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Perception about Food Adulteration among General Population in Bangladesh: A Cross Sectional Study

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Abstract

Food adulteration is a significant national issue, posing health risks to approximately 57% of people worldwide. In Bangladesh, an estimated 45 million people suffer from food poisoning or food-borne diseases annually. A cross-sectional study was conducted among semi-urban people to assess understanding, attitude, and practice towards food adulteration and raw-food washing. The study found that respondents with well-educated backgrounds had a good understanding of food adulteration, but their understanding did not reflect their practice and perception. They also did not consider factors such as buying place or food quality. The Bangladesh Government's Food Safety Act, 2013 aims to ensure food safety, but consumer awareness is crucial for reducing food adulteration, especially in low-income communities. COVID-19 transmission through the food sector is considered negligible, and tracing SARS CoV-2 is not a priority.

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Introduction

Food adulteration is the process of reducing the quality or character of food by including questionable or alien material or removing essential vitamins. It can occur accidentally or intentionally, with intentional adulteration aiming to increase profit margins or accidental contamination due to ignorance, carelessness, or inadequate equipment ^[1, 2]. Food contamination and adulteration have been a problem since civilization's beginnings, primarily due to industrialization and overuse of natural resources. In Bangladesh, this issue is prevalent due to business commercialism. It is very important to ensure hygienic, secure, and nourishing food is crucial for human health and productivity ^[3, 4]. The World Health Organization (WHO) has declared the COVID-19 pandemic a worldwide threat, requiring food safety as a crucial aspect of the food system. There have been no reports of COVID-19 transmission through food, but fresh items and packaging may be contaminated if infected individuals sneeze or cough on them. If the virus is quickly transmitted through hands or meals, it may be feasible ^[5, 6, 7]. Food adulteration is a major health issue in developing countries, with over 57% of people experiencing health issues from contaminated food. Food adulteration is a significant public health concern in Bangladesh, with a review study discussing examples, major causes, awareness, effects on human health, prevention methods, and laws against food adulteration. The FAO report on food safety during COVID-19 focused on kitchen tools, hand washing, and hygiene of raw poultry and animal origin products ^[21, 22]. A cross-sectional qualitative study among 100 school children found that students had little knowledge about food adulteration, economic effects, food fraud, and safety issues. A study in Dhaka city found that 97% of samples were adulterated, and the situation decreased significantly after 2006. Consumers had less knowledge about commonly adulterate food items and the adulterants used, and 85% knew about the existence of laws against food adulteration ^{[15, [16, 13]}. In India, 80% of milk is contaminated, and up to 30% of adults in developed nations may contract foodborne diseases annually ^[8, 2, 9, 10].

A study discussed various types, causes, health effects, and control approaches. Priority was given to education, research, and awareness. An overview of food adulteration was provided, detailing different types and their adulterants. A study on the safety of fresh-cut fruits and vegetables discussed the washing process and ensuring compliance with food safety requirements. A study in Ghana analyzed consumer perceptions of food adulteration and their response to it [17, 18, 20]. The pandemic has led to global food security issues, with food adulteration being a major cause of 7.9 million non-contagious illness deaths annually in South Asia. Improper food consumption poses a severe public health risk, with tainted food causing at least 4.5 million deaths. In Bangladesh, an estimated 45 million people experience food poisoning or other food-borne illnesses annually [11, 1, 12]. In Bangladesh, 64% of sellers and manufacturers admitted to using chemicals in their products, despite 74% being aware of their health risks. A study in Dhaka, Bangladesh, analyzed consumer awareness about food adulteration and consumer rights using a questionnaire-based survey. Results showed 90% of respondents checked expiry dates, 95% were aware of adulterant effects, and 52% were aware of potential cancer or vital organ diseases. However, 41% decreased food intake due to adulteration. The study's limitations include a limited sample size and question types [14]. These chemicals include calcium carbide, formalin, textile colors, artificial sweeteners, DDT, and urea. These chemicals can cause health issues, such as slow aging and affecting vital functions like eczema, circulation, and renal function. The raw food washing process during COVID-19 is crucial to prevent communicable diseases, and it is essential to remove these

harmful chemicals from the country [13, 12].

This study aimed to analyze knowledge and practice among general people during the COVID-19 pandemic, aiming to determine the problem behind food adulteration and the percentage of affected individuals. The study aimed to increase awareness about the types of chemicals used in adulteration, the health impact of adulterate food, and the existence of laws against food adulteration. The knowledge gained from this survey can help inform policy decisions and influence government policies. The percentage of people's knowledge can also influence education policies, influencing health policies to prevent both communicable and non-communicable diseases.

Methodology

A cross sectional study was performed among the semi-urban area during COVID-19 period. The areas of this study were Savar upazilla, in Dhaka District. People of all ages purposively selected from the study areas were the population of this study. To find the sample size of this study, a popularly used "Cochran formula" for sampling size determination in population studies was used. A total 337 people were enrolled in this study.

This study used a Quantitative method as well as pre-developed close ended & open-ended questionnaire for data collection. At first, all selected people (337) were interviewed by survey method in the study. With permission from them the data was collected. By using simple random sampling pick respondent from population randomly. On the basis of the questionnaire, the participants' data was analyzed to use Excel and SPSS version 25.

Result and Discussion

Table 1: Socio-demographic status of the respondents

Variables		Frequency	Percent
Gender	Male	182	54.0
	Female	155	46.0
Age	<15	5	1.5
	15-30	115	34.1
	31-40	107	31.8
	41-50	74	22.0
	>50	36	10.7
Level of Education	No formal schooling	53	15.7
	Primary	72	21.4
	Secondary	113	33.5
	Higher secondary	25	7.4
	Graduate	74	22.0
Occupation	Student	61	18.1
	Agricultural farming	85	25.2
	Businessman	80	23.7
	Housewife	68	20.2
	Employee	43	12.8
Monthly income	5,000-10,000	47	13.9
	10,001-15,000	87	25.8
	15,000-20,000	109	32.3
	>20,000	94	27.9

Table 1 shows that the sociodemographic status of the respondent. Both male and female respondent were participated in this study. 54% male and 46% female were participated. Among the total respondent 34.1% respondent were age of 15-30 years old and 31.8% were 31-40 years old. Others less than 15 years, 41-50 years and more than 50 years

old respondents were 1.5%, 22% and 10.7% respectively. According to the educational status, highest educational status found 33.5% of secondary level educated. And lowest 7.4% of higher secondary level educated. Others, no schooling complicated, above HSC were 15.7% and 22% respectively. In terms of occupation, 25.2% respondent were

employee and rest 23.7% businessman, 20.2% housewife, 18.1% students and 12.8% were no work respectively.

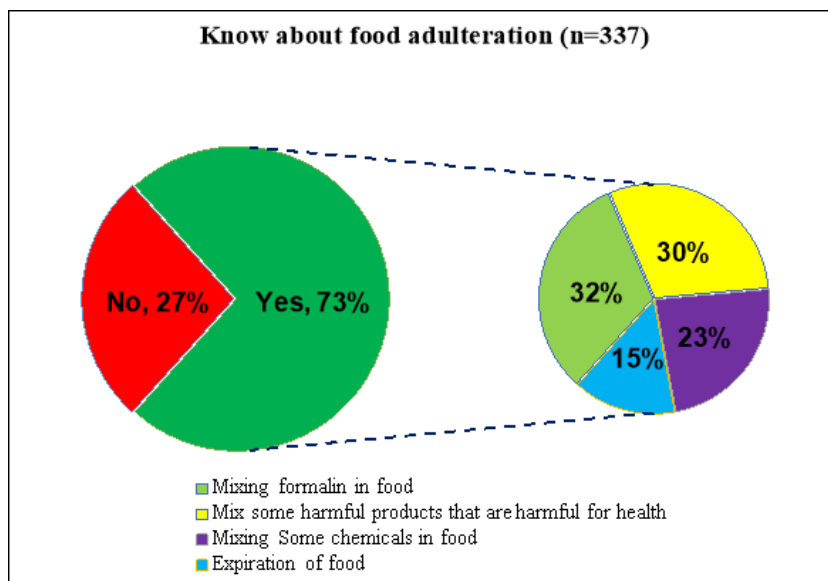


Fig 1: Know about food adulteration among respondent

Table 2: Association between know about food adulteration with sociodemographic status

Variables	I know about food adulteration		Total	χ^2 (p-value)		
	Yes	No				
Gender	Male	Count (%)	140(76.9%)	42(23.1%)	182(100.0%)	2.663 (0.103)
	Female	Count (%)	107(69.0%)	48(31.0%)	155(100.0%)	
Age	<15	Count (%)	4(80.0%)	1(20.0%)	5(100.0%)	20.377 (0.000***)
	15-30	Count (%)	100(87.0%)	15(13.0%)	115(100.0%)	
	31-40	Count (%)	69(64.5%)	38(35.5%)	107(100.0%)	
	41-50	Count (%)	46(62.2%)	28(37.8%)	74(100.0%)	
	>50	Count (%)	28(77.8%)	8(22.2%)	36(100.0%)	
Educational Status	No formal schooling	Count (%)	20(37.7%)	33(62.3%)	53(100.0%)	74.610 (0.000***)
	Primary	Count (%)	39(54.2%)	33(45.8%)	72(100.0%)	
	Secondary	Count (%)	97(85.8%)	16(14.2%)	113(100.0%)	
	Higher secondary	Count (%)	24(96.0%)	1(4.0%)	25(100.0%)	
	Graduate	Count (%)	67(90.5%)	7(9.5%)	74(100.0%)	
Occupation	Student	Count (%)	54(88.5%)	7(11.5%)	61(100.0%)	58.468 (0.000***)
	Agricultural farming	Count (%)	70(82.4%)	15(17.6%)	85(100.0%)	
	Businessman	Count (%)	70(87.5%)	10(12.5%)	80(100.0%)	
	Housewife	Count (%)	36(52.9%)	32(47.1%)	68(100.0%)	
	Employee	Count (%)	17(39.5%)	26(60.5%)	43(100.0%)	
Monthly income	5,000-10,000	Count (%)	25(53.2%)	22(46.8%)	47(100.0%)	22.177 0.000***
	10,001-15,000	Count (%)	57(65.5%)	30(34.5%)	87(100.0%)	
	15,000-20,000	Count (%)	83(76.1%)	26(23.9%)	109(100.0%)	
	>20,000	Count (%)	82(87.2%)	12(12.8%)	94(100.0%)	

Table 2 demonstrates the relationship between the know about food adulteration and demographic factors. Male respondents, who make up 76.9% of the total, have the highest level of knowledge regarding food adulteration, compared to female respondents, who make up 69%. In contrast, the percentage of male and female who don't have knowledge about food adulteration is 23.1% and 31% respectively. The relationship between knowledge about food adulteration and gender is not statistically significant as the p-value (0.103)>0.05. It is noticeable that the respondents between the ages of 15 and 30 have the highest percentage of knowledge regarding food adulteration (87%). On the other hand, the age group of 41 to 50 has the lowest percentage (62.2%) of knowledge regarding food adulteration. In addition, other respondents under 15 years of age, 31 to 40 years of age, and over 50 years of age have 80%, 64%, and

77.4% knowledge about food adulteration, respectively. The p-value from the chi-square test of the two variables, age and knowledge of food adulteration is 0.000 which is less than 0.05 indicating that there is statistical significance in the relationship between the two variables. Knowledge about food adulteration has also been observed according to the educational status of the participants. It is explicit that respondents with higher secondary education account for 96% of the knowledge regarding food adulteration, which is the largest percentage compared to other educational levels. The participants with the lowest educational status have the lowest percentage of knowledge about food adulteration at 37.7%. The percentages of those in the primary, secondary, and above HSC educational status categories who are cognizant of food adulteration are 54.2%, 85.8%, and 90.5%, respectively. To see the association between educational

status and knowledge about food adulteration a chi-square test has been done from which we got a p-value (0.000) < 0.05 which indicates that the association between educational status and knowledge about food adulteration is statistically significant. The percentage of knowing food adulteration may also differ according to occupation. The highest percentage of having knowledge about food adulteration has been found among students making up 88.5% of the total

while the participants who don't work make up the lowest percentage (39.5%). Besides other occupations such as employees, businessmen, and housewives knowing food adulteration make 82.4%, 87.5%, and 52.9% respectively. The table also shows that the relationship between occupation and Knowledge about food adulteration is statistically significant as we found the p-value (0.000) < 0.05.

Table 3: Association between perception about food adulteration and demographic factors

Variables			Perception about food adulteration		Total	χ^2 (p-value)
			No Acceptance	Don't Know about it		
Gender	Male	Count (%)	161(88.5%)	21(11.5%)	182(100.0%)	0.530 (0.467)
	Female	Count (%)	133(85.8%)	22(14.2%)	155(100.0%)	
Age	<15	Count (%)	5(100.0%)	0(0.0%)	5(100.0%)	26.259 (0.000***)
	15-30	Count (%)	113(98.3%)	2(1.7%)	115(100.0%)	
	31-40	Count (%)	82(76.6%)	25(23.4%)	107(100.0%)	
	41-50	Count (%)	61(82.4%)	13(17.6%)	74(100.0%)	
	>50	Count (%)	33(91.7%)	3(8.3%)	36(100.0%)	
Educational Status	No formal schooling	Count (%)	34(64.2%)	19(35.8%)	53(100.0%)	48.096 (0.000***)
	Primary	Count (%)	56(77.8%)	16(22.2%)	72(100.0%)	
	Secondary	Count (%)	106(93.8%)	7(6.2%)	113(100.0%)	
	Higher secondary	Count (%)	24(96.0%)	1(4.0%)	25(100.0%)	
	Graduate	Count (%)	74(100.0%)	0(0.0%)	74(100.0%)	
Occupation	Student	Count (%)	61(100.0%)	0(0.0%)	61(100.0%)	37.058 (0.000***)
	Agricultural farming	Count (%)	75(88.2%)	10(11.8%)	85(100.0%)	
	Businessman	Count (%)	77(96.3%)	3(3.8%)	80(100.0%)	
	Housewife	Count (%)	52(76.5%)	16(23.5%)	68(100.0%)	
	Employee	Count (%)	29(67.4%)	14(32.6%)	43(100.0%)	
Monthly income	5,000-10,000	Count (%)	36 (76.6%)	11(23.4%)	47(100.0%)	13.670 (0.003)
	10,001-15,000	Count (%)	71(81.6%)	16(18.4%)	87(100.0%)	
	15,000-20,000	Count (%)	97(89.0%)	12(11.0%)	109(100.0%)	
	>20,000	Count (%)	90(95.7%)	4(4.3%)	94(100.0%)	

Table 3 tries to demonstrate a comprehensible association between thoughts about food adulteration and demographic factors. Here, 88.5% of males think that food adulteration is bad, and the rest, 11.5%, don't know about it. On the other hand, 85.8% of females know that food adulteration is bad, while 14.2% do not know about it. The percentage data show a discrepancy in thinking about food adulteration by gender, but the chi-square test result indicates that there is no association between gender and thinking about food adulteration, as the p-value is greater than 0.05. By following the age demographic factor, those aged less than 15 years have 100% negative thinking about food contamination, which is the highest level in this age category. The age group 31–40 has the lowest level of bad consideration about this issue, which is 76.6%. Moreover, the 15–30 age, 41–50 age, and >50 age groups have 98.3%, 82.4%, and 91.7% bad perceptions about food contamination, respectively. When measuring the association between age and thinking about food adulteration, the p-value (0.000***) suggests the existence of a relationship between these two variables. Another demographic factor is education, and we would like to see different judgment levels based on different educational statuses. Among those who don't complete schooling, 64.2% of them have a bad perception, which is the lowest level in this category, and 35.8% of them don't know about this issue. Of those who have an educational status above HSC, 100% of them have bad thinking about food

adulteration, which is the highest level, and that's why the percentage of never knowing is 0 in this category. Other educational groups like primary, secondary, and higher secondary have 77.8%, 93.8%, and 96.0% bad thoughts about food adulteration, respectively, and correspondingly 22.2%, 6.2%, and 4.0% never known about this issue. This table shows that improving educational status consecutively increases the percentage of bad perceptions about food adulteration and decreases the percentage of never knowing. To see an association between educational status and think about food adulteration, a chi-square test has been done, and the test result shows that the p-value (0.000***) is less than 0.05, which means the relationship between them is present. The last demographic factor in Table 2 is occupation, which may involve the perception of food adulteration; that's why this factor is categorized into several classes. Among students, 100% of respondents think that food adulteration is bad, which is the greatest value in this category. Those with no work have the lowest value, 29%, for poor food adulteration consideration. The remaining classes are employees, businessmen, and housewives who have 88.2%, 96.3%, and 76.5% bad thoughts about food contamination, respectively. When we measure the association between occupation and thinking about food adulteration, chi-square test results suggest a p-value less than 0.05, which means these two variables have a relationship.

Table 4: Association between know about food adulteration and food purchasing behavior

Variables			I know about food adulteration		Total	χ^2 (p-value)
			Yes	No		
Checking the label, brand name and expire date of the food product during shopping	Yes	Count (%)	204(91.9%)	18(8.1%)	222(100.0%)	115.079 0.000***
	No	Count (%)	19(35.8%)	34(64.2%)	53(100.0%)	
	Never noticed	Count (%)	24(38.7%)	38(61.3%)	62(100.0%)	
experienced of purchasing adulterated food	Yes	Count (%)	207(83.1%)	42(16.9%)	249(100.0%)	47.157 0.000***
	No	Count (%)	40(45.5%)	48(54.5%)	88(100.0%)	
Think about foods purchasing place	Yes	Count (%)	107(91.5%)	10(8.5%)	117(100.0%)	34.055 0.000***
	No	Count (%)	88(68.2%)	41(31.8%)	129(100.0%)	
	Never known	Count (%)	51(56.7%)	39(43.3%)	90(100.0%)	
foods purchasing place	No	Count (%)	46(41.4%)	65(58.6%)	111(100.0%)	0.614 0.736
	Local market	Count (%)	159(72.3%)	61(27.7%)	220(100.0%)	
	Wholesale market	Count (%)	29(78.4%)	8(21.6%)	37(100.0%)	
Adulteration of food causes health problems	Retail market	Count (%)	59(73.8%)	21(26.3%)	80(100.0%)	151.299 0.000***
	Yes	Count (%)	223(91.4%)	21(8.6%)	244(100.0%)	
	No	Count (%)	13(30.2%)	30(69.8%)	43(100.0%)	
	Never known	Count (%)	10(20.4%)	39(79.6%)	49(100.0%)	

Table 4 shows the relationship between knowledge of food adulteration and food-purchasing habits. When shopping, the majority of respondents said they look at the food product's label, brand, and expiration date. 91.1% of respondents were aware of food adulteration, however 38.7% had never seen it. 83.1% of respondents reported having bought tainted food. When shopping, 91.5% of respondents consider whether they are buying food from a healthy or unhealthy location. Local

markets (72.3%), wholesale markets (78.4%), and retail markets (73.8%) all included respondents who were familiar with the phrase "food adulteration." According to this claim, food adulteration causes health issues (91.4% of respondents agree), 30.2% disagree, and 20.4% have no idea. All other factors, except the location of food purchases, were statistically significant.

Table 5: Association between respondent practice and demographic factors

Variables			Have experience of buying adulterated food		Total	χ^2 (p-value)
			Yes	No		
Gender	Male	Count (%)	137(75.3%)	45(24.7%)	182(100.0%)	0.395 (0.530)
	Female	Count (%)	112(72.3%)	43(27.7%)	155(100.0%)	
Age	<15	Count (%)	4(80.0%)	1(20.0%)	5(100.0%)	15.176 (0.004***)
	15-30	Count (%)	89(77.4%)	26(22.6%)	115(100.0%)	
	31-40	Count (%)	65(60.7%)	42(39.3%)	107(100.0%)	
	41-50	Count (%)	60(81.1%)	14(18.9%)	74(100.0%)	
	>50	Count (%)	31(86.1%)	5(13.9%)	36(100.0%)	
Educational Status	No formal schooling	Count (%)	39(73.6%)	14(26.4%)	53(100.0%)	7.179 (0.127)
	Primary	Count (%)	47(65.3%)	25(34.7%)	72(100.0%)	
	Secondary	Count (%)	81(71.7%)	32(28.3%)	113(100.0%)	
	Higher secondary	Count (%)	21(84.0%)	4(16.0%)	25(100.0%)	
Occupation	Graduate	Count (%)	61(82.4%)	13(17.6%)	74(100.0%)	19.521 (0.001***)
	Student	Count (%)	52(85.2%)	9(14.8%)	61(100.0%)	
	Agricultural farming	Count (%)	62(72.9%)	23(27.1%)	85(100.0%)	
	Businessman	Count (%)	67(83.8%)	13(16.3%)	80(100.0%)	
Monthly income	Housewife	Count (%)	45(66.2%)	23(33.8%)	68(100.0%)	5.075 (0.166)
	Employee	Count (%)	23(53.5%)	20(46.5%)	43(100.0%)	
	5,000-10,000	Count (%)	31(66.0%)	16(34.0%)	47(100.0%)	
	10,001-15,000	Count (%)	63(72.4%)	24(27.6%)	87(100.0%)	
15,000-20,000	Count (%)	78(71.6%)	31(28.4%)	109(100.0%)		
>20,000	Count (%)	77(81.9%)	17(18.1%)	94(100.0%)		

Table 5 represent association between respondent practice and demographic factors. In perspective of Gender, male (75.3%) was experienced of buying adulterated food more than female (72.3%) and here p-value is (0.530) which is more than 0.005 so association between gender and experienced of buying adulterated food was not significant. In case of Age, p-value is (0.004) which is less than 0.005 and so association between age and experienced of buying adulterated food was highly statistically significant and here percentage of buying adulterated food was high among 50 years old and above people (86.1%) and percentage was low

among 31 to 40 years old people (60.7%). The highest percentage of buying adulterated food was found among people who were completed higher secondary (84.0%) and lowest was found among people who were completed primary in perspective educational status. The association between occupation and buying adulterated food was highly statistically significant where p-value (0.001) and percentage of buying adulterated food according to occupation student (85.2%); businessman (83.8%); employee (72.9%); housewife (66.2%) and no work (53.5%) respectively.

Table 6: Logistic regression among variables

	Odd Ratio	P-value	95% C.I.		
			Lower	Upper	
Education	No formal schooling	7.904	.003**	7.81	1.57E+13
	Primary	3.411	.070	2.47	393564.4
	Secondary	1.042	.950	1.33	44.08
	Higher secondary	.308	.329	1.03	26.26
Occupation	Student	.501	.387	1.11	10.99
	Agricultural farming	.283	.022**	1.10	2.30
	Businessman	.186	.003**	1.06	1.74
	Housewife	.710	.570	1.24	10.10
Monthly income	5000-10000	2.762	.065	2.56	3340.91
	10001-15000	1.959	.161	2.15	151.11
	15001-20000	1.896	.169	2.14	112.39
Adulteration of food causes health problems	Yes	.054	.000**	1.01	1.26
	No	1.931	.469	1.38	96278.47
Checking the label, brand name and expire date of the food product during shopping	Yes	.037	.000**	1.01	1.22
	No	.791	.731	1.23	20.39
Experienced of purchasing adulterated food	Yes	.465	.335	1.10	9.06
	No				

Know about food adulteration are used for the dependent variables in this binary logistic analysis.

** p value is significant at $p < 0.01$

* p value is significant at $p \leq 0.05$

Assessing the impact of selected variables of the level of knowledge, Odds ratio (OR) of logistic regression have been presented in Table 6. At first, in the table the ORs of socio-demographic variables have been demonstrated. Logistic regression model was developed for knowing about food adulteration. Binary logistic regression was performed to assess the impact of several factors on the likelihood that respondents would report that they had a good knowing about with their sociodemographic status and food purchasing practice & perception. The model contained six independent variables (educational status, occupation, monthly income, perception of adulteration of food causes health problems, Checking the label, brand name and expire date of the food product during shopping and experienced of purchasing adulterated food). As shown in Table 6, only four of the independent variables made a unique statistically significant contribution to the model [education, occupation, Adulteration of food causes health problems and checking the label, brand name and expire date of the food product during shopping). The predictor of reporting a knowing about food adulteration was education, recording an odds ratio of 7.904 that was more than 1. This indicated that respondents who

had no formal schooling were over 7.904 times more likely to report a don't know about food adulteration than those whose were educated, controlling for all other factors in the model. The odds ratio of 0.283 and 0.186 for agricultural farming and businessman was less than 1, indicating that for agricultural farming group and businessman group, respondents were 0.283 and 0.186 times less likely to report having poor knowing of food adulteration, controlling for other factors in the model. The behavior of "checking the label, brand name, and expiration date of the food product during shopping" and the opinion that "adulteration of food causes health problems" were two additional independent variables that were statistically associated with understanding of food adulteration. The odds ratio of 0.054 and 0.037, which indicates that for these two groups respondents were 0.054 and 0.037 times less likely to report having knowledge about food adulteration, controlling for other factors in the model, respectively, for perception that food adulteration causes health problems and practice about checking the label, brand name, and expiration date of the food product during shopping, respectively.

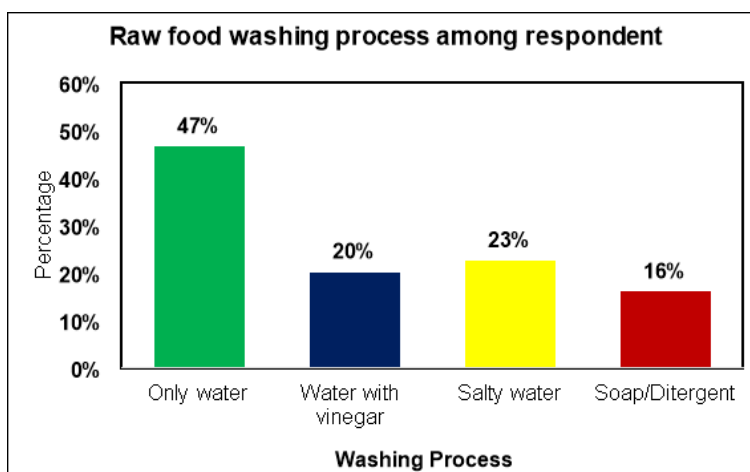


Fig 2: Raw food washing process among respondent

Above figure shows that, common practice about raw food washing process during covid-19 period. Maximum respondent used only water but surprisingly other practice was increased in this period. Though 47% respondent use

only water but 23%, 20% and 16% of respondent also use water with vinegar, salty water and soap/detergent mixed water respectively.

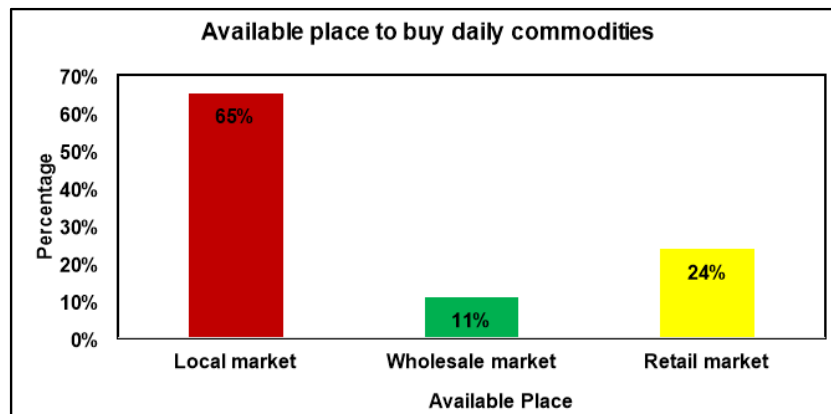


Fig 3: Available place to buy daily commodities

This figure demonstrated that, available market place that was situated near by respondent house. 65% respondent buy their daily commodities from local market and 24%, 11% respondent buy products from retail markets, wholesale market respectively.

Discussion

Food is an essential part of life and obviously it has impact on health. Food adulteration refers food got unsafe and unhygienic during food producing, storing, packaging, transforming, cooking, handling, serving and eating and this cause serious health problems like cholera, diarrhoea, cancer, asthma etc. So consumers and food producers both have to know about food adulteration, it's impact on health and process how to handling food to reduce food adulteration related health problem. This study assessed general people knowledge, attitude and practice on food adulteration and raw food washing process.

In case of knowledge about food adulteration, male respondents (76.9%) have the highest level of knowledge regarding food adulteration, compared to female respondents (69%). In perspective of age, the respondents between the ages of 15 and 30 have the highest percentage of knowledge regarding food adulteration (87%). According to educational status, respondents with higher secondary education account for 96% of the knowledge regarding food adulteration which have highest level. In case of occupation, the highest percentage of having knowledge about food adulteration has been found among students making up 88.5% of the total while the participants who don't work make up the lowest percentage (39.5%). In this study found statistically significant association between knowledge about food adulteration and demographic factors age, educational status and occupation. According to research from Dhaka city low-income people had low knowledge about food adulteration [14]. In our study found that 60.5% people did not had knowledge about food adulteration who were no work people.

Knowledge and perception about food adulteration problem among school children in Bangladesh in this study had shown participants knowledge on effect of consuming adulterated food on health and economy and perceptions regarding policies and responsibilities for food fraud issues and in this

study students' knowledge had found poor about food adulteration (Kohda & Haque, 2017). Our study was performed on general people which was about their knowledge, attitude and practice on food adulteration and raw food washing process during covid-19 in that study found participants knowledge was not so good about exact meaning of food adulteration and other knowledge was good, their attitudes was good on food adulteration but practice on food adulteration and raw food washing process is not good.

88.5% of males and 85.8% of females knew that food adulteration is bad; age group 15 years had 100% negative thinking about food contamination, age group 31–40 had bad consideration about this issue, which is 76.6%, moreover, the 15–30 age, 41–50 age, and >50 age groups have 98.3%, 82.4%, and 91.7% bad perceptions about food contamination, respectively. Educational status above HSC, 100% of them had bad thinking about food adulteration, other educational groups like primary, secondary, higher secondary and who don't complete schooling had 77.8%, 93.8%, 96.0% and 64.2% bad thoughts about food adulteration, respectively. In case of occupation, students, 100% of respondents thought that food adulteration is bad, remaining classes were employees, businessmen, no work and housewives who had 88.2%, 96.3%, 29% and 76.5% bad thoughts about food contamination, respectively. In research from Dhaka City found 95% of the respondents thought food adulteration is bad for health [14]. In our study found the association between respondent knowledge and perception about food adulteration where 96.8% people thought that food adulteration is bad who had knowledge about food adulteration.

In perspective of Gender, male (75.3%) was experienced of buying adulterated food more than female (72.3%). In case of Age, here percentage of buying adulterated food was high among 50 years old and above people (86.1%) and percentage was low among 31 to 40 years old people (60.7%). The highest percentage of buying adulterated food was found among people who were completed higher secondary (84.0%) and lowest was found among people who were completed primary in perspective educational status, percentage of buying adulterated food according to occupation student (85.2%); businessman (83.8%); employee (72.9%); housewife (66.2%) and no work (53.5%)

respectively. People experienced buying adulterated food which found in our study. In research from Volta Region of Ghana found that 50% of respondents who bought food product which were suspected as adulterated [17].

In our study found association between knowledge about food adulteration and practice of experienced of buying adulterated food was highly statistically significant and here 86.3% people experienced buying adulterated food who had knowledge about food adulteration. In research from Volta Region of Ghana found that 92.2% people did not buy product when they knew that product was adulterated [17].

Food Adulteration and Consumer Awareness in Dhaka City in that study they reviewed results of food sample and conduct a cross-sectional survey among consumers in 96 residents of Dhaka city where Stale or rotten food was the mentioned from of food adulteration by consumers; 85% know about law against food adulteration; 91.95% agreed on bad effect of food adulteration on health, 12% consumers checking labelling, 54.56% was used media as a source of information regarding food adulteration [13]. In research from Dhaka City found that while bought products 90% respondents checked the expiry date [14]. In our study found add preservative, add chemical in food, add unwanted substance, add poisonous substance in food and quality less food was mentioned from as food adulteration by participants; 98% agreed on bad effect of food adulteration on health and also found association between checking the label, brand name and expire date of the food product during shopping and practice of experienced of buying adulterated food among the respondent and 82.4% respondent experienced of buying adulterated food whose were checked the label, brand name and expire date of the food product during shopping.

Recommendation

- Further any study should be conducted food adulteration law in details.
- Food adulteration topic should add in primary level text book in easy way.
- Government and authorities should apply proper implementation of law strongly
- Encourage people to buy local and seasonal food
- Tag lines use in packet of food against food adulteration for advertising
- Should need awareness and health education in mass level

Conclusion

In Bangladesh food adulteration is still now one of the most common problems. During Covid-19 period it became more challenging to control food adulteration. To ensure food safety Bangladesh Government makes Food Safety Act, 2013 and latest law Food Recall Regulations, 2021. But laws are not enough to control food adulteration for this we have to know general peoples' situation in the matter of food adulteration. We have to know their knowledge, attitudes and practice about food adulteration before making proper law and policy against food adulteration. And also, to control food adulteration it is important to aware people about food adulteration. Mainly general people face the real situation of a country and so they know better limitation and challenging fact of a country in matter of food adulteration this is same. This is important to aware people about their rights so that they can protest when they noticed any unfairness activities

and can rise in their voice against them. By this we can reduce food adulteration because this is not only government responsibilities. During Covid-19 situation this pandemic is main priority to the responsible authorities so in this gap food adulteration situation would be uncontrolled. That is why general people would be more aware about food adulteration. In Covid-19 situation raw food washing is an important matter also. It is need to know how to people wash their raw food because it effects our health. If Government, authorities and general people all are conscious about food adulteration and try to control it then it will be possible to reduce food adulteration and we can ensure safe food to all.

Conflicts of interest: The authors declare no conflict of interest.

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