particularly those belong to the disadvantaged groups such as women who are from low socio-economic strata, follower of Muslim religion and residents of rural areas, do not follow the established immunization scheduled.

Numerous studies have also examined the empirical evidence concerning the influence of demographic and socio-economic factors influencing child immunization in the different settings such as Ethiopia, Nigeria and other Southeast Asian countries. Despite of all these factors contribution of prenatal care on subsequent child immunization is remained unanswered. Although researchers have also tried to link the prenatal care service utilization with child immunization but no documentation available which shows the actual impact of antenatal care (ANC) visits on subsequent child immunization. The relationship between ANC visits and subsequent utilization of child immunization in a cross-sectional study might not be strong enough due to the presence of selection bias.

Therefore, this paper aims to examine the net impact of ANC visits on subsequent utilization of child immunization after removing the presence of selection bias in the recent round of cross-sectional National Family Health survey data. An attempt has been made to know at what extent the net difference observed in the outcome between treated and untreated groups of women could be attributed due to ANC visits, given that all possible covariates are matched. Further, we also attempted to assess the sensitivity analysis of the applied procedure. This study adds the present knowledge in several aspects. First, it reduces the possible selection bias with the help of related covariates. Second, in place of conventional regression method, we use propensity score matching method with a counterfactual model that assesses the actual ANC visits effect on treated and untreated groups, and lastly with the help of Mantel-Haenszel bounds it tells that whether the result would be free from hidden bias or not.

As we know that the low immunization coverage and high level of infant and child mortality rates are of great concerned to both national and state governments. This suggests that novel approaches are required to extend access to child vaccination services to every eligible child, and this ultimately leads to reduce child morbidity and mortality and subsequently lower fertility. In the present context, ANC visits might plays a significant role. In developing countries like India although attendance at least one ANC visit is an encouraging (76 percent) worrying gap exists in the coverage of child immunization (44 percent). It could be argued that if all women who come for ANC visit would turn up for child immunization, infant and child death could be reduced extensively.

2. Materials and Methods

Outcome variable

The outcome of interest in this study is immunization status of children aged 12 to 23 months in the year 2005–06. The child was considered as 'fully immunized' if s/he had received one dose each of BCG and measles and three doses each of DPT and polio (excluding Polio 0 dose) by his/her first birthday. Those who had missed any one vaccine out of the six primary vaccines were described as 'partially immunized,' and those children who had not received any vaccine up to 23 months of age were defined as 'un-immunized'. For the analysis purpose dichotomous variable has been created, and full immunization has been coded as '1' and no immunization/partial immunization has been coded together as '0'. Information regarding child immunization is available for last three births during five years preceding the survey.

The dichotomous treatment case

NFHS-III collected information on ANC visits for the most recent birth that resulted in a live birth during the five years preceding the survey. Mothers were asked about the number of antenatal-care visits. In the present paper 'frequency of contact with health system/workers' is defined as 'number of ante natal care visits (No visit/1-2 visits /3 or more visits)'. The idea is that the number of times a woman visit health centre for ANC represents the frequency of her contact to the health systems/workers.

Finally, analysis has been carried out in two separate models, in the first model ANC visits has been classified as either '1-2 visits' or 'no visit'. In the second model, we compare 'three or more antenatal care visits' with 'no visit'. Of total 9020 children, 19 percent (1730)

mothers have not visited health facility for ANC, 21 percent (1921) make 1-2 visits and 60 percent (5369) make three or more antenatal care visits for ANC.

3. Results

Descriptive statistics

The finding discloses that socioeconomic and demographic characteristics of women who make 1-2 or more than two ANC visits were significantly different from those who did not make any ANC visits during pregnancy. Also, it clearly shows that selection bias was present in the study population, which could be solved by the matching process. The problem of bias cannot be address by multiple regressions analysis and this needs balancing of two groups in terms of all possible covariates.

Impact Assessment of ANC Visits on child immunization

Table 1

Turning to the result of the matching, Table 1 illustrates the matching estimates. Propensity score matching eliminates most of the bias attributable to observable covariates. The difference in mean outcomes in the matched samples can be used to obtain an estimate of the average treatment effect on the treated women. Unmatched sample estimate, presents the raw estimate, i.e. without matching result shows that those women who had visited health center 1-2 times for ANC had 18 percent higher chance to immunize their children compared to women who did not make any visits. ATT, ATU and ATE, show the estimates after matching.

Results summarize the estimates of the average treatment on treated of antenatal care visits, using the nearest neighbour matching with replacement method. ATT value in treated and control groups were 0.37 and 0.24 respectively, which means that among those women who had visited 1-2 times health centre for ANC if they would not visited then their only 24 percent children would get immunized. Similarly ATU value in treated and control groups were 0.19 and 0.31 respectively. This value shows that, if those women who did not visit health centre for ANC would have made 1-2 ANC visits, chances of their children would get immunized will increase up to 12 percent point.

The output shows that we get a significant positive treatment effect on the treated (ATT) of 0.13. That is, the child immunization of treated women is significantly 13 percent higher than that of matched control group women.

Panel B of Table 1 gives the estimates of the average treatment on treated women who have visited more than two times for ANC. The present case of unmatched sample estimate shows that those women who had visited health center more than two times for ANC had 43 percent higher chance of immunized their child compared to women who did not make any visits. ATT, ATU and ATE, show the correct estimates after matching. ATT values under treated and controls groups were 0.61 and 0.43 respectively which shows that among those women who have visited at least three times for ANC, only 43 percent women would have fully immunized their child, if they would have not visited health center. The output shows that we get a higher significant positive treatment effect on the treated women of 0.18. That is women who had visited health centre at least three times for ANC, child immunization of treated women were 18 percent higher than that of matched control group. Similarly, ATU value in treated group was 0.19, and for the under control group it was 0.40. This clearly shows that those women who have not visited health centre for ANC their chance of immunized their child will be an increase from 19 percent to 40 percent point if they would make at least three ANC visits. The result also gives the estimates of the average treatment on treated of antenatal care visits which was 0.19.

Discussion and Conclusions

Interestingly, findings clearly indicate that more number of times a woman makes ANC visits during pregnancy has a higher chance to get child immunized in comparison to the counterparts of those women who makes less number of ANC visits. More specifically results revealed that after matching the observed confounding covariates, child immunization among the groups of women who have completed 1-2 and those who had more than three ANC visits was about 13 percent and 19 percent respectively, higher than the group of women who have not made any visit. This positive interaction between the number of ANC visits and vaccination services can be described that every contact with health services change the women's knowledge and belief about advantages of using health services and eventually it helps in increasing the likelihood of uptake immunization services. This also indicates that

antenatal clinics are the conventional platforms for educating pregnant women on the benefits of child immunization.

While establishing the actual impact of ANC visits on child immunization, it is worth to examine the role of unobserved factors. We have employed Mantel-Haenszel bounds method for sensitivity analysis, which determine how strongly an unmeasured variable must influence the selection method to weaken the inferences of the matching analysis. Result based on sensitivity analysis provides an important tool for assessing the level of vigilance that one should use when interpreting the significance tests. The findings suggest that selection bias on unobserved covariates would have to be around 20 percent to alter these propensity score matching estimates in case of 1-2 ANC visits, i.e. if around 19 percent bias would be involved in the result then also we could observe the true positive effect of 1-2 ANC visits on child immunization.

Recently, Govt. of India has taken initiative to examine the ways to progress on child survival with several other countries including non-governmental organizations and has declared year 2012 as the year of intensification of routine immunization. Further, the target has been set to reduce the child mortality rates to 20 or fewer deaths per 1,000 live births by 2035 with the help of various child survival frameworks/modeling. The framework which has been derived from this research suggests that, specific efforts are needed to target pregnant women who come for ANC checkups at institution first time. Health workers should encourage women to return to the health centre for more number of visits as our results show that the information spillover from 'complete ANC visits' has a much larger impact on full child immunization, where '1-2 ANC visits' impact are not strong enough on child immunization. Efforts should also be made to search other possible ways to make contact with the women who did not make any ANC visit and encourage them for child immunization. The learning experience form developed countries and working in collaboration with local community and non-governmental organizations may help to attain the target.

Table 1: Matching estimates shows Impact Assessment of ANC Visits on child immunization.
(A)

1-2 ANC visits vs. No ANC visit	Treated	Controls	Difference	S.E.	T-stat	P>z	95% CI
Unmatched	0.37	0.19	0.18	0.02	12.52		
ATT	0.37	0.24	0.13	0.019*	6.95*	0.00*	0.096- 0.171*
ATU	0.19	0.31	0.12	.	.		
ATE			0.13	.	.		

(B)

2+ ANC visits vs. No ANC visit	Treated	Controls	Difference	S.E.	T-stat	P>z	95% CI
Unmatched	0.62	0.19	0.43	0.01	33.62		
ATT	0.61	0.43	0.18	0.030*	5.61*	0.00*	0.124-0. 242*
ATU	0.19	0.40	0.21	.	.		
ATE			0.19	.	.		

Note: * based on Bootstrap Standard Error