Sibling composition and child immunization in India and Pakistan, 1990-2007

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Background: **This study aimed to assess trends in gender differentials in child immunization beyond the conventional male-female dichotomy, by considering gender, surviving siblings, birth order and different compositions of older siblings in tandem, during 1990-2007 in India and Pakistan.**

Methods: **Using different rounds of Demographic and Health Survey datasets, we adopted the World Health Organization guidelines for appraising full immunization among children. Sex composition of surviving older siblings was combined. Cochrane-Armitage and the Chi-square tests were used to test linear and nonlinear trends, respectively.**

Results: **Although child immunization has increased during the period of 1990-2007 in both India and Pakistan, results showed that more than 50% of the eligible children did not receive the recommended immunization. The results also showed that boys and girls with no older surviving siblings and those with only surviving siblings of the opposite sex appeared to have fully immunized proportionally compared with the children with other sibling compositions.**

Conclusion: **The findings confirmed that girls and boys were not always treated equally, and that there was a clear pattern of selective neglect in child immunization in both countries during the period of 1990-2007.**

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Introduction

According to 2012 estimates, India and Pakistan contribute to 30% (over 1.7 million) of the global under-five deaths.[1] Globally, vaccine preventable diseases account for nearly 20% of all deaths that occur annually among children under five years of age, and immunization has a vital role in achieving the goals specified in the Millennium Declaration.[2] Studies examining child immunization in South Asian countries have rarely considered the role of sex composition of older surviving siblings. Earlier studies[3-5] have highlighted the importance of mother, household and community level factors that affect child immunization coverage in developing countries like India and Pakistan. For instance, studies documented maternal age at birth,[6] birth order[7] and mass media exposure[8] as significant determinants of child immunization. Mother's level of education is one of the most widely discussed factors in global public health literature and has consistently been recognized as a key determinant that enhances the incidence of child immunization in developing countries.[9] Studies also document that the relative socioeconomic position of the household determines the utilization of child healthcare services including immunization. For instance, a recent evidence from India has shown that household wealth contributes to nearly two-fifths of the overall inequality in child immunization.[10] Contextual factors such as urban-rural difference,[5] accessibility to healthcare facility,[11] healthcare expenditure[10] and availability of healthcare infrastructure,[12] determine the extent of child immunization in developing countries.

There are a number of studies in South Asian countries that evidence profound gender discrimination in the access to child healthcare services including immunization.[13,14] In most of South Asian countries, sons are preferred to daughters due to several socioeconomic and religious reasons including financial support, old age security, property inheritance, dowry, family lineage, prestige and power, rituals and beliefs about religious duties and salvation.[15,16] Earlier studies[15,17] have shown that sex-sibling composition may affect intra-family resource allocations, which may

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also influence child immunization. This study assesses trends in child immunization coverage during 1990 to 2007 in two South Asian countries, namely, India and Pakistan. The similarities in social and cultural practices in both countries also offer an opportunity to analyze the study objective.

Methods

Data

This study used data from different rounds of Demographic and Health Surveys (DHSs) conducted in India (during 1992-93, 1998-99, and 2005-06), and Pakistan (in 1990 and 2007) to compare estimates across both countries over the period. The DHSs are nationally representative surveys that measure demographics, health and nutrition with standard measures across nations using consistent surveys at certain intervals. The DHS in India is known as National Family Health Survey (NFHS). Data collection and management procedures were described in detail elsewhere.[18] The DHS procedures were approved by the ICF Macro International Institutional Review Board USA and the ethics review boards of both nations included in the study.

Defining full immunization and older sibling composition

The outcome variable of the study was full immunization among children aged 12-23 months. According to the guidelines developed by the World Health Organization (WHO), children are considered fully immunized when they receive vaccination against tuberculosis (Bacillus Calmette-Guerin, BCG), three doses of diphtheria, whooping cough (pertussis), and tetanus (DPT) vaccine; three doses of poliomyelitis (polio) vaccine and one dose of the measles vaccine by the age of 12 months. BCG should be given at birth or at first clinical contact, DPT and polio require three vaccinations at approximately 4, 8, and 12 weeks of age, and measles should be given at age 12 months or soon after reaching nine months of age. Information on child immunization was collected from the immunization cards shown by household members during the survey or in the absence of the immunization card, the information gathered from the mother of the respective child was recorded. This is the general practice commonly followed by the DHS.

DHS asked every eligible woman in the age group of 15-49 years, her complete birth history including sex, order of birth, survival status and healthcare services provided to her. Using this information, a combination of the sex composition of surviving older siblings was constructed for the last birth (child) to women. The index of the sex-sibling composition is classified into 12 categories: six sibling categories for each male and female child. The six sibling categories include "none" (no brother and sister), "one surviving older brother and no surviving older sisters", "one surviving older sister and no surviving older brothers", "two or more surviving older sisters and no older brothers", "two or more surviving older brothers and no older sisters", and a "mixed" category of surviving older brothers and sisters.

Statistical analysis

In order to assess the trend, this study examined the association between the predictor of interest and the outcome variable varied by survey rounds. This required data from all rounds (three rounds in India, and two rounds in Pakistan) to be pooled and tested for the trend using linear or nonlinear trend analysis. As the sampling design of the DHS offers an opportunity to make all the rounds of data comparable, several earlier studies have pooled the different rounds of DHS datasets to observe changes over the specified period.[19,20] The prevalence of child immunization with 95% confidence interval (CI) was estimated by older surviving sibling compositions using DHS calculated individual weights to take into account the multistage sampling design.[21] The Cochran-Armitage test[22] was used to test linear time-trend data by country, while the Chi-square test was used to detect nonlinear trends with tests adjusted for complex survey design.[23] All analyses were conducted in Stata version 10.0.[24] For better comparability across the countries and periods, children under three years of age were considered for the present analysis.

Results

Fig. 1 shows that the prevalence of full immunization coverage has increased in India (from 36% to 44%) and Pakistan (from 32% to 47%) during the last two decades. Despite such an increase, over fifty percent of the children under age five years did not receive essential immunization components in the period of 2005-2007. Moreover, a clear trend of gender bias was also evident in full immunization coverage in both South Asian countries; the girls received lower full immunization than the boys did during 1990-2007 (Fig. 2). Although, full immunization increased among both male and female children, the gender gap remained consistent in both countries during the last two decades.

The findings showed mixed trends in child immunization coverage by older surviving sibling composition in both countries during the period of 1990-2007 (Table). For instance, in India, the highest

number of full immunization cases was recorded among male children who did not have any older surviving sibling during the period of 1990-2007. The analysis further showed that the least number of full immunization cases during the last two decades was recorded among female children who had mixed surviving older sibling compositions (at least one older brother and sister). In case of Pakistan, the highest number of cases of full immunization in 1990 was recorded among male children who had two older surviving brothers (49%). However, in 2007, full immunization was the highest among male children

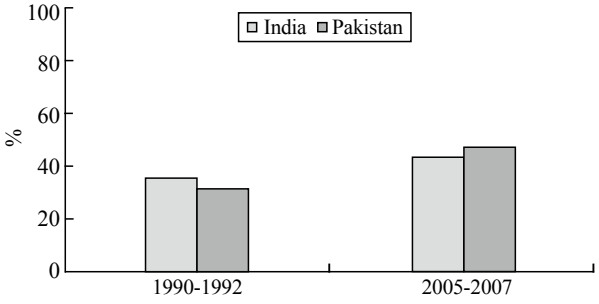

Fig. 1. Trends in full immunization coverage among children aged 12-23 months in India and Pakistan, Demographic and Health Survey, 1990-2007.

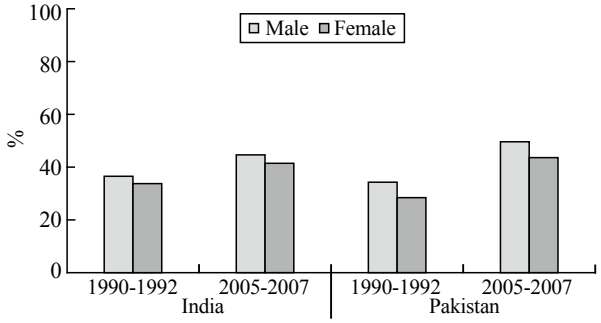

Fig. 2. Gender difference in full immunization coverage among children aged 12-23 months in India and Pakistan, Demographic and Health Survey, 1990-2007.

Table. Prevalence of full immunization among children aged 12-23 months in India and Pakistan Demographic and Health Surveys during 1990-2007

Older surviving sibling compositions	1990-1992			1998-1999			2005-2007			Relative change*	*P* value for trend†
	%	95% CI	*n*	%	95% CI	*n*	%	95% CI	*n*		
India											
Total	35.5	[34.2-36.7]	10972	41.1	[39.5-42.7]	8988	43.6	[41.8-45.3]	8978	23.0	0.000
Sex of the child											
Male	36.7	[35.0-38.4]	5641	42.3	[40.3-44.3]	4709	45.4	[43.3-47.5]	4787	23.6	0.000
Female	34.1	[32.6-35.7]	5331	39.9	[37.9-42.0]	4279	41.6	[39.4-43.8]	4191	21.8	0.000
Sibling composition											
Male with no older survival sibling	44.9	[41.9-47.9]	1545	53.5	[49.9-57.1]	1372	55.4	[51.9-58.8]	1509	23.4	0.000
Female with no older survival sibling	45.0	[41.9-48.1]	1452	49.6	[46.0-53.2]	1246	53.5	[49.8-57.1]	1363	18.8	0.010
Male with only 1 brother & no sister	42.3	[37.7-46.9]	702	47.4	[42.4-52.5]	643	48.5	[43.3-53.9]	675	14.8	0.283
Male with only 1 sister & no brother	44.6	[40.1-49.2]	708	47.2	[42.3-52.1]	616	53.2	[48.6-57.8]	758	19.3	0.004
Female with only 1 brother & no sister	38.0	[34.1-42.1]	697	49.6	[45.3-53.9]	621	47.2	[42.2-52.2]	639	24.2	0.000‡
Female with only 1 sister & no brother	39.9	[35.6-44.3]	638	47.3	[41.9-52.7]	524	50.2	[44.8-55.7]	584	26.0	0.061
Male with 2+ brothers & no sister	29.1	[23.9-34.9]	366	29.7	[23.4-36.9]	246	37.5	[30.1-45.5]	262	28.6	0.024
Male with 2+ sisters and & no brother	34.3	[29.1-39.9]	452	43.7	[37.8-49.6]	391	49.3	[42.8-55.8]	388	43.7	0.694
Male with 1+ brothers & 1+ sisters	25.9	[23.5-28.4]	1868	27.9	[25.1-30.9]	1441	29.2	[26.1-32.6]	1195	12.8	0.000
Female with 2+brothers & no sister	27.9	[23.0-33.3]	376	32.2	[26.2-38.7]	271	33.2	[25.5-41.9]	203	19.3	0.000
Female with 2+ sisters & no brother	34.0	[28.4-40.1]	398	28.2	[22.4-34.8]	294	34.3	[28.1-41.1]	321	0.9	0.524‡
Female with 1+ brothers & 1+ sister	22.6	[20.3-24.9]	1770	25.9	[22.9-29.2]	1323	24.6	[21.2-28.3]	1081	8.9	0.265‡
Pakistan											
Total	32.0	[28.5-35.6]	1140				47.3	[43.9-50.6]	1440	47.8	0.000‡
Sex of the child											
Male	34.6	[29.3-40.3]	561				49.8	[45.5-54.0]	776	43.8	0.000‡
Female	29.4	[24.9-34.2]	581				44.3	[39.7-49.0]	665	50.9	0.000‡
Sibling composition											
Male with no older survival sibling	31.8	[20.3-45.9]	84				49.5	[40.1-58.8]	150	55.4	0.040‡
Female with no older survival sibling	30.1	[19.9-42.7]	104				46.7	[36.4-57.3]	122	55.1	0.044‡
Male with only 1 brother & no sister	27.2	[14.1-45.7]	41				53.0	[39.4-66.0]	74	94.7	0.025‡
Male with only 1 sister & no brother	40.5	[24.6-58.6]	47				54.6	[41.3-67.2]	68	34.8	0.217‡
Female with only 1 brother & no sister	24.6	[12.0-43.6]	36				42.5	[29.6-56.3]	64	72.9	0.116‡
Female with only 1 sister & no brother	29.9	[15.4-49.8]	38				42.5	[29.4-56.6]	69	42.2	0.289‡
Male with 2+ brothers & no sister	48.6	[26.9-70.8]	42				50.5	[34.8-66.0]	62	3.8	0.900‡
Male with 2+ sisters and & no brother	39.1	[24.0-56.5]	47				49.9	[32.1-67.6]	52	27.6	0.211‡
Male with 1+ brothers & 1+ sisters	38.2	[31.2-45.6]	295				45.6	[39.5-51.6]	374	19.3	0.130‡
Female with 2+brothers & no sister	19.9	[9.2-37.6]	55				40.1	[23.8-58.7]	37	101.4	0.091‡
Female with 2+ sisters & no brother	24.7	[12.2-43.5]	42				39.7	[24.8-56.6]	36	60.5	0.001‡
Female with 1+ brothers & 1+ sister	30.7	[23.5-38.9]	309				40.5	[33.7-47.5]	332	31.7	0.071‡

*: Calculated as relative change=[(final period % - first period %)×100/first period]; †: Based on Cochran-Armitage time trend analyses (for linear trend) and χ^2 analyses; ‡: (for nonlinear trend) with Rao-Scott adjustments to assess significant trends over time. CI: confidence interval.

who had one older surviving sister (55%). During the period of 1990-2007, full immunization coverage was the lowest among female children who had 2+ older surviving brothers (20% in 1990, and 40% in 2007). Results showed that in case of male older surviving sibling composition, the coverage of full immunization was lower in female children than in male children.

Discussion

Progress in human development is now broadly measured with equitable access to healthcare services, and is one of the most profound agenda of the WHO's Commission on the Social Determinants of Health.[25] In the global public health literature, the strong association between gender and child health has been widely acknowledged, particularly in developing countries.[16,26] This study explores trends in gender differentials in child immunization beyond the conventional male-female dichotomy, by considering gender, surviving siblings, birth order and different compositions of older siblings in tandem. The study is a contribution to public health literature that assesses trends and patterns of child immunization coverage in the two South Asian countries, India and Pakistan in the last two decades.

The findings confirmed that girls and boys were not always treated equally, and there was a clear pattern of selective neglect in child immunization in both countries during the period of 1990-2007. For instance, boys and girls with no older surviving siblings and those with only surviving siblings of the opposite sex appeared to have been fully immunized proportionally higher than the children with other sibling compositions. The strength of preference for selective sex was evident, particularly in India, where the least increase in full immunization coverage during the period of 1992-2006 was observed among the female children with 2+ older surviving sisters, and female children with 1+ older surviving brothers and sisters. On the other hand, the highest increase in full immunization coverage was evident among the male children with 2+ surviving older sisters.

In the case of Pakistan, the smallest increase was recorded among male children with 2+ brothers only, while the highest change was evident among female children with 2+ older surviving brothers only. However, in general, the findings clearly revealed that in both countries, fewer female children (with the same older surviving sibling composition) as compared to their male counterparts received the required immunization during the period of 1990-2007.

Earlier studies[27,28] have shown that parental and societal norms about the value of girls relative to boys and about a desirable family sex composition help explain why certain children fare worse than their siblings. The sociological literature suggests that gender bias occur when male and female identities are assigned different "values" within the community or indeed the household they are born in, leading to boys and girls receiving different treatment, care and resources.[26] There are interconnecting social, cultural, political and economic factors which underpin son preference and bias against girls.[28] In the South Asian context, males are perceived as the economic lynchpin of future generations, while girls are considered a burden on resources, who will eventually leave the family home due to marriage patterns.[29] Parents may have made pragmatic choices based on their perception of how useful or valuable a male would prove over a female.[27] A significant volume of the literature in the South Asian context suggests that parity and sex of siblings may also have a pertinent impact on a girl's life-chances.[27,29,30-32]

Some theories suggest that parents invest in their child with the hope of great potential returns,[33] and that may depend on the sibling sex compositions in the household. According to models of the family developed by Becker and Tomes (1976), parents care about the welfare of their children and, as a result, finance human capital investments in their children.[34] In the absence of credit constraints and preferences for equality of earnings, investments in children are made until the return to additional investment equals the market rate of interest. For example, if the rate of return on investment in education or health is greater for male children than for female children, males will receive more of such investments than females. As Butcher and Case[35] note, these circumstances can lead to a systematic relationship between sibling sex composition and educational attainment, which might be applicable in the case of health care utilization too. In families with only female children, each daughter would receive more resources than a daughter in a family that had male children.[35]

According to the "inverse equity hypothesis", the difference in health care use decreases if the coverage rate increases.[36] But as long as the coverage of immunization remains poor in both countries, serious efforts at policy and program levels are needed to address the gender difference in immunization coverage. Policy implications of these results include the need to consider the role of gender while planning childhood vaccination strategies within the appropriate social context. There is evidence that childhood immunization campaigns could benefit from additional strategies aimed at reducing gender inequities, such as improving women's literacy and decision-making autonomy.[31]

This continuing selective difference in child immunization coverage leads to faltering growth in general and infant and child mortality among female

children, in particular. The continuing poor coverage of child immunization coupled with inequitable distribution hinders the efforts of both countries in reducing child mortality. It has also been estimated that measles, pertussis and tetanus, diseases that affect children, are responsible for the majority of disability-adjusted life years lost.[37] In the 65th World Health Assembly, in 2012, a Global Vaccine Action Plan (GVAP) for the period of 2011-2020 has been formulated to expedite the coverage of child immunization in developing countries.[38] One of the six guiding principles for GVAP was to ensure the greater equitable benefit of immunization. It was also decided that immunization should be recognized as a core component of the human right to health and an individual, community and governmental responsibility.

In both countries, the Expanded Program on Immunization (EPI) has been in place for many years, and provides immunization to children free of cost through a mass program that should ideally be accessible to all eligible children irrespective of gender, birth order and sibling compositions. However, the female disadvantage highlighted by the present study is unforeseen and refers to policy incompetence in both countries. Additionally, findings indicate that there are various heads of expenditure involved in the provision of child immunization, which may lead to the observed female disadvantage. These may include opportunity costs of time taken to reach the health facility, travel costs and waiting costs.[27] This study suggests that there should be greater awareness among individuals and communities about the benefits of child immunization. Moreover, several interconnected components of the immunization system require multidisciplinary attention in order to build a cohesive, non-fragmented and well-functioning gender sensitive program that works in synergy with other primary health care programs. More in-depth qualitative research is necessary to understand the sibling dynamics in relation to child health at the community level and propose specific programmatic implications. A potential limitation of the present study is the lack of clinical importance that could be a key avenue for future research. Since the present study does not take into account the other individual, household and contextual factors, it recommends further research into sibling trends in child immunization, in order to frame appropriate policy interventions in this domain.

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