Background: Child vaccination is perhaps the first line of defense to ensure a healthy society. Unfortunately, the coverage of child vaccination in Pakistan is poor resulting in unnecessary yet preventable deaths. This study investigated the determinants and reasons for not vaccinating children in Pakistan. 

Materials and Methods: The study used the Pakistan Integrated Household Survey/Household Integrated Economic Survey 2001–2002 data. Demographic, distance to health facility, poverty status, literacy and education, and location of residence were used as determinants of nonimmunization of children. Descriptive statistics including frequency distribution, proportions for categorical variables and mean for continuous variables, and logistic regression analysis were done using the Stata 11.0.

Results: Almost 7.73% children in Pakistan were never immunized. More than 87.4% of these lived in the rural areas. Prevalence of nonimmunization was highest in Balochistan compared to other provinces. Large households appeared to have increased risk of a child not being vaccinated. Moreover, low literacy and education of the head of the household and the spouse was also associated with low vaccination coverage. Distance from the health facility was found to be another factor related to nonimmunization of children. Increase in per capita income significantly decreased the risk of missing vaccinations.

Conclusions: Prevention and immunization programs should focus more on high-risk regions such as Balochistan and rural areas. Literacy, education, and economic status were among the other significant factors associated with low vaccination rates, which need a special focus in the public policy to achieve the target of a healthy society.

Key words: Child vaccination, education, health interventions, immunization, income, literacy
children worldwide are still not vaccinated.\textsuperscript{[4]} The number of children not vaccinated is highest in developing countries. More than one-fifth of children worldwide, particularly those living in poor countries, are not fully vaccinated.\textsuperscript{[9]} A study conducted in Gondar, Ethiopia, shows that only 47% children between 1 and 2 years of age were fully immunized.\textsuperscript{[6]} Though low coverage of vaccination is a characteristic of low-income countries, rich countries also have not achieved full coverage. According to Kahane \textit{et al.}, vaccination coverage of US toddlers was lower than the 90% target set in the USA Healthy People 2000 program.\textsuperscript{[7]} Immunization coverage in the USA through private medical practices is lower than the coverage through the public medical practices.\textsuperscript{[7]}

As found in the literature, factors such as demography, socioeconomic factors, and infrastructure contribute to the immunization status of a child. Parental poverty, literacy and educational level of parents, the mother’s lack of access to information, the absence of antenatal care, large family size, type of father’s work and location of residence are found to be factors related to low immunization in Pakistan.\textsuperscript{[8]}

In a study conducted at a hospital in Khyber Pakhtunkhwa (KP) province of Pakistan, the main reasons stated by parents for not having the children immunized were the lack of awareness of the benefits of immunization, perception that immunization was unimportant, lack of immunization services in their area, peer pressure not to immunize their child, and conflicts in residents’ localities resulting in internal displacement of population, which blocked their access to a vaccination center.\textsuperscript{[9]} Vaccine hesitancy appears to be linked with low vaccination coverage worldwide when parents have fear or doubts about immunization.\textsuperscript{[10]} Due to antivaccine campaigns, public confidence in vaccination is diminishing globally and, as a result, vaccine hesitancy is receiving a great deal of attention on the public health agenda.\textsuperscript{[11]} The evidence also suggests that vaccination coverage has a positive correlation with improved and increased services offered at health centers.\textsuperscript{[11]}

Conditions of child health in Pakistan are poor, and the rate infant mortality is among the highest in the world, i.e. around 80/1000 live births.\textsuperscript{[12]} Though child vaccination has been on the public health agenda in Pakistan for the last few decades, the coverage achieved is still far below the targets. According to Pakistan Institute of Legislative Development and Transparency, only 47% children in Pakistan received full vaccine coverage, i.e. all necessary vaccinations used by EPI program of WHO.\textsuperscript{[13]} In a periurban study in Pakistan, Siddiqi \textit{et al.} reported that age appropriate vaccination coverage for infants was 44.8%.\textsuperscript{[14]} According to Ahmad \textit{et al.} almost 35% of children under 3 years in the KP province of Pakistan were not fully immunized.\textsuperscript{[15]} According to Centers for Disease Control and Prevention (CDC), the estimated vaccination coverage in Pakistan was 58%.\textsuperscript{[16]} Such a large number of unvaccinated children could be a threat to the public health of the country. The worst is that a significant number of children in Pakistan are never immunized (in this study, it will be referred to as nonimmunization). This grim picture of child immunization in Pakistan provided the basis for this study. The objective of the study was to examine the determinants of nonimmunization of children under 5 years of age in Pakistan. The findings of this research could be helpful for health authorities and policy makers in Pakistan in formulating the policies for achieving the maximum coverage of child vaccination.

**MATERIALS AND METHODS**

This study used the Pakistan Integrated Household Survey/Household Integrated Economic Survey (PIHS/HIES) 2001–2002 data collected by the Pakistan Bureau of Statistics (PBS) using a systematic two-stage stratified random sampling methodology.\textsuperscript{[17]} The PIHS/HIES is a comprehensive nationwide cross-section household level survey for collecting data on socioeconomic variables. The survey was conducted on 14,831 households. The PIHS/HIES data is available to the public and was acquired directly from the PBS. There is no stated restriction on the use of this data for the academic purposes.

The present study involved children under 5 years of age (from now on this group will be referred to as “children”) living in Pakistan. According to the PIHS/HIES 2001–2002, the total population of children was 20,436,228. As per PIHS/HIES 2001–2002, a sample of 14,767 children belonging to 8333 households was studied.

To examine the determinants of nonimmunization in Pakistan, a multivariate logistic regression analysis was carried out. The binary dependent variable took two values: 1 if the child was not immunized and 0 if the child was immunized. A set of independent variables including continuous and dichotomous variables was identified which included: Household size, number of literate persons in the household, the number of years of schooling the head of household had, the number of years of schooling the spouse of the head of household had, per capita income of the household (in rupees), distance to health facility (in kilometers), poverty status of the household (poor or not poor), region of domicile (urban or rural), and province (Punjab or Sindh or KP or Balochistan). A person
RESULTS

The HIES/PHIS data indicated that almost 7.73% children in Pakistan, out of whom more than 87.4% lived in the rural areas were never immunized. Table 1 shows the proportion of children in urban and rural areas as well as in provinces who are not immunized. Table 1 reveals that (proportional) prevalence of nonimmunization was more than double in the rural areas (8.92%) as compared to the urban areas (4.01%). Furthermore, at the province level, the prevalence of nonimmunization was more severe in Balochistan than other provinces followed by KP. Table 2 presents a summary of reasons given by parents for nonimmunization of their children. Poverty status of the nonimmunized children is also included in Table 2 to provide an overview of the reasons for nonimmunizations viz-a-viz economic status of the household. The predominant reason for nonimmunization (25.84% cases) was that no (mobile) vaccination team visited the household. This was followed by the parents’ lack of knowledge of immunization (13.84% cases). Distance to health facility and the fear that child would get sick as a result of vaccination were also major reasons for nonimmunization, representing 11.50% and 11.19% respectively.

Table 3 presents the descriptive statistics (mean or proportion of total) for the independent variables used in the logistic regression. The average household size was 7.2 with only two literate persons. The average schooling of the head of household was 3.6 years. On the other hand, the average schooling of the spouse (mostly women) was just 1 year. The majority of the children (86.6%) lived within a distance of 2 km from a health facility. A substantial number of the children (41.9%) lived in poverty. Since Punjab is the largest province (with around 60% of the total population), more than half of the children lived in Punjab. However, more than three-fourth of the children lived in the rural areas. The output of logistic regression is presented in Table 4. Household size, the number of literate persons, education of the head of household and spouse, distance from the health facility, per capita income, province of domicile, and urban/rural location appeared to be significant determinants of nonimmunization.

DISCUSSION

The logistic results indicated that all variables, except two, significantly demonstrated their influence on the odds ratio (OR) of a child being not immunized. The estimated coefficients exhibited the expected sign, which were consistent with the theory. Around 1.6 million children in Pakistan were not vaccinated, the majority (1.4 million) of whom lived in the rural areas. The empirical results indicated that a child living in the rural area had almost 1.7 times higher odds of not receiving vaccination as compared to a child living in the urban area, which emphasizes the importance of improving vaccination coverage in rural areas. Of the provinces, nonvaccination was worst in Balochistan,
where more than 34% children were not vaccinated, which is an indication of the grim public health situation in Balochistan. It appeared that a child living in Balochistan had almost 11 times higher odds of not receiving vaccination compared to a child living in Sindh. However, the odds of a child living in Punjab not getting vaccination was about 1.4 times higher than a child living in Sindh. The significance of the location of the rural residence and the varying levels of the risk of nonvaccination in different provinces could be related to a number of factors. These might include the availability of (or access to) vaccination services, awareness of immunizations and vaccination, the level of education, economic conditions, etc., which are generally much less and poorer in the rural areas than the urban areas.\footnote{2}

The size of the household indicated a positive relationship with the risk of being not immunized, i.e., increase in the household size slightly increases the risk of a child not getting vaccinated. This seems consistent with the literature, as larger households tend to be poor, with less education and live in the rural areas.\footnote{20} A feature of the immunization plan in Pakistan is that in order to increase the coverage, the vaccination teams go from door to door. It appeared that low coverage of these teams was one of the major reasons which parents gave as being responsible for nonvaccination of their child. Distance from health facility significantly affected the risk of not receiving vaccination. Children who lived about 2–5 km from the health facility had 8.6 times higher chances of not receiving vaccinations as compared to children who lived <2 km away from the health facility. These results were consistent with Table 2, which indicated that around 11.5% children who were not vaccinated lived far away from the health facility.

Lack of knowledge of immunization appeared to be a major reason for not getting the child vaccinated. There were misconceptions and wrong beliefs about vaccination. Some such were that vaccination would make their child ill or that there was no benefit in vaccinations, which also appeared to be important reasons for nonvaccination of a child. Amin \textit{et al.} also indicated that beliefs of parents were important factors for nonimmunization of their children.\footnote{21} According to CDC (2009), misconceptions and beliefs of parents were one of the major factors associated with low vaccination coverage in Pakistan.\footnote{21}

### Table 3: Descriptive statistics of variables used in the logistic model

| Discrete/continuous independent variables | Mean |
|------------------------------------------|------|
| Household size (number of people)        | 7.2  |
| Number of literate persons in household  | 2.03 |
| Number of years schooling of head of household | 3.61 |
| Number of years schooling of the spouse of head of household | 1.04 |
| Per capita income of household (Rs.)     | 1158.60 |

| Dichotomous independent variables | Proportion (%) |
|----------------------------------|----------------|
| Distance to health facility      |                |
| Up to 2 km                       | 86.58          |
| Above 2 km and up to 5 km        | 9.08           |
| Above 5 km                       | 4.34           |
| Is the household poor?           |                |
| Yes                              | 41.90          |
| No                               | 58.10          |
| Province of abode                |                |
| Punjab                           | 53.90          |
| Sindh                            | 27.65          |
| KP                               | 13.83          |
| Balochistan                      | 4.61           |
| Region of abode (whole country)  |                |
| Urban                            | 24.23          |
| Rural                            | 75.77          |

Source: PIHS/HIES 2001-2002. KP: Khyber Pakhtunkhwa; PIHS/HIES: Pakistan Integrated Household Survey/Household Integrated Economic Survey

### Table 4: Logistic regression results: Determinants of nonimmunization of children

| Independent variable                        | OR      | z       | p>|z|   | 95% CI   |
|---------------------------------------------|---------|---------|-------|---------|
| Distance to health facility (above 2 km and up to 5 km) | 8.653573* | 30.48  | 0.000 | 7.532282 | 9.941785 |
| Distance to health facility (above 5 km)     | 2.259046* | 6.28   | 0.000 | 1.751472 | 2.913715 |
| Household size (number of people)            | 1.014878** | 1.84   | 0.065 | 0.999064 | 1.030943 |
| Is the child’s household poor?               | 0.9341374 | -0.82  | 0.410 | 0.79423  | 1.09869  |
| Number of literate persons in household      | 0.9123561* | -4.79  | 0.000 | 0.878767 | 0.94723  |
| Number of years of schooling of head of household | 0.9535562* | -5.81  | 0.000 | 0.938378 | 0.96898  |
| Region of abode: Punjab                      | 1.420838* | 3.61   | 0.000 | 1.174253 | 1.719205 |
| Province of abode: Balochistan               | 10.80108* | 25.98  | 0.000 | 9.026227 | 12.92494 |
| Province of abode: KP                        | 1.107052  | 0.99   | 0.320 | 0.905878 | 1.352902 |
| Region of abode: Rural                       | 1.692248* | 7.24   | 0.000 | 1.467484 | 1.951437 |
| (log) per capita income (Rs.)                | 0.7553048* | -2.31  | 0.021 | 0.595182 | 0.958505 |

Dependent variable: Child not immunized. Model: Number of observations=17,034; \( \chi^2 = 2104.98; \) \( P > \chi^2 = 0.000. \) *Significant at 5% level of significance; **Significant at 1% level of significance; \( \chi^2 \) : Chi-square; OR: Odds ratio.
Lack of awareness of the importance and significance of vaccination appeared to be a serious problem. The data further revealed that literacy and level of education were very low among parents who had no knowledge of vaccination or had misconceptions about vaccination programs.

As indicated in Table 2, around 31.45% of children were not immunized because their parents had no knowledge of immunization or were afraid that the child would get sick as a result of the vaccination, or they thought that immunization was unnecessary, which might reflect the lack of information or awareness about the immunization.

Literacy and education emerged as a significant factor associated with the risk of not getting vaccinated, i.e., children who lived in a household with more literate people and who had educated parents had less risk of missing vaccinations. The estimated model suggested that having one or more literate persons in the household was predictive of the reduction of the OR for a child being not vaccinated by nearly 9%. The number of schooling years completed by the head of the household and spouse also appeared to significantly contribute to lower the risk of a child not being immunized. For instance, keeping other factors constant, the increase of the education of the head of the household or spouse by 1 year could reduce the risk of a child not receiving vaccination by around 4.6% and 4% respectively. These results are consistent with USAID (2012) findings, which show that literacy and educational level of parents are positively associated with the vaccination coverage of their children. The dismal education and health (including healthcare and public health) situation in Pakistan is because public spending in Pakistan in these two important areas is among the lowest 5% in the world. In 2010, the public sector spending on education and health in Pakistan was 2.05% and 0.54% of the gross domestic product (GDP), respectively. Such low priority of health and education in public policy could be associated with the low coverage of vaccination in Pakistan.

Since the vaccination service in public health facilities in Pakistan is mostly free of charge, the poverty status of a child did not appear to be significantly associated with the risk of not receiving the vaccination, which could be the result of the calculation of poverty line (and thus poverty). It could also be that most of the children who are not immunized are clustered around the poverty line. However, the per capita income variable in the model captured the effect of economic status on the risk of missing vaccinations. The results showed that a 1% increase in per capita income tended to decrease the odds of not getting vaccinated by about 24%. This suggests that moving up on the income ladder significantly reduced the risk of a child without vaccination. This is also consistent with Siddiqi et al. who reported that the education of parents and economic status of the household was positively associated with vaccination coverage in Pakistan.

Improved vaccination coverage requires an all encompassing public policy focused on education, health, and other socioeconomic areas. Health interventions are, however, the key to the success of immunization programs and coverage, which include health education and the promotion of vaccination. In a society where literacy, education, and awareness of vaccination is poor, health interventions are necessary. Based on the findings of this study and evidence from the literature, it appears that effective professional interventions could be instrumental in improving vaccination coverage in Pakistan. These may include educational community discussions, home visits by health professionals, creation of immunization awareness by educating mothers at health centers, engaging the local community in order to publicize the benefits and advantages of immunization.

To achieve high vaccination coverage, advocacy for decentralization of the planning and management of immunization programs is growing. Since the main reason for nonimmunization of children is Pakistan found in this study was that no vaccination team visited the child, a door to door vaccination campaign could be useful in achieving better and wider vaccination coverage. To this end, the involvement of community workers and volunteers can be a cost-effective intervention. The community volunteers would keep close contact with every child and its family in their respective communities to check on the child’s vaccination status. On the other hand, immunization outreach can also be used as a means of providing other health services and products such as medicines, bed nets, nutritional supplements, antenatal advice to communities/people who have limited access to health centers. In this regard, the immunization programs in Pakistan may be developed around the WHO’s Reaching Every District strategy, which aims at increasing and improving equity in access to immunization by targeting difficult-to-reach populations.

Another health promotion awareness-related intervention linked with the overall socioeconomic development plans could be the promotion of popular education as it has been proved to be an effective instrument for creating a more equitable environment by enhancing empowerment and improving health. Promoting the importance and benefits of vaccination should be on the agenda of public health policy making. The public health message could be delivered through different campaigns such as public service messages through mainstream media, social media,
the engagement of the local authorities, education in schools, and the involvement of the health facilities and service providers, etc.

The aforementioned suggested health interventions will inform and educate people, especially mothers about the benefits and importance of vaccination and expunge the misconceptions and vaccine hesitancy so that immunization is increased and child health in Pakistan improved.

Since PIHS/HIES was conducted only by the Government of Pakistan, the reliability of the data could not be verified through independent sources. The data used in this study is old. Therefore, the findings correspond to the data period only. The situation on the ground might have changed (improved) since 2001–2002 that could be the basis of a future study.

CONCLUSION
About 8% of children in Pakistan never received any vaccination, majority being in rural areas. Among the four provinces of Pakistan, non-immunization was highest in Balochistan. Prevention and immunization programs should focus more on high risk regions such as Balochistan and rural areas. Literacy, education, and economic status were among the other significant factors associated with non-immunization. These factors need a special focus in the public policy for achieving the target of healthy society.

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Conflicts of interest
There are no conflicts of interest.

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