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Availability of Adequately Iodized Salt Consumption and its Association with Socio-Economic Factors in Bangladesh

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Abstract

For normal physiologic functions, Iodine is necessary in small amount. It sanctions the thyroid gland to creates thyroid hormones, which is essential for mature and enlargement of the brain, body structures and central nervous system (CNS). In developing countries mental impediment and insufficient commercial performance are one of the results of iodine insufficiency issue. Globally, universal salt iodization has been executed to eradicate iodine insufficiency. However, the sufficiency of iodine in salts needs close observing to match its deliberated target. From this study,we find the adequately iodized salt consumption is associated with some demographic features such as, education, region, wealth index, access to mass-media etc. These findings are important for policy makers and Government as they should take necessary steps to increase the accession to education and media and also take realistic plan to increase the availability of adequately salt in Bangladesh.

Keywords: Iodized salt, associated factors, chi-square, logistic regression, odds ratio.

I. Introduction

Nowadays, Iodine Insufficiency Issue (III) is one of the leading health problems all around the globe. Iodine presents within the body in little amounts, and it plays a vital role in the analysis of an important hormones namely thyroid. Importantly, if the body does not get proper iodine, thyroid analysis is hampered, causing in a state namely hypo-thyroidism and relating to a group of organizational and progressive malformations together called for "Iodine Insufficiency Issues"[1]. Iodine insufficiency is a significant worldwide issue for human health, especially for children & women who is pregnant. The highly dangerous consequence of iodine insufficiency is mental hindrance[2]. As for iodized salt, a study shows that the exposure of salt which is iodized and available in per home is less than or equal 15 ppm which if we state in percentage can be mentioned as 57.6 in general, with countryside, city and shantytown levels at 51.8%, 75.4% and 76.9%, respectively. A study has shown that a big number of the households purchase salt which is open salt; most people don't buy salt packets which is iodized due to their high price, and about quarter of these people do not have access to salt of this type. In conclusion, mass people awareness about the salt and its relevant importance of iodization is missing mostly.; salt consisting of proper proportion of iodine should have inclusive marketing policy and a few demographic factors could play a vital role in removing the III problem in the Bangladeshi people. This research tried to analyse the coverage of iodized salt in the root level of every household.

Iodine a necessary element which is essential for the analysis of a hormone namely thyroid. The lack of iodine relates to thyroid malfunction as the thyroid secretory organ can't generate enough of thyroid enzyme[3], this relates to improper physical and mental progress, intellectual damage, neuro-behavioural and scholarly ailments[4]. In addition, iodine insufficiency also enhanced the possibility of generative malfunction (like miscarriage, untimely birth, dead fetus etc.) for the expectant females[5]. Lack of sufficient iodine indicates to inadequate generation of thyroid enzyme, that impacts various components of the human physique, specially keyorgans growth like, building brain. Insufficient hormone generation negatively impacts these tissues resulting in the illness states known as iodine insufficiency issue (III)[6].

In Bangladesh, the III study (from 2004 to 2005) revealed that the occurrence of III amid kids and females of generative age from 15 to 49 was 34 percentiles and 39percentiles, correspondingly[7]. The Bangladesh National Micronutrients Status Survey from 2011 to 2012 showed that the occurrence of III was 40 percentiles and 42 percentiles in educational institute going kids and females, correspondingly[8]. Though the proportion of III is declining gradually, the topic of III yet insists at an extent of community wellbeing hindrance in nations like Bangladesh[9]. By increasing iodine level using comprehensive salt iodization, and this is a proven program to eliminate III for the last three decades[10].

Accordance with UNICEF 2018 estimates, only 88% of all houses globally had contact to sufficient salt having proper iodine[11]. For a country like Bangladesh, a developing state, the significance of iodine exposure isn't satisfactory. Nation-wide domestic studies have identified the usage of iodized salt which is greater than or equal to5 ppm and sufficiently iodized salt is greater than or equal to 15 ppm changed from 81 percentiles (from 2004 to 2005) to 80.3

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percentile (from 2011 to 2012) and 72.6 percentile (from 2012 to 2013) for salt which is iodized, and from 51 percentiles (from 2004 to 2005) to 57.0 percentiles (from 2011 to 2012) and 54.3 percentiles (from 2012 to 2013) for salt which is properly iodized[12].

The last study in Bangladesh relating to Iodization of Salt in 2015 states only half of the families in Bangladesh have approach to sufficient iodized salt, whereas only 65 percentile families can have approach to only just iodized salt even if it is improperly iodized. Though the condition hasn't improved in sufficient iodized salt treatment, a remarkable reduction in iodized salt exposure in recent times is alarming[13].

In line with Bangladesh Multiple Indicator Cluster Study (MICS) occurred in 2019, 23.4% of families in Bangladesh have zero iodine substance,17.5% of household have insufficient iodine greater than 15 ppm and 58.5% families have sufficient iodine greater than or equal to15 ppm in salt, that paves the way for more experiments to be performed in the region, specifically in selecting poor families[14]. While in Bangladesh, household SES mostly imply on the chief of the household[15], who takes all the monetary conclusions[16]. This implies an essential factor collected for domestic studies like the Bangladesh Demographic & Health Studies, where mostly leaders of families are male and Muslim[17]. The conventional supplier of salt is the household head[18], and it's the reason of the majority interference findings of iodine insufficiency, the chief is provided the salt with proper iodine to assure appropriate allocation[19].

World Bank (WB) recommends to the lawmakers of developing coutries should put emphasis on iodized salt to ensure viable economic & health growth[20]. While in the developed country people are more aware of iodized salt compared to the less developed ones[21]. Similarly, higher iodine areas availability is found in city areas in comparison to the remote areas, where goiter is widespread, although there is exception which do exist[22]. within line with disparity, geographical divisions are probable to be discriminating issues for domestic exposure of iodized salt[23].

II. Data and Methodology

Data collection and study design

The data used for the study has been taken from The Bangladesh Multiple Indicator Cluster Survey (MICS) conducted between January 2019 to June 2019 by Bangladesh Bureau of Statistics (BBS) in cooperation with United Nations Children's Fund (UNICEF) Bangladesh, as part of the global MICS program. Bangladesh MICS 2019 delivers the marketable and the upgraded information on the situation of children and women in Bangladesh.

The survey represents data from an equity viewpoint by signifying variation by gender, region, division, education, living standards, and other characteristics. Bangladesh MICS 2019 is based on a sample of 64,400 households questioned and deliversan overall image of children and women in the eight divisions of the country. For the choice of the survey sample a two-stage stratified sampling approach was applied.

III. Study Variables

Outcome Variable

The outcome variable of attention in this study is the usage iodized salt on household-levelin Bangladesh; which was categorized into: adequate iodized salt (if regular usage salt had ≥ 15 ppm iodine) and non-adequate iodized salt (if regular usage salt had < 15 ppm iodine). Thus, the outcome variable is divided into two groups: households with adequate iodized salt and non-adequate iodized salt. It is a binary variable. So we coded it "0" for "non-adequate iodized salt" and "1" for "adequate iodized salt".

Independent Variables

The study related independent variables are: gender of household head ('male', 'female'), type of place of residence ('urban', 'rural'), division ('Barishal', 'Chattogram', 'Dhaka', 'Khulna', 'Mymenshing', 'Rajshahi', 'Rangpur' and 'Sylhet'), age of household head ('≤ 24', '25 - 34', '35 - 44', '45 - 54', '55 - 64' and '65 +' years), educational attainment ('no education', 'primary', 'secondary' and 'higher'), wealth status ('poorest', 'poor', 'middle', 'rich', 'richest'), religion of household head ('muslim', 'hindu', 'christianity', 'buddhism'), number of household members ('≤ 5', '> 5'), access to media ('yes', 'no').

IV. Statistical Analysis

Exploratory Analysis

Exploratory data analysis is a tool for summarizing the characteristics of the data. This helps to figure out which independent variables are associated with the outcome variable. One of the plainest forms of statistical analysis is bivariate analysis. It allows to look at the associations among two variables. These measures of associations relate how well one variable relates to other and helps to understand therelationship. This is done by tabulating them in a two-way formation known as a contingency table. An additional statistic, chi-square is needed to perform a hypothesis testing about the dependency between two variables.

To check the correlation between two variables, an observed set of frequencies are contrasted with a relative set of frequencies that are expected under the hypothesis that there is no relation. Let, *Oij* (*i*=1,2,3,..., *r* and *j*=1,2,3, ...,*k*) denoted as reflected frequencies and *Eij*(*i*=1,2,3, ...,*r* and *j*=1,2,3, ...,*k*) denoted as the expected frequencies. Then the test statistics $\chi^2$is determined as,

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{k} \frac{[O_{ij}-E_{ij}]^2}{E_{ij}}, \quad (1)$$

which is distributed as χ^2*with (r-1)(k-1)* df.

Multivariate Analysis

Since an empirical association between dependent and explanatory variables does not necessarily imply a causal relationship between them, the relative importance of all the explanatory variables have to examined simultaneously by some multivariate techniques. Several statistical model exist for dichotomous data, such as Cox's linear logistic regression model, we have used Cox's linear regression model for multivariate analysis to determine the association and effect of each variable on usage of adequate iodized salt.

Objective of using a logistic regression model is same as any other statistical model, that is to find the most appropriate statistical model which can be easily interpretable. By logistic regression we can measure the effect of each independent variable (both continuous or categorical) on response variable. We calculate the quantity $\pi(x) = E(Y|x)$ to express the conditional mean of *Y* given x when the logistic distribution is used. The particular form of the model we apply is,

$$\pi(x) = \frac{\exp(\beta_0+\beta_1 x)}{1+\exp(\beta_0+\beta_1 x)}, \quad (2)$$

where β_0 and β_1 are the model parameters. The range of $\pi(x)$ is between 0 and 1. It is one of the main reason behind the popularity of logistic regression. We actually did not directly use model (2). We calculate a link function which also known as logit,*g(x).*It allows the outcome variable to be modelled as,

$$g(x) = \ln\left[\frac{\pi(x)}{1-\pi(x)}\right]. \quad (3)$$

The quantity $\pi(x) / (1 - \pi(x))$ is called odds and hence the logit is called log odds.

As in binary logistic regression the response variable is dichotomous, there can be two odds; one is when *Y*=1 and the other is when *Y=0.*The ratio of these two odds is known as odds ratio. It is more convenient and meaningful to interpret the model results by odds ratio. That's the main reason in logistics regression it converts the estimated parameter into odds ratio to measure the effect of independent variables on response variable.

We apply multiple logistic regression analysis when there is a single binary response variable and more than one independent variables. Then the regression model can be expressed as,

$$\pi(x) = \frac{\exp(\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_p x_p)}{1+\exp(\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_p x_p)}. \quad (4)$$

V. Findings

Among the selected sample of 50981 households, only 58.3% had adequate concentration of iodine in the salt sample they supplied during the survey period. Table 1 shows the percentage of accessibility of sufficient iodized salt in different categories of the factors.

The rate of usage of salt which is iodized per 100 households is higher (62.5%) for female head than male head (57.7%) and also higher in the urban household (78.8%) than the rural household (52.5%). The age group 25-34 of household head get the highest level of adequate iodized salt and the lowest (53.3%) in age group 65+. The availability of adequate iodized salt is the highest (77.4%) in Sylhet and the lowest (39.1%) in Barishal division. Higher the level of education of household head higher the percentage of getting iodized salt. It is also shown that higher the SES higher the level of getting iodized salt such as: highest for the household which are richest (88.1%) and the lowest (34.8%) for poorest (34.8%). The Buddhist people get more iodized salt compared to any other religious people. Household with lower member and media access get higher level of adequate iodized salt. Overall, 58.3% household get adequate iodized salt and 41.7% household does not get in Bangladesh.

From Table 2, we see that except the factor Number of Household Members the p-values for all other factors are less than 0.05, so there exist a strong association with accessibility of sufficient iodized salt and the factor Gender of Household Head, Place of Residence, Division, Age of Household Head, Educational attainment, Wealth Index, Religion, and Access to Media at household level in Bangladesh. So we exclude the factor Number of Household Members for the logistic regression analysis. adequate iodized salt 8% higher for the female household head than the male head and for the rural area the odds of accessibility of adequate iodized salt 34% lower for the rural area than the urban area. For Sylhet division, odds ratio is 5.01 that is the highest odds ratio among the divisions that means the odds of accessibilityof adequate

Table 1. Cross table for availability of idolized salt with associated factors

Variables	Categories	Availability of Iodized Salt			
		No		Yes	
		Count	Percent	Count	Percent
Gender of household head	Male	22482	42.3	30657	57.7
	Female	2890	37.5	4825	62.5
Place of residence	Urban	2868	21.2	10631	78.8
	Rural	22504	47.5	248541	52.5
Age of household head	<24	710	40.5	1043	59.5
	25-34	4338	38.8	6845	61.2
	35-44	6177	39.4	9518	60.6
	45-54	5403	41.3	7677	58.7
	55-64	5034	44.9	6169	55.1
	65+	3710	46.7	4230	53.3
Division	Barishal	2116	60.9	1357	39.1
	Chattogram	3442	32.3	7225	67.7
	Dhaka	4479	29.0	10949	71.0
	Khulna	3410	47.0	3849	53.0
	Mymenshing	2189	48.5	2323	51.5
	Rajshahi	4772	55.1	3896	44.9
	Rangpur	4137	57.6	3044	42.4
	Sylhet	828	22.6	2839	77.4
Educational attainment	No Education	11435	53.7	9846	46.3
	Primary	7206	43.8	9264	56.2
	Secondary	5264	33.8	10303	66.2
	Higher	1457	19.4	6052	80.6
Wealth index	Poorest	8353	65.2	4452	34.8
	Poor	6978	56.5	5381	43.5
	Middle	5237	44.3	6575	55.7
	Rich	3390	28.4	8560	71.6
	Richest	1415	11.9	10515	88.1
Religion	Muslim	23000	41.9	31904	58.1
	Hinduism	2104	40.4	3107	59.6
	Christianity	127	47.4	141	52.6
	Buddhism	142	30.1	330	69.9
Number of household members	≤ 5	20517	41.6	28807	58.4
	> 5	4856	42.1	6675	57.9
Access to mass-media	No access	16249	54.4	13623	45.6
	Have access	9124	29.4	21859	70.6
Total		25373	41.7	35482	58.3

Table 2. Chi-square test for availability of idolized salt with associated factors

Variables	Chi-square statistic	P-value
Gender of household head	61.10	<0.001
Place of residence	2153.50	<0.001
Age of household head	150.95	<0.001
Division	2875.40	<0.001
Educational attainment	2822.90	<0.001
Wealth index	7771.40	<0.001
Religion	53.82	<0.001
Number of household members	2.81	0.0936
Access to mass-media	3460.40	<0.001

Table 3. Multivariate analysis to determine the factors associated with availability of adequate iodized salt

Variables	Categories	Coefficient	Odds ratio	95% Confidence Interval
Gender of household head	Male (Ref.)			
	Female	0.0734	1.08*	(1.00 - 1.16)
Place of residence	Urban (Ref.)			
	Rural	-0.415	0.66***	(0.61 - 0.72)
Age of household head	<24 (Ref.)			
	25-34	0.089	1.09	(0.96 - 1.24)
	35-44	0.062	1.06	(0.94 - 1.21)
	45-54	0.027	1.03	(0.90 - 1.17)
	55-64	-0.071	0.93	(0.82 - 1.06)
	65+	-0.055	0.95	(0.83 - 1.08)
Division	Barishal (Ref.)			
	Chattogram	0.804	2.23***	(2.00 - 2.50)
	Dhaka	0.731	2.08***	(1.86 - 2.32)
	Khulna	0.266	1.30***	(1.16 - 1.46)
	Mymenshing	0.584	1.79***	(1.58 - 2.04)
	Rajshahi	0.046	1.05	(0.94 - 1.17)
	Rangpur	0.143	1.15*	(1.03 - 1.29)
	Sylhet	1.610	5.01***	(4.27 - 5.88)
Educational attainment	No Education (Ref.)			
	Primary	0.207	1.23***	(1.16 - 1.30)
	Secondary	0.320	1.38***	(1.30 - 1.46)
	Higher	0.678	`1.97***	(1.81 - 2.15)
Wealth index	Poorest (Ref.)			
	Poor	0.340	1.41***	(1.31 - 1.50)
	Middle	0.641	1.90***	(1.76 - 2.05)
	Rich	1.150	3.16***	(2.90 - 3.44)
	Richest	1.830	6.23***	(5.53 - 7.02)
Religion	Muslim (Ref.)			
	Hinduism	0.119	1.13*	(1.01 - 1.26)
	Christianity	-0.030	0.97	(0.56 - 1.67)
	Buddhism	0.694	2.00***	(1.53 - 2.62)
Access to mass-media	No access (Ref.)			
	Have access	0.247	1.28***	(1.21 - 1.35)

Note: * p-value<0.05, ** p-value<0.01, *** p-value<0.001

salt which is iodized is 5.01 times higher for the people who live in Sylhet division than the Barisal division. There is lesser odds ratio for the division Khulna, Mymensingh, Rangpur and higher odds ratio for Dhaka and Chattogram. Education level of household head is a too much effecting factor. Here we considered no education as reference category. The odds ratio for the household having primary, secondary and higher education is 1.23, 1.38 and 1.97 respectively comparing no education. Family's economic status that means wealth index is highly significant factor in this context. At household level higher the SES higher the odds of getting adequate iodized salt. The odds for poorest, middle, rich and richest household is 1.41, 1.90, 3.16 and 6.23 respectively, compare to poorest household. For the Buddhist household the odds ratio is 2.00 that is the highest among other religious people compare to Muslim household. Access to media of household is another significant factor. For the household with access to media the odds ratio of 1.28 stipulates that the availability of adequate iodized salt is 28% higher for the household with

access to media than the household without access to media.

VI. Discussion and Conclusion

Among the world population, only 20 percentiles had contact to proper salt which is iodized in the year 1990 and this increase to 58.3% within 2019; The long-standing pledge from the authority in various regions stay disputable[24]. Another survey in Cox's Bazar stated that salt which is iodized marked as a signature of status in the regional municipality as it established resource & education[25]. Additionally, females show more accountability relating domestic choices, that's the reason of Bangladesh's dependence on women for any credit issues[26]. With all these studies it can be concluded that various domestic SES factors are linked with domestic-level iodized salt accessibility or intake of salt that is iodized all over Bangladesh.

A latest study in Bangladesh revealed that poverty-stricken households were two times as expected to consume open salt and it is probable to collect salt from informal wholesale networks like the point of cultivation[8]. A survey information arranged by International Diarrhoeal Disease Research, Bangladesh (icddr,b) learned that the domestic exposure for sufficiently iodized salt has reduced to 51 percentile ever since 2011 and in the countryside area, the extent of open salt trade got doubled than the city region[13]. The situation can be made better by imposing a salt law, making salt available at a convenient price for people of all walks of life and arranging countrywide campaigns for mass awareness.

Present research established connections between iodized salt accessibility and several socio-economic variables of families of our country at household level. The research observed that domestic-level iodized salt accessibility was meaningfully connected with age of the household chief and their educational scenario. Additionally, substantial disparity in domestic-level iodized salt accessibility was observed owing to family revenue position and their place of stay. The research detected the accessibility of iodized salt in families differed significantly among topographical positions, like the districts of our country. Approximately 41.7% of families in Bangladesh don't have access to iodized salt. The Cox and Snell logistic model stated that after adjusting appropriate factors, household's head gender, education, wealth index, location, household's religion, and access to media are essential elements that provide to the regional domestic-level iodized salt exposure in Bangladesh. Higher the SES higher the chance of getting adequate iodized salt. The north-west part of the country severely lacks domestic iodized salt. The disparity between countryside and city regions also implies that the accessibility of iodized salt and buying capability of households are affecting severe inconsistency in adequate iodized salt accessibility. Higher education increases chance of getting adequate iodized salt. Getting adequate iodized salt media play an important role by increasing awareness about health issues.

Finally, we can say that unavailability of proper iodized salt is a serious problem in our country, so the government and the policy makers should take necessary steps to reduce it. The study outcomes indicate that salt which is iodized, interference needs to be given based on area changes, and this will assist law-makers of our country to redesign interventions under the circumstances. The law about the salt and obvious direction on implementation of guidelines, in line with the social campaign of mass awareness will enhance the condition. The government and the policy makers should also take necessary steps to increase the accession to education and media. This work can help them a little.

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