Original Research Article

Enablers of vitamin A coverage among children under five years of age from multi-country analyses of global demographic and health surveys in selected LMIC and LIC countries in Africa and Asia: a random forest analysis

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ABSTRACT

Background: Vitamin A deficiency is a common form of micronutrient malnutrition. The estimated relative risks associated with vitamin A deficiency in children were 1.86 (95% CI 1.32–2.59) for measles mortality, 2.15 (95% CI 1.83–2.58) for diarrhoea mortality, 1.78 (95% CI 1.43–2.19) for malaria mortality, 1.13 (95% CI 1.01–1.32) for other infectious disease mortality. Vitamin A supplementation reduces night blindness, child morbidity and mortality.

Methods: This paper tries to explore the socio-demographic causes of receipt of vitamin A in selected lower-middle-income and low income countries by analysing the data of the demographic and health surveys from 2012 and 2016 using PASW 18.0 software. Multivariate binary logistic regressions were conducted to explore the role of socio-demographic covariates in the receipt of vitamin A supplementation. In addition, random forest (RF) analyses were conducted using Python 3.6.

Results: After adjusting for related socio-economic and demographic factors, mother’s work status and education and among mass media channels, exposure to television seems to play an important role in predicting receipt of vitamin A in the selected countries in Asia, while education of the mother was significantly associated with the receipt of vitamin A in the selected countries of Africa. In all the selected countries, the RF analyses revealed mother’s education followed by wealth index and mass media (TV), as the variable of most importance.

Conclusions: It can be concluded that mother’s education and mass media seems to be working well in making the mothers aware about the vitamin A campaign, especially, the exposure to television. It also figures in the variable importance matrix in addition to wealth index.

Keywords: Vitamin A supplementation, Vitamin A deficiency, Maternal education, Mass media, Wealth index, Demographic and health surveys

INTRODUCTION

Vitamin A deficiency (VAD) is a major public health problem in many developing countries. VAD causes xerophthalmia, a range of eye conditions from night blindness to more severe clinical outcomes such as keratomalacia and corneal scars, and permanent blindness. WHO recommends vitamin A supplementation (VAS) with a dose of 30 mg retinol equivalents in infants aged 6–11 months and 60 mg retinol equivalents at least twice a year in young children aged 12–59 months living in settings where VAD is a public health problem. A
meta-analysis of 17 trials (11 in Asia, 5 in Africa and 1 in Latin America) for all-cause mortality indicated that vitamin A reduces the overall risk of death by 24% (risk ratio (RR) 0.76; 95% confidence interval (CI) 0.69–0.83).\textsuperscript{12} After considering an unpublished cluster-randomized trial involving one million children in north India (the DEVTA trial), VAS reduced the effect size of all-cause mortality from 24% to 12% (RR 0.88; 95% CI 0.84–0.94). Vitamin A programming is a prerequisite for achieving one of the sustainable development goals (SDG 3, target 3.2, indicator 3.2.1) of reducing under five mortality to at least as low as 25 per 1,000 live births by 2030. The global prevalence of VAD in children under age 5 has declined from about 39 per cent to about 30 per cent over the past two decades. However, progress has not been seen in South Asia and sub-Saharan Africa, where today, vitamin A deficiency still affects around 44 per cent and 48 per cent of children under age five years, respectively. More than 95 per cent of vitamin A-related measles and diarrhoea deaths occur in these regions — and VAS offers a powerful tool for preventing them.\textsuperscript{3}

A literature review was undertaken to understand the determinants of VAS in other studies. Agarwal and Agarwal have shown that rural children and children of educated mothers were more likely to receive VAS than others.\textsuperscript{4} Children born in a higher birth order (6+) and those residing in states with low levels of social and economic development were only about half as likely to receive VAS as their counterparts in a cross-sectional study of 20,802 children aged 12-35 months whose mothers participated in the third round of the National Family Health Survey (NFHS-3) conducted during 2005-2006, where the association between the socio-economic and demographic characteristics of the children, the social and economic development status of the State in which they reside and VAS status were examined by means of unadjusted and adjusted logistic regression models. Kimani-Murage et al, analyzed the data of Kenya Demographic and Health Survey 2008-09 and found a positive association between receiving VAS and stunting levels.\textsuperscript{5} They also found a strong negative relationship between receiving vitamin A supplement and underweight status. They found that VAS may be beneficial to the growth of young children. They have also noted that the analysis was not able to establish a causal relationship, given the cross-sectional nature of the data and have thus recommended longitudinal studies to determine causal relationships. Samba et al, found that maternal education is an important factor relating to receipt of a vitamin A capsule in the BDHS 2004 data.\textsuperscript{6} A higher level of formal education achieved by girls may be a key factor in breaking the intergenerational cycle of malnutrition and poverty. Since younger maternal age was also associated with the lower coverage, further efforts are, thus, required by the VAS programmes to reach young, uneducated primigravida mothers. Also, children of households of higher socioeconomic status were more likely to have received a vitamin A capsule. Thapa et al, have analysed the data of Nepal Demographic & Health Survey, 2001 and found that the beneficial effect of VAS on child mortality is larger than that found in most earlier clinical studies.\textsuperscript{7} This larger effect may be due mainly to the other health related activities undertaken by the female community health volunteers who distribute vitamin A capsules.

VAS of 6-59 months old children living in areas where vitamin A deficiency is a problem can reduce their risk of dying by an average of 23%.\textsuperscript{8} VAD was 1-5 more likely in children with anaemia than in children who did not have anaemia (95% CI 1.08–2.10; p=0.047).\textsuperscript{9} The latest estimates (2016) tell us that 64 per cent of children in need in priority countries were reached with two doses of vitamin A – but more than 140 million children were left behind, leaving them vulnerable to disease and death. VAD affects almost half of children under 5 years in south Asia and sub-Saharan Africa.\textsuperscript{10}

The effect of VAS on diarrhoea disease during infancy and, in particular, whether VAS would reduce rotavirus infection and morbidity, because rotavirus is one of the leading causes of life-threatening diarrhea in infants in sub-Saharan Africa.\textsuperscript{11} Three trials from southern Asia have reported that neonatal VAS reduced mortality by 21% in the first six months of life.\textsuperscript{12} Globally, night blindness affects 5.2 million pre-school age children (95% CI: 2.0–8.4 million) and 9.8 million pregnant women (95% CI: 8.7–10.8 million), which corresponds to 0.9% and 7.8% of the population at risk of VAD respectively. According to current estimates, 122 countries are classified as having a moderate to severe public health problem based on biochemical VAD in preschool-age children; while 88 countries are classified as having a problem of moderate to severe public health significance with respect to biochemical VAD in pregnant women.\textsuperscript{13} Further in 2013, VAD accounted for 2% of all deaths in children under 5 years of age in the sub-Saharan Africa region.\textsuperscript{14} Most importantly, vitamin A supplements can improve a child’s chance of survival by 12 to 24 per cent.\textsuperscript{15}

**Study objectives**

The objectives of the study are to examine the association between different socio-demographic characteristics and receipt of vitamin A in selected LMIC and LIC countries in the Africa and Asia region.

**METHODS**

This paper uses data from Demographic and Health Surveys (DHS) of ten countries; five countries each in Africa and Asia. The countries, for which the data has been analysed are Ethiopia (2016), Kenya (2014), Nigeria (2013), Senegal (2016) and Tanzania (2015-16) in Africa and Bangladesh (2014), India (2015-16), Indonesia (2012), Pakistan (2012-13) and Philippines (2013) in Asia. These surveys were carried out by ICF International, working in close conjunction with in-
country research institutes. We used the existing weighted data of children under five years of age for our analyses. Individual level datasets were analysed using PASW Statistics 18, Release 18.0 software.

**Multivariate binary logistic regression**

Multivariate Binary logistic regressions were conducted to explore factors associated with VAS. Logistic regression can be used to predict a dependent variable on the basis of independent variables, and to determine the per cent of variance in the dependent variable explained by independent variables; to rank the relative importance of independents; to assess interaction effects; and to understand the impact of covariates. Logistic regression applies maximum likelihood estimation after transforming the dependent variable into a logit variable (the natural log of the odds of the dependent occurring or not). In this way, logistic regression estimates the probability of a certain event occurring. Note that logistic regression calculates changes in the log odds of the dependent, not changes in the dependent variable itself, as OLS regression does. In addition to bivariate analysis, multivariate analysis was performed to control for the effects of other factors. Binary logistic regression models were used to explore associations between the dependent variable and independent variables, adjusting for socio-demographic and economic covariates. The dependent variable was coded as 1 if the child had received vitamin A supplements in the last six months and 0 if the child had not received vitamin A supplements in the last six months. The age group has been taken as 9-59 months to give adequate exposure of 6 months to a child considering the fact that usually in some countries, vitamin A campaign rounds are held biannually every six months.

**Random forest analyses (RF)**

In addition, random forest analysis was used to identify feature (independent variables) importance and model accuracy for two extreme countries from Africa and Asia each. Random forest is a recently developed machine learning technique that deals with classification and clustering of data non-parametrically. It is an ensemble method that combines a number of trees by taking the same number of bootstrap samples from the original data, and growing a tree on each bootstrap sample. Tree implementations are very simple and user-friendly and require fewer techniques from the investigator. The individual trees in a random forest are not pruned and used for decision in classification or clustering. Random forest uses a randomly selected subset of predictors for splitting the root nodes in to new daughter nodes for each split. From all trees grown in this process based on the bootstrap samples, we generate a forest. From the complete forest, the response variable for an instance is predicted as an average or majority vote of the predictions of all trees. Random forest can highly increase the prediction accuracy compared to an individual tree, as the ensemble reduces the variance. The RF is one of the most effective machine learning models for predictive analytics.\textsuperscript{16,17} The model feature importance from sklearn random forest was used to calculate feature importance. Random forest uses gini importance or mean decrease in impurity (MDI) to calculate the importance of each feature. Gini importance is also known as the total decrease in node impurity. This is how much the model fit or accuracy decreases when you drop a variable. The larger the decrease, the more significant the variable is. Here, the mean decrease is a significant parameter for variable selection. The Gini index can describe the overall explanatory power of the variables. For this RF analysis, Python 3.6 software was used.

**Covariates considered in random forest and multivariate binary logistic regression model**

Based on a literature review, the analysis of these survey data considered the following covariates in Figure 1.

**Demographic and socio-economic profile of the countries**

According to the World Bank classification of economies, seven of these countries belong to low-middle income countries (LMIC) (Bangladesh, Kenya, India, Indonesia, Nigeria, Pakistan and Philippines) and three belong to low income countries (LIC) (Ethiopia, Senegal and Tanzania). The population of these countries vary from about 16 million in Senegal to 1,339 million in case of India. The annual rate of population change varies from 1.2\% in each in Bangladesh and India to 3.1\% in Tanzania. The per cent of urban population varies from 19\% in Ethiopia to 46\% in Nigeria in Africa and it varies from 23\% in Bangladesh to 54\% in Indonesia in Asia. The under-five mortality rate varies from 51 in Senegal to...
128 in Nigeria in Africa and 29 under-five deaths per thousand live births in Philippines to 87 under-five deaths per thousand live births in Pakistan in Asia.

**Ethical approval**

Procedures and questionnaires for standard DHS surveys have been reviewed and approved by ICF Institutional Review Board (IRB). Additionally, country-specific DHS survey protocols are reviewed by the ICF IRB and typically by an IRB in the host country. ICF IRB ensures that the survey complies with the U.S. Department of Health and Human Services regulations for the protection of human subjects (45 CFR 46), while the host country IRB ensures that the survey complies with laws and norms of the nation: https://dhsprogram.com/What-We-Do/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm.

### Table 1: Socio-demographic profile of the selected countries in Africa and Asia.

| Sl. No. | Indicators                                                                 | Africa            | Asia            |
|--------|-----------------------------------------------------------------------------|-------------------|-----------------|
| 1      | Population(in million), 1st July'2017 (Projected)                           | Ethiopia 104.96   | Kenya 149.70    |
|        |                                                                             | Nigeria 190.89    | Senegal 15.85   |
|        |                                                                             | Tanzania 57.31    | Bangladesh 164.67|
|        |                                                                             | India 1,339.17    | Indonesia 262.99|
|        |                                                                             | Pakistan 197.02   | Philippines 104.92|
| 2      | Annual rate of population change (2017) (%) (Estimated)                     | 2.6              | 2.7             |
|        |                                                                             | 2.7              | 3.0             |
|        |                                                                             | 3.1              | 1.2             |
|        |                                                                             | 1.2              | 1.3             |
|        |                                                                             | 1.3              | 2.1             |
|        |                                                                             | 1.6              |                 |
| 3      | Urban population (%)                                                        | 19               | 25              |
|        |                                                                             | 46               | 43              |
|        |                                                                             | 30               | 23.3            |
|        |                                                                             | 31.2             | 54              |
|        |                                                                             | 32.5             | 44              |
| 4      | Population density (persons per sq. km)                                     | 100              | 83              |
|        |                                                                             | 199              | 78              |
|        |                                                                             | 61               | 1238            |
|        |                                                                             | 382              | 143             |
|        |                                                                             | 246              | 341             |
| 5      | Total fertility rate(lifetime births per woman)                             | 4.63             | 4.10            |
|        |                                                                             | 5.74             | 5.0             |
|        |                                                                             | 5.24             | 2.22            |
|        |                                                                             | 2.26             | 3.8             |
|        |                                                                             | 3.05             |                 |
| 6      | Crude birth rate (no. of live births per 1000 mid-year population)          | 33.6             | 33.1            |
|        |                                                                             | 40.5             | 37.6            |
|        |                                                                             | 39.8             | 20.2            |
|        |                                                                             | 20.8             | 20.4            |
|        |                                                                             | 29.8             | 24.1            |
| 7      | Neonatal mortality rate (no. of neonatal deaths per 1000 live births)       | 28               | 22              |
|        | (SDG3, Target 3.2, Indicator 3.2.2)                                        | 34               | 21              |
|        |                                                                             | 19               | 23              |
|        |                                                                             | 26               | 14              |
|        |                                                                             | 46               | 13              |
| 8      | Infant mortality rate (no. of infant deaths per 1000 live births)           | 41               | 36              |
|        |                                                                             | 51               | 34              |
|        |                                                                             | 40               | 34              |
|        |                                                                             | 43               | 22              |
|        |                                                                             | 64               | 22              |
| 9      | Under-five mortality rate (no. of under-5 deaths per 1000 live births)      | 58               | 49              |
|        | (SDG 3, Target 3.2, Indicator 3.2.1)                                        | 91               | 47              |
|        |                                                                             | 57               | 28              |
|        |                                                                             | 35               | 26              |
|        |                                                                             | 79               | 27              |
| 10     | Maternal mortality ratio (no. of maternal deaths per 100,000 live births)    | 412              | 362             |
|        | (SDG 3, Target 3.1, Indicator 3.1.1)                                        | 576              | 315             |
|        |                                                                             | 530              | 176             |
|        |                                                                             | 167              | 126             |
|        |                                                                             | 178              | 120             |
| 11     | Status of Human Development Index (in rank), UNDP                           | 172              | 146             |
|        |                                                                             | 152              | 162             |
|        |                                                                             | 151              | 139             |
|        |                                                                             | 131              | 113             |
|        |                                                                             | 147              | 116             |
| 12     | GDP per capita (Current USD)                                                | 768              | 1,508           |
|        |                                                                             | 1,969            | 1,033           |
|        |                                                                             | 936              | 1,384           |
|        |                                                                             | 1,940            | 3,847           |
|        |                                                                             | 1,548            | 2,989           |
| 13     | World Bank Classification                                                   | Low income       | Lower middle income |
|        |                                                                             | Low income       | Lower middle income |
|        |                                                                             | Low income       | Lower middle income |
|        |                                                                             | Low income       | Lower middle income |
|        |                                                                             | Low income       | Lower middle income |
|        |                                                                             | Low income       | Lower middle income |
|        |                                                                             | Low income       | Lower middle income |
|        |                                                                             | Low income       | Lower middle income |

Source: Demographic and Health Surveys 2007-16, United Nations, HDR 2016, UNICEF, 2018

**RESULTS**

The comparative analyses of the ten countries reveal that children 9 to 59 months of age, who received vitamin A varies from 41.8% in Nigeria to 81.3% in Senegal in Africa. It varies from 58.8% in India to 77.0% in Philippines in Asia. The trends in vitamin A coverage in the several rounds of demographic and health surveys vary from an average annual rate of increase (AARI) of -7.4% in Tanzania from 2010 to 2015-16 to 18.8% in Kenya from 2008-09 to 2014 in Africa and -0.3% in Bangladesh from 2007 to 2014 to 14.2% in case of India during 2005-06 to 2015-16. Receipt of VAS does not vary much by sex of the child.

**Results of the bivariate analyses**

A bivariate analysis was conducted for the receipt of vitamin A with several covariates. The variables considered for analysis were various background level and individual level socio-demographic and socio-economic covariates. Results indicate that a significantly higher proportion of mothers of children residing in urban areas received vitamin A as compared to rural areas.
across all countries similarly, receipt of vitamin A was also found to be higher among the literates, higher among those who had two or less two children, higher among the households belonging to the higher socio-economic status, higher among those who were exposed to mass media communication channels of newspaper, radio and television.

Table 2: Trends in per cent of children receiving vitamin A supplementation in the selected countries in Africa and Asia: DHS, 2007-16.

| Sl. No | Region | Country   | DHS rounds | % of children age 6 to 59 months who received vitamin A supplements in the six months preceding the survey | Average annual rate of increase (AARI (%)) |
|-------|--------|-----------|------------|------------------------------------------------------------------------------------------------|-----------------------------------------|
| 1     | Africa | Ethiopia  | 2011       | 53.1                                                                                           | -3.4                                    |
|       |        |           | 2016       | 44.7                                                                                           |                                         |
| 2     |        | Kenya     | 2008-09    | 30.3                                                                                           | 18.8                                    |
|       |        |           | 2014       | 71.7                                                                                           |                                         |
| 3     |        | Nigeria   | 2008       | 25.8                                                                                           | 9.9                                     |
|       |        |           | 2013       | 41.3                                                                                           |                                         |
| 4     |        | Senegal   | 2010-11    | 78.4                                                                                           | -0.2                                    |
|       |        |           | 2012-13    | 83.7                                                                                           |                                         |
|       |        |           | 2014       | 88.6                                                                                           |                                         |
|       |        |           | 2015       | 88.4                                                                                           |                                         |
|       |        |           | 2016       | 77.5                                                                                           |                                         |
| 5     |        | Tanzania  | 2010       | 60.8                                                                                           | -7.4                                    |
|       |        |           | 2015-16    | 41.3                                                                                           |                                         |
| 6     |        | Bangladesh| 2007       | 83.5                                                                                           | -0.3                                    |
|       |        |           | 2011       | 62.1                                                                                           |                                         |
|       |        |           | 2014       | 60.9                                                                                           |                                         |
| 7     | Asia   | India     | 2005-06    | 15.6                                                                                           | 14.2                                    |
|       |        |           | 2015-16    | 59.1                                                                                           |                                         |
| 8     |        | Indonesia | 2007       | 68.5                                                                                           | -2.3                                    |
|       |        |           | 2012       | 61.1                                                                                           |                                         |
| 9     |        | Pakistan  | 2006-07    | 60.2                                                                                           | 3.1                                     |
|       |        |           | 2012-13    | 72.1                                                                                           |                                         |
| 10    |        | Philippines| 2008      | 75.9                                                                                           | 1.9                                     |
|       |        |           | 2013       | 85.2                                                                                           |                                         |

Sources: Demographic & Health Surveys, 2007-16.

Table 3: Per cent of children age 6 to 59 months who received VAS in the six months preceding the survey by sex in the selected countries in Africa and Asia: DHS, 2012-16

| Sl. No | Region | Country   | DHS Rounds | Children (6 to 59 months) | Boys (6 to 59 months) | Girls (6 to 59 months) | Gender Parity Index in VAS coverage* |
|--------|--------|-----------|------------|---------------------------|-----------------------|------------------------|-------------------------------------|
| 1      | Africa | Ethiopia  | 2016       | 44.7                      | 44.9                  | 44.5                   | 0.99                                |
| 2      |        | Kenya     | 2014       | 71.7                      | 71.6                  | 71.9                   | 1.00                                |
| 3      |        | Nigeria   | 2013       | 41.3                      | 41.5                  | 41.1                   | 0.99                                |
| 4      |        | Senegal   | 2016       | 77.5                      | 77.4                  | 77.6                   | 1.00                                |
| 5      |        | Tanzania  | 2015-16    | 41.3                      | 41.9                  | 40.6                   | 0.97                                |
| 6      |        | Bangladesh| 2014       | 60.9                      | 61.7                  | 60.0                   | 0.97                                |
| 7      | Asia   | India     | 2015-16    | 59.1                      | 59.1                  | 59.1                   | 1.00                                |
| 8      |        | Indonesia | 2012       | 61.1                      | 60.5                  | 61.8                   | 1.02                                |
| 9      |        | Pakistan  | 2012-13    | 72.1                      | 72.1                  | 72.1                   | 1.00                                |
| 10     |        | Philippines| 2013      | 85.2                      | 84.1                  | 86.4                   | 1.03                                |

Note: * Gender Parity Index in vitamin A supplementation = (% of Girls received supplements /% of Boys received supplements).
Sources: Demographic & Health Surveys, 2012-16
Table 4: Socio-demographic and economic characteristics of the mothers in the selected countries in Africa and Asia, DHS (2012-16) (%).

| Socio-demographic and economic characteristics | Africa | Asia |
|-----------------------------------------------|-------|------|
| DHS rounds                                   |       |      |
| Ethiopia                                     | 2016  | 2015-16 |
| Kenya                                        | 2014  | 2014  |
| Nigeria                                      | 2013  | 6,635 |
| Senegal                                      | 2016  | 2012  |
| Tanzania                                     | 2015-16 | 2016-13 |
| Bangladesh                                   | 2014  | 2013  |
| India                                        | 2015-16 | 2013  |
| Indonesia                                    | 2012  | 2013  |
| Pakistan                                     | 2012-13 | 2013  |
| Philippines                                  |       |      |
| N (Weighted cases)                           | 8,392 | 201,758 |
| Kenya                                        | 15,262 | 16,948 |
| Nigeria                                      | 23,314 | 3,420  |
| Senegal                                      | 4,694  | 6,982  |
| Tanzania                                     | 7,481  | 26.4  |
| Bangladesh                                   | 201,758 | 26.4  |
| India                                        | 16,948 | 53.3  |
| Indonesia                                    | 3,420  | 53.3  |
| Pakistan                                     | 6,982  | 53.3  |
| Philippines                                  | 26.4  | 53.3  |
| Community level covariates                   |       |      |
| Place of residence                           |       |      |
| Rural                                        | 89.1  | 71.3  |
| Urban                                        | 10.9  | 28.7  |
| Place of residence                           | 71.3  | 46.1  |
| Individual level covariates                  |       |      |
| Maternal education                           |       |      |
| Non-literate                                 | 67.4  | 23.9  |
| Literate                                     | 32.6  | 76.1  |
| Maternal education                           | 67.4  | 76.1  |
| Demographic covariates                       |       |      |
| Maternal age (years)                         | 15-24 | 17.4  |
| 15-24                                        | 19.4  | 35.5  |
| 25-34                                        | 54.4  | 11.4  |
| 35-49                                        | 26.0  | 11.4  |
| Socio-economic covariates                    |       |      |
| Maternal work status                         |       |      |
| Not working currently                        | 71.5  | 76.4  |
| Working currently                            | 28.5  | 17.5  |
| Wealth index                                 |       |      |
| Poorest                                      | 23.9  | 23.9  |
| Poorer                                       | 22.9  | 23.9  |
| Middle                                       | 21.0  | 23.9  |
| Richer                                       | 18.0  | 23.9  |
| richest                                      | 14.2  | 23.9  |
| Communication exposure – Mass media          |       |      |
| Newspaper                                    |       |      |
| Never read Newspaper                         | 93.6  | 85.7  |
| Read Newspaper                               | 6.4   | 14.3  |
| Radio                                        |       |      |
| Never listened to Radio                      | 74.0  | 14.3  |
| Listened to Radio                            | 26.0  | 85.7  |
| Television                                   |       |      |
| Never watched TV                            | 82.5  | 49.0  |
| Watched TV                                   | 17.5  | 20.6  |

Continued.
### Table 5: Receipt of vitamin A in the last six months by socio-demographic and economic characteristics in selected countries in Africa, DHS.

| Socio-demographic and economic characteristics | Africa | Asia |
|-----------------------------------------------|--------|------|
| Vitamin A receipt among 9-59 months of children (weighted) |        |      |
| Did not receive Vitamin A in the last six months | 55.2   | 36.4 |
| Received Vitamin A in the last six months | 44.8   | 58.8 |

Socio-demographic and economic characteristics

| Country          | Vitamin A non-receivers (%) | Vitamin A receivers (%) | Prob. |
|------------------|-----------------------------|-------------------------|-------|
| Ethiopia, 2015-16| 56.8                        | 43.2                    | 0.000 |
| Kenya, 2014      | 57.9                        | 42.1                    | 0.000 |
| Nigeria, 2013    | 58.2                        | 41.8                    | 0.000 |
| Senegal, 2016    | 58.2                        | 41.8                    | 0.000 |
| Tanzania, 2015-16| 58.2                        | 41.8                    | 0.000 |
| Bangladesh       | 58.2                        | 41.8                    | 0.000 |
| India            | 58.2                        | 41.8                    | 0.000 |
| Indonesia        | 58.2                        | 41.8                    | 0.000 |
| Pakistan         | 58.2                        | 41.8                    | 0.000 |
| Philippines      | 58.2                        | 41.8                    | 0.000 |

### Community level covariates

**Place of residence**
- Rural: 57.0 (43.0, 64.9, 20.0, 66.2)
- Urban: 40.4 (59.6, 46.3, 0.000, 52.8)

### Individual level covariates

**Maternal education**
- Non-literate: 58.6 (41.4, 74.7, 20.3, 71.2)
- Literate: 48.1 (51.9, 42.6, 15.7, 54.2)

### Demographic covariates

**Maternal age(years)**
- 15-24: 57.4 (42.6, 64.8, 24.3, 59.1)
- 25-34: 54.4 (45.6, 56.1, 20.0, 57.5)
- 35-49: 55.3 (44.7, 56.5, 12.3, 57.2)

### Socio-economic covariates

**Maternal work status**
- Not working currently: 57.6 (42.4, 66.2, 21.0, 57.2)
- Working currently: 49.0 (51.0, 54.7, 15.6, 58.0)

**Wealth index**
- Poorest: 59.5 (40.5, 78.7, 25.1, 69.9)
- Poorer: 58.5 (41.5, 68.8, 19.4, 60.2)
- Middle: 56.8 (43.2, 56.1, 16.2, 54.2)
- Richer: 54.4 (45.6, 46.2, 15.3, 50.5)
- Richest: 41.2 (58.8, 32.5, 14.3, 49.6)

Continued...
Socio-demographic and economic characteristics | Ethiopia, 2015-16 | Kenya, 2014 | Nigeria, 2013 | Senegal, 2016 | Tanzania, 2015-16
--- | --- | --- | --- | --- | ---
Vitamin A non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A non-receivers (%) | Vitamin A receivers (%) | Prob.
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---

Communication exposure- Mass media

**Newspaper**

Never read Newspaper | 56.3 | 43.7 | 0.000 | 29.8 | 70.2 | 0.000 | 62.2 | 37.8 | 0.000 | 19.2 | 80.8 | 0.000 | 63.0 | 37.0

Read Newspaper | 38.8 | 61.2 | 23.7 | 76.3 | 0.000 | 33.5 | 66.5 | 0.000 | 14.6 | 85.4 | 0.000 | 48.6 | 51.4 | 0.000

**Radio**

Never listened to Radio | 58.2 | 41.8 | 33.4 | 66.6 | 0.000 | 70.7 | 29.3 | 0.000 | 23.3 | 76.7 | 0.000 | 64.8 | 35.2

Listened to Radio | 46.5 | 53.5 | 26.6 | 73.4 | 0.000 | 50.0 | 50.0 | 0.000 | 17.8 | 82.2 | 0.000 | 55.5 | 44.5 | 0.000

**Television**

Never watched TV | 57.0 | 43.0 | 31.2 | 68.8 | 0.000 | 70.3 | 29.7 | 0.000 | 24.9 | 75.1 | 0.000 | 61.5 | 38.5

Watched TV | 46.7 | 53.3 | 0.000 | 23.9 | 76.1 | 0.000 | 44.1 | 55.9 | 0.000 | 16.0 | 84.0 | 0.000 | 52.7 | 47.3 | 0.000

Prob.: Probability value.

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### Table 6: Receipt of Vitamin A in the last six months by socio-demographic-economic variables in the countries in Asia, DHS

| Socio-demographic and economic characteristics | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 | Prob. |
| --- | --- | --- | --- | --- | --- | --- |
| Vitamin A Non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A Non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A Non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A Non-receivers (%) | Vitamin A receivers (%) | Prob. |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Community level covariates

**Place of residence**

Rural | 37.5 | 62.5 | 42.3 | 57.7 | 39.1 | 60.9 | 23.4 | 76.4 | 22.8 | 77.2

Urban | 33.4 | 66.6 | 0.000 | 38.4 | 61.6 | 0.000 | 34.0 | 66.0 | 0.000 | 31.9 | 68.1 | 0.000 | 23.1 | 76.9 | 0.783

**Individual level covariates**

Maternal education

Non-literate | 41.4 | 58.6 | 49.9 | 50.1 | 73.7 | 26.3 | 27.0 | 73.0 | 34.8 | 65.2

Literate | 35.4 | 64.6 | 0.000 | 37.4 | 62.6 | 0.000 | 35.8 | 64.2 | 0.000 | 24.7 | 75.3 | 0.120 | 22.8 | 77.2 | 0.783

**Demographic covariates**

Maternal age (years)

15-24 | 37.2 | 62.8 | 39.6 | 60.4 | 40.8 | 59.2 | 24.7 | 75.3 | 28.6 | 71.4

25-34 | 35.5 | 64.5 | 41.1 | 58.9 | 36.5 | 63.5 | 26.4 | 73.6 | 22.0 | 78.0

35-49 | 37.3 | 62.7 | 0.357 | 47.4 | 52.6 | 0.000 | 33.2 | 66.8 | 0.000 | 26.0 | 74.0 | 0.664 | 19.2 | 80.8 | 0.000

Prob.: Probability value.
| Socio-demographic and economic characteristics | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
|-----------------------------------------------|----------------|----------------|----------------|-------------------|------------------|
| Vitamin A Non-receivers (%)                  | Vitamin A receivers (%) | Prob. | Vitamin A Non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A Non-receivers (%) | Vitamin A receivers (%) | Prob. | Vitamin A Non-receivers (%) | Vitamin A receivers (%) | Prob. |
| **Socio-economic covariates**                | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
| **Maternal work status**                     | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
| Not working currently                        | 35.8            | 64.2           | 41.2           | 58.8              | 25.7             | 74.3            | 25.5             | 74.5            |
| Working currently                            | 38.0            | 62.0           | 0.093          | 40.7              | 0.512            | 35.5           | 64.5            | 0.006           | 26.7           | 73.3            | 0.572            | 19.0             | 81.0            | 0.000           |
| **Wealth index**                             | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
| Poorest                                      | 42.6            | 57.4           | 48.0           | 52.0              | 31.6             | 68.4            | 27.8             | 72.2            |
| Poorer                                       | 36.6            | 63.4           | 43.0           | 57.0              | 38.2             | 61.8            | 18.8             | 81.2            | 20.5             | 79.5            |
| Middle                                       | 35.8            | 64.2           | 39.3           | 60.7              | 34.2             | 65.8            | 27.9             | 72.1            | 21.2             | 78.8            |
| Richer                                       | 36.7            | 63.3           | 35.6           | 64.4              | 31.6             | 68.4            | 23.2             | 76.8            | 20.2             | 79.8            |
| Richest                                      | 29.3            | 70.7           | 0.000          | 36.4              | 0.000            | 31.6           | 68.4            | 0.000           | 28.5           | 71.5            | 0.000           | 23.4             | 76.6            | 0.000           |
| **Communication exposure- Mass media**       | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
| **Newspaper**                                | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
| Never read Newspaper                         | 38.1            | 61.9           | 44.7           | 55.3              | 26.5             | 73.5            | 25.0             | 75.0            |
| Read Newspaper                               | 26.3            | 73.7           | 0.000          | 33.8              | 0.000            | 34.3           | 65.7            | 0.000           | 24.5           | 75.5            | 0.269            | 21.6             | 78.4            | 0.001           |
| **Radio**                                    | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
| Never listened to Radio                      | 36.7            | 63.3           | 42.1           | 57.9              | 38.6             | 61.4            | 26.1             | 73.9            | 27.6             | 72.4            |
| Listened to Radio                            | 31.0            | 69.0           | 0.041          | 35.1              | 0.000            | 34.6           | 65.4            | 0.000           | 25.5           | 74.5            | 0.755            | 21.8             | 78.2            | 0.000           |
| **Television**                               | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
| Never watched TV                             | 41.2            | 58.8           | 49.4           | 50.6              | 56.3             | 43.7            | 27.7             | 72.3            | 33.9             | 66.1            |
| Watched TV                                   | 33.0            | 67.0           | 0.000          | 37.5              | 0.000            | 35.6           | 64.4            | 0.000           | 25.0           | 75.0            | 0.086            | 21.7             | 78.3            | 0.000           |

Prob.: Probability value
Table 7: Adjusted odds ratio from the multivariate binary logistic regression of factors associated with receipt of vitamin A in the last six months in the selected countries in Africa. (Dependent variable: Receipt of Vitamin A).

| Predictors used in the model | Africa |  |  |  |  |  |
|------------------------------|--------|--------|--------|--------|--------|--------|
|                              | Ethiopia, 2015-16 | Kenya, 2014 | Nigeria, 2013 | Senegal, 2016 | Tanzania, 2015-16 |
| N (Weighted cases)           | 8,392 (1.143-1.498) | 15,262 (0.957-1.165) | 23,314 (0.725-0.842) | 4,694 (0.575-0.894) | 7,480 (0.743-1.006) |
| N (Unweighted cases)         | 8,053 (1.176-1.461) | 16,480 (1.295-1.647) | 22,923 (1.974-2.277) | 5,176 (1.005-1.481) | 7,644 (1.373-1.788) |
| Community level covariates   |        |        |        |        |        |
| Place of residence           |        |        |        |        |        |
| Rural                        |        |        |        |        |        |
| Urban                        | 1.221 (0.995-1.498) | 1.056 (0.957-1.165) | 0.782 (0.725-0.842) | 0.717 (0.575-0.894) | 0.864 (0.743-1.006) |
| Demographic covariates       |        |        |        |        |        |
| Maternal age (years)         |        |        |        |        |        |
| 15-24                        |        |        |        |        |        |
| 25-34                        | 1.163 (1.031-1.311) | 1.020 (0.936-1.111) | 1.158 (1.076-1.247) | 1.235 (1.031-1.480) | 1.081 (0.963-1.214) |
| 35-49                        | 1.210 (1.055-1.388) | 1.064 (0.957-1.182) | 1.249 (1.150-1.357) | 2.186 (1.742-2.743) | 1.201 (1.055-1.369) |
| Socio-economic covariates    |        |        |        |        |        |
| Maternal work status         |        |        |        |        |        |
| Not working currently        |        |        |        |        |        |
| Working currently            | 1.261 (1.143-1.391) | 1.147 (1.059-1.242) | 1.206 (1.130-1.286) | 1.276 (1.090-1.493) | 0.971 (0.861-1.095) |
| Wealth Index                 |        |        |        |        |        |
| Poorest                      |        |        |        |        |        |
| Poorer                       | 0.992 (0.873-1.128) | 1.177 (1.052-1.317) | 1.370 (1.251-1.501) | 1.264 (1.021-1.565) | 1.459 (1.262-1.685) |
| Middle                       | 1.024 (0.897-1.168) | 1.208 (1.071-1.363) | 1.935 (1.751-2.138) | 1.531 (1.097-1.922) | 1.749 (1.508-2.028) |
| Richer                       | 1.019 (0.884-1.174) | 1.356 (1.183-1.555) | 2.447 (2.176-2.751) | 1.595 (1.156-2.198) | 1.975 (1.672-2.332) |
| Richest                      | 1.401 (1.143-1.717) | 1.318 (1.120-1.551) | 3.721 (3.253-4.257) | 1.699 (1.188-2.430) | 1.981 (1.597-2.458) |
| Continued                    |        |        |        |        |        |

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### Predictors used in the model

#### Africa

|                      | Ethiopia, 2015-16 | Kenya, 2014 | Nigeria, 2013 | Senegal, 2016 | Tanzania, 2015-16 |
|----------------------|-------------------|-------------|---------------|---------------|--------------------|
|                      | Adjusted Odds ratio (95% CI) | Prob. | Adjusted Odds ratio (95% CI) | Prob. | Adjusted Odds ratio (95% CI) | Prob. | Adjusted Odds ratio (95% CI) | Prob. |
| **Communication Exposure - Mass Media** |                     |           |               |               |                    |
| Newspaper            |                   |           |               |               |                    |
| Never read Newspaper | 1.174 (0.955-1.445) | 0.128     | 1.117 (1.023-1.220) | 0.014 | 1.286 (1.176-1.406) | 0.000 | 0.981 (0.730-1.317) | 0.897 |
| Read Newspaper       |                   |           |               |               |                    |
| Radio                |                   |           |               |               |                    |
| Never listened to Radio | 1.379 (1.228-1.548) | 0.000     | 1.018 (0.925-1.121) | 0.716 | 1.346 (1.258-1.440) | 0.000 | 1.166 (0.958-1.419) | 0.125 |
| Listened to Radio    |                   |           |               |               |                    |
| Television           |                   |           |               |               |                    |
| Never watched TV     | 0.847 (0.729-0.984) | 0.030     | 1.129 (1.022-1.246) | 0.017 | 1.024 (0.945-1.110) | 0.558 | 1.386 (1.119-1.716) | 0.003 |
| Watched TV           |                   |           |               |               |                    |

CI: Confidence Interval, ref Refers to Reference Category. Prob.: Probability value

#### Table 8: Adjusted odds ratio from the multivariate binary logistic regression of factors associated with receipt of vitamin A in the last six months in the selected countries in Asia. (Dependent variable: Receipt of Vitamin A).

| Predictors used in the model | Asia                           |
|------------------------------|--------------------------------|
|                              | Bangladesh, 2014 | India, 2015-16 | Indonesia, 2012 | Pakistan, 2012-13 | Philippines, 2013 |
|                              | Adjusted Odds Ratio (95% CI) | Prob. | Adjusted Odds Ratio (95% CI) | Prob. | Adjusted Odds Ratio (95% CI) | Prob. | Adjusted Odds Ratio (95% CI) | Prob. |
| N (weighted cases)           | 6,634             | 201,757       | 16,948         | 3,420          | 6,982            |
| N (unweighted cases)         | 6,462             | 208,785       | 18,021         | 3,372          | 7,216            |
| Community level covariates   |                   |               |               |               |                  |
| place of residence           |                   |               |               |               |                  |
| Rural ref                    |                   |               |               |               |                  |
| Urban                        | 0.987 (0.862-1.129) | 0.845     | 0.953 (0.931-0.976) | 0.000 | 0.981 (0.912-1.055) | 0.606 | 0.485 (0.391-0.601) | 0.000 |
| Urban                        | 0.849 (0.747-0.964) | 0.011     |                   |               |                  |                   |                  |
| Individual level covariates  |                   |               |               |               |                  |
| Maternal education           |                   |               |               |               |                  |
| Non-literate ref             |                   |               |               |               |                  |
| Literate                     | 1.097 (0.949-1.267) | 0.211     | 1.310 (1.279-1.341) | 0.000 | 3.659 (2.864-4.675) | 0.000 | 1.084 (0.865-1.359) | 0.484 |
| Literate                     | 1.289 (0.851-1.952) | 0.230     |                   |               |                  |                   |                  |

Continued.

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### Predictors used in the model

| Demographic covariates | Maternal age (years) | 15-24 Ref | 25-34 | 35-49 |
|------------------------|----------------------|--------|-------|-------|
| Bangladesh, 2014       | Adjusted Odds Ratio (95% CI) | 1.100 (0.987-1.225) | 0.969 (0.949-0.988) | 1.135 (1.047-1.231) |
| Prob.                  | 0.084                | 0.002              | 0.002          |
| India, 2015-16         | Adjusted Odds Ratio (95% CI) | 0.969 (0.949-0.988) | 1.354 (1.233-1.487) | 0.963 (0.759-1.222) |
| Prob.                  | 0.002                | 0.000              | 0.756          |
| Indonesia, 2012        | Adjusted Odds Ratio (95% CI) | 1.135 (1.047-1.231) | 0.963 (0.759-1.222) | 1.703 (1.452-1.998) |
| Prob.                  | 0.002                | 0.000              | 0.000          |
| Pakistan, 2012-13      | Adjusted Odds Ratio (95% CI) | 0.937 (0.769-1.142) | 0.963 (0.759-1.222) | 1.404 (1.230-1.604) |
| Prob.                  | 0.517                | 0.756              | 0.000          |
| Philippines, 2013      | Adjusted Odds Ratio (95% CI) | 1.404 (1.230-1.604) | 1.703 (1.452-1.998) | 1.395 (1.174-1.657) |
| Prob.                  | 0.000                | 0.000              | 0.000          |

### Socio-economic covariates

| Maternal work status | Not working currently | Working currently |
|----------------------|------------------------|-------------------|
| Bangladesh, 2014     | Adjusted Odds Ratio (95% CI) | 0.924 (0.825-1.036) | 1.048 (0.995-1.0105) |
| Prob.                | 0.176                  | 0.077             |
| India, 2015-16       | Adjusted Odds Ratio (95% CI) | 0.924 (0.825-1.036) | 1.024 (0.854-1.165) |
| Prob.                | 0.176                  | 0.008             |
| Indonesia, 2012      | Adjusted Odds Ratio (95% CI) | 0.924 (0.825-1.036) | 1.048 (0.854-1.165) |
| Prob.                | 0.176                  | 0.008             |
| Pakistan, 2012-13    | Adjusted Odds Ratio (95% CI) | 0.924 (0.825-1.036) | 1.024 (0.854-1.165) |
| Prob.                | 0.176                  | 0.008             |
| Philippines, 2013    | Adjusted Odds Ratio (95% CI) | 0.924 (0.825-1.036) | 1.024 (0.854-1.165) |
| Prob.                | 0.176                  | 0.008             |

| Wealth index | Poorest Ref | Middle | Richer | Richest |
|--------------|-------------|--------|--------|---------|
| Bangladesh, 2014 | Adjusted Odds Ratio (95% CI) | 1.212 (1.036-1.417) | 1.007 (0.979-1.035) | 1.234 (1.116-1.364) | 1.268 (1.033-1.557) |
| Prob. | 0.016 | 0.634 | 0.000 | 0.066 |
| India, 2015-16 | Adjusted Odds Ratio (95% CI) | 1.212 (1.036-1.417) | 1.007 (0.979-1.035) | 1.234 (1.116-1.364) | 1.268 (1.033-1.557) |
| Prob. | 0.016 | 0.634 | 0.000 | 0.066 |
| Indonesia, 2012 | Adjusted Odds Ratio (95% CI) | 1.212 (1.036-1.417) | 1.007 (0.979-1.035) | 1.234 (1.116-1.364) | 1.268 (1.033-1.557) |
| Prob. | 0.016 | 0.634 | 0.000 | 0.066 |
| Pakistan, 2012-13 | Adjusted Odds Ratio (95% CI) | 1.212 (1.036-1.417) | 1.007 (0.979-1.035) | 1.234 (1.116-1.364) | 1.268 (1.033-1.557) |
| Prob. | 0.016 | 0.634 | 0.000 | 0.066 |
| Philippines, 2013 | Adjusted Odds Ratio (95% CI) | 1.212 (1.036-1.417) | 1.007 (0.979-1.035) | 1.234 (1.116-1.364) | 1.268 (1.033-1.557) |
| Prob. | 0.016 | 0.634 | 0.000 | 0.066 |

### Communication exposure- Mass media

| Newspaper | Never read Newspaper Ref | Read Newspaper | 1.453 (1.230-1.717) |
|-----------|--------------------------|----------------|-------------------|
| Pakistan, 2012-13 | Adjusted Odds Ratio (95% CI) | 0.000 | 0.000 | 1.049 (0.828-1.328) |
| Prob.      | 0.692                    | 0.613          | 0.021             |
| Radio      | Never listened to Radio Ref | Listened to Radio | 1.146 (0.893-1.471) |
| Philippines, 2013 | Adjusted Odds Ratio (95% CI) | 0.000 | 0.000 | 1.157 (0.955-1.402) |
| Prob.      | 0.135                    | 0.000          | 0.000             |
| Television | Never watched TV Ref | Watched TV | 1.280 (1.126-1.454) |
| Philippines, 2013 | Adjusted Odds Ratio (95% CI) | 0.000 | 0.000 | 1.528 (1.252-1.866) |
| Prob.      | 0.000                    | 0.000          | 0.000             |

CI: Confidence Interval, Ref Refers to Reference Category. Prob.: Probability value
| Variable                      | Ethiopia | Kenya | Nigeria* | Senegal** | Tanzania | Bangladesh | India* | Indonesia | Pakistan | Philippines** |
|------------------------------|----------|-------|----------|-----------|----------|------------|--------|-----------|----------|--------------|
| Maternal age                 | 10       | 10    | 5        | 15        | 12       | 12         | 7      | 12        | 9        | 15           |
| Place of residence           | 11       | 14    | 4        | 10        | 12       | 13         | 6      | 10        | 21       | 10           |
| Maternal education           | 12       | 19    | 29       | 13        | 14       | 10         | 30     | 20        | 10       | 6            |
| Exposure to newspaper        | 9        | 9     | 7        | 10        | 11       | 11         | 18     | 8         | 9        | 9            |
| Exposure to radio            | 11       | 10    | 9        | 13        | 10       | 14         | 6      | 8         | 10       | 10           |
| Exposure to television       | 18       | 16    | 17       | 14        | 10       | 13         | 12     | 16        | 11       | 18           |
| Wealth index                 | 15       | 11    | 23       | 13        | 21       | 12         | 12     | 14        | 19       | 14           |
| Maternal work status         | 14       | 11    | 7        | 12        | 10       | 15         | 8      | 13        | 11       | 17           |
| Total                        | 100      | 100   | 100      | 100       | 100      | 100        | 100    | 100       | 100      | 100          |

| Training Accuracy            | 59       | 68    | 67       | 73        | 63       | 61         | 84     | 63        | 62       | 80           |
| Test Accuracy                | 56       | 66    | 66       | 74        | 64       | 59         | 84     | 62        | 60       | 80           |
| Coverage of vitamin A supplementation | 45 | 72 | 42 | 81 | 42 | 64 | 59 | 63 | 74 | 77 |

**Figure 2:** Random forest (RF) analyses using Python of assessment of variable importance in the selected ten countries in Africa and Asia (%). Note: *Low Coverage Country; ** High Coverage Country.
Figure 3: Per cent of children 6 to 59 months who received vitamin A supplements in the six months preceding the survey in selected countries around the world in recent DHS surveys.

Source: Stat compiler, ICF, 2015.
Results of the multivariate binary logistic regression analyses

Predictors used in the model: Background community level and individual level socio-demographic and economic covariates, which are expected to be associated with vitamin A receipt have been entered in the model. The predictors used in the model are the place of residence, age of the woman, education of the mother, current work status of the mother, possession of household assets used in the construction of wealth quintile and exposure to mass media.

Education and working status of mothers was found to play a significant role; as a significant proportion of working mothers reported that the child received vitamin A as compared to non-working mothers and educated mothers reported that the child had received vitamin A compared to non-literate mothers. Examining the exposure to different mediums of communication, it was found that a significant proportion of mothers who watched television were more likely to have received vitamin A with the adjusted odds ratio ranging from 1.157 times to 1.528 times in the five countries in Asia. Mother’s education was found to be significantly associated with the receipt of vitamin A in all the five countries in Africa with adjusted odds ratio ranging from 1.220 times to 1.567 times.

Results of the random forest analyses

Predictors used in the model: The same list of background community level and individual level socio-demographic and economic covariates used what has been used for multivariate binary logistic regression. Analysis was carried out for all the ten countries including the lowest and highest vitamin A coverage countries; India and Philippines from Asia; and Nigeria and Senegal from Africa. Mother’s education was found to be one of the most important variable followed by wealth index and exposure to television, which was strongly associated with the receipt of vitamin A. It was found to have higher importance (>25%) in model score compared to other factors.

Levels and trends in vitamin A around the world in DHS countries: Among the 47 DHS countries, the most recent round of DHS surveys reveal that the vitamin A coverage varies from as low as 4.5% in Peru in the 2012 DHS to as high as 86.4% in Rwanda in the 2014-15 DHS round.

DISCUSSION

VAS has been around for many years in different countries of the world. Education and working status of mothers was found to play a significant role; as a significant proportion of working mothers reported that the child received vitamin A as compared to non-working mothers and educated mothers reported that the child had received vitamin compared to non-literate mothers. Current paper is an effort to assess or find out the factors that may affect the uptake of vitamin A among children under five years of age across countries and regions of Asia and Africa. In addition to bivariate, multivariate analysis by considering the receipt of vitamin A in last six months as the dependent variable and different socio-economic and demographic covariates as predictors revealed that place of residence of mothers is significantly associated the receipt of vitamin A among the children across the regions and countries, except Philippines, where place of residence did not play any significant role and receipt of vitamin A was almost equal among rural and urban children. Covariates like mothers’ education, economic status of the mothers as well as exposure to mass media i.e. Television has significantly influenced the receipt of vitamin A across regions. This indicates that children of literate mothers, belonging to better off section of the society and having access to medium of communication like TV were having higher probability of receiving vitamin A. Work status of mother was found to have more of its impact on vitamin A coverage in African countries indicating that children of working mothers had a higher probability of vitamin A receipt. In few countries of both the regions it was found that probability of receiving the vitamin A by children increased with age of the mother. Results from the multivariate binary logistic regression depicts that education of mother and exposure to Television were the most significant factors affecting uptake of vitamin A, which corroborates the findings of Semba et al, who found that maternal education is an important factor relating to receipt of a vitamin A capsule in the BDHS 2004 data and that children belonging to households with higher socioeconomic status were more likely to have received a vitamin A capsule. Proximity of the mothers to the health facility, proper positioning of the VAS in the country health programs, frequent supplementation rounds as well as sweeping strategies post round also plays key role in enhancing the coverage. For assessing these factors there is a need to look upon country specific vitamin A programs and their strategies to bring in the more vulnerable sections of the population in geographical and social terms.

CONCLUSION

Earlier clinical trials have already established the fact that VAS can substantially reduce the mortality from all causes among the children. Review of available literature and results from analysis of the current study shows that for a mother residing in an urbanized area, having formal education, exposure to medium of communication (TV) positively affect the uptake of vitamin A for their child. This section of the society is already getting benefitted by the program, thus, in addition to the current program strategies, there is need to mould the program components and strategies in a way that they also focus
young mothers, not formally educated or illiterate mothers and mothers residing in rural areas. This can be achieved by training community health workers extensively to counsel about the benefits of vitamin A, conducting more localized and intensified behaviour change communication activities and most importantly by doing frequent supplementation rounds with extensive sweeping plans. Lessons from other health programs i.e. polio eradication can be considered as the best practice where extensive planning is done and an effort is made to not leave even a single child. Exposure to mass media seems to be a good predictor of VAS in the countries of Asia and mother’s education seems to be a good predictor in the countries of Africa. The need of the hour to is to use more and more mass media to communicate messages regarding the bi-annual vitamin A campaign in the countries of Asia and stress on mothers’ education in the countries of Africa.

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