

Comparative Study of Lactose Intolerance in Rural and Urban Population in Bangladesh

*Bimal Chandra Shil¹, Madhusudan Saha², ASM Nazmul Islam³, ANM Saifullah⁴, Md. Shakhawat Hossain⁵, Imteaz Mahbub⁶, Md Mamun-Ur-Rashid⁷.

¹Dr. Bimal Chandra Shil, Associate Professor, Department of Gastroenterology, Sir Salimullah Medical College, Dhaka, Bangladesh. Email: bimalcshil@yahoo.com

²Dr. Madhusudan Saha, Professor, Department of Gastroenterology, North East Medical College, Sylhet, Bangladesh.

³Dr. ASM Nazmul Islam, Assistant Professor, Department of Gastroenterology, Shaheed M Monsur Ali Medical College, Sirajganj, Bangladesh.

⁴Dr. ANM Saifullah, Assistant Professor, Department of Gastroenterology, Sir Salimullah Medical College, Dhaka, Bangladesh.

⁵Dr. Md. Shakhawat Hossain, Assistant Registrar, Department of Gastroenterology, Rangpur Medical college Hospital, Rangpur, Bangladesh.

⁶Dr. Imteaz Mahbub, MD Resident (Phase-B), Department of Gastroenterology, Sir Salimullah Medical College, Dhaka, Bangladesh.

⁷Dr. Md. Mamun-urRashid, MD Resident (Phase-B), Department of Gastroenterology, Sir Salimullah Medical College, Dhaka, Bangladesh.

Corresponding Author: Bimal Chandra Shil

Abstract: Lactose intolerance is a common problem worldwide, especially in tropical areas. This study was carried out to see the comparison of prevalence of lactose intolerance and its symptom pattern in rural and urban areas. Fasting blood sugar and blood sugar after 30 minutes of intake of 25 gram lactose was measured in apparently healthy volunteers. Blood sugar level rise <1.1 mmol/l after 30 minutes was considered as positive lactose tolerance test. Specific symptoms like abdominal pain, diarrhea, vomiting, flatulence, nausea, headache, muscle pain and frequency of micturition were noted from the participants over 24 hour period. Among 133 participants, 57 were male and 76 were female with mean age of 31.17 ± 10.63 . Prevalence of lactose intolerance in urban, rural and total study population were 80.6%, 83.3% and 82.0% respectively. Male were slightly more lactose intolerant than female. Most significant symptom in overall population was borborygmi ($P=0.048$). In urban population the most significant symptoms were flatulence ($P=0.009$) and nausea ($P=0.017$), while in rural population it was borborygmi ($P=0.013$). Borborygmi ($P=0.005$), flatulence ($P=0.001$), diarrhea ($P=0.032$), nausea ($P=0.025$) and vomiting ($P=0.025$) shows good significance in regression analysis of overall study population. There is no significant difference in prevalence of lactose intolerance between urban and rural area. But there are differences in symptoms which develop after lactose intake in these two distinct groups.

Keywords: Lactose intolerance, lactose tolerance test, urban area, rural area.

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I. Introduction

In the adult population, lactose intolerance is a common problem throughout the world, especially in the tropics^{1,2,3}. To specify more, It is very common among African, Jews, Asian and Orientals^{4,5,6,7}. By definition, lactose intolerance or lactose malabsorption is a “ Physiologic problem and is attributable to an imbalance between the amount of ingested lactose and the capacity for lactase to hydrolyze the disaccharide”⁸. In subjects with lactose intolerance, undigested lactose is fermented by colonic flora causing diarrhea, abdominal pain and flatulence⁹. In subjects with lactose intolerance, the above stated symptoms depend on the amount of lactose intake. Surprisingly most of them can take up to 6-12 gram lactose (120-240 ml milk) without developing symptoms due to colonic adaptation to regular lactose intake^{10,11}.

Several methods exist for the diagnosis of lactose intolerance. The measurement of lactase activity in jejunal biopsies has been proposed as gold standard¹². However, this is much too aggressive test for the study of a mild condition, with results that may be influenced by irregular lactose activity distribution along the small bowel mucosa¹³. Among other noninvasive tests, lactose hydrogen breath Test is considered as the best test to

diagnose lactose intolerance¹⁴ while lactose tolerance test is simple, cheap and practiced with high sensitivity and specificity^{15,16,17,18}.

Milk ingestion is common in adult population of Bangladesh for its well known nutritious values¹⁹. A study conducted by Alam and associates in Dhaka reported 67.5% prevalence of lactose intolerance in patients with irritable bowel syndrome (IBS) diagnosed by ROME-II criteria²⁰. Another notable study visualized prevalence of lactose intolerance among Bangladeshi village children about 80% over 36 months of age but in none of the participated children were under age of six months²¹. Saha et al conducted another study and showed that, prevalence of lactose intolerance is 85.4% among adult population of Bangladesh²². There are certain differences in food and nutrient intake in rural and urban people²³. It may lead to differences in lactose digestion in those communities. But there is no adequate data regarding the prevalence and symptoms pattern of lactose intolerance among healthy adult in the developed urban area and less developed rural areas. This study was designed to identify the prevalence and symptom pattern of lactose intolerance in urban and rural adult healthy people.

II. Materials and Methods

This cross sectional study was conducted from April 2014 to October 2014. Apparently healthy individuals hailing from different districts of Bangladesh as companions or guardians of patients admitted in the gastroenterology department of Sir Salimullah Medical College Mitford Hospital, Dhaka were enrolled in this study irrespective of their age and sex. The participants were 133 in number.

Study Design: Descriptive type of cross sectional study

Study Location: This was a tertiary care teaching hospital based study done in Department of Gastroenterology, at Sir Salimullah Medical College Mitford Hospital, Dhaka, Bangladesh.

Study Duration: April 2014 to October 2014, over 07 months period.

Sample size: 133 healthy individuals.

Subjects & selection method: Urban area is defined as the Dhaka metropolitan city and district towns. Rural area is defined as the other remaining parts of Bangladesh.

Inclusion criteria: Apparently healthy individuals hailing from different districts of Bangladesh as companions or guardians of patients admitted in the gastroenterology department of Sir Salimullah Medical College Mitford Hospital, Dhaka

Exclusion criteria:

- 1) Person having antibiotic within last 30 days,
- 2) Recent use of proton pump inhibitors (within 7 days),
- 3) Major abdominal surgery,
- 4) Suffering from irritable bowel syndrome,
- 5) Hyperthyroidism/ hypothyroidism and
- 6) Diabetes mellitus.

Procedure methodology: Consent was taken from each individual participants. The healthy volunteers underwent lactose tolerance test after being administered 25 gram lactose dissolved in 500ml water under fasting condition, with blood draws from a vein at baseline and 30 minutes to measure blood glucose using CareSens N blood glucose meter. The failure of blood glucose level to rise above 1.1 mmol/l from fasting level was considered abnormal irrespective of development of symptoms. The symptoms developed after lactose intake were recorded from the volunteers over 24 hours by direct inquiry or by telephone conversations.

Statistical Analysis: Statistical significance was set at $P < 0.05$. The statistical analysis was carried out with the SPSS 17.0 software (SPSS, Inc. USA). The Chi-squared test was utilized to analyze differences between proportions. Differences in the mean age of volunteers, positive and negative lactose tolerance test were compared by using the unpaired Student's 't' test. All sensitivity, specificity, predictive values and likelihood ratios were calculated by using the absence of the specific symptoms or the absence of any symptom as references.

III. Results

Apparently 133 healthy volunteers participated in this study. Among them 57 (42.9%) were male and 76 (47.1%) were female participants. Their age varied from 16 to 78 years with mean age of 31.17 ± 10.63 . Total number of urban participants were 67. Among them 54 were lactose intolerant. Among 66 rural participants, 55 were Lactose intolerant.

Table 1 shows the overall demographic picture of the study, irrespective of their residence (urban/ Rural), age and sex. Lactose intolerance was slightly higher in male participants 49 (86.0%) than female participants 60 (79.0%). The most common symptoms were borborygmi 51(46.78%) with good significance (0.048) followed by flatulence 47 (43.11%).

	Lactose Intolerant	Lactose tolerant	Total/ percentage	P value
Participants	109(82.0%)	24(18.0%)	133(100%)	0.209
Male	49(86.0%)	8(33.33%)	57(42.9%)	
Female	60(79.0%)	16(66.67%)	76(47.1%)	
Mean age	30.11±10.67	41.11±13.81	31.17±10.63	
Symptom pattern:				
Abdominal pain	51(41.68%)	11(45.83%)	62(46.62%)	0.557
Borborygmi	51(46.78%)	5(20.43%)	56(42.11%)	0.048
Flatulence	47(43.11%)	13(54.16%)	60(45.11%)	0.080
Diarrhea	17(15.59%)	3(12.5%)	20(15.04%)	0.508
Nausea	45(41.28%)	8(33.33%)	53(39.85%)	0.171
Vomiting	14(12.84%)	5(20.83%)	19(14.3%)	0.095
Headache	31(28.44%)	5(20.83%)	36(27.07%)	0.489
Muscle pain	21(19.26%)	8(33.33%)	29(21.80%)	0.239
Frequency of micturition	20(18.34%)	3(12.50%)	23(17.3%)	0.598
Total symptoms:				
None	30(26.79%)	3(14.29%)	33(24.81%)	None
1 symptoms	12(10.71%)	3(14.29%)	15(11.28%)	1 symptoms
2symptoms	14(12.5%)	5(23.81%)	19(14.29%)	2symptoms
3 symptoms	11(9.82%)	5(23.81%)	16(12.03%)	3 symptoms
4 symptoms	17(15.18%)	5(23.81%)	22(16.54%)	4 symptoms
5 symptoms	12(10.71%)	0(00.00%)	12(9.02%)	5 symptoms
6 symptoms	8(7.14%)	0(00.00%)	8(6.01%)	6 symptoms
7 symptoms	8(7.14%)	0(00.00%)	8(6.01%)	7 symptoms
8 symptoms	0(00.00%)	0(00.00%)	0(00.00%)	8 symptoms
9 symptoms	0(00.00%)	0(00.00%)	0(00.00%)	9 symptoms

Table 1: Demographic features of total study population

Table 2 shows demographic features urban population where Male 22 (88.0%) are more lactose intolerant than female 32 (76.2%) and nausea is the most common symptom 28(51.9%). Flatulence (0.009) and nausea (0.017) showed good significance.

	Lactose Intolerant	Lactose Tolerant	Total /Percentage	P value
Participants	54(80.6%)	13(19.4%)	67(100%)	0.196
Male	22(88.0%)	3(23.07%)	25(37.31%)	
Female	32(76.2%)	10(76.93%)	42(62.7%)	
Mean age	29.13±8.033	47.4±14.11	31.25±10.7	
Symptom pattern				
Abdominal pain	26(48.15%)	5(38.5%)	31(46.3%)	0.377
Borborygmi	23(42.6%)	5(38.5%)	28(41.8%)	0.521
Flatulence	24(44.44%)	11(84.6%)	35(52.23%)	0.009
Diarrhea	11(20.37%)	1(7.7%)	12(17.9%)	0.265
Nausea	28(51.9%)	2(15.4%)	30(44.8%)	0.017
Vomiting	12(22.22%)	1(7.7%)	13(19.4%)	0.219
Headache	12(22.22%)	1(7.7%)	13(19.4%)	0.219
Muscle pain	9(16.67%)	2(15.4%)	11(16.4%)	0.639
Frequency of micturition	7(13.0%)	1(7.7%)	8(11.9%)	0.539

Table 2: Demographic features of urban study population

Table 3 shows demographic features of rural population, where male 27 (84.40%) are more lactose intolerant than female 28(82.40%) and borborygmi is the most common symptom 23 (49.09%). Borborygmi (0.013) showed good significance.

	Lactose Intolerant	Lactose Tolerant	Total/ percentage	P value
Participants	55(83.3%)	11(16.7%)	66(100%)	0.544
Male	27(84.4%)	5(45.46%)	32(48.5%)	
Female	28(82.4%)	6(54.54%)	34(51.5%)	
Mean age	30.87±10.96	33.25±4.66	31.09±10.56	
Symptom pattern				
Abdominal pain	25(45.45%)	6(54.54%)	31(47.0%)	0.411
Borborygmi	27(49.09%)	1(9.09%)	28(42.42%)	0.013

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Flatulence	22(40.0%)	3(27.27%)	25(37.9%)	0.411
Diarrhea	5(9.09%)	3(27.27%)	8(12.12%)	0.122
Nausea	18(32.72%)	5(45.45%)	23(34.84%)	0.316
Vomiting	1(2.0%)	5(45.45%)	6(9.09%)	0.000
Headache	17(30.90%)	6(54.54%)	23(34.84%)	0.125
Muscle pain	13(23.6%)	5(45.45%)	18(27.3%)	0.134
Frequency of micturition	12(21.8%)	3(27.27%)	15(22.73%)	0.480

Table 3: Demographic features of rural study population

Table 4 shows sensitivity, specificity and predictive values for overall study populations. Borborygmi has the highest sensitivity with 46.78 % and highest positive predictive value of 91.07%.

Symptoms	Sensitivity	Specificity	PPV	NPV	PLR	NLR
Abdominal pain	46.78%	54.16%	82.23%	18.3%	1.02	0.98
Borborygmi	46.78%	79.16%	91.07%	24.67%	2.24	0.67
Flatulence	43.11%	45.83%	78.33%	15.06%	0.80	1.24
Diarrhea	15.59%	87.5%	85.0%	18.58%	1.25	0.96
Nausea	41.28%	66.67%	84.9%	20.0%	1.24	0.88
Vomiting	12.84%	79.16%	73.68%	16.67%	0.61	1.10
Headache	28.44%	79.16%	86.11%	19.59%	1.36	0.90
Muscle pain	19.26%	66.67%	72.4%	15.38%	0.58	1.21
Frequency of micturition	18.34%	87.5%	86.9%	16.15%	1.47	0.93

Table 4: Sensitivity, Specificity, PPV and NPV of major symptoms after lactose intake in overall study population

Table 5 shows sensitivity, specificity and predictive values for rural study populations. Diarrhea has the highest sensitivity with 59.09 % and borborygmi has the highest positive predictive value of 96.40%.

Symptoms	Sensitivity	Specificity	PPV	NPV	PLR	NLR
Abdominal pain	45.45%	45.46%	80.6%	14.28%	0.83	1.2
Borborygmi	49.09%	90.91%	96.4%	26.32%	5.4	0.56
Flatulence	22.4%	72.73%	88.0%	19.5%	0.82	1.06
Diarrhea	59.09%	72.73%	62.5%	13.8%	2.17	0.56
Nausea	32.72%	54.55%	78.3%	14.0%	0.72	1.23
Vomiting	2.0%	54.55%	16.67%	10.0%	0.04	1.80
Headache	30.90%	45.46%	73.91%	11.63%	0.57	1.52
Muscle pain	23.60%	54.55%	72.22%	12.5%	0.52	1.40
Frequency of micturition	21.8%	72.73%	80.0%	15.7%	0.80	1.07

Table 5: Sensitivity, Specificity, PPV and NPV of major symptoms after lactose intake in rural study population

Table 6 shows sensitivity, specificity and predictive values for urban study populations. Nausea has the highest sensitivity with 51.9 % and has the highest positive predictive value of 93.33%.

Symptoms	Sensitivity	Specificity	PPV	NPV	PLR	NLR
Abdominal pain	48.15%	61.50%	83.9%	22.22%	1.25	0.84
Borborygmi	42.6%	61.50%	82.14%	20.51%	1.11	0.93
Flatulence	44.44%	15.4%	68.6%	6.25%	0.53	3.60
Diarrhea	20.37%	92.3%	91.67%	21.81%	2.65	0.86
Nausea	51.9%	84.6%	93.33%	29.73%	3.37	0.57
Vomiting	22.22%	92.3%	92.3%	22.22%	2.89	0.84
Headache	22.22%	92.3%	92.3%	22.22%	2.89	0.84
Muscle pain	16.67%	84.6%	81.81%	19.64%	1.08	0.98
Frequency of micturition	13.0%	92.3%	87.5%	20.34%	1.69	0.94

Table 6: Sensitivity, Specificity, PPV and NPV of major symptoms after lactose intake in rural study population

Table 7 shows regression analysis of overall study population. It reveals that borborygmi was the most common (OR 5.656) with good significance (0.005).

	Crude OR B	SIGNIFICANCE (P)	OR Exp(B)	95% C.I for OR	
				Lower	Upper
Abdominal pain	1.663	1.900	05.275	0.438	63.563
Borborygmi	5.656	0.005	285.886	5.713	14306.115
Flatulence	-8.243	0.001	000.000	0.000	0.032
Diarrhoea	3.947	0.032	51.780	1.392	1926.293
nausea	4.836	0.025	125.942	1.821	8708.663
Vomiting	-4.513	0.025	0.011	0.000	0.569
Headache	-1.025	0.556	0.359	0.012	10.844
Muscle pain	-3.378	0.088	0.034	0.001	1.647
Frequency of micturition	-1.691	0.284	00.184	0.008	4.053

Table 7: Association of major symptoms with lactose intolerant participants

IV. Discussion

Lactose intolerance in adult population is a genetically designed disorder of decreased lactase level. It is found that, about 70% of the whole world population has been found to be suffering from primary lactase deficiency²⁴. Symptoms of lactose intolerance which are frequently found are abdominal pain, flatulence and diarrhea⁹. Severity of these symptoms depends upon age²⁵, ethnicity²⁶, degree of lactase deficiency²⁷, amount of lactose ingestion^{10,11}, gastrointestinal transit time⁹.

Our study demonstrated prevalence of lactose intolerance is high in overall population and almost same in both urban and rural areas. The test was done with 25 gram lactose load which revealed the prevalence of lactose intolerance 82.0% superiority of 25 gram lactose load over 50 gram lactose load¹⁸. The distribution of lactose intolerance was 80.6 % in urban and 83.3% in rural area. If we look upon the data available regarding lactose intolerance in Asia, we find, it is between 60-70% and 20-30% in Southern and Northern part of India²⁸ respectively which is quite low than our study. But our results resemble the data regarding lactose intolerance in Malays (88%), Chinese (91%), Indians (83%) residing in Malaysia²⁹ and previous study of Bangladesh (82.5%)³⁰. It was also found that, male participants are slightly more intolerant than female participants in overall, urban and rural population.

In our study, common symptoms which were experienced among the participants were borborygmi (46.78%), flatulence (43.11%), abdominal pain (41.68%), nausea (41.28%), and headache (28.44%) which is quite similar to the study data of Saha and associates²². But there are differences of symptoms in urban and rural settings. In urban areas, main symptom was nausea (51.9%) and rest of the common symptoms were abdominal pain (48.15%), flatulence (44.44%) and borborygmi (42.6%). But in rural people, most common symptoms were abdominal pain (45.45%), flatulence (40.0%), nausea (32.72%) and headache (30.90%). Beyerlein³¹ reported that, among the symptoms bloating is the most sensitive symptom (70%) and diarrhea as the most specific symptom following oral lactose load in lactose intolerance. Our study showed the same as borborygmi (46.78%) was the most sensitive symptom and diarrhea (87.5%) was the most specific symptom in total population. In urban population nausea (51.9%) and abdominal pain (48.15%) had reasonable sensitivity. In contrast, in rural setting diarrhea (59.09%) and borborygmi (49.09%) high sensitivity. In urban population, diarrhea and vomiting (both 92.3%) had high specificity. But in rural population borborygmi (90.91%) and flatulence (72.73%) had high specificity. All these symptoms had high (> 85%) PPV. Regression analysis of overall study population showed borborygmi (0.005), flatulence (0.001), diarrhea (0.032), nausea (0.025) and vomiting (0.025) had good significance though neither of the symptoms were found to be significant in previous studies of lactose intolerance conducted by Saha et al^{22,30}.

Study report from Beyerlein³¹ revealed 80% subjects developing 5 symptoms after lactose ingestion had lactose intolerance and it was found to be increasing in proportion with increasing symptoms. The same thing was found in our study. Lactose intolerance prevalence was found to be 100% among participants having 7 symptoms.

There were some limitations in this study. Genetic testing or measurement of lactase activity in jejunal biopsies were not possible due to absence of proper facility. Moreover, lactose hydrogen breath test which is the most wide spread approach³² was not used due to lack of facility in the study site. It can easily be assumed that the results could be much higher if several methods could be applied. But with all the limitations this study revealed some similar and contrasting features of lactose intolerance in urban and rural setting which will pave easier ways for our physicians for further management.

V. Conclusion

Lactose intolerance has no difference in prevalence between urban and rural community and it is very common in all over Bangladesh. Though there is not much difference in prevalence; there are certain variations in symptoms of lactose intolerance between urban and rural people. While nausea and abdominal pain are the common symptoms in urban people; borborygmi is the main symptom in rural people after exposure to lactose.

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