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Vitamin A knowledge and household consumption frequency of vitamin A – rich foods in Tangail, Bangladesh

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ABSTRACT

Introduction: Vitamin A deficiency is one of the most serious health problems in developing countries. This study aims to explore the comparative figure of vitamin A knowledge, household consumption frequency of vitamin A-rich foods, and association of socio-demographic factors with knowledge and consumption in four residential areas in Tangail district, Bangladesh. **Methods:** This study used a population-based cross-sectional design with 400 study participants selected using purposive sampling technique. Knowledge and consumption frequency were assessed by a structured questionnaire along with food frequency table. Data were analysed using descriptive statistics. **Results:** Only 33.5% participants had primary vitamin A knowledge, where most from urban (48.5%) and semi-urban (30.6%) areas had comparatively higher knowledge than those from rural (11.2%) and slum (9.7%) areas. Specific knowledge level was also poorer in rural and slum areas than urban and semi-urban areas. Most of the participants received knowledge through commercial advertisements (65.7%). Household consumption frequency of vitamin A-rich foods (plant and animal) was comparatively lower in rural and slum areas than in urban and semi-urban areas. Different socio-demographic factors (place of residence, education and household income) significantly influenced participant's vitamin A knowledge and household consumption of vitamin A-rich foods ($p<0.05$). **Conclusion:** In general, the study population lacked knowledge regarding the importance of vitamin A. Consumption frequency of vitamin A-rich foods was still poorer in slum and rural areas than in urban and semi-urban areas.

Keywords: Vitamin A knowledge, consumption frequency, plant sources, animal sources, socio-demographic factors

INTRODUCTION

Micronutrients such as vitamins and minerals play an important role in the promotion of health and prevention of diseases (Paul, 1998). Global estimates show that one third of the world's preschool-age population suffers from vitamin A deficiency disorders and the populations from South Asian developing countries are the most vulnerable groups

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(Akhtar *et al.,* 2013). Vitamin A deficiency affects about 19 million pregnant women and 190 million preschool-age children, mostly from Africa and South-East Asia (WHO, 2011). Vitamin A deficiency alone is responsible for almost 8% of deaths among children under the age of 5 years in South-East Asia (WHO, 2009).

Vitamin A is an essential component of the human diet. Human ingest two types of vitamin A: provitamin A from plants and preformed vitamin A from animal sources (Akram *et al.*, 2011). All pigmented vegetables and fruits (particularly orange and yellow), leafy green vegetables, and yellow corn supply provitamin A in the diet. Common dietary sources of carotenoids such as carrot, spinach, broccoli, lettuce, green peas, tomatoes, mango, and papaya have provitamin A activity (Southon & Faulks, 2003). Vitamin A (preformed) occurs mainly in animal products such as milk, liver, meat, butter, egg yolk, and in animal fat. The richest food source is liver, with other animal and fish sources providing substantial amounts of the preformed vitamin (Bates, 1995; Roos, Islam & Thilsted, 2003). The Recommended Dietary Allowance for adults 19 years and older is 900 mcg retinol activity equivalent for men (equivalent to 3,000 IU) and 700 mcg retinol activity equivalent for women (equivalent to 2,333 IU) (National Institutes of Health Office of Dietary Supplements, 2018). Vitamin A deficiency could result in impaired cellular differentiation, reduced resistance to infection, anaemia, and ultimately death, which is a serious health problem in developing nations (Arlappa, 2011; Jiang *et al.,* 2006). Different strategies like food diversification, fortification, and supplementation are helpful to cope with vitamin A deficiency (Tang *et al.,* 2005).

Many factors contribute towards vitamin A deficiencies, such as diets with low nutrient quality and diversity, low household purchasing power, inadequate knowledge of nutritional practices, and inequality (Ahmed, Prendiville & Narayan, 2016). According to the Household Income and Expenditure Survey Bangladesh (HIES) 2016 (BBS, 2019), the level of education and monthly income in rural areas were comparatively lower than urban areas. Similarly, consumption of vitamin A-rich foods such as vegetables, milk, egg etc. was comparatively lower in rural areas than urban areas, which provides substantial evidence regarding the influence of place of residence and other socio-demographic factors on food consumption. However, data on vitamin A knowledge and intake of vitamin A-rich foods among different places of residence in Tangail district, Bangladesh are scarcely reported. Thus, this study was conducted to evaluate the primary and specific knowledge about vitamin A among targeted participants of selected residential areas. This study also explored the household consumption frequency of vitamin A-rich foods (plant and animal sources) in different places of residence and identified various socio-demographic factors associated with the level of knowledge about vitamin A and consumption frequency of vitamin A-rich foods.

MATERIALS AND METHODS

This was a population-based cross-sectional study. A purposive sampling technique was adopted to select samples from each residential area of the Tangail district and the selected areas were marked as urban (Tangail city), semi-urban (Santosh), slum (Tangail sadar) and rural (Porabari, Charabari and Kabila-para) areas. Sample size was calculated by following the formula described by Charan & Biswas (2013) at 95% confidence interval.

$$n = \frac{(Zr^2 \times PQ)}{d^2} = 385$$

Here, n = Sample size, P = Estimate of the expected proportion (Expected rate 0.5), $Q = (1\text{-}P) = (1\text{-}0.5) = 0.5$, d = 5% level of confidence interval = 0.05, Z = 1.96; value of the normal variable, which is equal to 1.96 at 5% level of significance. Although the minimum sample size was calculated to be 385 households, a total of 400 samples were collected considering 5% non-response rate.

A structured and semi-structured questionnaire containing (i) socio-demographic and personal information; (ii) knowledge about vitamin A (only heard about vitamin A was considered as primary knowledge and knowledge about vitamin A deficiency problems was considered as specific knowledge); (iii) weekly household intake frequency of vitamin A-rich foods including both plant and animal sources (quantitative), was used in this study. Vitamin A knowledge, education, age and income were assessed on the chief household earning member (study respondent), whereas consumption of vitamin A-rich foods was assessed on the respondent's entire family. Respondent's family size was one of the inclusion criteria of this study and it was categorised as small (1-4 members) and large (5-8 members) family. Pretesting was conducted to test the survey instrument and data collection procedures before data collection began. The objective was to ensure that the questions being asked accurately reflected the information the researchers desired and that the respondents could and would answer these questions. At the same time, all the enumerators were trained on the questionnaire and methodology. A day long training programme was conducted by Department specialists on related fields. The programme included providing the enumerators with an overview of the background, objectives, method/skill of data collection, eliciting good data, time management, and relevance of the survey.

Data were collected by face-to-face interview with the participants. Collected data were coded and entered into the computer, and analysed using SPSS programme for Windows Version 17.0 (SPSS 17.0, Chicago, IL, USA). Descriptive statistics [cross tabulation, chi-square test (χ^2)] were used to describe both categorical and numerical variables. All the participants received an explanation before becoming a study participant and completed an informed consent form. Research approval was obtained from the Department of Food Technology and Nutritional Science, Mawlana Bhashani Science and Technology University, Tangail-1902, with the ethics approval number MBSTU/FTNS/ERB/2019 (02).

RESULTS

The socio-demographic characteristics of the study participants from different residential areas of Tangail are depicted in Table 1. Most of them were in the age range of 31-40 years (38.5%) and 41-50 years (34.3%). Most of the participants belonged to small families consisting of 1-4 members (54.3%). Majority of the small families were found in urban (31.8%) and semi-urban (26.3%) areas. In contrast, 45.8% of large families, which consisted of 5-8 members, were found in rural (32.8%) and slum (26.8%) areas. The education levels of the participants recorded were illiterate (33.0%), primary (26.3%), Secondary School Certificate (24.4%), Higher Secondary School Certificate (8.3%), Graduate and above (8.0%). Most of the graduate (68.8%) and illiterate (45.5%) participants were from the urban and slum areas, respectively. The majority of the respondent's household monthly income was <$118 (38.5%) and most of these

lower household incomes were recorded in rural (32.5%) and slum (50.0%) areas. In contrast, higher household incomes ($354-472 and above) were recorded in urban and semi-urban areas.

Knowledge about vitamin A

Among 400 participants, 33.5% (*n*=134) had primary knowledge about vitamin A and majority of them were found in urban (48.5%) and semi-urban (30.6%) areas, whereas 66.5% (*n*=266) had no knowledge about vitamin A and most of them were from rural (32%) and slum (32.7%) areas (Figure 1). Several factors influenced their level of knowledge. These included participant's residence ($p<0.01$; $x^2=81.29$) and educational qualification ($p<0.01$; $x^2=101.14$), which were found to be significantly correlated with level of knowledge about vitamin A.

Specific knowledge about vitamin A was also analysed (Figure 2). It revealed that most of the participants (51.5%) believed that vitamin A deficiency only causes night blindness. A poor number of participants (9.0%) believed that vitamin A deficiency may cause other health problems. In a comparative analysis, the overall specific knowledge level was found to be poorer in rural and slum areas than urban and semi-urban areas as most of the participants from rural and slum areas did not have any primary knowledge about vitamin A.

Sources of knowledge

The study participants received vitamin

Table 1. Demographic characteristics of study population

Characteristics	*Residence n (%)*					*p-value* (x^2)
	Urban	*Semi-urban*	*Rural*	*Slum*	*Total*	
Age group (years)						
21-30	4 (13.8)	4 (13.4)	7 (24.1)	14 (48.3)	29 (7.3)	0.03 (18.86)
31-40	32 (20.8)	39 (25.3)	43 (27.9)	40 (26.0)	154 (38.5)	
41-50	37 (27.0)	39 (28.5)	36 (26.3)	25 (18.2)	137 (34.3)	
51-60	27 (33.8)	18 (22.5)	14 (17.5)	21 (26.3)	80 (20.0)	
Family size						
1-4 (small)	69 (31.8)	57 (26.3)	40 (18.4)	51 (23.5)	217 (54.3)	<0.01 (17.68)
5-8 (large)	31 (16.9)	43 (23.5)	60 (32.8)	49 (26.8)	183 (45.8)	
Education						
Graduate and above	22 (68.8)	7 (21.9)	3 (9.4)	0 (0)	32 (8.0)	<0.01 (122.45)
HSC	13 (39.4)	11 (33.3)	7 (21.2)	2 (6.1)	33 (8.3)	
SSC	37 (37.8)	35 (35.7)	20 (20.4)	6 (6.1)	98 (24.4)	
Primary	11 (2.8)	30 (7.5)	32 (8.0)	32 (30.5)	105 (26.3)	
Illiterate	17 (12.9)	17 (12.9)	38 (28.8)	60 (45.5)	132 (33.0)	
Household monthly income (USD)						
<$118	8 (5.2)	19 (12.3)	50 (32.5)	77 (50.0)	154 (38.5)	<0.01 (217.36)
$118-236	16 (13.6)	47 (39.8)	35 (29.7)	20 (16.9)	118 (29.5)	
$236-354	30 (43.5)	23 (33.3)	13 (18.8)	3 (4.3)	69 (17.3)	
$354-472	19 (90.5)	1 (4.8)	1 (4.8)	0 (0)	21 (5.3)	
>$472	28 (73.6)	10 (26.3)	0 (0)	0 (0)	38 (9.5)	

Significant when $p<0.05$

USD=United States Dollar; HSC=Higher Secondary School Certificate; SSC= Secondary School Certificate

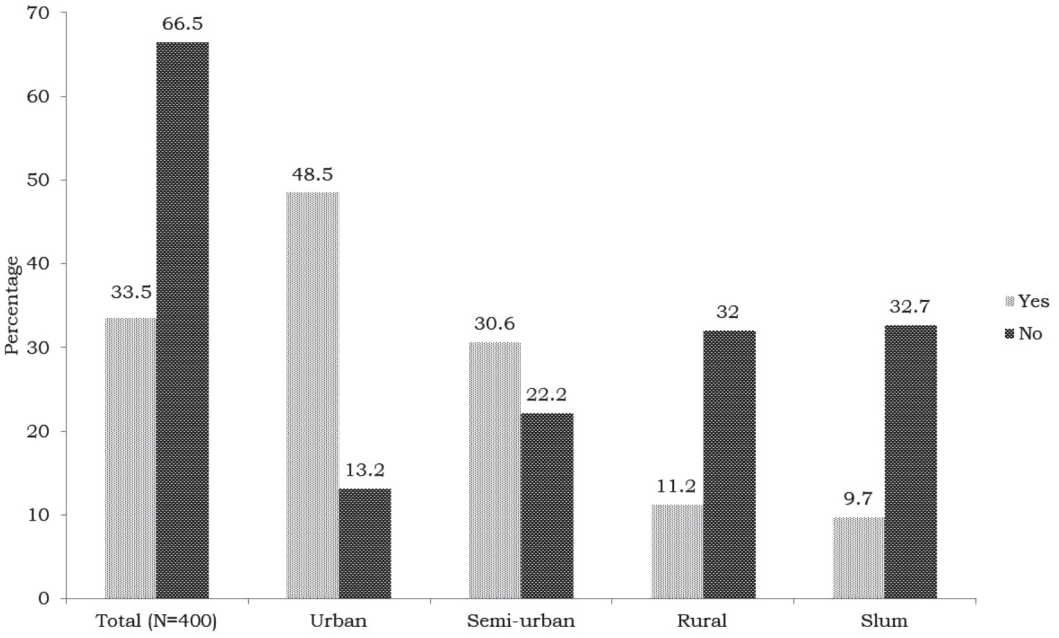

Figure 1. Distribution of primary knowledge about vitamin A

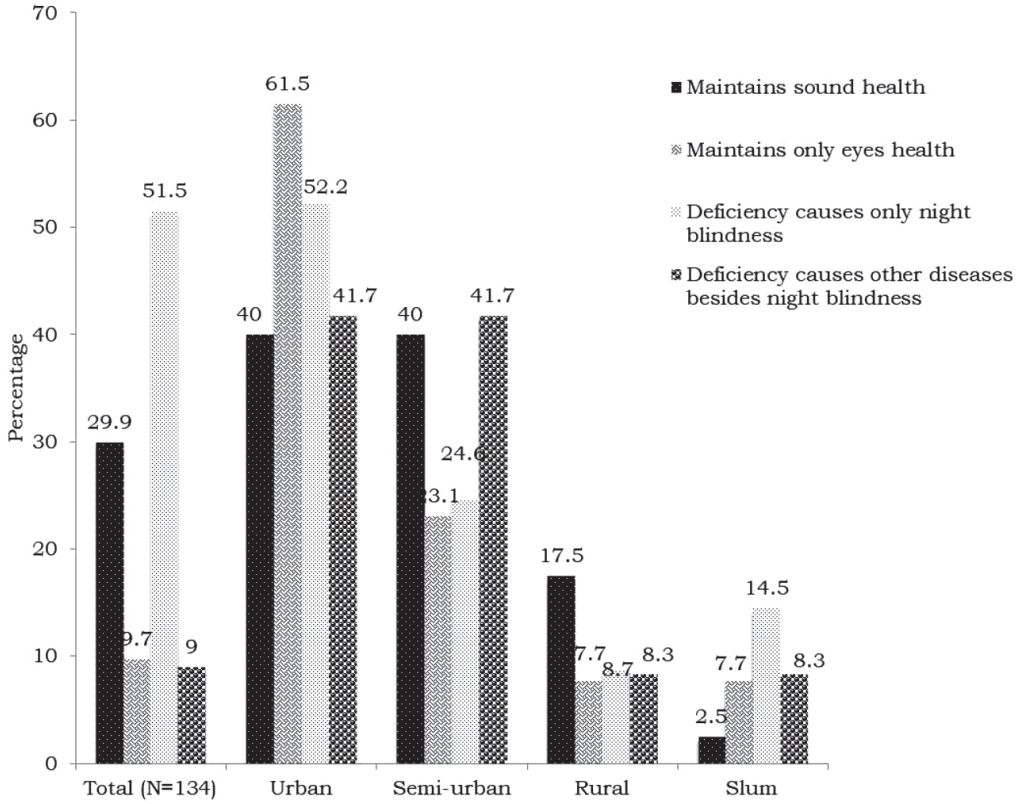

Figure 2. Distribution of specific knowledge about vitamin A

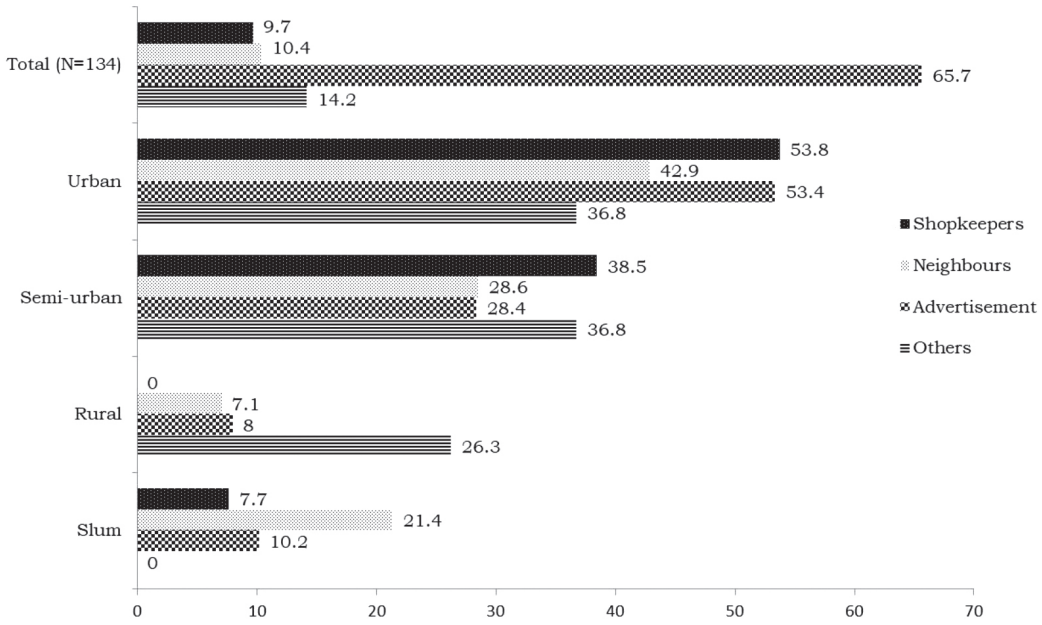

Figure 3. Sources of knowledge about vitamin A

A knowledge through various mediums and those are depicted in Figure 3. A total of 65.7% participants gained vitamin A knowledge through various advertisements on vitamin A (in print and electronic media) and most of them were from urban areas (53.4%). Advertisements were found to be less effective in rural (8.0%) and slum areas (10.2%), whereas dissemination of knowledge through other mediums such as shopkeepers (9.7%), neighbours (10.4%) and others (e.g. peers, relatives, friends, books and some other sources which the participants could not remember) (14.2%) were recorded as comparatively lower than advertisements.

Household consumption of vitamin A-rich foods

The results of the current study revealed that almost all the families from different study areas consumed green leafy vegetables on a regular basis with quantitative variations. Most of the families (48.3%) consumed nearly 2-3 kg green leafy vegetables per week (Table 2). Similar findings were found for spinach (35.3%), pumpkin (51.4%), and tomato (50.3%) consumption. In contrast, most of the families consumed carrot (39.3%), sweet potato (36.35%), and ripe papaya (37.8%) at <2 kg per week. A significant number of families from the urban, rural and slum areas did not consume sweet potato at all, whereas maximum consumption of sweet potato was found in semi-urban area. Lower consumption of carrot, spinach, pumpkin, tomato, and ripe papaya was observed in rural and slum areas as most families from these areas consumed <2 kg per week, with the least number of families consuming >3 kg per week.

Vitamin A fortified soybean oil consumption frequency was also analysed. A total of 38.1% families consumed vitamin A fortified soybean oil on a regular basis. Among these families, consumption rate was found to be higher in urban (53.5%) and semi-urban

Table 2. Household consumption frequency of vitamin A-rich foods

Sources	*Amount per week*	*Residence, n (%)*				*Total*	*p-value* (x^2)
		Urban	*Semi-urban*	*Rural*	*Slum*		
Plant sources							
Green leafy vegetables	< 2 kg/week	12 (19.4)	10 (16.1)	30 (48.4)	10 (16.1)	62 (15.5)	<0.01 (44.59)
	2-3 kg/week	44 (22.8)	55 (28.5)	54 (28.0)	40 (20.7)	193 (48.3)	
	> 3 kg/week	39 (29.1)	34 (25.4)	13 (9.7)	48 (35.8)	134 (33.5)	
	Never	5 (45.5)	1 (9.1)	3 (27.3)	2 (18.2)	11 (2.8)	
Carrot	< 2 kg/week	22 (14.0)	42 (26.8)	45 (28.7)	48 (30.6)	157 (39.3)	<0.01 (56.54)
	2-3 kg/week	24 (21.4)	33 (29.5)	22 (19.6)	33 (29.5)	112 (28.0)	
	> 3 kg/week	29 (55.8)	15 (28.8)	6 (11.5)	2 (3.8)	52 (13.0)	
	Never	25 (31.6)	10 (12.7)	27 (34.2)	17 (21.5)	79 (19.8)	
†Sweet potato	< 2 kg/week	37 (25.5)	49 (33.8)	29 (20.0)	30 (20.7)	145 (36.3)	<0.01 (25.10)
	2-3 kg/week	7 (20.0)	8 (22.9)	6 (17.1)	14 (40.0)	35 (8.8)	
	> 3 kg/week	11 (52.4)	3 (14.3)	4 (19.0)	3 (14.3)	21 (5.3)	
	Never	45 (22.6)	40 (20.1)	61 (30.7)	53 (26.6))	199 (49.8)	
†Spinach	< 2 kg/week	16 (16.8)	23 (24.2)	30 (31.6)	26 (27.4)	95 (23.8)	<0.01 (45.36)
	2-3 kg/week	28 (19. 9)	49 (34.8)	19 (13.5)	45 (31.9)	141 (35.3)	
	> 3 kg/week	19 (41.3)	12 (26.1)	8 (17.4)	7 (15.2)	46 (11.5)	
	Never	37 (31.4)	16 (13.6)	43 (36.4)	22 (18.6)	118 (29.5)	
Pumpkin	< 2 kg/week	27 (24.8)	31 (28.4)	29 (26.6)	22 (20.2)	109 (27.3)	0.12 (13.94)
	2-3 kg/week	45 (22.0)	53 (25.9)	49 (23.9)	58 (28.3)	205 (51.4)	
	> 3 kg/week	18 (36.0)	11 (22.0)	8 (16.0)	13 (26.0)	50 (12.5)	
	Never	10 (28.6)	4 (11.4)	14 (40.0)	7 (20.0)	35 (8.8)	
†Tomato	< 2 kg/week	12 (20.3)	14 (23.7)	15 (25.4)	18 (30.5)	59 (14.8)	<0.01 (35.97)
	2-3 kg/week	32 (15.9)	56 (27.9)	65 (32.3)	48 (23.9)	201 (50.3)	
	> 3 kg/week	45 (39.1)	25 (21.7)	14 (12.2)	31 (27.0)	115 (28.8)	
	Never	11 (44.0)	5 (20.0)	6 (24.0)	3 (12.0)	25 (6.3)	
Papaya	< 2 kg/week	23 (15.2)	39 (25.8)	48 (31.8)	41 (27.2)	151 (37.8)	<0.01 (69.30)
	2-3 kg/week	40 (28.6)	43 (30.7)	30 (21.4)	27 (19.3)	140 (35.0)	
	> 3 kg/week	30 (60.0)	11 (22.0)	5 (10.0)	4 (8.0)	50 (12.5)	
	Never	7 (11.9)	7 (11.9)	17 (28.8)	28 (47.5)	59 (14.8)	
Vitamin A fortified soybean oil	Yes	68 (53.5)	31 (24.4)	15 (11.8)	13 (10.2)	127 (31.8)	<0.01 (96.37)
	No	26 (10.4)	61 (24.5)	78 (31.3)	84 (33.7)	249 (62.3)	
	Occasionally	6 (25.0)	8 (33.3)	7 (29.2)	3 (12.5)	24 (6.0)	
Animal sources							
Liver	<1 kg/week	32 (24.2)	52 (39.4)	27 (20.5)	21 (15.9)	132 (33.0)	<0.01 (35.22)
	1-2 kg/week	15 (35.7)	12 (28.6)	8 (19.0)	7 (16.7)	42 (10.5)	
	>2 kg/week	1 (50.0)	0 (0.0)	0 (0.0)	1 (50.0)	2 (0.5)	
	Never	52 (23.2)	36 (16.1)	65 (29.0)	71 (31.7)	224 (56.0)	
Whole milk	<1 L/week	22 (21.8)	12 (11.9)	22 (21.8)	45 (44.6)	101 (25.3)	<0.01 (77.85)
	1-2 L/week	32 (25.6)	41 (32.8)	35 (28.0)	17 (13.6)	125 (31.3)	
	>2 L/week	44 (35.8)	39 (31.7)	28 (22.8)	12 (9.8)	123 (30.8)	
	Never	2 (3.9)	8 (15.7)	15 (29.4)	26 (51.0)	51 (12.8)	
Whole egg	<1 dozen/week	3 (4.3)	14 (20.0)	7 (10.0)	46 (65.7)	70 (17.5)	<0.01 (104.03)
	1 dozen/week	25 (19.2)	35 (26.9)	39 (30.0)	31 (23.8)	130 (32.5)	
	>1 dozen/week	71 (38.2)	49 (26.3)	47 (25.3)	19 (10.2)	186 (46.5)	
	Never	1 (7.1)	2 (14.3)	7 (50.0)	4 (28.6)	14 (3.5)	

†Consumption frequency on seasonal basis; significant when $p<0.05$

(24.4%) than rural (11.8%) and slum (10.2%) areas. A small percentage (6.0%) of families consumed vitamin A fortified soybean oil occasionally. Several factors were found to influence this different consumption rate at different study areas. Table 2 reveals the association of study participant's residence with their consumption rate of vitamin A-rich plant food items. In this study, participant's residence was found to be significantly correlated with their consumption rate of green leafy vegetables, carrot, sweet potato, spinach, tomato, ripe papaya, and vitamin A fortified soybean oil ($p<0.05$), whereas no significant influence was found for pumpkin consumption with residence ($p>0.05$).

Consumption frequency of vitamin A-rich animal sources were also analysed in Table 2. Most of the families (33.0%) consumed liver (beef and chicken) at <1 kg per week, whereas 56.0% families did not consume liver at all. Majority who did not consume liver belonged to the rural (29.0%) and slum (31.7%) areas. Whole milk consumption rate at 1-2 litres per week was found (31.8%) and recorded as highest among all families. Lower consumption rate was observed in the slum areas. Majority of slum families (44.6%) consumed <1 litre milk per week, whilst a minority of them (9.8%) consumed >2 litres milk per week. Whole egg is considered one of the important and cheaper sources of vitamin A and in this study, about 46.5% families mostly consumed >1 dozen eggs per week. Higher consumption rate was found in urban (38.2%) and semi-urban (26.3%) areas than rural (25.3%) and slum (10.2%) areas. In this study, the consumption rate of all vitamin A-rich animal food items was found to be strongly correlated with participant's residence ($p<0.05$).

Income and education are also considered as important determinants that can influence consumption rate of vitamin A-rich foods among respondent's household in various study areas. In this study, income was found to be significantly correlated with the consumption rate of various plant sources of vitamin A, such as green leafy vegetables ($p=0.02$; $x^2=24.02$), carrot ($p<0.01$; $x^2=61.90$), spinach ($p<0.01$; $x^2=42.45$), pumpkin ($p=0.03$; $x^2=22.65$), tomato ($p<0.01$; $x^2=29.44$), ripe papaya ($p<0.01$; $x^2=43.52$), and vitamin A fortified soybean oil ($p<0.01$; $x^2=107.23$). In contrast, there was no correlation found between the consumption of sweet potato and income ($p=0.23$; $x^2=15.15$). Similar strong correlations were found between income and consumption rates of animal sourced vitamin A, such as liver ($p<0.01$; $x^2=29.88$), whole milk ($p<0.01$; $x^2=91.17$), and whole egg ($p<0.01$; $x^2=73.04$).

Besides income, education also influences the consumption rate of plant and animal sources of vitamin A. In the current study, participant's education was found to be significantly correlated with the consumption of carrot ($p<0.01$; $x^2=32.10$), spinach ($p=0.01$; $x^2=25.20$), ripe papaya ($p<0.01$; $x^2=47.08$), vitamin A fortified soybean oil ($p<0.01$; $x^2=101.14$), liver ($p<0.01$; $x^2=32.06$), whole milk ($p<0.01$; $x^2=43.98$), and whole egg ($p<0.01$; $x^2=57.29$). No correlations were found between education and consumption of green leafy vegetables ($p=0.96$; $x^2=4.93$), sweet potato ($p=0.11$; $x^2=18.22$), pumpkin ($p=0.09$; $x^2=19.13$), and tomato ($p=0.10$; $x^2=18.48$).

DISCUSSION

In general, the results of the current study have revealed that majority of the participants seemed to have poor knowledge about vitamin A. People living in urban and semi-urban areas knew more about vitamin A compared

to slum and rural areas. Consistent with our results, the Bangladesh National Micronutrient Survey 2011-12 (IPHN, 2014) reported that at the national level, 73.7% of participants had knowledge about the source of vitamin. Importantly, the knowledge about vitamin A was found more in urban areas than rural and slum areas e.g., yellow/orange vegetables and fruits are rich sources of vitamin A was mentioned by 49.2% of urban participants, 39.5% of slum, and 35.9% of rural participants.

As vitamin A is essential for so many bodily functions, (e.g., embryonic development, organ formation during foetal development, normal immune functions, and eye development and vision), insufficient vitamin A in the diet has such a severe negative impact on human health and is considered a major worldwide health problem. Night blindness is one of the first signs of vitamin A deficiency. Xerophthalmia, keratomalacia, and complete blindness can also occur since vitamin A has a major role in photo transduction (Micronutrient Information Centre, 2019). According to the Bangladesh National Micronutrient Survey 2011-12 (IPHN, 2014), over 50.0% of respondents mentioned that eating vitamin A-rich foods is good for eyesight and over 80.0% of respondents mentioned that eating vitamin A-rich foods is good for health, while eating vitamin A-rich food prevents night blindness was mentioned by 20% of respondents. But this specific knowledge about vitamin A was found to be very poor among the population of our selected study areas. Our study revealed that most of the participants were unaware of the many other important functions of vitamin A, as well as about other vitamin A deficiency diseases. Large number of them believed that vitamin A deficiency only causes night blindness. A few of them knew that vitamin A is important for human health (though the specific reasons were not known to them) and its deficiency might cause many other diseases.

Mass media including radio, television (TV), newspapers, magazine, cinema, and press has always been used primarily as the most effective method for disseminating knowledge and prevention messages worldwide (Myhre & Flora, 2000). According to the National Media Survey (NMS, 2016), TV, print including newspaper, and radio coverages in Bangladesh are 82.9%, 23.8% and 16.7%, respectively. Rahman (2009) conducted a survey on the knowledge about AIDS in urban and rural areas in Bangladesh whereby he found that advertisements and programmes in TV were the major source of information to both these areas, followed by radio and friends or relatives. In this study, similar findings indicated that a large number of the study population learnt about vitamin A through various advertisements telecasted in TV, newspaper, radio, magazine, and other mass media as these mediums reach more easily from urban to remote areas of Bangladesh.

The top food sources of vitamin A include carrots, dairy products, liver, fish, milk, eggs, and fortified cereals (Solomons, 2006; Institute of Medicine, 2001). However, the consumption of animal food sources is expensive and is not economically feasible for most families. Naturally, plant sources are the primary and cheapest source of vitamin A. According to the report of Household Income and Expenditure Survey Bangladesh (HIES) 2016 (BBS, 2019), the overall consumption of vitamin A-rich foods per capita in Bangladesh is lower than recommendation. Among different sources of vitamin A, green leafy vegetables provide a convincing amount of vitamin A in regular diet. However, according to HIES 2016 (BBS, 2019), the overall consumption

of vegetables including both leafy and non-leafy vegetables in Bangladesh is lower (167.3g/capita/day) than the daily requirement. Precisely, it reported that vegetables consumption is lower in rural areas (164.8g/capita/day) than in urban areas (174.1g/capita/day). These results also revealed substantial evidence that the place of residence significantly influence food consumption. The current study also shared some similar findings where consumption rate was higher in urban and semi-urban areas than in rural and slum areas.

Foods fortified with vitamin A is a feasible and cost effective approach to reduce vitamin A deficiency. Bangladesh has also successfully piloted edible oil fortification with Vitamin A. In Bangladesh, soybean oil is used sparingly in cooking, hence total oil and fat intake on the national basis is low (26.8g/capita/day). In the same study, comparative analysis revealed that edible oils including vitamin A fortified soybean oil consumption is higher in urban (29.57g/capita/day) than in rural (25.70g/capita/day) area (BBS, 2019). Similar findings were also recorded in the current study where higher consumption rate of vitamin A fortified soybean oil was recorded in urban areas than other areas, with the lowest consumption found in slum and rural areas.

Consumption of different animal sources (liver, whole milk and egg) of vitamin A was also analysed. According to HIES 2016 (BBS, 2019), the consumption of animal sourced vitamin A such as egg (13.6g/capita/day) and milk (27.3g/capita/day) was lower than daily requirement. Precisely, it reported that egg consumption in urban areas (15.9g/capita/day) was recorded to be higher than in rural areas (12.7g/capita/day). Similarly, lower consumption of milk and milk products was recorded for rural areas (26.3g/capita/day) than urban areas (30.0g/capita/day). The current study also revealed some similar findings. The lower consumption rates in slum and rural families may be due to various socio-demographic factors as these factors account for around 10% of the variation in food consumption, while individual factors account for about 25% (Ball, Crawford & Mishra, 2006). Inequalities or disparities derived from socioeconomic factors are proposed to have an influence on the dietary and health habits of individuals and now these are considered a matter of great concern (Bartrina *et al.,* 2015; Forouzanfar *et al.,* 2016; James *et al.,* 1997). Our analysis also identified that place of residence, family income, and level of education as significant correlates of vitamin A-rich food consumption. Samaniego-Vaesken *et al.* (2018) conducted a research study and reported that place of residence and habitat size have a limited influence on food choices and consumption, regardless of age and gender among the Spanish ANIBES study population. In contrast, the current study indicated that participant's place of residence significantly influenced most of the vitamin A-rich food (both plant and animal sources) consumption ($p<0.05$).

Several studies have indicated that the level of education can influence dietary behaviour (Kearney *et al.,* 2000). Similar correlations were found in this study where consumption of many vitamin A-rich foods was significantly correlated with participant's level of education ($p<0.05$). However, nutrition knowledge and good dietary habits are not always strongly correlated. This is because knowledge about health does not always lead to direct action (De Almeida MDV *et al.,* 1997). Likewise, the current study also found many of the vitamin A-rich foods consumption (green leafy vegetables, sweet potato, pumpkin, and tomato) were not correlated with participant's level of

education. This may also be linked with household income, because people with higher education level usually have a higher income as well. Raine (2005) reported that insufficient income is the most significant barrier to healthful eating in adults. This study revealed that vitamin A-rich foods consumption was correlated with household monthly income ($p<0.05$).

In general, the results of the current study have revealed that knowledge about vitamin A was poorer in rural and slum areas than in urban and semi-urban areas. Similarly, household consumption of most vitamin A-rich foods were found to be lower in rural and slum than in urban and semi-urban families. Most of the rural and slum families consisted of large number of members (Table 1), but their consumption was not as high as urban and semi-urban families. Moreover, various socio-demographic factors influenced the study participant's knowledge level about vitamin A, as well as their household consumption frequency of vitamin A-rich foods in different residential areas.

CONCLUSION

Different population from different residential areas showed variations in terms of knowledge about vitamin A and also in their household consumption frequency of vitamin A-rich foods. This study revealed that many participants in the rural and slum areas were unaware of vitamin A and its importance. There may be several reasons, such as poverty, lack of basic health education and awareness campaign on proper nutrition in these areas, which may have aggravated the situation. They should be educated about basic health, nutrition, low cost and easily available vitamin A-rich food sources to help them understand the importance of vitamin A. Effective future policy initiatives are required to promote greater consumption of vitamin A-rich foods. Education and behavioural change programmes are also needed to promote the consumption of these foods. Special attention needs to be given in order to improve the consumption of vitamin A-rich animal sources especially in lower income families from the rural and slum areas. The findings of this survey will provide reference data to aid in future policy making and nutrition promotion programmes regarding vitamin A in this region. In addition, these data will also provide the basis for national level nutrition policy making and strategic action planning for the central region of Bangladesh.

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Authors' contributions

RB, principal investigator, designed, formulated and supervised the experiment, and finally reviewed the manuscript; MNR, developed questionnaire, preliminary reviewing and correction of manuscript; RI, MYJ & SAT, performed the data collection and analysis; MRH, developed questionnaire, analysed data and prepared manuscript.

Conflict of interest

The authors declare that there is no conflict of interest.

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