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Trends and socioeconomic inequalities in receiving vitamin A supplementation among children aged 6–59 months in Bangladesh: analysis of nationwide cross-sectional data from 2004 to 2017

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ABSTRACT

Introduction The coverage of vitamin A supplementation (VAS) is still short of the target set by the government to reach 90% coverage of VAS in Bangladesh. The present study aims to examine the socioeconomic and geographical inequalities in receiving VAS among children aged 6–59 months in Bangladesh from 2004 to 2017.

Methods The Bangladesh Demographic and Health Surveys for the years 2004–2017 were accessed through the WHO's Health Equity Assessment Toolkit. Inequalities were explored from socioeconomic and geographical perspectives. Specifically, it considered wealth quintile and education as socioeconomic dimensions and place of residence as geographical dimensions. We calculated difference, population attributable fraction (PAF), population attributable risk (PAR) and ratio as summary measures and their associated 95% CIs to quantify and assess the extent of health disparities.

Results The study revealed a fluctuating trend over the years in the prevalence of receiving VAS among children in Bangladesh. The prevalence shifted from 78.68% in 2004 to a low of 62.09% in 2011, subsequently increasing to 79.29% in 2017. The PAF in 2017 for the variable wealth was 4.61 (95% CI 2.38 to 6.85), highlighting the extent of the disparity that favoured wealthier individuals. The study also detected inequalities based on educational levels; in 2017, the difference measure of inequality was 9.24 (95% CI 3.69 to 14.79), indicating a notable advantage for children from the higher educated group. Children from urban areas were also observed to have a higher likelihood of receiving VAS compared with their rural counterparts.

Conclusion This study identified a persistent regional inequality in receiving VAS in Bangladesh over time. These inequalities remained a concern, especially for children from poor wealth groups, low-educated families and rural regions. This understanding will inform the development of a comprehensive programme aimed at increasing the prevalence of VAS among all children in Bangladesh.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The vitamin A supplementation (VAS) coverage among children aged 6–59 months in Bangladesh remains below the government's goal of achieving 90% coverage.
⇒ To date, no study has been conducted in Bangladesh assessing the trends and socioeconomic inequalities in receiving VAS among children.

WHAT THIS STUDY ADDS

⇒ We found significant wealth-driven, education-related and rural–urban disparities in receiving VAS among children aged 6–59 months based on both absolute and relative inequality measures.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this study will assist policymakers in finding the areas and subgroups that need improved coordination.
⇒ Policy measures are necessary to address inequalities and improve the coverage of VAS among children from various socioeconomic backgrounds.

INTRODUCTION

Vitamin A deficiency (VAD) is a global problem characterised by an insufficient intake of vitamin A, and it is particularly prevalent in low and middle-income countries (LMIC).[1 2] In LMIC, VAD is closely associated with increased childhood mortality, resulting from measles and diarrhoea.[3] It is estimated that approximately 190 million preschool children are affected by VAD worldwide.[2] A study revealed that while only 1.7% of under-5 mortality in LMICs was directly attributed to VAD, a staggering 95% of these fatalities occurred in Sub-Saharan Africa and South Asia.[3] Evidence suggests that approximately 23% of all causes of infant mortality may be avoided with adequate vitamin A supplementation (VAS) by strengthening the immune system and resilience, especially for children with VAD.[1 4] A randomised trial undertaken in the South Asian region has

provided evidence of a noteworthy reduction (21%) in mortality rates during the initial 6 months of life among neonates who received VAS.[5]

Considering the contribution of vitamin A in reducing under-5 mortality, the WHO recommends providing children with VAS two times a year until they reach age 5, particularly in areas where VAD is a significant public health concern.[6] Following the declaration, many LMICs including Bangladesh have adopted the application of routine VAS to children aged 6–59 months.[7] Despite this, 20% of preschool children were found to have VAD in a previous report.[8] To reduce the avoidable deaths of children under 5 to a maximum of 25 per 1000 live births by the year 2030 and achieve goal 3 of the sustainable development goal.[9] In 2016, the Directorate General of Health Services in Bangladesh set a target of 90% coverage of VAS.[10] However, the VAS coverage remains low (79%) in Bangladesh as compared with a few other countries (reported coverage rates of up to 85%).[11 12]

Several studies worldwide have indicated that factors such as age, gender, BMI, religion, maternal age, maternal education, family type, occupation, income, dietary habits, type of residence, access to media, wealth index and social development status of the child's state of residence are associated with increased intake of VAS.[7 13 14] Studies conducted previously in Bangladesh identified the greater levels of education and had been exposed to mass media to be associated with higher VAS intake in children.[7 15 16] Another study conducted in Bangladesh revealed differences in the coverage of VAS among urban and rural residents.[17] Moreover, parents lacking formal education and belonging to lower socioeconomic strata exhibited a reduced likelihood of administering VAS to their children.[15] Despite the reduction in under-5 child mortality from 53 to 45 deaths per 1000 live births between 2011 and 2018 in Bangladesh,[12 18] it is concerning that the decline has not been more substantial, especially given the national efforts towards VAS. This raises a critical concern—did the programme fail to reach children from socioeconomically disadvantaged groups who needed supplementation the most? Previous studies conducted in Bangladesh have reported variations in the prevalence of VAS uptake among children aged 6–59 months, which resulted from differences in socioeconomic status, geographic location and educational accessibility inferring significant gaps in receiving VAS based on the socioeconomic and geographic domains.

Given the evidence, it is critical to address the extent of disparity in VAS prevalence based on these domains. There is a dearth of evidence in inequality assessment on VAS among children aged 6–59 months, and to the author's knowledge, no study has been conducted in Bangladesh assessing the magnitude of inequality in receiving VAS. Therefore, this study aims to explore the inequality in VAS use among Bangladeshi children over the years using nationally representative demographic and health survey data. Understanding the magnitude of these disparities will help to identify the main associated factors contributing to poor health outcomes among under-5 children in Bangladesh and support developing policies and programmes aimed at promoting health for all.[19] Recognising these inequalities is also crucial for achieving universal health coverage.[20] This research holds substantial importance to public health practitioners and policymakers by providing statistics about the trends and inequalities of VAS use, so that strategies, including tailored educational campaigns in underserved areas, the promotion of community-based outreach efforts and the introduction of wealth-targeted incentives may be developed to maximise vitamin A uptake coverage in Bangladesh.

METHOD

Study design and data source

Five consecutive data sets from the Bangladesh Demographic and Health Survey (BDHS) from the years 2004–2017 were used to detect whether inequality is present in vitamin A uptake among children in Bangladesh. BDHS data are a part of the Demographic and Health Survey (DHS) program conducted in over 90 countries globally. In Bangladesh, the National Institute of Population Research and Training and the Ministry of Health and Family Welfare of Bangladesh conducted this survey for DHS, which was supported by the United States Agency for International Development (USAID). To collect the data, DHS adopts a cross-sectional study design, and all data are deposited in the online build-in database edition of the Health Equity Assessment Toolkit (HEAT) by WHO. The DHS collects data implementing a two-stage stratified cluster sampling technique to capture the nationwide representation. In the sampling technique, the enumeration areas were selected in the first stage from the last population census, which were considered the clusters and primary sampling unit. From the selected clusters, 30 households were selected using a systematic sampling technique to conduct the survey. The detailed methodology of BDHS is elaborately described elsewhere.[12] For our study, the sample population encompasses mothers having children between the age of 6–59 months.

Description of variables

The outcome measure of this study was whether children aged 6–59 months received VAS in the 6 months preceding the survey or not.[12] It was assessed by asking the mother whether the baby within the age of 6–59 months got VAS or not. The response was recorded as binary (yes or no). The response of the mother whose baby received the supplement was considered yes. For the analysis purpose, the response for the outcome variable was coded as 1 for yes and 0 for no.[21]

To measure the inequalities in receiving VAS among children aged 6–59 months, we used four equity stratifiers: wealth status of the household, educational level of the mother, place of residence and subnational regions. The household wealth status was measured as quintile,

and the household was categorised from poorest to richest. The categorisation was derived by the principal component analysis.[22] The completion of formal education was considered as the educational level of the mother of the children and divided as no education, primary and secondary/higher. Rural and urban were considered as the categories of place of residence, and the administrative divisions of Bangladesh were taken into account as the subnational regions as Dhaka being in the centre, the administrative division represents all the geographical regions, including coastal and hilly regions. Inequality in receiving VAS in administrative division was calculated for six divisions throughout the survey period. The Mymensingh division was separated from the Dhaka division in 2015, and the Rangpur division was separated from the Rajshahi division in 2010. Hence, the estimates for BDHS 2004–2014 data of Mymensingh and BDHS 2004–2007 data of Rangpur division were not measured.

Statistical analysis

According to the recommendation of WHO, we used both absolute and relative summary measures to measure the inequality[23 24] in getting VAS among children in Bangladesh. For the analysis, we used V.4.0 of the HEAT software developed by WHO. As the absolute summary measures, we chose Difference (D) and Population Attributable Fraction (PAF), while population attributable risk (PAR) and ratio (R) were employed as the relative measures. At the same time, D and R were simple measures, and PAF and PAR were complex-weighted measures that considered the survey design and survey weight. The summary measures are chosen such that they applicable to all equity dimensions whether it is ordinal variables or not. The measurements and use of the summary measures are described elaborately by WHO.[23]

The calculation of the summary measures differs in the case of ordered and non-ordered dimensions. In the ordered dimension, D is the simple difference between the advantageous and disadvantageous subgroup for the favourable outcome. For example, the D for the wealth quintile as an ordered variable is the difference between the richest and the poorest group. R is calculated as the ratio of the advantageous and disadvantageous subgroups. For instance, R is the quotient of the prevalence of the group with secondary/higher educational attainment by the prevalence of the group with no education. For the non-ordered variables like place of residence and subnational region, D is the difference between the group with the highest prevalence and the group with the lowest prevalence, and R is the quotient of the highest prevalence by the lowest prevalence.[25 26] Unlike simple measures, complex measures like PAF and PAR take the population-level average and sample weight into account. For our analysis, we have considered the national average (μ) as the population mean, and both measures were calculated. The measurements of PAR and PAF are below:

$$\text{PAR}=Y_{\text{ref}}-\mu\ ;\ \text{PAF}=\frac{PAR}{\mu}\times 100$$

Here, μ is the national average. The Y_{ref} for the ordered variables is the most advantageous group, and for the non-ordered variables, it is the subgroup with the highest prevalence. The calculations and the assumptions of the summary measures are described elsewhere.[23 24] The significant level of the summary measures was shown through a 95% CI with the point estimate of each measure. The value of the summary measures, namely D, PAF and PAR, was considered to be significant if their corresponding CIs did not contain 0 within the upper and lower limits. For the value of R to be significant, the confidence corresponding to the value must not contain 1 in the interval.

RESULT

Distribution of receiving VAS in different equity dimensions

The trend in the prevalence of children receiving VAS remained relatively stable over the years, with a minor increase from 78.7% in 2004 to 79.3% in 2017. There was a slight peak in 2007 (83.5%), but this was followed by a significant drop in 2011 (62.1%) and 2014 (62.1%). However, there was another upward trend observed from 2014 to 2017 (figure 1).

Table 1 summarises these findings of the prevalence of children receiving VAS. The results show fluctuating patterns across different wealth quintiles and different geographic regions. In the poorest quintile, the prevalence was 74.62% in 2004, then declined to 57.38% in 2011, and eventually rose to 78.89% in 2017. In contrast, the richest quintile had a prevalence of 83.31% in 2004, which dropped to 66.03% in 2011 and increased to 82.95% in 2017. Similar fluctuating patterns were observed in other factors such as education, place of residence and subnational region. VAS prevalence was consistently higher among the more educated group, with 81.35% in 2004 and 81.44% in 2017, compared with the group with no education, where the prevalence was 76.15% and 72.20% in the same years, respectively. Regarding the place of residence, urban people had a higher prevalence of VAS with 81.17% in 2004 compared with rural people with 78.07%. However, this pattern reversed in 2017, with 79.54% prevalence for rural people and 78.62% for urban people. Khulna, followed by Dhaka and Chattogram, had higher prevalence compared with other geographical regions, with respective rates of 81.20%, 80.45% and 80.30% in 2004 and 80.35%, 75.60% and 81.88% in 2017. Sylhet consistently had the lowest prevalence at 70.91% in 2004 and 77.92% in 2017, alongside Barisal, which maintained lower rates in all survey years.

Magnitude of inequality in receiving VAS

From this study, it is evident that inequalities persist in receiving VAS among the subgroups of different wealth quintile. The analysis shows there is pro rich inequalities seen for all the summary measures in most of the survey years. Although the inequalities fluctuated along the survey period of the last two decades, they decreased from

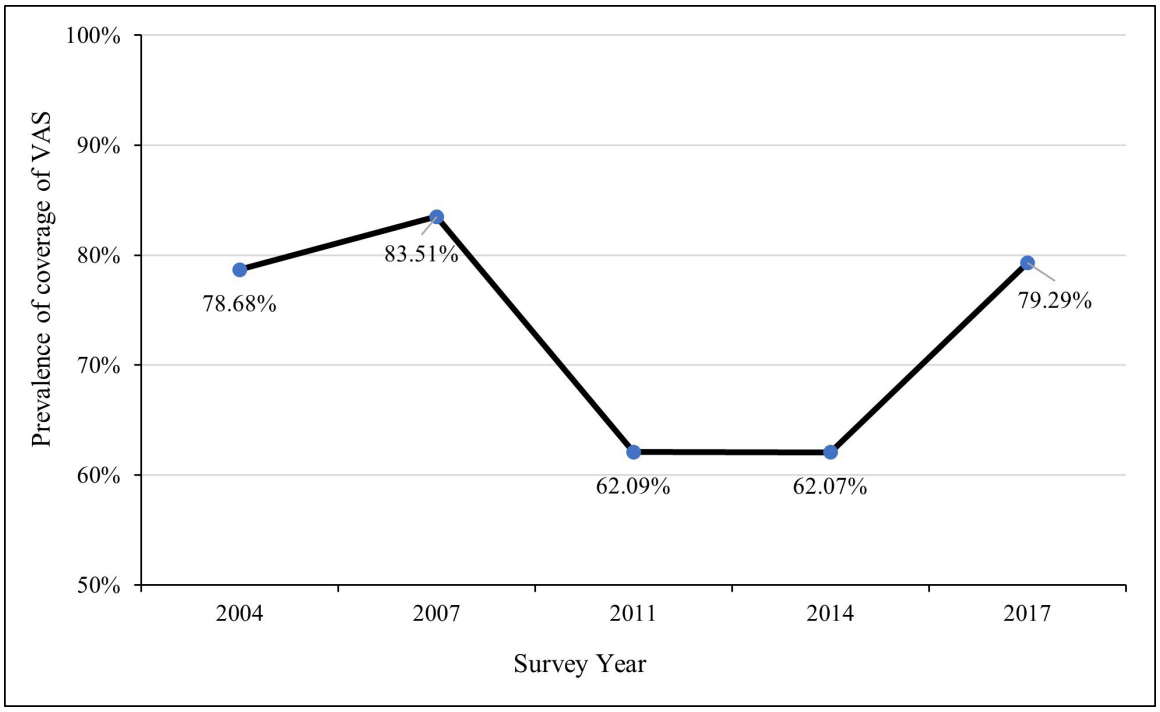

Figure 1 Trends in the prevalence of receiving vitamin A supplementation (VAS) among children aged 6–59 months in Bangladesh.

the year 2004 (PAF: 5.89; 95% CI 3.50 to 8.27) to 2017 (PAF: 4.61; 95% CI 2.38 to 6.85). A similar pattern of fluctuating inequalities was observed in the educational-level dimension. In all the survey years, a higher prevalence of VAS was shown among the subgroups attaining secondary or higher education compared with those who have no formal education. For example, D in 2011 was 12.45 (95% CI 7.87 to 17.04), and in 2017, it lowered down to 9.24 (95% CI 3.69 to 14.79), which shows significant inequalities where children of women with secondary or higher education were found advantageous in getting VAS. In terms of geographical dimension, inequalities were found in both domains—level of residence, and subnational region. Children from the urban areas were found to be more favoured than those from rural children. Like the socioeconomic domain, inequalities according to the level of residence decreased over the years. Among the subnational regions, Khulna was dominant in receiving the VAS, while Sylhet was the most disfavoured. For instance, the magnitude of D was 10.83 (95% CI 4.24 to 17.42) in 2004, which reduced to 8.10 (95% CI 2.30 to 13.90) in 2017. It shows a persistent, significant inequality in receiving VAS among the subnational region in Bangladesh over the years (table 2).

DISCUSSION

In this study, we found the overall coverage of VAS among children aged 6–59 months fluctuated over time. A similar fluctuating prevalence of the coverage of VAS was found in Ethiopia.[27] The overall prevalence of VAS among children aged 6–59 months increased from 78.68% in 2004 to 83.51% in 2007 and from 62.07 in 2014 to 79.29% in 2017, which could be due to the extraordinary achievement of the government in implementing timely biyearly VAS campaign all over Bangladesh. Despite this extraordinary achievement, the sudden fall in the coverage of VAS in the years 2011 and 2014 could be explained by the mistimed survey in 2011, missing by a 6-month margin the national immunisation day according to Bangladesh National Malnutrition Survey.[28] On the other hand, the political unrest situation in the country during the period of 2013–2014 could be the possible reason behind the lower coverage of VAS during the survey period. The coverage of VAS in our country was higher than in India at 60.5% in 2015,[29] and Ethiopia 44.7% in 2016.[27] On the contrary, this finding was lower than Nepal's 79% in 2015.[30] The country-wide variation in the coverage of VAS could be due to the difference in women's literacy and exposure to mass media.[31] Inequalities based on the socioeconomic and geographic dimension of the coverage of the VAS among children aged 6–59 months in Bangladesh over the years from 2004 to 2017 were found significant in our analysis. Although the inequality pattern varied across different summary measures.

We found pro-rich inequalities based on all the summary measures in most of the survey years. This finding is in line with the studies conducted in Bangladesh previously[32] and also in India[29] and Philippines.[33] The plausible explanation behind this could be the fact that wealthier women have better access to healthcare facilities leading to exposure to better health knowledge, which could influence the choice of getting children VAS.[27] Besides, women in

Table 1 Prevalence of receiving vitamin A supplementation across sub-groups of four equity stratifiers from 2004 to 2017 in Bangladesh

	2004	2007	2011	2014	2017
Inequality dimension	**Estimate (95% CI)**	**Estimate (95% CI)**	**Estimate (95% CI)**	**Estimate (95% CI)**	**Estimate (95% CI)**
Economic status					
Quintile 1 (poorest)	74.62 (70.88, 78.03)	85.61 (82.87, 87.98)	57.38 (53.35, 61.32)	55.98 (51.63, 60.25)	78.89 (75.54, 81.89)
Quintile 2	79.07 (75.99, 81.85)	79.23 (76.12, 82.02)	58.22 (54.47, 61.88)	60.93 (57.48, 64.28)	79.29 (76.68, 81.69)
Quintile 3	78.04 (74.87, 80.91)	83.22 (80.28, 85.80)	64.09 (60.55, 67.48)	62.78 (57.51, 67.75)	78.90 (75.32, 82.09)
Quintile 4	80.43 (76.97, 83.48)	85.87 (81.78, 88.02)	66.45 (63.14, 69.61)	61.99 (57.90, 65.91)	76.50 (73.21, 79.51)
Quintile 5 (richest)	83.31 (80.61, 85.71)	84.57 (82.20, 86.67)	66.03 (62.42, 69.48)	69.81 (66.22, 73.18)	82.95 (80.14, 85.43)
Level of education					
No education	76.15 (72.87, 79.15)	82.66 (79.99, 85.05)	53.88 (49.79, 57.91)	57.48 (52.49, 62.33)	72.20 (66.56, 77.21)
Primary school	79.21 (76.62, 81.58)	84.30 (81.86, 86.47)	60.87 (57.49, 64.14)	55.45 (51.47, 59.36)	76.32 (73.23, 79.15)
Secondary/higher	81.35 (79.13, 83.39)	83.54 (81.62, 85.30)	66.33 (64.16, 68.44)	66.75 (64.27, 69.15)	81.44 (79.82, 82.96)
Place of residence					
Rural	78.07 (75.86, 80.13)	83.03 (81.35, 84.60)	62.47 (59.90, 64.98)	60.97 (58.15, 63.72)	79.54 (77.52, 81.43)
Urban	81.17 (78.28, 83.75)	85.33 (83.47, 87.01)	60.77 (56.90, 64.51)	65.30 (61.84, 68.60)	78.62 (75.77, 81.22)
Sub-national regions					
Barisal	70.37 (65.51, 74.80)	81.15 (76.88, 84.78)	73.71 (68.40, 78.41)	64.13 (59.99, 68.08)	75.99 (70.43, 80.79)
Chattogram	80.30 (76.79, 83.40)	82.23 (78.83, 85.20)	67.86 (63.35, 72.07)	65.01 (61.03, 68.79)	81.88 (78.56, 84.79)
Dhaka	80.45 (78.22, 82.50)	84.29 (81.43, 86.77)	52.41 (47.51, 57.26)	61.95 (56.99, 66.68)	75.60 (70.95, 79.72)
Khulna	81.20 (76.01, 85.47)	86.32 (83.16, 88.96)	59.50 (54.04, 64.73)	64.50 (59.84, 68.89)	80.35 (75.71, 84.29)
Mymenshingh	–	–	–	–	81.05 (76.12, 85.17)
Rajshahi	78.57 (72.33, 83.72)	83.12 (80.58, 85.39)	67.95 (62.36, 73.06)	56.64 (49.95, 63.09)	79.30 (75.34, 82.76)
Rangpur	–	–	60.16 (55.05, 65.05)	65.47 (59.05, 71.38)	83.70 (79.54, 87.15)
Sylhet	70.91 (65.40, 75.87)	83.41 (78.37, 87.46)	71.35 (65.20, 76.80)	55.49 (48.74, 62.05)	77.92 (73.76, 81.59)

Mymensingh division was separated from Dhaka division in 2015, and Rangpur division was separated from Rajshahi division in 2010. Hence, the estimates for BDHS 2004–2014 data of Mymensingh, and BDHS 2004–2007 data of Rangpur division are not shown in the table.

Table 2 Estimates of inequalities in the prevalence of receiving vitamin A supplementation in Bangladesh, years 2004–2017

Inequality dimension	2004	2007	2011	2014	2017
	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)	Estimate (95% CI)
Economic status					
D	8.69 (4.33, 13.06)	−1.04 (−4.41, 2.32)	8.65 (3.33, 13.97)	13.83 (8.29, 19.37)	4.06 (−0.06, 8.18)
PAF	5.89 (3.50, 8.27)	1.26 (−0.88, 3.41)	6.34 (3.14, 9.55)	12.47 (9.05, 15.89)	4.61 (2.38, 6.85)
PAR	4.63 (2.76, 6.51)	1.05 (−0.74, 2.85)	3.94 (1.95, 5.93)	7.74 (5.62, 9.86)	3.66 (1.88, 5.43)
R	1.12 (1.06, 1.18)	0.99 (0.95, 1.03)	1.15 (1.05, 1.26)	1.25 (1.14, 1.37)	1.05 (1.00, 1.11)
Level of education					
D	5.21 (1.44, 8.98)	0.88 (−2.23, 3.99)	12.45 (7.87, 17.04)	9.27 (3.78, 14.76)	9.24 (3.69, 14.79)
PAF	3.40 (1.68, 5.11)	0.00 (−1.98, 1.99)	6.82 (3.26, 10.38)	7.54 (3.42, 11.66)	2.71 (−1.80, 7.23)
PAR	2.67 (1.32, 4.02)	0.00 (−1.65, 1.66)	4.24 (2.03, 6.45)	4.68 (2.12, 7.24)	2.15 (−1.43, 5.73)
R	1.07 (1.02, 1.12)	1.01 (0.97, 1.05)	1.23 (1.13, 1.34)	1.16 (1.06, 1.27)	1.13 (1.05, 1.22)
Place of residence					
D	3.10 (−0.35, 6.55)	2.29 (−0.09, 4.68)	−1.70 (−6.27, 2.87)	4.32 (−0.05, 8.70)	−0.92 (−4.27, 2.43)
PAF	3.15 (2.51, 3.80)	2.17 (1.57, 2.77)	0.00 (−0.94, 0.94)	5.19 (4.14, 6.24)	0.00 (−0.72, 0.72)
PAR	2.48 (1.97, 2.99)	1.81 (1.31, 2.31)	0.00 (−0.59, 0.59)	3.22 (2.57, 3.88)	0.00 (−0.57, 0.57)
R	1.04 (1.00, 1.09)	1.03 (1.00, 1.06)	0.97 (0.90, 1.05)	1.07 (1.00, 1.15)	0.99 (0.95, 1.03)
Sub-national region					
D	10.83 (4.24, 17.42)	5.17 (0.31, 10.03)	21.30 (14.31, 28.29)	9.98 (0.88, 19.08)	8.10 (2.30, 13.90)
PAF	3.19 (−2.76, 9.14)	3.36 (−1.53, 8.24)	18.70 (16.01, 21.39)	5.47 (−0.13, 11.08)	5.56 (3.52, 7.61)
PAR	2.51 (−2.17, 7.19)	2.80 (−1.27, 6.88)	11.61 (9.94, 13.28)	3.40 (−0.08, 6.88)	4.41 (2.79, 6.03)
R	1.15 (1.06, 1.26)	1.06 (1.00, 1.13)	1.41 (1.25, 1.58)	1.18 (1.01, 1.37)	1.11 (1.03, 1.19)

D, difference; PAF, population attributable fraction; PAR, population attributable risk; R, ratio.

the wealthier quintile have more access to mass media than their poorer counterparts giving them higher access to knowledge through mass media related to the benefit of VAS.[34]

Inequalities were found to be concentrated in the higher-educated group compared with the lower-educated group. The finding coincides with the findings from previous studies from Bangladesh,[32] India,[29] Cambodia[35] and Philippines.[33] This finding could be reasonably explained by the better utilisation of the healthcare services by educated women compared with non-educated women since education not only increases the opportunity to access the healthcare facilities but also better communication skill of educated women with the healthcare provider helps them to understand the importance of the healthcare need.[27] Also, educated women usually belong to wealthier groups and are highly likely to access and afford healthcare facilities to be more aware and get the services.[34]

Geographical inequalities in terms of both place of residence and subnational region were observed over time. In both dimensions, the inequalities were found to be fluctuating in nature over the years, where respondents living in the urban area and in the Khulna and Chattogram divisions were found to have a higher prevalence of vitamin A uptake among children. The possible reason behind these findings could be women in urban areas are more likely to be highly educated and belong to wealthier household,[12] both of which are associated with higher utilisation of the health facility by the mother, which might lead to a higher prevalence of receiving VAS. On the other hand, disparities at the subnational level could be due to the difference in wealth and educational levels in different regions of Bangladesh. Besides, lower coverage of VAS in the Sylhet division could be due to more hard-to-reach areas than any other divisions.[12]

Strength and limitation

In our study, we used WHO's HEAT software to measure the magnitude of the inequalities in getting the VAS by children aged 6–59 months. This is a standard software that makes our results more definitive and dependable. Besides, the use of nationwide BDHS data makes our results generalisable. The absolute and relative measures were used to measure the inequalities according to the recommendation of WHO, which not only increases the strength of the methodology but also makes the findings more directed to policy. The use of socioeconomic and geographic dimensions helps to create a wider multidimensional view of the inequality in getting the VAS by children aged 6–59 months. Despite such strengths, our study is not free from limitations. The main limitation of our study is that we could not take into consideration some important dimensions like cultural and religious

beliefs and exposure to the mass media that could have affected the inequality of receiving the VAS by children. Aside from this, we could not establish any causal relation due to the cross-sectional nature of the data. Also, we could not address the susceptibility of the recall and reporting bias in the data.

CONCLUSION

Over the past two decades, there have been fluctuating but significant inequalities in various equity dimensions, including wealth quintile, educational level, place of residence and subnational region for VAS. While these inequalities showed some reduction from previous survey periods, they persist significantly in most summary measures during the latest survey year. These findings suggest the need for the government of Bangladesh to develop and implement comprehensive programmes to reduce these inequalities in accessing VAS. The programme should pay special attention to underprivileged groups, particularly those in the poorest wealth quintile, with no formal education, residing in rural areas, and belonging to the Sylhet division. Although Bangladesh has made progress in the higher coverage of VAS, the study finding implies that specific efforts should be made to include the disadvantaged group in the coverage to reduce inequality of VAS. This targeted approach is essential to ensure equitable distribution of VAS and site-specific interventions to enhance VAS coverage. Furthermore, the study suggests conducting further research to identify the root causes of these inequalities.

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Contributors SK is responsible for the overall content [as guarantor]. SK and SSAC also take responsibility for the integrity and accuracy of the data analysis. SK performed the statistical analysis. SSAC, SK, IJ and RD produced the first draft of the manuscript. SK, ABS and AH reviewed and undertook the scientific editing of the manuscript both for statistical correctness and language appropriateness. All authors read and approved the final version for publication.

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Ethics approval The study used deidentified data from the Demographic Health Survey program, which has already received ethical approval from the participating countries, no further ethical permission was sought to carry out this research. Data were collected from an online source (https://dhsprogram.com) with an appropriate request. Written informed consent from the respondents enrolled in the survey and other ethical review documents are available at: https://dhsprogram.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm. The dataset is available online publicly for all researchers, hence there is no need to approve. All the procedures were performed following the relevant guidelines and regulations.

Provenance and peer review Not commissioned; externally peer-reviewed.

Data availability statement Data are available upon reasonable request. The study used data from the Bangladesh Demographic and Health Survey 2004, 2007, 2011, 2014 and 2017–18. Data are available in a public, open access repository. Data are available upon reasonable request. BDHS datasets are freely available from https://dhsprogram.com/data/available-datasets.cfm.

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