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Socio-economic covariates of micronutrients supplementation and deworming among children in Ghana

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ABSTRACT

Objective: To investigate the socio-economic covariates of vitamin A and iron supplementation as well as deworming among children in Ghana. **Methods:** The 2014 Ghana Demographic and Health Survey, which was a cross-sectional survey carried out from early September to mid-December, 2014, was the source of data for the study whiles the binary probit regression model was the empirical model of estimation. **Results:** The study among other findings revealed that children from the Greater Accra, Northern and Western regions were less likely to have received vitamin A supplements (VAS). Employed mothers were also revealed to be more likely to utilize VAS and dewormer for their children relative to unemployed mothers. Furthermore, mothers with secondary education, primary education, and educated mothers, respectively, were more likely to utilize VAS, iron supplements, and dewormer for their children relative to the uneducated mothers. Further, mothers with health insurance were more probable to utilize VAS for their children relative to uninsured mothers. Furthermore, children from the Guan, Ewe, Mole-Dagbani, Gurma, and Grusi ethnic backgrounds were found to be less likely to have received iron supplements. **Conclusion:** Given the above, the study concludes that women empowerment through education and employment, maternal health insurance, regional and ethnic behavior change communication could be effective tools in ensuring child health utilization (VAS, iron supplements, and deworming).

KEY WORDS: Child health, deworming, Ghana, iron supplement, malnutrition, vitamin A supplement

INTRODUCTION

Malnutrition is a major killer of children worldwide. It is persistently one of the most leading development challenges of the world which worsens the deleterious effects of infectious diseases and is responsible for the deaths of around 6 million under-five children annually [1]. Further, it is estimated to contribute to around 45% of the mortalities in children under five [2].

During early childhood, poor nutrition leads to dangerous and irreparable physical and cognitive damage. There exists an intrinsic relationship between malnutrition and poverty. Vital economic losses, therefore, may result due to decreased productivity, increased cost of health care and bad cognitive development resulting from malnutrition [1]. However, one of the major solutions offered to tackle malnutrition in children is through the supplementation of micronutrients such as vitamin A and iron. Hence, the leading economists of the Copenhagen Consensus in 2004 using the cost-benefit approach, chose tackling micronutrient malnutrition as the second topmost priority only after fighting HIV/AIDS [1].

Some of the micronutrient deficiencies, which are of public health significance in Ghana, are vitamin A and iron deficiencies and hence the vitamin A supplements (VAS) program and anemia control program, respectively [3]. Vitamin A is important to the immune system because it aids in maintaining the epithelial tissue. Iron is also vital because its deficiency leads to anemia whiles frequent deworming in children is also essential for their health since it helps in combating intestinal parasites [4].

With children as a major source of future human capital and the fact that Ghana is trying to meet the sustainable development goal 3.2 of reducing under-five mortalities to 25 deaths per 1000 live births by 2030, this study sought to find out the factors that influence the utilization or demand for vitamin A and iron supplements as well as deworming among children under five in Ghana given that malnutrition is a major killer of children. Thus, bringing to light the factors that must be targeted by policy makers with regards to the Ghana VAS and anemia control programs in our quest to increase vitamin A and iron supplementation among children in Ghana.

Aside the above, the paucity of studies on the factors that influence the utilization of vitamin A and iron supplements as well as deworming among children under five in Ghana makes this study very important in our quest to improve the current

under-five mortality rate of 60 deaths per 1000 live births in Ghana as reported by Ghana Statistical Service, Ghana Health Service, ICF International [4].

On the literature, the utilization of health or demand for health basically stems from the works of Grossman [5-8]. According to Grossman, health can be seen as a consumption good and as capital (investment) good. Thus, direct utility is obtained from the consumption of health inputs such as VAS, iron supplements, and deworming which would lead to healthy days and hence increase our performance in the market and non-market sectors. Basically, Grossman points to the fact that individuals are the producers of health. Thus, health inputs are consumed not for their own sake but to produce health, and hence, there exist a derived demand for health. The framework of the UNICEF [9] on the causes of child malnutrition also provides insights into variables that could be used in an attempt to explain factors that influence micronutrients supplementation.

On the empirical literature in other countries, in India (Bihar), it was found that being married as an adult, educated, and belonging to the fourth richest quintile increased the probability of receiving iron and folic acid (IFA) among pregnant women. Furthermore, more frequent and early antenatal care was revealed to increase the probability of receiving any IFA whiles conversely Muslims or other religious faith women relative to being Hindu were found to be less likely to receive any IFA [10]. Furthermore, in Brazil, a higher prevalence ratio to iron supplementation among mothers was found after adjusting for confounding factors among women with at least six antenatal visits, with black skins, primiparous, women who received public sector prenatal care, being a teenager and receiving vitamins during pregnancy [11]. In Karnataka (India), it was revealed that being a male child, maternal antenatal blood test, wealth and maternal postnatal iron utilization were linked with children receiving iron supplements [12]. Furthermore, a study conducted in Indonesia found an increase in the odds of not using antenatal iron/folic acid supplements among infants with high birth rank, rural mothers and mothers with less mass media exposure, less independence on health care, less knowledge of obstetric complications, with challenges in paying for health care and distance to the health facility or the absence of a companion to accompany them to access health care [13].

Further, residence, age of the mother, region, household size, household income, and features of the household head (education, employment status, and sex) were found not to be significant determinants of VAS among children whiles mother's education and employment as well as child's age were revealed to be the key predictors of VAS in Zambia [14]. In India, a higher probability of VAS was found among children with mothers who are educated and children in rural areas whiles children with birth rank of six or more and children from states with less economic and social development were revealed to be only around ½ as probable to receive VAS as compared to their counterparts [15]. Also, an increase in VAS was found to increase with rising maternal education and employment in Kenya [16]. Further in Nepal, gender of the child was found not to influence VAS. Also, among other findings, 10-11 and 6-9 months aged children as well as poorest children were revealed to be less likely to have received VAS whiles rural children were found to be more probable to have received VAS [17]. Further, maternal education was found to influence VAS among pre-school children whiles paternal education and maternal age were insignificant in Cambodia [18]. In Indonesia, it was found that younger children, male children, children with younger mothers, with less maternal education and less paternal education among other factors were more probable not to have received VAS [19].

With regards to studies on Ghana, in rural northern and rural middle part of Ghana, children enrolled in day care centers were found to have better energy, calcium, protein, iron, and zinc daily intakes as compared to those who were not enrolled [20]. Moreover, poor VAS coverage was found to be linked with knowing the medical consequences of VAS, living in a brick building, not able to identify the supplement, and receiving VAS in schools in three districts of Ghana [21]. Another study by Hill *et al.* [22] in the Kintampo District of Central Ghana found that false anticipations, traveling, perceived side effects, forgetfulness, no motivation, the notion that doctor drugs are for curative purposes, misconceptions that VAS is used as a family planning measure among others are some of the potential challenges to supplementation.

Concerning the works on Ghana, this study, however, differed from the work of Harding [20] because it did not focus on the nutritional components of children's diet and how is affected by attending a day care center. Rather, it focused on whether children were given iron sprinkles, pills, or syrup in the past 7 days before the survey.

In addition, none of the studies on iron supplementation and VAS on Ghana used data with nationwide coverage. Therefore, to the best of the authors' knowledge, this paper was the first to use data with a nationwide coverage to investigate the factors that influence VAS and iron supplements utilization among children in Ghana.

Last but not the least, this study to the best of our knowledge, was also the first of its kind to investigate the determinants of deworming among children in Ghana.

METHODS

Data

This study used the most recent nationally representative demographic and health survey, *viz.*, the 2014 Ghana Demographic and Health Survey, which was a cross-sectional survey carried out from early September to mid-December, 2014, by the Ghana statistical service, the Ghana health service, and other partners as the main source of data. During the survey, mothers or caregivers were asked whether children under five were given VAS in the past 6 months before the survey, whether children were given iron pills, syrup, or sprinkles

in the past 7 days before the survey and whether children were given a dewormer (drug for intestinal parasite) in the past 6 months before the survey. Therefore, if a mother answered yes it was coded as 1 and if no, it was coded as 0. All do not know responses in the data were treated as missing values. Furthermore, variables such as wealth status, mother's marital status, and religion were subjected to recoding from how they were coded in the original data.

Model Specification and Empirical Estimation

Given that children are not old enough to make choices on their own, mothers would utilize health input or health care based on their expected utility. Following [23] and [24 as outlined in 25] with some modification, the study assumed that the utility a mother obtained was of the function

$$U = U\ (I, J, H) \tag{1}$$

Where, I may represent health neutral good, J represents socio-cultural and demographic factors, and H represents the health status of the child.

Therefore, the child health production function would be given by:

$$H = F\ (K, L) \tag{2}$$

K may involve a health input such as dewormer, vitamin A supplement, iron sprinkles in this case and L represents characteristics of the child (sex, birth order, age, etc.). Therefore, the caregiver or mother maximizes utility given the health production function subject to the constraint given by:

$$Y = IP_i + KP_k \tag{3}$$

Thus, Y would be household income, P_i, and P_k would be the respective prices of I, and K, and the health investment good (K) only enters the mother's utility function through H.

Therefore, we can manipulate equations 1, 2, and 3 to yield the demand function for a particular health input (K) as

$$K = D_k\ (P_k, P_i, J, Y, L) \tag{4}$$

Equation 4 is just in the form of a functional form which shows the relationship between a particular health input and other variables. However, for the purpose of estimation, the paper specified equation 5 below:

$$K = \phi M + \mathit{JJ} C + \varpi S + \mu \tag{5}$$

Where, K represents the likelihood that a particular health input was utilized for the child, M is mother's characteristics such as age, education, and employment, C shows child characteristics such as sex, age, and birth order, and S shows other socio-cultural, economic, and demographic variables such as region, ethnicity, partner's education, household wealth status, and residence type. ϕ, JJ, and ϖ are vector of parameters of the explanatory variables and μ is the disturbance term.

In this study, the dependent variables were binary. Thus, whether a mother chose a particular input (dewormer [deworming] or vitamin A supplement or iron sprinkles) for the child which was coded as 1, and 0 if she did not choose. Since the dependent variables were dichotomous, the study adopted the binary probit regression model assuming that the error terms were normally distributed. To give the results better intuitive meaning as Williams [26] contends, the probit results were reported in the form of the average marginal effects of the regressors. It must be stated that before the probit model application which is a multivariate analysis, the study utilized a univariate analysis in the form of the Pearson Chi-square to find out whether there were significant differences in the demand for a particular health input and the various categorical independent variables. Also in the multivariate analyses (probit model), all categorical explanatory variables were treated as dummy variables. Stata 11 software was used for the analyses of data in this study.

It must, however, be stated that the non-inclusion of price was justified by the fact that prices would have been difficult to obtain for children not utilizing a particular health input as [27,28] contends in the case of insecticide-treated nets. Furthermore, the difficulty in identifying those who received subsidized health inputs makes the price variable misleading [28]. Also, in the case of the price of the health neutral good, the difficulty arises in as to which good to be chosen.

RESULTS AND DISCUSSION

Univariate Analyses

The univariate analyses as shown in Table 1 revealed that there were significant differences among various regions, religions, ethnic groups, level of mother's education, money and distance to seek medical care or help by mother, partner's education, and sex of the household head with regards to the utilization of all the health inputs for children in Ghana. Moreover, there was a significant difference within residence and deworming among children. The results further showed that there were significant relationships between the utilization of both VAS and deworming for children and mother's health insurance status and employment. In addition, mother's marital status and household wealth status were both found to have significant relationships with regards to iron supplementation and deworming among children. Moreover, the distribution of the various variables with regards to the utilization of VAS, iron supplementation, and dewormer utilization or usage (deworming) can easily be seen in Table 1.

However, since these univariate analyses were done for each independent categorical variable and hence did not control for other variables that may determine the demand for a particular health input, the study adopted multivariate analyses whiles controlling for other factors.

Table 1: Univariate analyses of micronutrient supplementation and deworming among children in Ghana

Variable	Vitamin A (%)		Chi-square	Iron (%)		Chi-square	Deworming (%)		Chi-square
	No	Yes		No	Yes		No	Yes	
Region			236.3710***			236.4997***			351.5915***
Western	41.40	58.60		63.60	36.40		58.05	41.95	
Central	32.45	67.55		76.38	23.62		61.13	38.87	
Greater Accra	47.29	52.71		79.32	20.68		59.41	40.59	
Volta	30.57	69.43		77.04	22.96		71.27	28.73	
Eastern	34.92	65.08		69.96	30.04		57.31	42.69	
Ashanti	43.07	56.93		78.75	21.25		53.01	46.99	
Brong Ahafo	30.24	69.76		68.65	31.35		72.10	27.90	
Northern	61.38	38.62		89.45	10.55		86.53	13.47	
Upper East	37.76	62.24		81.02	18.98		68.19	31.81	
Upper West	35.18	64.82		91.70	8.30		86.80	13.20	
Residence			0.1133			2.7131			52.6473***
Urban	40.80	59.20		76.75	23.25		62.69	37.31	
Rural	40.34	59.66		78.63	21.37		71.98	28.02	
Religion			35.1305***			31.9368***			88.2788***
Christian	38.22	61.78		75.96	24.04		64.65	35.35	
Islam	44.35	55.65		81.51	18.49		75.49	24.51	
Traditional	50.52	49.48		85.26	14.74		81.34	18.66	
Ethnicity			167.5302***			172.7031***			265.9490***
Akan	35.70	64.30		70.88	29.12		57.02	42.98	
Ga/Dangme	40.08	59.92		69.51	30.49		62.35	37.65	
Ewe	34.86	65.14		76.92	23.08		68.51	31.49	
Guan	45.67	54.33		81.75	18.25		73.44	26.56	
Mole-Dagbani	41.94	58.06		86.24	13.76		79.38	20.62	
Grusi	31.91	68.09		83.40	16.60		74.89	25.11	
Gurma	63.95	36.05		87.39	12.61		80.94	19.06	
Mande	34.12	65.88		71.43	28.57		56.47	43.53	
Other	47.57	52.43		66.67	33.33		77.23	22.77	
Mother's education			59.7390***			80.1924***			199.0324***
Uneducated	47.27	52.73		84.47	15.53		79.81	20.19	
Primary	38.93	61.07		74.23	25.77		66.99	33.01	
Secondary	35.61	64.39		73.82	26.18		60.44	39.56	
Higher	40.95	59.05		81.34	18.66		55.07	44.93	
Mother's insurance			14.2464***			1.8857			10.6780***
Uninsured	44.29	55.71		76.72	23.28		65.18	34.82	
Insured	38.86	61.14		78.39	21.61		69.63	30.37	
Marital status			1.2004			16.9715***			9.5551***
Single	39.50	60.50		74.62	25.38		65.55	34.45	
Married	41.04	58.96		79.51	20.49		69.65	30.35	
Mother's employment			9.3650***			1.5291			16.6934***
Unemployed	44.50	55.50		76.53	23.47		73.35	26.65	
Employed	39.50	60.50		78.24	21.76		67.01	32.99	
Permission to seek medical care/help by mother			1.0858			0.2301			0.8729
Big problem	37.94	62.06		76.88	23.12		70.46	29.54	
Not a big problem	40.70	59.30		77.95	22.05		68.12	31.88	
Money to seek medical care/help by mother			16.8707***			17.2436***			52.0358***
Big problem	43.32	56.68		80.27	19.73		72.93	27.07	
Not a big problem	37.88	62.12		75.63	24.37		63.88	36.12	
Distance to seek medical care/help by mother			5.9371**			25.2752***			50.3955***
Big problem	42.88	57.12		82.00	18.00		74.80	25.20	
Not a big problem	39.41	60.59		75.96	24.04		65.24	34.76	
Partner's education			38.2868***			65.3539***			171.3081***
Uneducated	46.97	53.03		85.23	14.77		81.17	18.83	
Primary	40.42	59.58		75.04	24.96		67.20	32.80	
Secondary	37.42	62.58		74.83	25.17		62.45	37.55	
Higher	37.34	62.66		77.49	22.51		60.57	39.43	
Sex of household head			7.7126***			5.4419**			35.5360***
Male	41.53	58.47		78.60	21.40		70.33	29.67	
Female	37.18	62.82		75.51	24.49		61.48	38.52	
Sex of child			0.5788			0.0639			0.3756
Male	41.01	58.99		77.75	22.25		67.91	32.09	

(Contd...)

Table 1: *(Continued)*

Variable	Vitamin A (%)		Chi-square	Iron (%)		Chi-square	Deworming (%)		Chi-square
	No	Yes		No	Yes		No	Yes	
Female	40.00	60.00		78.03	21.97		68.68	31.32	
Wealth status			1.2385			9.6955***			104.6024***
Non-rich	40.97	59.03		78.95	21.05		72.22	27.78	
Rich	39.32	60.68		75.05	24.95		57.86	42.14	

Source: Authors computation from the 2014 GDHS. Notes: 1. */**/***Showing a significant difference at 10%, 5%, and 1%, respectively, within the predictor and vitamin a, iron supplementation, and deworming among children in Ghana. 2. Traditional in this study means traditional/spiritualist/no religion

Multivariate Analyses

From Table 2, with regards to the factors that influence VAS among children in Ghana, the results showed that on average, children from the Greater Accra, Western, Volta, Northern, and Ashanti regions were, respectively, 11% and 11% less probable, 11% more probable, 15% and 8% less probable to have received VAS relative to those from the upper West region. Further on average, urban children were 4% less likely to have received VAS in the past 6 months before the survey relative to their rural counterparts which are similar to the findings of Thapa [17] and Agrawal and Agrawal [15], who found higher likelihood of VAS among rural children. The results send signals on the importance of region with regards to child health utilization since children in regions such as Greater Accra, Western, Northern, and Ashanti regions were less likely to have received VAS. The less likelihood of urban children to utilize VAS could be attributed to the over-focus on rural areas to the neglect of urban areas in child health utilization drives.

Further with regards to ethnicity, children from Mande and Grusi ethnicity were on average 13% and 12% more likely to have received VAS, respectively, relative to those from the other ethnic groups. In addition, mothers with secondary education were 6% more probable to have utilized VAS for their children as compared to their uneducated counterparts. This is not surprising since educated mothers are well placed to understand and comprehend the importance of VAS to child health as compared with the uneducated mothers.

Also on average, employed and insured mothers were 6% and 5% more likely to have utilized VAS for their children relative to the unemployed and uninsured mothers, respectively. This is because employed mothers are well-empowered enough to afford child health inputs such as VAS as compared with their unemployed counterparts. Also, mother's health insurance may give them access to health inputs like VAS for children as compared to the uninsured mothers. The findings on maternal education and employment with regards to VAS are similar to that of Kabwe [14] in Zambia and Kamau *et al.* [16] in Kenya and only the maternal education on VAS finding similar to that of Agrawal and Agrawal [15] in India and Grover *et al.* [18] in Cambodia.

Further, mothers with big problems in seeking permission for medical care were 6% more likely to have utilized VAS for their children as compared to mothers without big problems in getting permission to seek medical care for themselves. This could have been that since mothers have challenges in getting permission for self-medical care, they adopt more of preventive care for themselves and their children. Also, mothers with big monetary challenges in seeking medical care for themselves were revealed to be 3% less probable to have utilized VAS for their children relative to those without big monetary challenges. This is not surprising since monetary challenges in utilizing maternal health could as well affect child health utilization negatively.

Still on VAS, a unit increase in the age of the household head decreased the likelihood that children received VAS in the past 6 months before the survey by 0.1%. This could be attributed to the perception of some elderly in the Ghanaian society that modern medicine or "doctor drugs" are harmful to human health.

On the determinants of iron supplementation among children in Ghana, on average, children from the Central, Western, Eastern, Volta, Ashanti, Upper East, and Brong Ahafo regions were, respectively 6%, 17%, 12%, 9%, 6%, 10%, and 16% more likely to have received iron supplements in the last 7 days before the survey relative to those in the upper West region. Also, Muslim children were 5% more likely to have received iron supplements relative to those from the traditional/spiritualist/no religion background. On average with regards to ethnicity, children from the Guan, Ewe, Mole-Dagbani, Gurma, and Grusi ethnicity were 12%, 10%, 15%, 12%, and 15%, respectively, less likely to have received iron supplements as compared with those from the other ethnic groups. Further on average, mothers with primary education were revealed to be 4% more probable to have utilized iron supplements for their children relative to their uneducated counterparts. The same explanation under VAS can be given for the result on maternal education with regards to iron supplements utilization. The finding on iron supplementation and maternal education is similar to that of Wendt *et al.* [10] and Pasricha *et al.* [12] both in India.

On average, children of mothers to whom seeking permission for medical care was a big problem, were 6% more probable to have used iron supplements relative to children whose mothers had no big problems in seeking permission for personal medical care. This is contrary to the findings of Titaley and Dibley [13] in Indonesia. Further, it was revealed that, if mothers felt distance to seek medical care was a big problem, the likelihood of demanding iron supplements for children fell by 2%. This is similar to the findings of Titaley and Dibley [13]. Thus, longer

Table 2: Probit results on socio-economic covariates of vitamin A, iron, and dewormer utilization among children <5 years of age in Ghana

Dependent variable	Vitamin A	Iron	Deworming
Independent variable	AME	AME	AME
Region (Ref: Upper West)			
Western	−0.1053272***	0.1710965***	0.1618013***
Central	0.0443385	0.0639307**	0.1419414***
Greater Accra	−0.107817**	0.0303716	0.1422767***
Volta	0.108176***	0.092419***	0.1138219***
Eastern	0.0276054	0.1168925***	0.2095177***
Ashanti	−0.0763002*	0.0632794**	0.2119331***
Brong Ahafo	0.0451931	0.1627078***	0.0689525**
Northern	−0.1513601***	0.0156581	−0.017168
Upper East	−0.0135762	0.0969607***	0.1660644***
Residence (Ref: Rural)			
Urban	−0.0371255**	−0.0109003	0.0149096
Religion (Ref: Traditional)			
Christian	0.0156592	0.0209195	0.0475983**
Islam	0.0005687	0.0493288*	0.0669689**
Ethnicity (Ref: Other)			
Akan	0.0733577	−0.0532749	0.1053591**
Ga/Dangme	0.0592216	0.0195845	0.0586548
Ewe	0.0064202	−0.0959865*	0.0327242
Guan	0.0592762	−0.1215884**	0.0811661
Mole-Dagbani	0.0654454	−0.1482313***	0.0402404
Grusi	0.1223084**	−0.1525082***	0.0280522
Gurma	−0.090029	−0.1156099**	0.1404425***
Mande	0.1277893*	−0.0856542	0.1710363***
Mother's education (Ref: Uneducated)			
Primary	0.0309024	0.0402661**	0.0517014***
Secondary	0.0559491***	0.022199	0.0641099***
Higher	−0.0369804	−0.0206289	0.1061602**
Mother's insurance (Ref: Uninsured)			
Insured	0.0459969***	−0.0081185	−0.010028
Marital status (Ref: Single mothers)			
Married	−0.008711	−0.0029466	0.0021149
Mother's employment (Ref: Unemployed)			
Employed	0.0559453***	−0.018124	0.040425***
Permission to seek medical care by mother (Ref: Not a big problem)			
Big problem	0.0633386**	0.0597507**	0.0362537
Money to seek medical care by mother (Ref: Not a big problem)			
Big problem	−0.0331187**	−0.0102701	−0.0446312***
Distance to seek medical care by mother (Ref: Not a big problem)			
Big problem	0.0121437	−0.0247027*	−0.0098121
Partner's education (Ref: Uneducated)			
Primary	−0.0128165	0.0342317	0.0566044**
Secondary	−0.000862	0.0038302	0.0446402**
Higher	0.024 8966	0.0106523	0.0387314
Sex of household head (Ref: Female head)			
Male head	0.005183	0.0177639	−0.0201359
Sex of child (Ref: Female)			
Male child	−0.0057552	0.0078008	0.0048499
Wealth (Ref: Non-rich)			
Rich	0.0031105	−0.0036941	0.0075039
Mother's age	0.0022043	0.004088***	0.0034749**
Age of household head	−0.0014277**	−0.0016338***	−0.0001777
Birth order of child	0.0000818	−0.0086206*	−0.0109291**
Childs age	0.0024817	0.0058074	0.0792306***
	N=5065	N=5079	N=5078
	Prob >Chi²=0.0000	Prob >Chi²=0.0000	Prob >Chi²=0.0000

Source: Authors computation from the 2014 GDHS. Notes: 1. ***$P<0.01$, **$P<0.05$, *$P<0.1$ and 2. Traditional in this study means traditional/spiritualist/no religion

distance to health facilities could discourage mothers from visiting such facilities where iron supplements could easily be obtained for children.

Also on average, a unit increase in mother's age was revealed to increase the likelihood of iron supplementation among children in Ghana by 0.4%. This is not surprising since older mothers

are more experienced with regards to taking care of children and hence would better utilize child health inputs such as iron supplements as compared to younger mothers. This finding is similar to that of Berger *et al.* [19], who investigated VAS utilization in Indonesia.

Moreover, a unit increase in the birth order of the child and age of the household head reduced the likelihood of iron supplementation by 0.9% and 0.2%, respectively. Thus, if you take for instance two children, where one has a birth order of 1 and the other is of birth order 2, the one with birth order 2 would be 0.9% less likely to have received iron supplementation. The finding on birth order is similar to that of Titaley and Dibley [13]. The results could be attributed to the fact that some mothers or caregivers might think they have been utilizing certain child health inputs for their previous births and hence would not feel the need to utilize for subsequent births. It could also be that they observed some side effects of such supplements in their older children and hence would not be willing to utilize for their subsequent births. However, this is worrying since the subsequent births are those who would need these inputs even more given that more subsequent births by mothers would mean they (mothers) are aging and thus might be relatively weaker as compared to when they were younger which may negatively affect the health of their children (subsequent births [high birth ranked children]).

With regards to deworming, on average, children from the Western, Greater Accra, Central, Volta, Brong Ahafo, Ashanti, Eastern, and Upper East regions were, respectively, 16%, 14%, 14%, 11%, 7%, 21%, 21%, and 17% more probable to have received a dewormer relative to those in the upper West region. Also, Christian and Muslim children were, respectively, 5% and 7% more likely to have received a dewormer relative to those from the traditional/spiritualist/no religion backgrounds. Gurma, Akan, and Mande ethnicity children were, respectively, 14%, 11%, and 17% more likely to have received a dewormer relative to those from the other ethnic groups. Mothers with secondary, primary, and higher education were, respectively, 6%, 5%, and 11% more probable to have utilized a dewormer for their children as compared with the uneducated mothers. Also, employed mothers were 4% more likely to have utilized a dewormer for their children relative to their unemployed counterparts. Further, if the mother of a child had big monetary challenges in getting self-medical care, it reduced the likelihood of the child receiving a dewormer by 4%. Furthermore, children whose mothers had partners with secondary and primary education were, respectively, 4% and 6% more likely to have used a dewormer relative to those whose mothers had uneducated partners. This is not surprising since educated partners better appreciate the essence of health inputs such as dewormer to the health of children relative to the uneducated partners.

On average, a unit rise in the age of the child and the age of the mother increased the likelihood that a child received a dewormer in the past 6 months before the survey by 8% and 0.3%, respectively. On the contrary on average, a unit increase in the child's birth order led to a 1% reduction in the probability of children receiving a dewormer. The explanations given above for maternal education, maternal age, and child's birth order with regards to the other health inputs still apply under deworming.

CONCLUSION

Based on the findings, the study can conclude that VAS utilization among children in Ghana is influenced by residence type, region, ethnicity, mother's insurance, mother's education, mother's employment, age of the household head, and permission and money to seek medical care by mother. Iron supplements intake among children in Ghana can be concluded to be influenced by mother's education, religion, region, ethnicity, permission and distance to seek medical care by mother, age of the household head, mother's age, and birth order of the child. On deworming among children in Ghana, the study concludes that religion, region, ethnicity, mother's employment, mother's education, partner's education, money to seek medical care by mother, mother's age, child's age, and birth order of the child are the main determinants.

Based on the above, the study would recommend effective regional and urban health behavior change communication (BCC) activities to sensitize the utilization of micronutrients among children. This is because, children from urban areas, Western, Ashanti, Grater Accra, and Northern regions were less likely to have received VAS. The BCC must have various ethnic/local language dimensions given that children from the Guan, Ewe, Mole-Dagbani, Gurma, and Grusi were less likely to have been given iron supplements. The BCC should also demystify the relevance of birth order in child health utilization.

Measures should be initiated toward encouraging mothers without any health insurance to register, especially with the national health insurance scheme which has free registration for pregnant women and children. This is because mothers with health insurance were highly probable to have utilized VAS for their children as compared to the uninsured mothers.

Targeting and informing uneducated mothers on the need to utilize VAS, deworming, and iron sprinkles for their children must be adopted since uneducated mothers were less likely to utilize micronutrients and deworming for their children as compared to mothers with secondary education (in the case of VAS), mothers with primary education (in the case of iron supplementation), and educated mothers (in the case of a dewormer). Uneducated partners and older household heads should also be given education on the need for deworming, both VAS and iron utilization among children, respectively, since they were less likely to do so. As a long-term strategy, encouraging girl child education could be a very effective tool toward encouraging child health utilization.

Finally, aiding the unemployed mothers and empowering women through job creation could be effective tools toward ensuring the utilization of child health inputs given that employed mothers were more likely to utilize VAS and a dewormer for their children as compared to their unemployed counterparts whiles mothers

with monetary challenges in seeking self-medical care were also less likely to utilize VAS and a dewormer for children.

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