A Thesis
entitled
Gender Disparity in Childhood Immunization in India
by
Monika Salkar
Submitted to the Graduate Faculty as partial fulfillment of the requirements for the
Master of Science Degree in
Pharmaceutical Sciences

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An Abstract of

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Background: While the gender disparity in health and mortality in various stages of life in India is well documented, there is limited evidence in female disadvantage in childhood immunizations in India.

Objectives: (1) To identify gender difference in childhood immunizations in India, (2) To compare the data (2011-2012) with the data (2004-2005) to identify the trends in full childhood immunization coverage, and (3) To decompose the gender gap in full immunization and to quantify the impact of different socioeconomic and demographic variables contributing to the gender gap in 2011-12

Data & Method: Using two rounds of nationally representative data- the India Human development survey (IHDS) 2004-2005 and 2011-2012 (IHDS I & II)- we analyze prevalence of gender difference in the 2011-12 data and examine the adjusted effect of gender on childhood immunizations by using a logistic regression model using the both rounds of data separately. Further, we did Fairlie decomposition of the gender gap in
childhood immunizations to understand the contribution of demographic and socioeconomic factors.

**Results/ Discussion**: Using the IHDS II, the immunization rate amongst female child is less as compared to the immunization rate of male child. This shows existence of gender disparity in childhood immunization. Logistic regression model confirms that using IHDS II data gender is a significant factor associated with childhood immunizations which is not seen in IHDS I. Thus, gender disparity has increased from IHDS I to IHDS II. For instance the, the male-female gap in childhood immunizations in 7.6%. A decomposition analysis of gender gap in childhood immunization demonstrates that only 23.6 % of the gap is attributable to differences in demographic and socio-economic factors.
I dedicate this thesis to my Mother, Father and Sister,

for their constant support, love and motivation.
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List of Abbreviations

WHO ......................World Health Organization
EPI ..........................Expanded Program Immunization
UIP ..........................Universal Immunization Program
PPP ..........................Pulse Polio Immunization
NGO ..........................Non-Government Organization
PPPI ..........................Pulse Polio Immunization Program
NFHS ..........................National Family Health Survey
OPV ..........................Oral Polio Vaccine
UNICEF .....................United Nations International Children’s Emergency Fund
DTP ..........................Diphtheria Tetanus Polio
BCG ..........................Bacillus Calmette- Guérin
IHDS ..........................India Human Development Survey
NCAER .........................National Council of Applied Economic Research
NIH ..........................National Institute of Health
PSU ..........................Primary Sampling Unit
HDPI ..........................Human Development Profile India
GOI ..........................Government of India
SC ..............................Scheduled Caste
ST ..............................Scheduled Tribe
OBC ..............................Other Backward Class
Chapter 1

Introduction

1.1 Background

Child mortality is defined as “The death of children less than 5 years of age.”\(^{(1)}\) In 2012, worldwide 6.6 million deaths of children occurred under the age of 5 years.\(^{(2)}\) Amongst these deaths approximately one quarter of the deaths occurred in India.\(^{(2)}\) Compared to other countries India experienced the highest level of childhood mortality.\(^{(2)}\) This was echoed in the 2015 statistics when the childhood mortality rate in India was 48 per 1000 live births leading India to have the highest number of child deaths globally.\(^{(3)}\)

Evidence indicates that one of the most prevalent causes of infant mortality is lack of preventative care, which includes immunizations and screening.\(^{(4)}\) To decrease the global burden of childhood mortality immunization is one of the most cost effective ways.\(^{(4)}\) It provides safety against preventable morbidity and mortality and has been a major contributor in decline of childhood mortality rate in the last fifty years.\(^{(4,5)}\)

There are 26 million new births in India each year – leading India to have the highest birth cohort.\(^{(2)}\) However when compared to other countries India has one of the lowest immunization rates\(^{(2)}\). Thus for many decades, India has been afflicted by the issue of
infant and child mortality. This has prompted the government of India to identify the causes of the problem and take appropriate measures to decrease the childhood mortality rate.

To solve this problem of childhood mortality due to lack of immunization, the government of India has implemented many programs. These programs aim to increase the immunization rate in the country. In 1978, India adopted the World Health Organization’s (WHO) initiative of Expanded Program of Immunization (EPI). \(^4,\,5\) In 1985, the program was converted into Universal Immunization Program (UIP) with a goal to cover ‘all’ eligible children in the country. \(^4,\,5\)

The purpose of this program was to provide vaccination against the six vaccine preventable disease (Tuberculosis, Diphtheria, Pertussis, Tetanus, Poliomyelitis, and measles) to all the children nationwide. \(^5\) In 1995, the Pulse Polio Program (PPP) was expanded throughout the country. \(^5\) From 1995 to 2009, there has been a 97% decline in the number of polio cases. \(^5\) In 2014, the Infant Mortality rate was 40 per 1,000 live births. Thus, despite continuous efforts by the government, India has failed to meet the goal of universal immunization coverage. \(^6\)

Efforts taken to increase immunization rates have been hindered by many factors. These factors are related to the demand and supply of vaccine. \(^5,\,7\) Supply related factors are essential, however, evidence suggests that adequate supply of vaccines does not translate into children being immunized. \(^5,\,7\) Other causes contributing to low immunizations are: low investment by government, more attention on polio eradication at the cost of other immunizations and low demand as a result of poorly educated population. \(^9\) From the national health budget only 2.1 % is allocated to routine immunization. The additional cost per capita to cover 90% of children with the six basic vaccines is estimated
to be less than three rupees or eight cents. (9) Socio-economic and demographic factors play a major part in building the demand for full immunization of children in a household. (5, 10) These factors which affect the demand of immunization include place of residence, parental education, mother’s age at child birth, child’s gender, caste and religion and socioeconomic status of the household. (4, 10, 11, 12) All of these factors affect the demand for immunizations. However, gender disparity is also one of the critical elements that contribute to the low immunization rate in India. (4, 12)

Gender disparity is defined as “discrimination based on a person’s gender or sex, which more often affects girls and women.” (12) The Indian society is patriarchal and consistent son preference is one of the greatest determinants of gender inequality in Indian society. (13) Gender disparity begins from the time the daughter is born and continues throughout lifetime. (13) Favoring a son over a daughter are grounded in a number of social, economic and religious beliefs which include financial security, old age support, property inheritance, dowry, family lineage, prestige, death rituals and beliefs. (4, 11, 12, 13) In northern Indian states, marriage is exogamous. Parents of the girl have to search a suitable groom for her and also meet the dowry demands from the groom’s family side. (5, 11, 12, 13) After marriage the girl is considered to be a part of the groom’s family and has very little interaction with her natal kin. (14) In contrast, in the southern states of India, marriage is endogamous. (14) The female’s freedom is less limited and dowry is not a major marriage demand. (14) Also married daughters are more likely to help their parents financially. (14) Thus a great variation in gender discrimination is seen across regions.

Besides region, religion also influences son preference. (15, 16) Hinduism, a major religion in India, believes that sons are essential. (15, 16) In Hindus, a dead parent’s soul can
attain peace only if the son lights the funeral fire. (15, 16) Also, the practice of giving away the daughter in marriage (kanyadaan) is considered righteous. Preference for a son also exists in other religious groups much as Muslims or Sikhs. (16)

Caste may also be associated with cultural practices and may impact having a son’s preference. (15) Compared to lower castes, higher castes have a stronger gender classification system, with strict law and regulations placed on women and greater use of dowry. (15) Lower caste and tribal women have fewer restrictions on movement and employment, as they have to go outside to earn due to economic conditions. (15, 16) Also cultural practices render sons necessary to inherit family property, assure household security and take forward the family name. (15, 16)

This discrimination against girl child even extends to the attainment of education and food. (5) Such gender-based discrimination also hinders the girls from receiving proper nutrition, preventive care and treatment for illnesses, the repercussion of which is excess female mortality and poor health of girl child. (4, 10, 13, 15) Gender difference in immunization coverage has been reported in many studies. (4, 9, 11, 12, 13) These studies have reported that girls are found to be immunized at a lesser rate compared to boys, but these differences were not strikingly significant. (4, 9, 11, 12, 13) Also, the immunization coverage across the nation is largely skewed because of variation in socioeconomic and demographic factors across various regions. Thus the average results may mask the actual condition due to high diversity across regions, socioeconomic and demographic and cultural contexts in the nation. (4, 8, 10, 11, 12) Thus in this study we examined the gender disparity in immunization across various regions, socioeconomic and demographic factors.
1.2 Rationale

Immunization is one of the most cost effective public health interventions and is largely responsible for reduction in the childhood mortality rate. (4) Vaccine preventable diseases are still responsible for over 5 lakh deaths annually in India. This underlines the need for studying the factors affecting childhood immunizations. Multiple studies have identified gender disparities in healthcare utilization across various developing countries. However, there is a gap in studying the gender disparity which exists in immunization of children aged 1-2 years. Studies have focused on individual factors for vaccination including gender, age of mothers, birth order, and other household factors such as number of siblings, family size, household income, maternal education and have targeted particular regions of India. However, many of these studies did not take into account factors such as caste, religion, state-level effects etc. Thus there is a need to look at an all-inclusive list of factors associated with gender disparity in childhood immunization.

1.3 Goal

To study the effect of different socioeconomic and demographic factors on the gender disparity in childhood immunization.

1.4 Specific Aims

1. To identify existence of gender disparities in full childhood immunization
2. To identify trends in factors affecting childhood immunization in India from 2004-05 and 2011-
3. To decompose the gender gap in full immunization and to quantify the impact of different socioeconomic* and demographic** variables contributing to the gender gap in full immunization of children aged between 1-2 years.

Chapter II

Literature review

This chapter will provide an overview of relevant topics related to the study. The chapter will also cover the literature review. The literature review section will include the effect of the following subtopics on immunization:

1) Gender Disparity
2) Birth Order
3) Residential Area (Urban, Rural)
4) Effect of Poverty and Wealth (Economic status)
5) Education or Literacy
6) Effect of social factors (Religion, Caste, Women Empowerment)
7) Effect of Access to Health-Care Services and other Infrastructure
8) Effect of Pulse Polio Program (PPP)
9) Maternal Age at childbirth
2.1 Gender Disparity

In the National Family Health Survey-3 (NFHS-3) there was greater number of boys (53%) than girls surveyed. (17) The complete vaccination rate varied from 45.3% in boys to 41.5% in girls. (17) This gender imbalance existed irrespective of the method of determination of vaccination status. (17) Those whose vaccination card was reviewed, it was seen that 38.8% of boys and 36.1% of girls were fully immunized. (17) On comparing the rates of boy’s verses girls who did not receive any immunization at all, there were 4.3% of boys compared to 6.0% girls. (17) The gap between the genders was about 5% for vaccines such as BCG, DPT and measles. (17) However, due to the pulse polio drive the gender gap was considerably less for the three doses of OPV (around 2%). (17)

Another study assessed the gender differences by examining data from the NHFS surveys as well as other studies. (18) The pooled data had a relative probability of vaccination amongst girls of 0.93, thus proposing a 7% lower likelihood. (18) Analysis of the three surveys suggested that gender disparity did not increase over time. (11) However, the vaccination coverage varied greatly all over India. (18) For example, the vaccination coverage ratio varied from 0.86-0.90 in Punjab, Haryana and Bihar. (18)

The 2009-10 UNICEF survey also determined the percentage of completely vaccinated and unvaccinated infants. (19) Complete vaccination was seen in 61.9% of boys and 59.9% girls, while unvaccinated were 7.9% and 7.2% respectively. (19)
from District Level Household Survey under the Reproductive and Child Health project (2002-2004) examined 1279 infants in age range of 1-3 years in West Bengal. It had 54% of full vaccination rate.

In another study conducted in Surat, the incidence of measles among children below five years was collected, using parental past remembrance and immunization card examination. The study reported coverage rate of 49.3% in boys compared to 47.2% amongst girls. Although the overall difference was not statistically significant; analysis by age of children revealed gender-based differences among younger infants.

Thus all the studies reviewed showed a gender disparity in childhood immunization.

2.2 Birth Order

The NFHS-3 data showed a trend of decreasing vaccination with increasing birth order rate. This study assessed that the percentage of fully immunized infants was 54.6% (first order), 45.3% (second or third), 29.9% (fourth or fifth) and 18.5% (sixth or higher). The study also determined coverage of individual vaccines, the results of which were that the coverage for OPV is more compared to DTP and the gaps between increasing birth order is significantly lower for OPV compared to other vaccines.

Pande et al studied the impact of the gender of older siblings on rate of immunization in rural India. The study used the NFHS-1 data and reported that first birth order boys had 38% of full immunization compared to 36% in first birth order girls. The full immunization rate of infants with one older sister was 35% among boys and 31% among girls. The study had an interesting finding that, infants with two older brothers had significantly lower vaccination rates; 22% for boys and 26% for girls.
The study using three NFHS surveys showed that even though higher birth order children has lower immunization rate, the vaccination coverage for girls was much lower compared to boys.\(^{(18)}\) In third birth order children having two elder sisters, only 36.1% of girls received age appropriate vaccination compared to 45.0% of boys.\(^{(18)}\)

In a survey done in Goa, it was reported that that there is a lower proportion of fully immunized infants who have a higher birth order.\(^{(22)}\) The results reported were 86.6%, 88.8%, 69.2% and 75.0%; for birth orders 1, 2, 3 and 4 respectively.\(^{(22)}\)

Thus majority of the studies reported that birth order has an effect on immunization of the child immunization.\(^{(22)}\)

### 2.3 Residential Area

There was a significant disparity in the vaccination rates in urban and rural India. In the NHFS-3 survey, 57.6% of urban infants were completely immunized as compared to 38.6% in the rural parts.\(^{(17)}\) The unvaccinated infant percentage varied from 5.7% in rural areas to 3.3% in urban areas.\(^{(17)}\) There was a notable gap in urban rural vaccination coverage for individual vaccines, however the gap was seen to lowest with the 3 doses of OPV.\(^{(17)}\)

A secondary analysis of NHFS-3 data showed that in urban areas, there were significant differences in immunization coverage of individual vaccines (BCG, measles, 1\(^{st}\) and 3\(^{rd}\) dose of DPT) by gender, maternal education, maternal occupation, partner’s occupation, consistency of occupation (full year vs occasional), caste and religion.\(^{(23)}\)
The UNICEF nation-wide survey, 2005, surveyed 30 rural and 15 urban areas across 22 different states. (24) They reported that 47.4% of children in rural area were fully immunized as compared to 67.8% in the urban areas. (24)

The UNICEF 2009-2010 survey reported complete immunization in 58.5% rural infants compared to 67.4% urban infants, the unvaccinated infants were 8.5% and 5.2% respectively. (19)

The study done in West Bengal reported complete vaccination coverage of 64% in urban areas and 49% in rural areas. (25) Low coverage was reported among the poor minorities, especially in rural areas. (25) Another study in 3 districts of Assam reported full immunization among 85.9% infants in urban areas compared to 58.7% in rural areas. (26) Therefore, majority of the studies show that residential area significantly affects gender based on childhood immunization.

2.4 Effect of poverty and wealth

The NFHS-3 survey categorized the economic status of families using the ‘wealth index’. (17) The ‘wealth index’ is defined as a composite score of living standards based on assets (such as television sets, owned vehicle, number of houses etc.) and other characteristics such as type of construction; access to amenities like electricity, water, etc., sanitation system etc. (17) This wealth index then classified the sample population into different wealth quintiles. The survey reported that infants in families with a higher wealth quintile had better vaccination status. (17)

Gaudin, et al study compared cumulative population characteristics such as wealth with cumulative vaccination coverage using concentration ratios. (27) This method was then
used to evaluate changes over time by comparing NFHS data from different years 1992-93 and 1998-99. \(^{(27)}\) It was reported that in 1999 wealth based inequalities decreased in urban population, however there was no significant change in rural population. \(^{(27)}\) It suggested that less wealthy people in villages had lower immunization. \(^{(27)}\) Rate of immunization was seen to have increased over the years however, it occurred mostly in the wealthier segment of the rural population. \(^{(27)}\)

Mohtany, et al analyzed NFHS data by using household economic status to assess for childhood vaccination. \(^{(28)}\) The economic status of the household was calculated from consumer goods, land area, residence, water and sanitation facilities of the household. \(^{(28)}\) The gap between the wealthier and less wealthy was calculated using the concentration index. On comparing the NFHS surveys 1-3, it was seen that the rate of change of immunization coverage among the lowest wealth quintile was 18\%, 23\% and 24\% during the three surveys. \(^{(28)}\) In contrast, coverage for the wealthiest quintile was not only higher than the less wealthy group but it also showed a significant rising trend over time, from 64\% (NFHS-1) to 71\% (NFHS-3). \(^{(28)}\)

### 2.5 Education or Literacy

In the NFHS-3 Survey, the mother’s education status was assessed. \(^{(17)}\) It was seen that there was greater complete immunization of infants among mother’s with higher level of education as compared to mothers who weren’t educated or had just primary school education. \(^{(17)}\) However, no statistical analysis was done. \(^{(17)}\)

In the UNICEF 2009-10 survey, significant relation between education and complete immunization was seen. \(^{(19)}\) There were 45.3\% with no maternal education, 55.4\%
with less than 5 years, 64.9% with 5-7 years, 64.9% with 8-9 years, 74.1% with 10-11 years, and 76.6% with more than 12 years of education. The corresponding unimmunized infants were 14.3%, 9.0%, 5.1%, 3.8%, 2.1% and 2.0%.

In the 2005 UNICEF Survey, a direct relationship was seen between parental education and immunization status. Only 38.2% of infants were vaccinated who had illiterate parents as compared to 53.8% of vaccinated infants who had less than 5 years of school education. Also parents with less than high school of education covered 59.6% of fully immunized infants, while parents with more than at least high school education covered 82.4% of fully vaccinated infants.

In a cross-sectional study of 693 children, in Delhi, 34.4% Children of mothers with no education received complete immunization. In contrast, 48.1% and 50.7% of mothers who had less than high school education and at least high school education respectively were fully immunized. Similarly only 31% of children whose fathers were uneducated received full immunization compared to 33.7% and 45.7% where father’s education was less than high school and at least high school respectively. On comparing the odds ratio for literate verses illiterate mothers and literate verses illiterate fathers; it was seen that maternal literacy was a more important determinant of childhood vaccination.

2.6 Effect of Social Factors (Religion, Caste, Women Empowerment)

The NFHS-3 survey described the religion of the new born by that of the head of the family. It was seen that complete immunization was higher among Sikhs and Christians, but the rate of non-vaccinated infants was also higher among these groups. On comparing with Hindu households, Muslim households had lower complete immunization and higher non vaccination. The survey also reported that infants from
open category had higher immunization as compared to infants from scheduled class families and other backward class families. \(^{(17)}\)

The UNICEF coverage evaluation 2010 evaluated that 58.9% had complete vaccination rate from scheduled caste families, 49.8% among scheduled tribes, 60.6% among other backward caste and 66.3% among other castes.\(^{(19)}\) The non-vaccinated rate was 7.8%, 9.9%, 8.6% and 5.5% respectively.\(^{(19)}\) On comparing immunization rates by religion full immunization was seen in 61.2% Hindu infants, 55.7% Muslim Infants, 78.2% Sikh infants, 65.6% Christian infants and 76.6% infants of other religions.\(^{(19)}\)

Another study done by the Department of Family Welfare, it was reported that highest full vaccination was seen in Sikh families (71.4%), followed by Christian (65.9%), Jain (61.8%), Hindu (56.9%) and Muslim (47.2%) infants. \(^{(30)}\) The survey also reported 54% of full immunization among infants from scheduled caste families, 51.7% schedules tribe families and 58.1% amongst other backward classes. \(^{(30)}\)

A study done in West Bengal determined that 68.2% of infants from Hindu general caste families received complete immunization as compared to 47.5% of Hindu’s from scheduled caste/tribe and 57.1% among Hindu backward class. \(^{(19)}\) Complete vaccination status amongst Muslims was 39.8% and 50% among other religion. \(^{(19)}\)

### 2.7 Effect of Access to Healthcare Services and Other Infrastructure

The ICMR survey done reported that complete vaccination coverage was seen only amongst 19% infants living in villages more than 5km away from health facilities. \(^{(31)}\) However, villages located in a radius of 1 km of a healthcare facility were seen to have
59.6% coverage. (31) Contrastingly villages which were near to the healthcare facilities were seen to have a lower immunization. (31)

Another study conducted in Udaipur in the state of Rajasthan, stated that there was a relationship between the immunization status of children and the distance of their households from the healthcare centers. (32) Full immunization rate was 55% for households <1km away, 47% for distances 1-2 km, 32% for distance 2-7 km; and 30% for >7 km from healthcare centers. (32)

Another study reporting a study done in Assam divulged to have seen a positive relationship between access to healthcare facilities and complete immunization. (26) It was seen that 64.5% received complete vaccination that had access compared to 57.4% among those with no access. (26) The data also indicated that better immunization status was seen among those residing within 2 km of healthcare centers. (26)

2.8 Effect of Pulse Polio Program (PPIP)

Some researchers studied the effect of pulse polio immunization program on timely immunization of infants residing in rural areas of some states such as Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh. (33) They assessed the immunization coverage before and after the implementation of the program. (33) They compared NHFS-1(1992-93) and NHFS-2 (1998-99) data. (33) The final result observed were receipt of first dose of OPV and at least one dose of any of the non-polio EPI vaccines. (33) They reported that the percentage of children who received the first dose of OPV was 48.1% in 1993 which was seen to increase to 72.6% in 1999. (33) Similarly, there was no significant change in coverage with at least one dose of non-polio EPI vaccines, 50.9% and 56.4% in 1993 and
1999 respectively. (33) Thus it was seen that there was a great increase in vaccination coverage of OPV vaccines overtime as compared to other non-polio EPI vaccines. (33) The authors offered two explanations, which is that PPIP enhanced knowledge of polio vaccination but it not have effect on other vaccines, or increase in routine vaccination was hindered due to PPIP. (33)

2.9 Maternal Age at Childbirth

The UNICEF survey reported a relationship between maternal age at childbirth and infant vaccination. (19) Complete vaccination was seen in 59.8% infants with mothers 15-19 years, 65.7% with 20-24-year-old mothers, 59.5% for maternal age 25-34 years, 45.5% for 35-44 years, and 56.6% for >44 years. (19) The respective non-vaccination rates were 6.9%, 5.8%, 7.7%, 17.3%, and 13.8%. (19)

The 2005 UNICEF survey reported that among infants with mothers less than 25 years of age, complete vaccination was observed in 56.9%; among mothers 25-34 years old, it was 54.5%; however, infants of mothers >35 years had 37.8% complete vaccination rate. (24)

The NFHS-3 data determined complete immunization in 41% infants born to adolescent mothers (15-19years). (24) Within this group younger mothers (less than 18years) were associated with lower vaccination rate (39.8%) compared to 43.6% of mothers aged 18-19years old. (24)

Thus, a direct relationship was seen between maternal age at childbirth and infant immunization.
2.10 Household size

Not many studies in literature have looked into the relationship between childhood immunization and household size. (34) One survey based study done in Goa, determined that the proportion of fully vaccinated infants was related to the household size. (34) Households with 3 or less members had an immunization rate of 98.4%. While household with a size between 3-6 members had an immunization rate of 85.4% and 68% with household size greater than 6. (34)

2.11 State-level differences

The NFHS-3 study showed that nine states did not have complete immunization coverage. (17) These included the states of Madhya Pradesh, Jharkhand, Meghalaya, Bihar, Assam, Arunachal Pradesh, Rajasthan, Uttar Pradesh and Nagaland. (17) The states having below average immunization coverage include the highly populous states such as Uttar Pradesh. (17)

Mohtany, et al compared childhood immunization by socioeconomic status in states of Maharashtra and Uttar Pradesh. (28) Using NFHS data, a great dissimilarity in vaccination status was observed between Maharashtra and Uttar Pradesh. (28) It was observed that the rich to poor gap calculated from the concentration index increased overtime. (28) This suggested that even in better performing states like Maharashtra, there was significant inequity based on economic status. (28)

Another study tried to determine the factors affecting childhood immunization in two different states of India. (34) The states selected were Maharashtra and Bihar. (34) These states were selected as they had similar population size, but diverse economic status,
development, health indicators (infant mortality and life expectancy), administrative policies etc.\(^{(34)}\) The researchers evaluated around 3000 children aged 1-3 years old.\(^{(34)}\) They reported that almost two thirds of children were fully vaccinated in Maharashtra as compared to 10% in Bihar.\(^{(34)}\) The researchers attributed this to a number of factors such as more educated parents in Maharashtra, more use of prenatal healthcare services, better exposure to media and better healthcare services.\(^{(34)}\)

The 2009-10 UNICEF Survey reported that a great variation in immunization status was seen across the different states.\(^{(19)}\) The study reported that 16 out of 29 states had immunization status greater than the national average of 61%.\(^{(19)}\) The Union Territories together had an immunization status of 71.3%. Four states had an immunization status greater than 80%, these included Goa, Sikkim, Punjab and Kerala.\(^{(19)}\) The lowest rate was seen in states of Arunachal Pradesh and Nagaland.\(^{(19)}\) Other than these states all other states had full immunization coverage over 40%.\(^{(19)}\)

### 2.12 Summary

There are limited nation-wide data exploring inequity in childhood immunization in India. The traditionally poor performing states have greater inequities; however, there is significant inequity even among better performing states. There are considerable inequities in childhood vaccination by various individual (gender, age, number of off-springs), family (area of residence, wealth, parental education), social (religion, caste), and societal (immunization camps, woman empowerment programs) characteristics. In general it is seen that girls fare worse than boys; there is an almost 5% relative difference between boys and girls. Household with many children are seen to have lower vaccination rates; the precise
reasons for this have not been elucidated. Urban infants have higher coverage than rural infants and those living in urban slums. There is a direct relationship between household wealth and vaccination rates. The vaccination rates are lower among infants with mothers having no or low literacy, and families with insufficient empowerment of women. Paternal literacy has an inconsistent positive relationship with infant vaccination. There is a relationship between religion and caste, and childhood vaccination; however, data are limited to determine whether these are independent influences or dependent on some other factors. Immunization camps and women empowerment programs are associated with better vaccination coverage of infants.
Chapter III

Methods

This chapter explains the methodology used in the study. It includes the following subtopics:

1. Study design
2. Data source
3. Patient selection
4. Study variables
5. Theoretical Model
6. Data analysis

3.1 Study Design

This was a retrospective, cross sectional study using secondary database. This database was used to obtain information about the study variables. Data collected from the year 2004-2005 and 2011-2012 in India Human Survey Database (IHDS), a publically available database, was used for the purpose of the study.
3.2 Data Source

3.2.1 Database overview

The India Human Development Survey (IHDS) is the product of collaboration between the National Council of Applied Economic Research (NCAER) and AMS consulting along with researchers from the University of Maryland. (37) The IHDS-I is a nationally representative, multi-topic survey carried out in 1,503 villages and 971 urban areas in India. (38) The 41,554 households covered had two one-hour face to face interviews by pairs of male and female enumerators in local languages. (38) The topics concerned were health, employment, education, consumption, economic status, agriculture, marriage, fertility, gender relations and social capital. (38) The respondent was a person who had good knowledge regarding the household’s economic condition and an ever-married woman aged 15-49 years. (38)

The IHDS-II (2011-2012) is a nationally representative survey of 42,152 households. (38, 40) The IHDS-II re-interviewed about 85% households, which were surveyed previously in 2004-2005 under the NIH grants. (38, 40) New households were also added to maintain a representative sample. (38, 40) Unlike most of the national surveys which are single topic surveys, the IHDS collects information on various aspects of human development such as education, caste, gender relations, infrastructure, income and farmlands. (38, 40) These cross sectional surveys give a snapshot of the Indian society at different points in time. The IHDS- II was developed with two specific aims: A. Resurvey
the households interviewed in 2004-2005 again in 2011-2012. Given the vast changes taken place since 2005 in the Indian society, IHDS- II permits analyses of associations across a range of social and economic conditions. It also provides the investigation of two programs started in 2005 which were the National Rural Employment Guarantee Scheme and the National Rural (and now Urban) Health Mission. These programs had the goal to make changes in the male/female wage gap and the IHDS – II panel analyzed these changes to find out the determinants of gender gaps in employment, education and health.

B. Expanded the range of data collected. Seven questions from IHDS- I were revised based on the panels field experience, analysis results and feedbacks obtained. Seven new modules were added to study the disparity in health and education. Also the IHDS-II has an expanded geographic data and institutional survey when compared IHDS-I.

3.2.2 Sampling

The IHDS covers all states and union territories of India with the exception of Andaman/Nicobar and Lakshadweep. It includes 41,554 households and includes 215,754 individuals. These households are spread over 33 states and union territories, 384 districts, 1503 villages and 971 urban blocks.

Villages and urban blocks formed the primary sampling unit (PSU) from the households selected. Both the urban and rural PSU’s were selected using different designs. In urban households, random sample was drawn using the probability proportional to size sampling method. In this method all urban areas in a state were listed in order of their size with number of blocks drawn from each urban area. After the number of
blocks for each urban area was determined, the enumeration blocks were selected randomly using the Registrar General of India. (37) From these Census Enumeration Blocks of about 150-200 households, a complete household listing were conducted and household sample of 15 households were chosen per block. (37) For convenience of sampling some smaller states were combined with larger nearby states. (37)

About half the households that were interviewed initially by NCAER in 1993-94 survey entitled Human Development Profile of India (HDPI) were included in the rural sample and the other half was obtained from both districts surveyed in HDPI as well districts and union territories not covered in HDPI. (37)

After a span of 11-12 years, about 82% of these households were contactable for reinterview. (37) There was a resurvey of 11,153 original households as well as 2,440 households which were separated from these root families but was still living in the village. (37, 38) To maintain sample representativeness, from each village where re-interviews were conducted, two fresh villages were randomly selected using the probability proportional to size technique. (37, 38) Additionally 3,993 rural households were randomly selected from states where NCAER 1993-94 survey was not conducted, or where re-contact information was not available. (37, 38)

3.3 Data selection

For both rounds of data we used files available through the household questionnaire and the birth history questionnaire. These files contained information related to children and their household. The 12-23 months age group was taken into consideration, because as per International and Government of India (GoI) guidelines children should be fully
immunized by one year of birth.\textsuperscript{(41)} Data on immunization is based on vaccination card for each living child or on the mother’s report in case of non-availability of the card. \textsuperscript{(41)} According to the world health organization guideline, children who received BCG, measles, and three doses each of DPT, and Polio (excluding polio 0) are considered to be fully vaccinated.\textsuperscript{(41)}

\textbf{3.4 Study Variables}

\textbf{3.4.1 Dependent Variable}

a) \textbf{Immunization}

Immunization is the dependent variable used in this study. This variable is taken as binary dependent variable. It includes information about the immunization of children aged 12-23 months. Full immunization information was obtained from the vaccination card for each living child or on mother’s report in case of non-availability of the card. Immunization information was also available for the following antigens- Bacille Calmette-Guerin (BCG), oral Polio vaccine (OPV), Diphtheria, Pertussis and Tetanus (DPT) vaccine and Measles vaccine.

\textbf{3.4.2 Independent Variable}

a) \textbf{Socioeconomic Variables}

For all objectives, a more comprehensive list of factors based on prior studies was used to determine the disparities in immunization. These factors included income of household, mother’s education, major occupation of household.

- Income of household was taken as a continuous variable.
• Mother’s education was classified as no education, primary, secondary or higher secondary.

• Major occupation was divided into business, salaried and others.

b) **Demographic variables**

For all objectives, a more comprehensive list of factors based on prior studies was used to determine the disparities in immunization. These factors included gender of the child, place of residence, caste, religion, birth order, mother’s age, and regions in India.

• Gender was categorized into either male (1) or female (0).

• Place of residence was classified as rural, urban, urban slum.

• Castes considered in this study were scheduled caste (SC), scheduled tribes (ST), Other Backward Class (OBC)

• Birth order was taken as a continuous variable and was used to see the effect of siblings on the immunization coverage.

• Mothers age was taken as a continuous variable

• Immunization coverage was also determined in the different states of India.

c) **Other Variables**

For all objectives, a more comprehensive list of factors based on prior studies was used to determine the disparities in immunization. These factors included mass media exposure, place of child delivery, no. of anganwadi or other childcare center in village, member of Mahila Mandal, antenatal checkup, no. of health sub centers, no. of immunization camps.
• Exposure to mass media included access to radio, newspaper and television.
• Place of child delivery were categorized into home, government hospital, clinic, private nursing home and other.
• Anganwadi or number of childcare centers was a continuous variable.
• Member of Mahila Mandal was used as a proxy for woman empowerment. it was taken as a binary variable, Yes(1) and No(0).
• Antenatal checkup was taken as a binary variable, Yes(1) and No(0).
• Number of health sub centers was taken as continuous variable.
• Number of immunization camps centers was taken as continuous variable.

3.5 Theoretical Framework

There are many Health Utilization and Behavior Models that help to explain the care-seeking behavior of a patient. These models act as a guide in a process of selecting significant factors that influence patients to seek care.\(^{42}\) One of these widely known models is Andersen Health Service Utilization Model.\(^{43}\) This model was developed by Andersen in 1968.\(^{43}\) Its purpose is to combine the “individual and contextual determinants” of an individual leading to that person’s care-seeking decision.\(^{43}\) The model is comprised of three main constructs – predisposing factors, enabling factors, and need factors. Predisposing factors contain demographic, social/cultural, and health-related attitudinal characteristics that influence people’s care-seeking behavior even before they are sick.\(^{42},\,43\) Demographic characteristics can include age, gender, married status, ethnicity, or culture. For instance, an older white male may be more likely to seek health services than a young, black male. Enabling factors are those that allow or facilitate people
to utilize health services whether they are inclined to seek care or not. Enabling factors can include insurance, income, or even availability of health services.\textsuperscript{(42, 43)} For example, a person with low-income is probably less likely to seek care than a person with higher income. Need factors is the individual perception of whether getting care is necessary.\textsuperscript{(42, 43)} Need factors are often the most immediate ones that influence patients to utilize health services. Examples of need factors include well-being, newly diagnosed diseases, or when disease becomes more severe.\textsuperscript{(42)} Together, these factors help to indicate a patient’s behavior in utilizing health services, as illustrated in picture 3-1.

![Figure 3.2: Andersen Health Services Utilization Model](image)

Based on previous studies, factors that influence disparity in immunization include age, gender, place of residence, caste, religion, mother’s education, major occupation of household, mother’s age, member of mahila mandal, birth order, mass media exposure. These are baseline variables, and they also fitted the definition of predisposing factors of the Andersen Health Service Utilization Model. The need factors of the model would include the severity of symptoms and diseases. Because immunization is a preventative
measure so it would not have need factors. Thus the Andersen’s Health Service Utilization Model is modified utilizing only predisposing and enabling factors as per the need of the study.

Income of the household has been already defined by the Andersen model classified as enabling factors. Like income, place of delivery, no. of Anganwadi or childcare center in village, antenatal checkup, postnatal checkup, no. of health centers and no. of immunization camps were also factors that allowed children to obtain immunization services. For example, a young mother having no education, having delivered the infant at home may not get proper information on immunizations which she may have otherwise got at a government hospital or private clinic. Thus, place of delivery fitted the definition of enabling factors. The applied Andersen Health Services Utilization Model is illustrated in figure 3-2:
Figure 3.3: Applied Andersen Health Services Utilization Model
3.6 Data Analysis

This study examined different factors retrospectively from IHDS I & II which were prominent factors for lower childhood immunization. Descriptive statistics were used to describe the sample population used from IHDS II panel. For objective 1, a chi-square test has been used to determine if there is a difference between female and male child immunizations. The dependent variable used is full childhood immunization and the group variables were male child and female child. For objective 2, a regression model was used to determine factors associated with full childhood immunizations. The dependent variable used was full childhood immunization with the references category set to “yes” as the response for full immunization.

For objective 3, a Fairlie Decomposition test was used to analyze gender discrimination. This technique is an extension of popular Binder-Oaxaca decomposition analysis. Fairlie decomposition computes the nonlinear decomposition of binary outcome differentials proposed by Fairlie (1999, 2003, 2005). That is, fairlie computes the differences in Pr (Y#0) between the two groups and quantifies the contribution of group differences in the independent variables to the outcome differential. Furthermore, fairlie estimates the separate contributions of the individual independent variables.

This study aims to study the contribution of gender in the immunization gap. The blinder Oaxaca decomposition technique is useful in quantifying the separate contribution of the factors and also how behavioral differences or discrimination contribute to the gap. This technique only requires coefficient estimates from linear regressions for the outcomes of interest and sample means of the independent variables used in the regressions. However, the standard Oaxaca test cannot be used when the dependent variable is binary.
In this study the dependent variable immunization is binary. Therefore we use Fairlie decomposition technique which is used when the dependent variable is binary.

To examine the role of demographic and socio-economic factors in gender gap in childhood immunizations, we used the Fairlie Decomposition method. The outcome variable is childhood immunizations. Therefore the gap between mean outcome, \( Y \) male and \( Y \) female, is equal to

\[
Y_{\text{male}} - Y_{\text{female}} = \beta_{\text{male}} x_{\text{male}} - \beta_{\text{female}} x_{\text{female}}
\]

\[
= \beta_{\text{female}} x_{\text{male}} - \beta_{\text{male}} x_{\text{female}} + \beta_{\text{male}} x_{\text{female}} - \beta_{\text{female}} x_{\text{male}} + (\beta_{\text{male}} x_{\text{male}} - \beta_{\text{female}} x_{\text{male}}
\]

\[
- \beta_{\text{male}} x_{\text{female}} + \beta_{\text{female}} x_{\text{female}})
\]

\[
= \beta_{\text{female}} (X_{\text{male}} - X_{\text{female}}) + X_{\text{female}}(\beta_{\text{male}} - \beta_{\text{female}}) + (X_{\text{male}} - X_{\text{female}})(\beta_{\text{male}} - \beta_{\text{female}})
\]

\[
= \beta_{\text{female}} \Delta X + X_{\text{female}} \Delta \beta + \Delta X \Delta \beta
\]

\[
= E + C + CE
\]

In the above equation, \( x \) male and \( x \) female are the vectors of explanatory variables evaluated at the means for male, and females, respectively. Thus, the gap between male and female childhood immunization is due to (a) a gap in endowments (or due to the distribution of \( X \) s) (E) or (b) a gap in coefficients (C) or (c) a gap arising from interaction of endowment and coefficients (CE) (for a detailed description of this method, see O’Donnell et al. (44)
Chapter 4

Results

This chapter contains a description of the studied population and the results carried out by the statistical analysis.

(1) Sample population

(2) Baseline Characteristics

(3) Existence of gender disparity in childhood immunizations

(4) Factors affecting childhood immunizations using 2011-2012 & 2004-05 dataset

(5) Decomposition of gender gap in childhood immunization using the 2011-12 dataset

4.1 Patient Population

A total of 390,103 patients met the study criteria and were included in the analysis.

At the beginning, there were 204,569 respondents in the cross-sectional panel (2011-2012). Among these, 180,490 had declined to answer the question if their child was immunized
and 5044 respondents did not have any child. The final study population included 18,709 respondents who had reported their child’s immunization and respondents who had child/children.

Figure 4.1: Selection process for the final study sample

 IHDS 2011-12 Cross Sectional Panel N=390,103

 Respondents not having child/children were excluded

 Sample population having child/children N=199525

 Respondents who declined to answer if their child/children had immunization were excluded

 Final study population N=204569

 Final study population after applying person weights N=1,212,277,319
4.2 Baseline characteristics:

The baseline characteristics of the studied population are summarized in Table 1. The assigning weights of 204,569 respondents represented a cohort of 1,212,277,319 respondents who had a child and answered if their child received immunization or not. The sample had a fairly equal distribution of female and male child (42% vs 57%, respectively). The majority of the respondents were Hindu (N=180837, 89.06%) followed by Muslims (N=16322, 7.57%) of the other backward class(OBC) (N=139367, 72%) having a fairly equal distribution of married status (N=98537, 48.08%) and unmarried status (N=92489, 45.12%), and with Mother’s education less than high school (N=179997, 89.58%). Additionally, those who have had antenatal checkup (N=101968, 99.24%), having done post-natal checkup only for both mother and child (N=79796, 80.03%) and having a government hospital as their place of delivery (N=80479, 80.28%) also represented the majority of the sample. Also females who were not a part of mahila mandal (N=200071, 98.6%) and salaried households (N=113517, 58.39%) amounted a major part of the sample. The sample also has a certain amount of women who have never had exposure to radio (N=178603, 89.25%) and newspaper (N=107716, 52.27%) and women who had regular exposure to TV (N=175416, 90.01%). The average age of mothers in this sample was 25 years old. The average number of immunization camps were ~3 and average total household income annually was 175,623 rupees. The average number of children in the household were ~4. Sample population was from urban region (N=93504, 45.86%) and rural region (N=111064, 54.13%) was fairly equal.
Table 1: Description of the sample by socioeconomic and demographic factors, IHDS data 2011-2012

<table>
<thead>
<tr>
<th>Factors</th>
<th>Frequency N=204569</th>
<th>Frequency (%)</th>
<th>Weighted Value=1,212,277,319 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother’s Age, Mean (S.E)</td>
<td>----</td>
<td>25 (0.1)</td>
<td>25 (0.11)</td>
</tr>
<tr>
<td>Gender of child</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>116730</td>
<td>57.06</td>
<td>57.69</td>
</tr>
<tr>
<td>Female</td>
<td>87839</td>
<td>42.93</td>
<td>42.30</td>
</tr>
<tr>
<td>Place of residence</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>111065</td>
<td>54.29</td>
<td>54.13</td>
</tr>
<tr>
<td>Rural</td>
<td>93504</td>
<td>45.71</td>
<td>45.86</td>
</tr>
<tr>
<td>Marital Status</td>
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<td></td>
</tr>
<tr>
<td>Married</td>
<td>98537</td>
<td>49.73</td>
<td>48.08</td>
</tr>
<tr>
<td>Unmarried</td>
<td>92489</td>
<td>44.00</td>
<td>45.12</td>
</tr>
<tr>
<td>Widowed</td>
<td>12256</td>
<td>5.79</td>
<td>6.14</td>
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<td>Separated</td>
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<td>0.50</td>
<td>0.64</td>
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<td>Hindu</td>
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<td>89.06</td>
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<td>Brahmin</td>
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<td>10.93</td>
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<td>ST</td>
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<td></td>
<td>139368</td>
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<td>3946</td>
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<td></td>
<td>68.15</td>
<td>16.44</td>
<td>1.93</td>
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<tr>
<td></td>
<td>72.02</td>
<td>15.80</td>
<td>1.08</td>
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<table>
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<tr>
<th>Member of Mahila Mandal (Women’s Group)</th>
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<th>Yes</th>
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<tbody>
<tr>
<td></td>
<td>200072</td>
<td>4440</td>
</tr>
<tr>
<td></td>
<td>97.83</td>
<td>2.17</td>
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<td></td>
<td>98.82</td>
<td>1.18</td>
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<th>Private nursing home</th>
<th>Home</th>
<th>Other</th>
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<tr>
<td></td>
<td>80480</td>
<td>18891</td>
<td>4167</td>
<td>65</td>
</tr>
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<td></td>
<td>77.68</td>
<td>18.23</td>
<td>4.02</td>
<td>0.06</td>
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<td></td>
<td>80.28</td>
<td>17.67</td>
<td>2.01</td>
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<th>Antenatal checkup</th>
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<tr>
<td></td>
<td>101969</td>
<td>1745</td>
</tr>
<tr>
<td></td>
<td>98.31</td>
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<td></td>
<td>99.24</td>
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<th>For mother only</th>
<th>For baby only</th>
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<td></td>
<td>9550</td>
<td>7485</td>
<td>6744</td>
<td>79797</td>
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<td></td>
<td>7.47</td>
<td>6.69</td>
<td>5.79</td>
<td>80.03</td>
</tr>
</tbody>
</table>

| #Immunization camps, mean (S.E)       | -----           | 3 (0.01)        | 3 (0.01)      |

| Total Household Income, annually in Rupees, mean (S.E) | ----- | 175,623 (2109.82) | 156,462 (1855.36) |

| Total # children in household, mean (S.E) | ----- | 4 (0.02)           | 4 (0.02)        |

<table>
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<th>Household Occupation</th>
<th>Cultivator &amp; allied</th>
<th>17686</th>
<th>8.46</th>
<th>6.24</th>
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<td></td>
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<td>--------------------------</td>
<td>---------</td>
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<td>Ag &amp; non Ag labor</td>
<td>58710</td>
<td>28.70</td>
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<td>Business</td>
<td>14639</td>
<td>7.15</td>
<td>7.5</td>
<td></td>
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<td>Salaried &amp; others</td>
<td>113518</td>
<td>55.5</td>
<td>58.39</td>
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<tr>
<td><strong>Mother’s Education</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school</td>
<td>179997</td>
<td>88.61</td>
<td>89.58</td>
<td></td>
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<tr>
<td>High school</td>
<td>3683</td>
<td>1.81</td>
<td>1.71</td>
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<tr>
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<td>12339</td>
<td>9.57</td>
<td>8.70</td>
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<td><strong>Exposure to TV</strong></td>
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<td></td>
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<tr>
<td>Never</td>
<td>8926</td>
<td>4.38</td>
<td>2.43</td>
<td></td>
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<tr>
<td>Sometimes</td>
<td>1918</td>
<td>9.41</td>
<td>7.55</td>
<td></td>
</tr>
<tr>
<td>Regularly</td>
<td>175417</td>
<td>86.20</td>
<td>90.01</td>
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<tr>
<td><strong>Exposure to newspaper</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>107717</td>
<td>52.94</td>
<td>52.27</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>39527</td>
<td>19.42</td>
<td>27.39</td>
<td></td>
</tr>
<tr>
<td>Regularly</td>
<td>56218</td>
<td>27.63</td>
<td>19.67</td>
<td></td>
</tr>
<tr>
<td><strong>Exposure to radio</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>178604</td>
<td>87.78</td>
<td>89.25</td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>10711</td>
<td>5.26</td>
<td>3.95</td>
<td></td>
</tr>
<tr>
<td>Regularly</td>
<td>14148</td>
<td>6.95</td>
<td>6.8</td>
<td></td>
</tr>
</tbody>
</table>

4.3 To identify existence of gender disparities in full childhood immunization

Table 2 shows the prevalence of full immunization by child gender in both rounds of the IHDS dataset. The immunization rate is considerably higher for males (2011-2012: male 74.23 vs. female 25.77). A chi-square test shows that the difference in prevalence rate by gender is statistically significant (p<0.001)
Table 2: (Objective 1) To identify existence of gender disparity in full childhood immunization, IHDS 2011-12.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Table of child immunization by child gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Immunization</td>
<td>Child Gender</td>
</tr>
<tr>
<td></td>
<td>Boy</td>
</tr>
<tr>
<td>No immunization</td>
<td>5452</td>
</tr>
<tr>
<td></td>
<td>29.07</td>
</tr>
<tr>
<td></td>
<td>35.20</td>
</tr>
<tr>
<td></td>
<td>69.23</td>
</tr>
<tr>
<td>Full Immunization</td>
<td>2423</td>
</tr>
<tr>
<td></td>
<td>12.92</td>
</tr>
<tr>
<td></td>
<td>74.23</td>
</tr>
<tr>
<td></td>
<td>30.77</td>
</tr>
<tr>
<td>Total</td>
<td>7875</td>
</tr>
<tr>
<td></td>
<td>41.99</td>
</tr>
</tbody>
</table>

Statistics table for child immunization by child gender

<table>
<thead>
<tr>
<th>Statistic</th>
<th>DF</th>
<th>Value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square</td>
<td>1</td>
<td>1686.60</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Likelihood Ratio Chi-Square</td>
<td>1</td>
<td>1695.07</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Continuity Adj. Chi-Square</td>
<td>1</td>
<td>1685.00</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mantel-Haenszel Chi-Square</td>
<td>1</td>
<td>1686.512</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Phi Coefficient</td>
<td></td>
<td>0.2999</td>
<td></td>
</tr>
<tr>
<td>Contingency Coefficient</td>
<td></td>
<td>0.2872</td>
<td></td>
</tr>
<tr>
<td>Cramer’s V</td>
<td></td>
<td>0.2999</td>
<td></td>
</tr>
</tbody>
</table>

37
4.4 To identify trends in factors affecting childhood immunization in India from 2004-05 and 2011-2012

Using “yes” as the reference group for full immunization, binary logistic regression was employed to determine which baseline factors significantly associate with full immunization among children between the ages 0-5 years. Table 3 demonstrates the results of logistic regression that examines the adjusted effect of child gender on childhood immunization in India from 2004-2005 and 2011-2012.

The results show that in 2011-2012, child gender was significantly associated with the outcome variable of childhood immunization ($\beta=0.491$, 95%CI=0.324, 0.744). Marital status, income and post natal care only for child or only for mother were not significantly associated with the outcome variable. After adjusting the effect of all background characteristics, it was found that the groups significantly associated with childhood immunization were member of mahila mandal, religion, caste, household occupation, place of child delivery, exposure to media, ante natal care, post natal care for both mother and child, total number of children in household, place of residence and number of immunization camps in the area. Compared to Hindu’s, Christians and Sikh’s were 3.9 times (95% CI, 1.620-4.623) and 1.1 (95% CI, 1.028-1.403) times respectively more likely to give their child full immunization, while Muslims were 0.01 times (95% CI, 0.006-0.030) less likely to provide full immunization. Castes such as Brahmins were 2.8 times more likely than OBC to have full immunization. Compared to OBC, castes such as ST and other castes were seen to have 3.7 (95% CI, 2.433-6.474) times and 1.5(95% CI, 1.333-2.068) times more likelihood of having full immunization. In addition, income did not have any effect on childhood immunizations. Comparing childbirth in a private clinic, births at a
government hospital or at home or any other place had 7.8%, 39.8% and 5.6% respectively less possibility of receiving full childhood immunizations. Comparing with families who have not had antenatal care with those who have had antenatal care there is 13.26 times more possibility for full immunization with those who have had antenatal care. Compared to no postnatal care, there was significant association of postnatal care only for mother (OR 3.402, 95% CI, 1.421-8.145) and for mother and (OR 0.157, 95% CI, 0.076-0.324) with childhood immunizations. In addition, factors such as no exposure or some exposure of the household to TV were seen to have 0.388 times (95% CI, 0.149-0.728) and 0.32 (95% CI, 0.147-0.698) times less likelihood to have full immunization. Sometimes (OR=6.138, 95% CI, 3.111-12.110) and regular (OR=43.482, 95% CI, 17.196-109.951) exposure to newspapers were seen to increase the likelihood of immunization. Some exposure to radio was seen to be significantly associated with full immunization (OR 3.95, 95% CI, 1.488-10.523). Interestingly number of immunization camps were seen to decrease full immunization by 0.6 (95% CI, 0.482-0.859) times. Factors such as number of total children in the household were seen to 1.2 (95% CI, 1.070-1.347) times increase the likelihood of immunization. Living in urban area increases the likelihood of being fully immunized by 3.1 times (95% CI, 1.202-8.014).

The results from 2004-2005 data show that gender was significantly associated with the childhood immunizations (β=0.901, 95% CI=0.778, 0.947). After adjusting the effect of all background characteristics, it was found that the groups significantly associated with childhood immunizations were mother’s education and age, exposure to TV and some exposure to radio and newspaper, place of residence, religion, occupation, place of delivery and marital status. Having high school education was seen to increase the likelihood of being immunized by 2.7%
(95% CI, 1.015-1.040). Compared to salaried occupation, business had 2.7 times (95% CI, 2.419-3.082) the likelihood to increase childhood immunizations. Additionally, compared to private health clinics, government health centers were found to decrease immunization by 51.7% (95% CI, 0.411-0.651). In this analysis, income was found to have no effect on childhood immunization (OR 1). Religion such as Muslim were 0.68 times (95% CI, 0.559-0.835) and other religions were 0.68 times (95% CI, 0.474-0.987) less likely to have full immunization. Sikhs were 3.6 times likely to increase full childhood immunization. Postnatal care only for the baby were 1.6 times (95% CI, 1.336-2.063) likely to increase childhood immunizations. Factors such as no exposure or some exposure to TV were found to have a negative association with full childhood immunization.

Table 3: Logit model estimates of factors affecting childhood immunization pooled IHDS 2004-05 and 2011-12.

<table>
<thead>
<tr>
<th>Category</th>
<th>Reference Group</th>
<th>2011-2012 Odds Ratio Estimate</th>
<th>2004-2005 Odds Ratio Estimate</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother’s Age</td>
<td>**</td>
<td>0.997</td>
<td>1.875</td>
<td>0.989</td>
<td>0.995</td>
<td>1.860</td>
<td>1.926</td>
</tr>
<tr>
<td>Child Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Female</td>
<td>0.491</td>
<td>0.324</td>
<td>0.744</td>
<td>0.901</td>
<td>0.788</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Place of residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>Rural</td>
<td></td>
<td>3.104</td>
<td>1.202</td>
<td>8.014</td>
<td>1.689</td>
<td>1.618</td>
</tr>
<tr>
<td>Household Income</td>
<td>-----</td>
<td></td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Religion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslim</td>
<td>Hindu</td>
<td>0.013</td>
<td>0.006</td>
<td>0.030</td>
<td>0.683</td>
<td>0.559</td>
<td>0.835</td>
</tr>
<tr>
<td>Christian</td>
<td></td>
<td>3.9</td>
<td>1.620</td>
<td>4.623</td>
<td>0.785</td>
<td>0.580</td>
<td>1.064</td>
</tr>
<tr>
<td>Sikh</td>
<td>Others</td>
<td>0.106</td>
<td>0.028</td>
<td>0.403</td>
<td>3.659</td>
<td>2.911</td>
<td>4.599</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.527</td>
<td>0.273</td>
<td>75.164</td>
<td>0.684</td>
<td>0.474</td>
<td>0.987</td>
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<td>Caste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brahmin</td>
<td>OBC</td>
<td>2.830</td>
<td>0.090</td>
<td>7.346</td>
<td>1.471</td>
<td>1.198</td>
<td>1.807</td>
</tr>
<tr>
<td>SC</td>
<td></td>
<td>1.178</td>
<td>0.431</td>
<td>3.221</td>
<td>1.415</td>
<td>1.247</td>
<td>1.605</td>
</tr>
<tr>
<td>ST</td>
<td>Others</td>
<td>3.722</td>
<td>2.433</td>
<td>6.474</td>
<td>1.303</td>
<td>1.055</td>
<td>1.609</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.500</td>
<td>1.333</td>
<td>2.068</td>
<td>1.751</td>
<td>1.541</td>
<td>1.991</td>
</tr>
<tr>
<td>Member of Mahila Mandal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>2.743</td>
<td>1.139</td>
<td>6.603</td>
<td>1.022</td>
<td>0.836</td>
<td>1.248</td>
</tr>
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<td>Occupation</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultivation and</td>
<td>Salaried &amp; Others</td>
<td>0.068</td>
<td>0.025</td>
<td>0.186</td>
<td>0.992</td>
<td>0.865</td>
<td>1.138</td>
</tr>
<tr>
<td>Allied</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ag &amp; Non-Ag</td>
<td></td>
<td>4.610</td>
<td>2.401</td>
<td>8.849</td>
<td>1.065</td>
<td>0.941</td>
<td>1.205</td>
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<td>Labor</td>
<td>Business</td>
<td>3.644</td>
<td>0.595</td>
<td>22.311</td>
<td>2.731</td>
<td>2.419</td>
<td>3.082</td>
</tr>
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<td>Mother’s Education</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; high school*</td>
<td>High school</td>
<td>0.135</td>
<td>0.106</td>
<td>0.142</td>
<td>0.981</td>
<td>0.882</td>
<td>1.261</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.193</td>
<td>0.772</td>
<td>1.844</td>
<td>1.027</td>
<td>1.015</td>
<td>1.040</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Unmarried**</td>
<td>Married</td>
<td>Widowed</td>
<td>Separated</td>
<td>Unmarried**</td>
<td>Married</td>
<td>Widowed</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------</td>
<td>---------</td>
<td>---------</td>
<td>-----------</td>
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<td>---------</td>
</tr>
<tr>
<td></td>
<td>1.053</td>
<td>0.940</td>
<td>1.181</td>
<td>1.363</td>
<td>1.063</td>
<td>1.746</td>
<td>1.164</td>
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<td></td>
<td>1.220</td>
<td>0.851</td>
<td>2.561</td>
<td>0.628</td>
<td>0.268</td>
<td>1.472</td>
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<tr>
<td>Place of Child</td>
<td>Private</td>
<td>0.078</td>
<td>0.036</td>
<td>0.171</td>
<td>0.517</td>
<td>0.411</td>
<td>0.651</td>
</tr>
<tr>
<td>Delivery</td>
<td>Government</td>
<td>0.398</td>
<td>0.177</td>
<td>0.896</td>
<td>0.953</td>
<td>0.774</td>
<td>1.173</td>
</tr>
<tr>
<td>Clinic*,**</td>
<td>Home*</td>
<td>0.056</td>
<td>0.010</td>
<td>0.307</td>
<td>0.994</td>
<td>0.405</td>
<td>2.441</td>
</tr>
<tr>
<td>Ante Natal Care</td>
<td>Yes*</td>
<td>13.265</td>
<td>3.205</td>
<td>54.906</td>
<td>1.184</td>
<td>0.950</td>
<td>1.475</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Natal Care</td>
<td>For mother only*</td>
<td>3.402</td>
<td>1.421</td>
<td>8.145</td>
<td>1.386</td>
<td>0.978</td>
<td>1.964</td>
</tr>
<tr>
<td></td>
<td>For baby only**</td>
<td>None</td>
<td>1.811</td>
<td>0.813</td>
<td>5.224</td>
<td>1.660</td>
<td>1.336</td>
</tr>
<tr>
<td></td>
<td>For both*</td>
<td>1.157</td>
<td>1.076</td>
<td>1.324</td>
<td>0.898</td>
<td>0.726</td>
<td>1.111</td>
</tr>
<tr>
<td>Number of Immunization * Camps</td>
<td>------</td>
<td>0.644</td>
<td>0.482</td>
<td>0.859</td>
<td>0.977</td>
<td>0.916</td>
<td>1.041</td>
</tr>
<tr>
<td>Total number of children in household*,**</td>
<td>------</td>
<td>1.201</td>
<td>1.070</td>
<td>1.347</td>
<td>0.915</td>
<td>0.885</td>
<td>0.945</td>
</tr>
<tr>
<td>Exposure to TV</td>
<td>Never**</td>
<td>0.388</td>
<td>0.149</td>
<td>0.728</td>
<td>0.826</td>
<td>0.709</td>
<td>0.962</td>
</tr>
<tr>
<td></td>
<td>Sometimes*</td>
<td>0.320</td>
<td>0.147</td>
<td>0.698</td>
<td>0.649</td>
<td>0.574</td>
<td>0.734</td>
</tr>
<tr>
<td>Exposure to Radio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

42
**Statistically significant -** year 2011-12,
**Statistically significant -** year 2004-05

### 4.5 Decomposition of gender in childhood immunization IHDS 2011-2012

The Fairlie decomposition analysis reveals that almost 75% of the male and female child gap in childhood immunization is explained by the differential distribution of demographic and socioeconomic factors (Table 4 & 5). While media exposure (TV, radio, newspaper) and social events (member of mahila mandal, immunization camps) contributed significantly towards reducing the male-female gap in childhood immunizations, cultural influences (caste, religion) and lower age and education of mother contributed towards widening this gap. The contribution of lower age and education of the mother (about 54%) towards widening the gap was the highest; it indicates substantial low immunization in children whose mothers have conceived at a young age and have a lower education level. The highest contribution towards narrowing the gap was media exposure (about 63%).
Table 4: (objective 4) Oaxaca Decomposition: Contribution of selected predictors on differences in means and in coefficients to male-female difference in healthcare expenditure in pooled IHDS 2004-2005 and 2011-2012

|                  | Coefficient | Standard error | P>|z| | 95% confidence interval |
|------------------|-------------|----------------|-----|--------------------------|
| Male child       | 0.135       | 0.014          | 0.000 | 0.058                   | 0.152 |
| Female child     | 0.059       | 0.013          | 0.000 | 0.044                   | 0.075 |
| Difference       | 0.076       | 0.019          | 0.000 | 0.052                   | 0.089 |
| Explained        | 0.057       | 0.011          | 0.000 | 0.032                   | 0.063 |
| Unexplained      | 0.019       | 0.017          | 0.000 | 0.016                   | 0.064 |
| Explained (%)    | 23.6        |                |      |                          |      |
| Unexplained (residual; %) | 75.3    |                |      |                          |      |
| Details of explained part (Explanatory factors) | % contribution to total difference | Standard error | P>|z| | 95% Confidence Interval |
|------------------------------------------------|------------------------------------|----------------|---------|----------------------|
| Household Factors                             | -8.2                               | 0.006          | 0.824   | 0.003 0.032          |
| Lower Mother’s age/Education                  | 52.53                              | 0.003          | 0.029   | 0.000 0.011          |
| Cultural influences                           | 12.62                              | 0.006          | 0.512   | 0.003 0.016          |
| Social events                                 | -8.55                              | 0.004          | 0.147   | 0.003 0.008          |
| Media Exposure                                | -63.34                             | 0.002          | 0.003   | 0.000 0.005          |
| Total explained part                          | 100.0                              |                |         |                      |
Chapter 5

Discussion

This chapter will discuss the results of the study, its implication, limitation, and future research in the following order:

(1) First objective: Existence of gender disparity in childhood immunizations

(2) Second objective: Factors affecting gender disparity in childhood immunizations using 2004-05 & 2011-12 data

(3) Third objective: to decompose the gender gap in childhood immunizations

(4) Limitation

(5) Implications of the study and Future research

5.1 First objective: Existence of gender disparity in childhood immunizations

Recent literature focusses more on gender differentials in health outcomes, such as mortality and nutrition among children and, to a certain extent, among women in
reproductive age groups. The importance of examining gender difference in childhood immunization grows tremendously due to the emergence of diseases and its impact on disability status particularly in infants and children. Using a recently available nationally representative data, this study aimed to answer three questions a) Is there gender disparity in childhood immunizations in India? b) Socioeconomic and demographic factors, which predict the causes of gender disparity in childhood immunizations c) What are the factors widening or reducing the gender gap in childhood immunizations?

The majority of the samples were married females having at least high school degree, majorly of the Muslim religion and OBC caste having done antenatal checkup and post-natal checkup only for the mother. Most of the women were not a member of the mahila mandal and living in a household whose main occupation is salaried jobs. Most of the child deliveries were at a private nursing home. Most of the sample population was from the urban region with an average income of 143,970 rupees (Indian currency), was in line with the findings from other studies. The average number of children per household was found to be 5 and the average number of immunization camps were found to be 2 per year. The average mother’s age of this sample was found to be ~45 years. The average number of immunization camps were found to be 2 per year.

Using the data from 2011-2012, our findings indicate that, at the national level, girls have lower immunization coverage than boys, which is consistent with prior findings such as Corsi et al and Kumar et al. This finding can be explained by the fact that a number of socioeconomic and demographic factors are seen to play a key role in full childhood immunization.
5.2 Second objective: Factors affecting gender disparity in childhood immunizations using 2004-05 & 2011-12 data

For both genders in the year 2011-2012, variables that affect childhood immunization significantly included mothers age and education, religion, castes, household occupation, place of child delivery, exposure to media, immunization camps, place of residence and total number of children in the household. Ante-natal and post-natal care for both mother and child were also significant factors. Generally, women spend more time with childbearing and child health, therefore the mother’s education and age is of significance. If the mother is educated and of an appropriate child bearing age there are more chances of the child being timely immunized, as the mother would have the knowledge of timely vaccination.

Additionally, the finding of effect of mother’s age and education on childhood immunization is in line with Corsi et al Joe W et al and Elliot C et al. In terms of religion, Muslims and Sikhs were found to have a significant negative impact on childhood immunizations. This was in accordance with NFHS-3 survey, which stated that lower immunization was seen amongst Muslims. Christian households had higher complete vaccination coverage than Hindu families. One possible explanation could be the different religious beliefs and customs associated with these religions. Similarly, castes such as Brahmins and ST were seen to have higher full childhood immunization rate when compared to OBC. This could be due to the greater education level associated with the Brahmin caste and the great number of health facilities made available to ST caste in the last few years.

In contrast, income levels did not have any effect on acquiring childhood immunizations, not similar to findings by Gudin et al. This might be because essential immunizations are provided free of cost by the government of India. Moreover, the number of
immunization camps positively impact childhood immunizations, as most of the children receive their immunizations at these camps other than those received at childbirth. Household occupation such as cultivation and allied work and agricultural labor are significantly associated with childhood immunization. Agricultural labor was seen to be positively associated with the outcome, while cultivation and allied work had a negative impact when compared with salaried jobs.

The place of child delivery also has a significant impact on child immunizations. When compared to private health clinics, it was seen that child birth at government clinics or at home had a negative impact on child immunizations. This could be because of the more individualized care provided at a private health clinic. In terms of antenatal care, mothers who received antenatal care were seen to have greater chance of providing their children immunization. Such a positive relationship is also found by Choi et al 2006, Gatchell et al 2008, and Islam et al 1996. This shows the possibility of positive information transfer or learning by doing (Lee et al 2005) from antenatal care during pregnancy. In addition, mothers who were a part of Mahila Mandal were seen to be associated with better likelihood of being immunization. Such women empowerment groups counsel those regarding pregnancy and child immunizations.

Media exposure has a significantly positive effect on immunization. Full immunization possibility is higher in household who have regular media exposure to TV, radio and newspaper. Parents who have regular exposure to newspapers where seen to have the highest immunization likelihood. In accordance with majority of studies such as Choi et al, Gudin et al, Das Gupta 1987, full immunization rate was seen to be higher in urban areas when compared to rural areas. This is very understandable, because of the greater amenities, more
media exposure and higher socioeconomic status associated with urban areas when compared
to rural areas. The total number of children in the household has a positive impact on full
childhood immunization. This is in line with Corsi et al, which states that with greater number
of children in the household there are higher chances that the younger female child’s health
would be neglected.

On comparing the 2011-12 data results with the 2004-05 results, we see that gender was
significantly associated with childhood immunizations in the 2011-12 data but was not of
significance in the 2004-05 dataset. The factors, which are significant in both datasets, are
mothers age and education, religion, place of delivery, media exposure and place of residence.
This shows that factors which were prevalent in the 2004-05 year have possibly worsened or
remained the same over the period of six years. This is in line with the results of the fairlie
decomposition test which shows which of the factors are responsible towards decreasing /
increasing the gender gap.

5.3 Third objective: to decompose the gender gap in childhood immunizations

The fairlie test gives interesting results, that only one-fourth of the gender disparity in
childhood immunizations is due to male child-female child differences in demographic and
socioeconomic factors. Factors such as lower mother’s age and education and cultural
influences increase the gap in gender disparity while factors such as media exposure,
household factors and social events decrease the gender gap. The rest of the unexplained part is
due to a myriad of factors not captured by socioeconomic and demographic condition. This
huge unexplained section perhaps represents the role of gender in childhood immunizations i.e
less attention is given to the female child health because of the notion that female child health

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is not as important as male child health, and not because of differences in socio-demographic conditions. Usually, we can consider unexplained part as a measure of discrimination. This, however, needs further investigation.

5.4 Limitation

Like many other disparities studies, this study had the cross sectional design. The data used to compare the trends in gender disparities in childhood immunizations was from 2004-05 and 2011-12. This study could not find the recent scenario of gender disparity in childhood immunizations. The data used was relatively old and the results may not be consistent with today’s society. Multiple changes have occurred over these years such as policy change and introduction of immunization programs.

Another limitation was that data collected in IHDS were interview-based. Therefore, it was difficult to verify the accuracy of the data collection and data entry process. Other limitations of using a retrospective database included missing information, social desirability bias. However, many studies have used IHDS and deemed that the database has an acceptable quality.

The information on child immunizations was collected with the help of immunization card. In cases where the immunization card was not available, the information was collected from mother’s reporting. This could lead to recall bias as the mother’s may not exactly remember if their child was fully immunized or not.

5.5 Implications of the Findings and Future Studies
This study was one of the few gender disparity studies that examined a more comprehensive lists of factors with a cross-sectional design. It also included region, caste, religion, number of immunization camps, antenatal and post natal care. To the author’s knowledge, there has not been a study that included a comprehensive list of factors. The study found that for the 2011-12 data the factors that were significant were, place of residence, mothers age and education, member of mahila mandal, religion, caste, place of delivery and exposure to media. Factors such as total number of children in the household and number of immunization camps were also significantly associated with childhood immunizations.

From this study, Policy makers could integrate gender issues into India’s child immunization program particularly in the rural areas, scheduled castes and among Muslims. Also social workers and NGO’s may target young pregnant women in rural areas t increase female education and promote women empowerment. Policy makers may use factors such as mother’s education, area of residence, ante-natal care to identify high risk group for low childhood immunizations. Health care providers may also take active role in recommending routine immunization to the vaccine hesitant parents.

To tackle gender related discrimination in childhood immunizations and to bring about equity, it is essential not only to introduce a social protection scheme but also to guarantee gender equitability in those schemes. The Rashtriya Swasthya Bima Yojana (RSBY), India’s social protection scheme, is a remarkable step towards addressing the health needs of disadvantaged groups, especial emphasis should be given to foster the health care utilization among children and infants. At the same time woman empowerment and their involvement in decision-making is essential, since mother’s have an important role in the infant healthcare decision-making.
Thus future studies need to look into factors such as composition and order of siblings and how it is associated with gender disparity in childhood immunizations. Since this study looks into gender disparity in full childhood immunizations, further studies can look into age appropriate immunizations, as different immunizations need to be given at different ages during childhood.

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