

Original Article

Association of Nutrition and Common Eye diseases with Dietary Behavior: Comparison in Perceived Knowledge Between Urban and Rural Communities.

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Date of received: 04 march 2026

Date of acceptance: 25 March 2026

Abstract

Introduction

Eye diseases are regarded as one of the leading causes of nonfatal debilitating ailments, nutrients remain essential for healthy eyes since it assist in promoting ocular function towards protecting our eyes. Reportedly, proper nutrition improves eyesight. However good food and proper nutrition may vary between urban and rural regions due to varying access to nutrition information and health eye care facilities. This may also lead to varying understanding about food, diet and nutrition, and, as such its relationship with eye and visual activity. We, therefore, tried to find out if perceived knowledge differs between urban and rural inhabitants in food choices/dietary behaviors/ nutrition related eye diseases.

Aim and Objective:

To assess the level of perceived knowledge among rural and urban respondents regarding the prevalent eye diseases and to determine if those are associated with proper dietary habits and nutrition behavior.

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Methods:

This cross-sectionally designed observational study was conducted among 298 people; 179 from urban Dhaka and

119 from rural community of Pangsha, Rajbari. Data were collected using a pre-tested hybrid-designed questionnaire administering face-to-face interviews to assess respondents' perceived knowledge.

Results and Findings:

Findings of our study revealed that respondent's knowledge on nutritional related eye diseases were fair but not good. However, respondents' knowledge on balance diet were highly associated with nutrition ($p < 0.00$), food and nutrition ($p < 0.001$), main source of carbohydrates ($p = 0.05$), protein ($p < 0.001$) and fat ($p < 0.001$), drinking water ($p = 0.05$), and, if knowledge on nutrients remain helpful to eye vision ($p < 0.001$), and visionary issues ($p = 0.04$). Significant association were also found on 'staying in sunshine for 30 minutes in morning ($p = 0.05$) and using mobile device/day ($p = 0.00$). However, consuming several types of food and vegetable within the last 7 days did not yield any significant association (with varying p-values). Lifestyle, dietary behavior, not having proper sun exposures, and, knowledge on eye health remain lower among the rural than urban population.

Conclusion:

Reduced use of cellphone device proper dietary guidelines, knowledge on nutrition and better information system can indeed improve eye health both among urban & rural populations. Access to information and appropriate guidance on nutrition can help individuals make informed choices that support their eye health, even much better. We recommend further large scale in similar research to understand such urban-rural differences in eye diseases towards gathering further insights/stronger evidence to establish knowledge on eye diseases if varies significantly between urban-rural areas of Bangladesh.

1. Background

Without our eyes, we cannot see or live normally. It as essential to take its good care of our eyes and nutrients are vital for healthy eyes to support our eye functions to survey better to protect our this against harmful light. Nutrients lowers risk of age-related degenerative eye illnesses and

improve our vision,¹ including our diet as the key lifestyle factor which has long-term effects on ocular health.² Nutrients and diet helps in improving one's vision,³ through intake of vitamin A, C, E, K, zinc, lutein and zeaxanthin.⁴ Since vitamins, micronutrients & minerals remain essential to keep one healthy, active and leading to a long life. Everyone needs to have a sound knowledge on these vitamins and minerals, at par. The eyes plausibly remain the most vital organ connected to the senses, some vitamins and nutrients can help protect the eye in our old days from most likely age-related macular degeneration (ARMD).

Annual eye examinations, early detection of eye diseases is important where good nutrition play a vital role to keep our eyes healthy,⁵ ensures functioning eyes supporting our eye function in protecting from harmful UV radiation, Health reducing the risk of vision loss due to aging.⁶ Vitamin deficiencies mostly influence in many ophthalmological conditions to protect from eye diseases may even be the first presenting finding of eye diseases.⁷

Vitamin A deficiency can affect ocular health viz dry eyes, night blindness, corneal ulcers and increased risk of eye infections leading to cataracts,⁸ Vitamin A maintains corneal and conjunctival epithelial cell integrity, and its deficiency led to metaplasia and keratinization. Vitamin A is sourced from green leafy vegetable, fish oils, egg yolks, butter, and orange-colored vegetables. ⁹ The American Heart Association therefore recommends a balanced diet to antioxidants, and beta-carotene.¹⁰ Which is more common in developing countries where diets suffer from low-thiamine foods like polished rice and wheat.¹¹ Causing beriberi where both men and women are affected equally. But pregnant women and infants remain at higher risk.¹² And is therefore suggested that adults more than 18 years old should consume 1.2 mg/ day for men and 1.1 mg/day for women.¹³

While rare cases of **riboflavin (Vit B2)** insufficiency are reported more from lower & mid-income countries (LMIC) where no enough food are available mostly like Asia and Africa.¹⁶ For example, riboflavin shortage often cause clinical nyctalopia due to cellular alterations in the retina,¹⁹ reducing embryonic neural abnormalities, women are advised to take folate supplements in their 1st to 3rd months of pregnancy.²⁰ For adults of 18 years old, the suggested daily dose of Vit B2, 1.1 to 1.3mg/day for men and 0.9 to 1.1mg/day for women.¹⁸ Siva prasad et al. In India 50% of 270 healthy urban dwellers among 30-70 years having had a vitamin B2 deficit.¹⁷ Since human body system do not produce folate and can store it for a limited time only, it is crucial to take Fe+ supplement on a regular basis.²¹

Cobalamin has been connected to relieve pain associated with dry eye disease²⁴ as reported from UK.²² Another epidemiological study in 2013 reported that persons with

vitamin B12 deficits (185 µmol/L) suffered from early and late AMD (Age related macular degeneration).²³ Ozen et al. discovered that treating vitamin B12 deficiency alongside topical therapy alleviated neuropathic pain in patients with dry eye illness.²⁵ A 28-year-old patient with bilateral searing pain and a foreign body sensation in both eyes was the subject of a case study in 2015 that revealed cobalamin insufficiency.²⁶

Humans (like some animals) do not endogenously produce vitamin C from glucose or galactose,²⁷ but severe vit. C insufficiency is uncommon due to its easy availability in diet-²⁸ without which drunkenness, malabsorption diseases, or kidney failure can cause it. The Scurvy is characterized by exhaustion, anemia, easy bruising, gum disease & hyperkeratotic hair follicles with hemorrhages due to hypovitaminosis C²⁹ along with other disorders like common cold, cardiovascular diseases, and neurological diseases.³⁰

A water-soluble **vitamin C**, also known as **ascorbic acid**, is required for numerous biological processes.³¹ **Ascorbic acid** can easily be transformed from its reduced form to its oxidized form, dehydroascorbic acid.³² **Vitamin C** is an extremely strong antioxidant as a result. **Vitamin C** works as an antioxidant to combat nitrogen and reactive oxygen species (ROS).³³ **Vitamin C** levels in the tissue of the eyes are related to plasma concentrations, which serve as a measure of dietary consumption.³⁴ Vitamin C may also be able to replenish other antioxidants, such vitamin E, in the eye.³⁵ A poor diet, alcoholism, anorexia, smoking and dialysis are risk factor for **Vitamin C** deficiency.³⁶

Worldwide, **vitamin D insufficiency** is a serious public health issue. Bangladesh also suffers the lack of it. Comparative studies by age and sex show that women and the elderly have higher prevalence's.³⁷⁻³⁸ Additionally, a lack of **vitamin D** increases the risk of developing cancer, cardiovascular disease, and autoimmune disorders like diabetes, multiple sclerosis, and inflammatory bowel disease.³⁹ **Vitamin D** is found as a dietary supplement when added to some foods, and naturally in a small number of foods. When ultraviolet (UV) rays from sunshine strikes human skin and start the synthesis of **vitamin D**, it is also created endogenously.⁴⁰ Although it has many different functions, such as maintain calcium homeostasis, mineral metabolism, and bone health. ⁴¹ Vitamin D hydroxylases are native in ocular structures like ciliary body, cornea, and the retina. ^{42-43.}

Although the human gastrointestinal tract naturally manufactures vitamin K, an adult still requires to meet Vitamin D by a diet high in soy, alfalfa, spinach, and tomatoes.⁴⁵ Hypovitaminosis K is uncommon in comparison to other earlier nutrients addressed.⁴⁶ Vitamin K is a fat-soluble vitamin that plays a crucial role in blood clotting but also has some significant benefits for eye. ⁴⁴

2. Aim

We aimed to compare the perceived knowledge on eye diseases in association with nutrition deficiency and dietary habits between the urban and rural communities.

2. Objective (s): While the general objective was to compare level of perceived knowledge on eye diseases if associated with respondent's dietary habits or nutrition to compare these findings between urban and rural communities that we surveyed.

Specific Objectives:

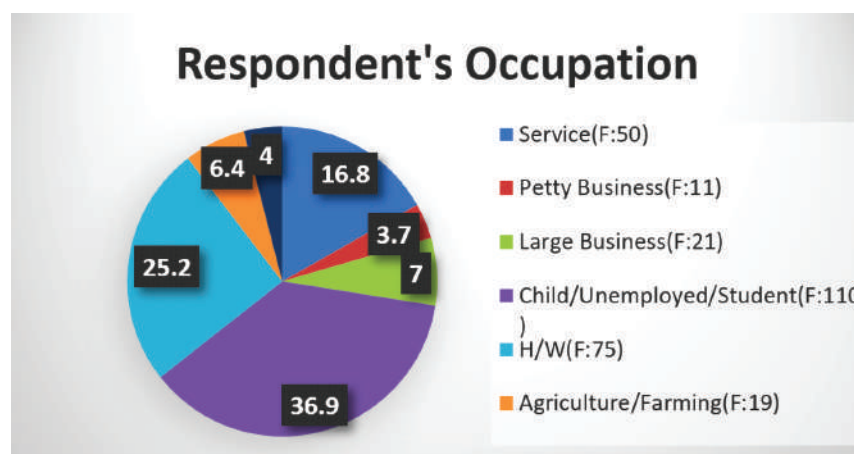
1. To determine the perceived knowledge of eye diseases and associated nutritional deficiencies among the respondents.
2. To assess knowledge on nutrition related eye diseases if associated with dietary habit and to compare respondents' knowledge between urban and rural communities.

3. Rationale of the study:

Globally, eye disorders associated with malnutrition present serious public health issues and if remain untreated, it can result in significant visual impairments, even blindness that negatively affect people's quality of life (QoL) and socioeconomic status. Developing effective preventative strategies/interventions for eye disorders requires an understanding of knowledge on dietary habits and nutrition. Understand if any differences exist between urban and rural populations perceived knowledge on nutritional deficiencies-related eye illnesses and their dietary practices. Our findings had the potential to significantly advancing eye health equity thus lessening the incidence of avoidable blindness by identifying right intervention addressing specific needs both in urban and rural inhabitants. effectively.

5. Results/Findings:

Chart-1 Types of respondent's occupation



4. Methodology:

We planned this cross-sectionally designed observational type of **KAP** study among randomly selected population living in rural Pangsha, Rajbari and Dhaka sub/urban areas during mid-Aug 2023 to mid-Jan 2024 (6 months).

Inclusion criteria: Any male & female belonging to our specified age groups of 10-65 years-old having any eye problems living in Pangsha, Rajbari and randomly selected urban and peri-urban Dhaka who consented to take part in this study.

Exclusion criteria included who were temporary visitors in any study areas not having any eye disease, who were too sick to be interviewed, &/or who were not willing to consent in taking part in this study.

Sample Size for this KAP study was **calculated** using a standard formula of **Z2pq/d2** which yielded as **317** respondents. But we could not reach that sample size due to time constraints and unavailability of respondents or who did not consent, so we had to limit our study to **298 persons** as the final sample size.

Data Management:

Data collection (for quantitative analysis) was performed using a hybrid-designed questionnaire (structured: some close-ended and some open-ended) to collect data/information both from urban dwellers and rural inhabitants, at the same value/pace.

As the data was cleaned through verifying and double-checking to avoid duplication, all data was recorded to ensure anonymity (name, identity, addresses, etc.) all data was entered into the SPSS/ Window V.23.0 and Quality Control of data was ensured & double checked using logical checking. Only then was the data analyzed using required statistical tools and statistical packages.

The findings described in Pie Chart-1 explaining occupation of respondents that most (~37%) were unemployed, students or children, followed by most female respondents being housewives (~25%) followed by 25,2% as service holders leaving ~11% being engaged with business (petty or large ones).

Chart 2 Respondents monthly household income (BDT) (As Per World Bank Data Help Desk, 2016):

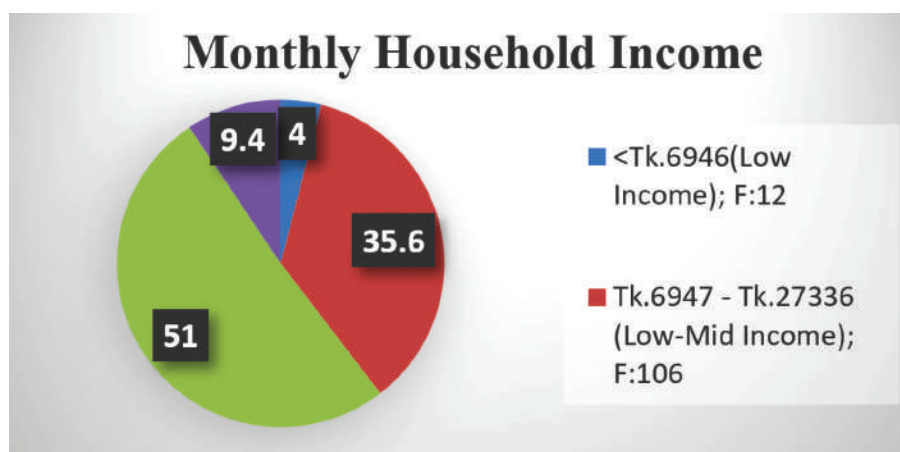


Chart 7.2 explains that monthly household income of most households (~87%) belonged from lower to lower-mid income groups as per World Bank Data Help Desk, 2016 [$>1/2$ respondents (51%) were middle income group with Tk..27337-84564, followed by 35.6% to lower middle-income (Tk.6947- 27336).

Table 1.1 Comparison of knowledge on 'Balance diets between urban & rural inhabitants

Study place	Knowledge on what is balance diet				Total	Statistical Association (χ^2)
	Balanced	High carbohydrate	High protein	N/A		
Rural	57	3	5	54	119	P<0.00
Urban	142	4	3	30	179	
Total	199	7	8	84	298	

Table 1.1 yields that knowledge of urban respondents on balanced diets were significantly better (142/179, **71%**) than that of rural counterparts (57/199, **29%**), **p<0.00**.

Table 1.2 Association of their drinking water per day between urban & rural inhabitants (n=298).

Study place	Intake of water per day			Total	Statistical Association (χ^2)
	4-5 glasses	6-7 glasses	more than 8 glasses		
Rural	34	46	39	119	P=0.073
Urban	38	93	48	179	
Total	72	139	87	298	

Table 1.2 evidence that there was no difference everyday amount of water drinking between urban and rural areas (**p>0.07**).

Table 1.3 Comparison in knowledge on 'More important nutrients' between urban and rural inhabitants

Study areas	Knowledge of important nutrients						Total	Statistical Association (χ^2)
	Don't know	CHO	Protein	CHO + Protein	Minerals	Overall		
Rural	10	21	22	2	12	52	119	P<0.00
Urban	7	73	37	0	6	56	179	
Total	17	94	59	2	18	108	298	

Table 1.3 illustrates that knowledge of nutrients showed significant difference between urban and rural people. While rural people have less knowledge of carbohydrates, protein, both-CHO+ protein, minerals/overall than their urban counterparts having better knowledge in CHO, protein and overall nutrients that yielded statistically significant differences ($p < 0.00$).

Table 1.4 Comparison of knowledge on main source of carbohydrates between urban & rural inhabitants

Study place	Knowledge of main sources of carbohydrate						Total	Statistical Association
	Rice	whole wheat	Maize flour	Potato	No idea	Rice + potato		
Rural	90	2	2	3	21	1	119	P=0.052
Urban	161	4	0	4	10	0	179	
Total	251	6	2	7	31	1	298	

Table 1.4 shows the main sources of carbohydrates in rural and urban areas, focusing on rice, whole wheat, maize flour, and potatoes. While in urban areas, rice remained the main source of carbohydrate that differed from rural areas including those who did not have any idea, yielding a nearly significant difference, but statistically it is not ($p < 0.051$).

Table 1.5 Association of knowledge on main source of protein between urban & rural inhabitants

Study place	Knowledge on main sources of protein							Total	Statistical Association
	Meat	Fish	Pulse	Veg	No idea	Fish+ Pulse	Meat +Fish		
Rural	31	34	4	15	22	4	8	119	P<0.001
Urban	131	30	4	1	9	0	4	179	
Total	162	64	8	16	31	4	12	298	

Table 1.5 indicates knowledge on main source of protein in rural and urban regions, categorized into meat, fish, pulse (legumes), vegetables, and "no idea" category. It also shows the total number of respondents for each region.

Table 1.6 Association of knowledge on main source of fat contained foods between urban & rural inhabitants (n=298).

Study place	Knowledge on main source of fat						Total	Statistical Association
	Meat	Fish	Pulse	Veg	No idea	Fish+ Pulse		
Rural	13	12	77	11	2	4	119	P<0.001
Urban	11	5	133	30	0	0	179	
Total	24	17	210	41	2	4	298	

Table 1.6 Shows the association between two region and fat contained food. From the above table a significant association ($P < 0.001$) was found.

Table 1.7 Association of knowledge between urban & rural inhabitants on important food for growth (n=298).

Study place	Important food for growth								Total	Statistical Association
	Prot	Carb	Fat	Vit	Min	No idea	Vit & Min	All		
Rural	45	21	0	15	2	34	1	1	119	P<0.00
Urban	143	16	3	6	2	8	0	1	179	
Total	188	37	3	21	4	42	1	2	298	

Table 1.7 shows the significant association between two region and knowledge on important food for growth.

Table 1.8 Association of knowledge on foods associated with eye disease between rural and urban inhabitants (n=298)

Study place	Foods associated with eye disease		Total	Statistical Association
	Yes	No		
Rural	68	51	119	P= 0.02
Urban	133	46	179	
Total	201	97	298	

Table 1.8 represents association between two region and knowledge on foods related to eye disease. There was a statistical association denoted by $P=0.02$, suggesting that there was a significant relationship between knowledge on foods related to eye disease and residential region, with a higher proportion of individuals having this knowledge in urban areas compared to rural areas.

2.0 Sum-up (overall) findings yielding main differences on knowledge on food/nutrition associated with eye diseases between Urban & Rural population.

Overall Assessment of Knowledge based on 10 issues/ points:	Level of knowledge (No., %) on various components of nutritional parameters		Differences in Chi-Sq tests (p-value)
1. Knowledge on balance diet	Balanced Diet	Urban respondents (71%) showed significantly better knowledge than rural counterparts (29%).	$p < 0.00$
2. Intake of water per day	Drinking Water Intake	No significant difference was found	$p = 0.073$
3. Knowledge important nutrients	Important Nutrients	Urban dwellers showed higher knowledge of carbohydrates and protein; rural dwellers had less specific knowledge	$p < 0.00$
4. Knowledge on main sources of carbohydrate	Source of Carbohydrates	Rice is the primary source for both; urban knowledge was slightly more distinct, though the difference was marginal.	$p = 0.052$
5. Knowledge on main sources of protein	Source of Protein	Significant difference in identifying meat, fish, and pulses as primary protein sources.	$p < 0.001$
6. Knowledge on main source Fat contained food	Source of Fat	Strong association found between residential region and knowledge of fat-containing foods.	$p < 0.001$
7. Important food for growth	Food for growth	Urban respondents (143) were much more likely to identify protein as the vital nutrient for growth compared to rural (45).	$p < 0.00$
8. Food related to eye disease	Food related to eye disease	Urban residents (133) demonstrated significantly higher awareness of foods that benefit eye health than rural residents (68).	$p = 0.02$

Discussion:

Nutrients are essential for optimum eye health care to take care of it, modestly. Micronutrients (vitamins, minerals, etc.) are essential for healthy ocular function that also reduce risks of ocular disorders/ diseases¹. A global report informs that ~250 million people suffer from varying degrees of vision loss, some of such leading causes remains eye cataract, age-related macular degeneration (AMD), glaucoma and diabetic retinopathy,² and also responsible for 50% of vision loss as reported from UK.²

Epidemiological studies yielded that healthy lifestyle choices like as maintaining a quitting smoking balance diet and engaging in physical activity have been linked to a decreased incidence of AMD¹. However, high dose antioxidant supplements and anti-antigenic therapies are two current treatments modalities for AMD- advancement. AMD can be halted also by dietary interventions and/or long-term use of high dose antioxidants, though remain debating.¹

In our study, we analyzed the socio-demographic status of the respondent; about 60% respondents came from urban area. And only 33.9% were from rural area. Majority of the respondents came from 20-39 years age group. Most of the respondents were female and more than half of the respondent's marital status was married (53.0%). A large number of respondents were Muslim which was 95.6%.

Majority of the respondents were service holders (25%), only 3.7% had petty business. 51% respondents reported that they belonged to a mid-income family.

We also analyzed association of knowledge on nutrients and foods with rural and urban areas.

Here we found a significant difference in having better knowledge on food and nutrition from urban areas than the rural respondents ($P < 0.01$), and, most urban people knew about the balance diet. Similar reports have been found that knowledge score on nutrition differed significantly between rural and urban slums ($p < 0.001$).²

In our study, we analyzed the association of knowledge on important nutrients. Majority of urban people (73) think carbohydrates are the most important for them and rural people think (53) carbohydrate, protein, minerals all are important for them. 56 urban people also think all the nutrients are important for them. Majority of urban people know rice as the main source of carbohydrate and a few rural people (90) know rice as the main source of carbohydrates. We have also analyzed respondent's knowledge on main source of protein, fat and important food for growth. Significant association was found on knowledge about protein, fat and food important for growth ($P < 0.001$).

Knowledge of food groups and buying food from food groups have also significant association between two

regions as $P < 0.001$. Majority of urban people know about food groups (144) and buy foods from food groups (145). Next, we tried to assess the knowledge of respondents on foods related to eye disease are fish (omega-3 fatty acids), Nuts and legumes, seeds, citrus fruits rich in vitamin C rich in omega-3 fatty acids, citrus fruits enrich with vitamin C, leafy green vegetables, Carrots, Sweet potatoes, Beef, lean meat and poultry, Eggs and water.¹ Majority of the urban people (133) know have knowledge on food related to eye disease and most urban people (143) know about nutrients helpful to eye vision.

Statistical association was found on knowledge about foods related to eye disease ($P = 0.02$). An institute reported that a combination of three antioxidant vitamins (C, E and beta carotene) and the minerals, zinc and copper have reduced advancement of ARMD by 25% & risk of moderate vision loss by 19%.⁴ ($p < 0.01$).

Vitamin A (137) and D supplements (132) are not taken by majority of urban people. No significant statistical association between knowledge of nutrients and region was found to be significant association was found on taking vitamin A supplements ($P = 0.24$) while a statistically found on taking vitamin-D supplements ($p = 0.01$).

Vitamin A & D found in foods like carrot, fish, nuts and seeds are well for eyes.¹ Eye problems were found in majority of urban people (170) and a few of them feel visionary problems at day and night (81). No association was found on people having eye problems. ($P = 0.24$). People who feel visionary problems has an association between two regions as $p = 0.04$. Majority of urban people (109) can see well without glass. Seeing well without glass has no association between two regions as the P value is 0.33.

Vitamin D deficiency has an adverse effect on ocular health. About 27 studies reported an association between vitamin D and DES (Dry Eye Syndrome). Sunshine activates the active form of vitamin D and reduces sun exposure may lead to vitamin D deficiency. 37 The majority of urban people (125) reported that they did not stay at the sunshine for 30 minutes in the morning. And a rare association was found here as P value was 0.06.

Using mobile devices for a long time had also an association between the two regions ($P = 0.01$). Most of the people from rural (67) and urban (69) had used mobile devices for less than 4 hours. Where the urban people mostly use their mobile devices more than 6 hours a day.

Findings of our study demonstrate that the consumption of staple food (brown rice) every day was 164 in urban and 105 in rural within last 7 days. There was no association found as $P = 0.62$. Other staple foods like wheat and corn were never eaten per week by majority of rural (92, 107) and urban (144, 168) people. No association found here as

$P=0.81$, 0.54 . Egg consuming frequency was 2-4 days mostly by urban people (57) and no association found here. ($P= 0.89$). Fish and meat were not consumed per week by most of the urban people (66 and 151). Fruits were consumed by urban people mostly (64) in once per week or two. Dairy items and nuts were never consumed in a week by majority of urban people (74, 95). There was no association found in dietary recall frequency.

Conclusion:

To improve vision health for everyone in Bangladesh whether they live in urban or rural area, we need a combination of better dietary habits, more awareness of nutrition, and a reduction in excessive screen time. When people have easy access to clear information and expert guidance on how food affects their sight, they are empowered to make healthier choices that protect their eyes in the long run.

To truly understand the challenges faced by different communities, we recommend for more extensive, large-scale studies. Expanding this research will provide the solid evidence needed to confirm how knowledge gaps vary across the country and will help us create better eye-care strategies for both urban and rural families.

Reference:

1. Dr. Russel Lazarus. Optometrists Network Eyes and Nutrition, May 31, 2020
2. Lawrenson JG, Downie LE. Nutrition and eye health. *Nutrients*. 2019 Sep 6;11(9):2123. Diet, Nutrition & Good Eye Health, myvision.org Jun 2, 2022. *Nutrients* 2019, 11(9), 2123;
3. Rasmussen HM, Johnson EJ. Nutrients for the aging eye. *Clinical interventions in aging*. 2013 Jun 19;741-8. *Clin Interv Aging*. 2013; 8: 741–748.
4. Published online 2013 Jun 19. doi: 10.2147/ CIA.S45399
5. Manouchehr Saljoughian, PharmD, PhD, uspharmacist, Nutrition and Eye Health at a Glance.
6. El-Sheikh M. Vitamin deficiencies in relation to the eye. *Br J Ophthalmol*. 1960;44(7):406–414
7. Subhadeep Das, M optom, Importance of nutrition for the eye health, Vision Science Academy
8. Austin Pereira, R Damilola Adekunle, Michele Zaman and Michael J Wan, 2023 Jul 19 Vitamin Deficiencies and Ophthalmological Conditions, National Library of Medicine
9. Dr. Alberto Lozano, 06-06-2023, The adverse effect of vitamin A deficiency in ocular health
10. George Wolf July 2001 The Discovery of the Visual Function of Vitamin A Journal of Nutrition Source PubMed
11. Wiley KD, Gupta M. Vitamin B1 Thiamine Deficiency. *StatPearls*; 2023
12. Whitfield KC, Bourassa MW, Adamolekun B, et al. Thiamine deficiency disorders: diagnosis, prevalence, and a roadmap for global control programs. *Ann N Y Acad Sci*. 2018;1430(1):3–43
13. Martel JL, Kerndt CC, Doshi H, Franklin DS. Vitamin B1 (Thiamine). *StatPearls*; 2023
14. Isen DR, Kline LB. Neuro-ophthalmic manifestations of wernicke encephalopathy. *Eye Brain*. 2020;12:49–60.
15. Tarnutzer AA, Straumann D. Nystagmus. *Curr Opin Neurol*. 2018;31(1):74–80
16. Peechakara BV, Gupta M. Vitamin B2 (Riboflavin). *StatPearls*; 2023.
17. Siva prasad M, Shalini T, Reddy PY, et al. Prevalence of vitamin deficiencies in an apparently healthy urban adult population: assessed by subclinical status and dietary intakes. *Nutrition*.
18. Pinto JT, Zemleni J. Riboflavin. *Adv Nutr*. 2016;7(5):973–975
19. Zhao X, Tebbe L, Naash MI, Al-Ubaidi MR. The neuroprotective role of retbindin, a metabolic regulator in the neural retina. *Front Pharmacol*. 2022; 13:919667
20. Austin Pereira, R Damilola Adekunle, Michele Zaman & Michael J Wan (2023) Association Between Vitamin Deficiencies and Ophthalmological Conditions, *Clinical Ophthalmology*, , 2045-2062, DOI: 10.2147/OPHTH.S401262
21. Froese DS, Fowler B, Baumgartner MR. Vitamin B(12), folate, and the methionine remethylation cycle-biochemistry, pathways, and regulation. *J Inherit Metab Dis*. 2019;42(4):673–685
22. Ankar A, Kumar A. Vitamin B12 deficiency. In *StatPearls [Internet]* 2022 Oct 22. StatPearls Publishing.
23. Rochtchina E, Wang JJ, Flood VM, Mitchell P. Elevated serum homocysteine, low serum vitamin B12, folate, and age-related macular degeneration: the blue mountains eye study. *Am J Ophthalmol*. 2007;143(2):344–346
24. Ren X, Chou Y, Jiang X, et al. Effects of oral vitamin B1 and mecobalamin on dry eye disease. *J Ophthalmol*. 2020; 2020:9539674.
25. Ozen S, Ozer MA, Akdemir MO. Vitamin B12 deficiency evaluation and treatment in severe dry eye disease with neuropathic ocular pain. *Graefes Arch Clin Exp Ophthalmol*.
26. Shetty R, Deshpande K, Ghosh A, Sethu S. Management of ocular neuropathic pain with vitamin B12 supplements: a case report. *Cornea*. 2015;34(10):1324–1325
27. Jacob RA, Sotoudeh G. Vitamin C function and status in chronic disease. *Nutr Clin Care*. 2002;5(2):66–74.
28. Cahill L, Corey PN, El-Sohemy A. Vitamin C deficiency in a population of young Canadian adults. *Am J Epidemiol*. 2009;170(4):464–471.

29. Hirschmann JV, Raugi GJ. Adult scurvy. *J Am Acad Dermatol.* 1999; 41(6):895–906.
30. Grosso G, Bei R, Mistretta A, et al. Effects of vitamin C on health: a review of evidence. *Front Biosci.* 2013;18(3):1017–1029
31. Padh H. Vitamin C: newer insights into its biochemical functions. *Nutr Rev.* 1991;49 (3): 65-70.
32. Figueroa-Mendez R, Rivas-Arancibia S. Vitamin C in health and disease: its role in the metabolism of cells and redox state in the brain. *Front Physiol.* 2015; 6: 397. Good luck my der
33. Padayatty SJ, Katz A, Wang Y, et al. Vitamin C as an antioxidant: evaluation of its role in disease prevention. *J Am Coll Nutr.* 2003;22 (1):18–35
34. Taylor A, Jacques PF, Nowell T, et al. Vitamin C in human and guinea pig aqueous, lens and plasma in relation to intake. *Curr Eye Res.* 1997; 16:857–864.
35. Carr AC, Frei B. Toward a new recommended dietary allowance for vitamin C based on antioxidant and health effects in humans. *Am J Clin Nutr.* 1999; 69:1086–1107.
36. MaxfieldL, Crane, JS. Stat Pearls. Treasure, Island(FL):StaPearls,Publishing;2021.Vitamin-C Deficiency
37. Vitamin D deficiency in Bangladesh: A review of prevalence, causes and recommendations, for, mitigation; Md. Zahirul Islam 1, Nizamul Hoque Bhuiyan 2, Mohammed Akhtaruzzaman 2, Christel Lamberg Allard 3, MikaelFogelholm,2022;31(2):
38. Vitamin D and Ocular Diseases: A Systematic Review; Hei-Nga Chan 1, Xiu-Juan Zhang 1, Xiang-Tian Ling 1, Christine Huyen-Trang Bui 1, Yu-Meng Wang 1, Patrick Ip 2, Wai-Kit Chu 1 3, Li-Jia Chen 1 3 4, Clement C Tham 1 3 4 5 6, Jason C Yam 1 3 4 5 6, Chi-Pui Pang 1 3; 2022 Apr 11;23(8):4226
39. Plum LA, DeLuca HF. Vitamin D, disease and therapeutic opportunities. *Nat Rev Drug Discover.* 2010;9(12):
40. Vitamin D-Health Professional Fact Sheet, n.d.
41. *J Investig Med.* Author manus; available in PMC 2012 Aug 1. Published in final edited: *J Investig Med.* 2011 Aug; 59(6).
42. Association Between Vit Deficiencies and Ophthalmological Conditions, Altmetric Austin Pereira; R Damilola Adekunle; Michele Zaman &Michael J WanPages 2045-2062 | Received 25 Apr 2023, Accepted 12 Jul 2023, Published online: 2013
43. Rullo J, Pennimpede T, Mehraban Far P, et al. Intraocular calcidiol: uncovering a role for vitamin D in the eye. *J Steroid Biochem Mol Biol.* 2020;197:
44. Serum Vitamin D Deficiency Is an Independent Risk Factor for Thyroid Eye Disease; Curtis J. Heisel, Alixandra L. Riddering, Christopher A Andrews, Alon Kahan; July 2019
45. Choi EY, Neustein RF, Krebs NF, Walton DS. Ocular manifestations of vitamin disorders. *The Eye in Pediatric Systemic Disease.* Springer; 2017:773–785.
46. Marchili MR, Santoro E, Marchesi A, Bianchi S, Rotondi Aufiero L, Villani A. Vitamin K deficiency: a case report and review of current guidelines. *Ital J Pediatr.* 2018;44(1):36