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Physiology

Prevalence of Lactose Intolerance in Healthy Medical Students

Dr. P. Kiranmayi[1], Dr. Y. Radha Krishna, MD; DM[2*], Dr. M. Padma Geetanjali[3]

[1]Assistant Professor, Department of Physiology, GITAM Institute of Medical Sciences, Rushikonda, Visakhapatnam, Andhra Pradesh 530045, India
[2]Assistant Professor, Department of Medicine, GITAM Institute of Medical Sciences, Rushikonda, Visakhapatnam, Andhra Pradesh 530045, India
[3]Professor, Department of Physiology, Andhra Medical College, Medical College Road Opp Collector Office Maharanipeta King George Hospital Campus, Andhra Pradesh 530002, India

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***Corresponding author:** Dr. Y. Radha Krishna

Abstract **Original Research Article**

The aim of this study is to analyse the prevalence of lactose intolerance in healthy subjects of Andhra Pradesh a south eastern state in India. Hydrogen Breath tests are currently used to diagnose Lactose Intolerance. We have enrolled 100 healthy medial students in Andhra Medical College, Visakhapatnam. Fifty eight were males and Fourty two were females, age range was between 17 years to 21 years. These students were subjected to Lactose Hydrogen Breath Test (Gastrolyzer UK Bedfont Hydrogen Breath Analayser) using 25 gm lactose. The subjects are instructed to come in the fasting state and Baseline readings of three breath samples were noted and later 25 gm lactose was administered , six breath samples were recorded at 20 ,40,60,80,100 and 120 minutes. A rise of 20 ppm above baseline was taken as positive hydrogen breath test. Abdominal Symptoms like pain, discomfort, bloating and diarrhoea after lactose ingestion was also noted. Appropriate measures like overnight fasting were ensured and subjects with any ailments or antibiotics were excluded. Fourty two (42 percent) were positive, that is lactose intolerant and Fifty eight (58 percent) were negative, i.e. lactose tolerant. Twelve subjects had crampy abdominal pain and four had bloating post lactose ingestion all of them were lactose intolerant. The degree of Indo-Aryan migration and intermixing with the native population is the possible cause of this dissimilarity in prevalence.

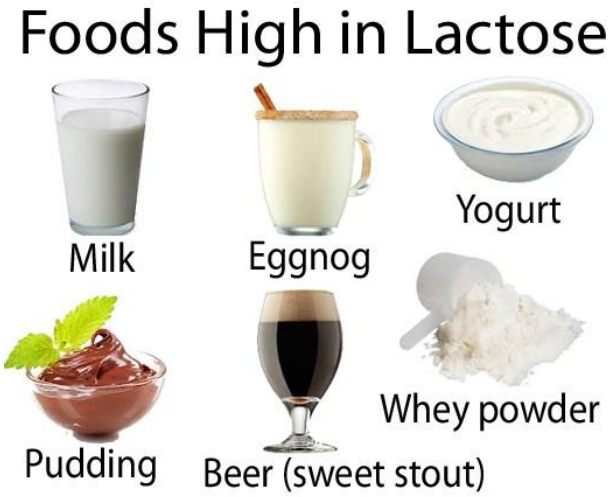
Keywords: Lactose Intolerance, Hydrogen Breath test, Bloating, Diarrhoea.

INTRODUCTION

Lactose intolerance is very common in Indian population, however there has been a wide variation of prevalence among north Indians and south Indians ranging from 27.4 percent to 66.6 percent [6].

Lactose intolerance or mal absorption is the inability to breakdown lactose because of reduced concentration of enzyme lactase. Thus lactose intolerance is not a disease rather than a normal physiological phenomenon as the infant's capacity to digest lactose is not retained into adult [7].

Lactose intolerance has been implicated for many common gastro intestinal ailments like indigestion, bloating, gas and diarrhoea Hydrogen Breath tests and lactose tolerance tests are currently used tests to diagnose Lactose Intolerance [11].



Prevalence of Lactose Intolerance across the World

Physiology of Lactose digestion in Gut

Lactose (□-D-galactopyranosyl-(1□4)-D-glucose) found exclusively in milk and some milk products, and is the principle carbohydrate of all mammalian milks, of which human milk contains the highest concentration (70 g/L). Cows' milk and products immediately derived from it (such as yoghurt) are major potential sources of lactose [16].

The lactase enzyme is located in the brush border (microvilli) of the small intestine enterocyte. The enzyme splits and hydrolyzes dietary lactose into glucose and galactose for transport across the cell membrane. The enzyme activity and the transit time of lactose through the jejunum mucosa are important for proper absorption [16].

Lactose intolerance occurs as a result of a loss of the capacity of the enterocytes of the duodenum to hydrolyse lactose to its constituent monosaccharides (glucose and galactose) after weaning, as a result of programmed absence of the enzyme lactose phlorizin hydrolase (LPH) on the mucosal surface of these enterocytes. (The equivalent bacterial enzyme to LPH is sometimes called "lactase", but is more usually known as "□-galactosidase") [6].

LPH in normal human neonates appears very late in fetal life. At 23 weeks gestation the LPH activity in the proximal jejunum is about 10% of that of a neonate and rises to 30% between 26 and 34 weeks gestation.

In lactose intolerant human subjects (by far the majority of the World's population), LPH activity decreases progressively after weaning, becoming very low by five years of age.

Thus most humans have negligible LPH levels by the time they reach adulthood. This loss of intestinal LPH activity is genetically programmed [27]. It is irreversible, as subsequent consumption of lactose will not re-induce LPH in the human intestine.However, there is a minority of humans (the so-called "lactase persisters" or "lactose tolerant" individuals) who maintain high levels of LPH throughout adult life [9]. Low LPH activity in the small intestine is the primary cause of lactose intolerance.

METHODS AND MATERIAL

Assessment of Lactose Intolerance

Mucosal biopsy of the duodenum followed by biochemical lactase assay to directly measure lactase activity is the criterion standard for diagnosing lactase insufficiency. Although this approach also may exclude other causes of secondary lactose malabsorption, utility is limited due to the invasiveness of the procedure and the patchy expression of lactase in the duodenum [13].

Several methods are available to assess lactose tolerance and intolerance in adults. Each one of these alternatives has its advantages and drawbacks.

Direct Assessment

Direct assessment of LPH enzyme activity can be performed on tissue obtained from a small intestinal biopsy. This test is the so-called "gold standard" method for determining lactose tolerance or intolerance.

However, the process is highly invasive as it requires an upper gastrointestinal endoscopy. Moreover, the LPH activity in a particular biopsy specimen is not necessarily representative of the general activity in that region of the small intestine, influencing the reliability of the test [11].

Lactose Hydrogen Breath Test

Hydrogen breath tests are specific and sensitive diagnostic tests that can be used to either confirm or eliminate the possibility of carbohydrate malabsorption or SIBO.

After the ingestion of lactose, the un absorbable disaccharide is hydrolysed into the monosaccharides glucose and galactose, that are absorbed.

If the lactase enzyme activity is inadequate, the unabsorbed lactose will reach the large intestine, where the gut flora ferments the sugar molecules into short-chain fatty acids, carbon dioxide (CO2), hydrogen (H2), and methane (CH4). Thus released co2 is assed in breath.

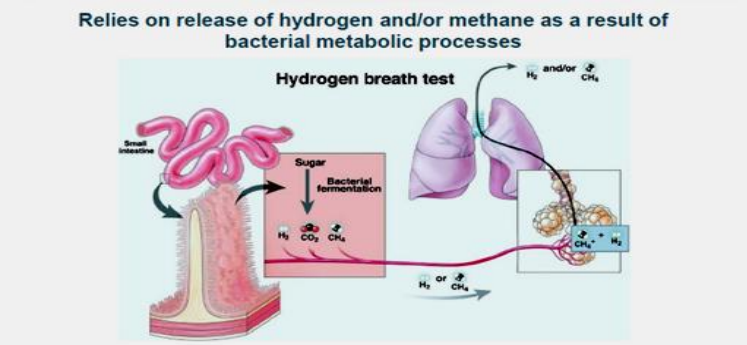
Hydrogen breath tests are specific and sensitive diagnostic tests that can be used to either confirm or eliminate the possibility of carbohydrate malabsorption or SIBO. Glucose hydrogen breath test is

more acceptable for diagnosis of SIBO whereas lactose and fructose hydrogen breath tests are used for detection of lactose and fructose maldigestion respectively. Lactulose hydrogen breath test is also used widely to measure the orocecal transit time for GI motility. These methods are noninvasive and inexpensive.

Hydrogen Breath Test Technique

Gastrolyzer UK Bedfont
Hydrogen Breath Analayser

Hydrogen Breath Test principal



The prevalence of lactose intolerance in the general population of North coastal Andhra is not known. Therefore, sample size was calculated according to established formula,

Sample size, $n = (Z_{1-\alpha})^2\{P(1-P)/d^2\}$

Where a) $Z_{1-\alpha} = Z_{0.95} = 1.96$, b) Anticipated population proportion
P = 50% and c) d = (absolute precision, 40-60%) = 10 percentage points = 0.1.
For P 0.50 and d 0.10, a sample size of 96 would be needed.

We included 100 subjects in the study and expected that would be sufficient to find out the prevalence of lactose intolerance in our community.

Statistical analysis was done using SPSS 16 version with significance level set at ≤0.05. The chi-squared test was utilized to analyze differences between proportions. Differences in the mean age of patients with positive and negative breath test were compared by using the unpaired Student's 't' test. Correlations between variables were quantified by calculating the Spearman rank correlation coefficients. The significance level of all statistical analyses was set at alpha = 0.05. All sensitivity, specificity, predictive values and likelihood ratios (LR) were calculated by using the absence of the specific symptom or the absence of any symptom as reference (=test negative).

We have enrolled 100 healthy medial students in Andhra Medical College, Visakhapatnam in north coastal Andhra Pradesh in the month of June 2016.

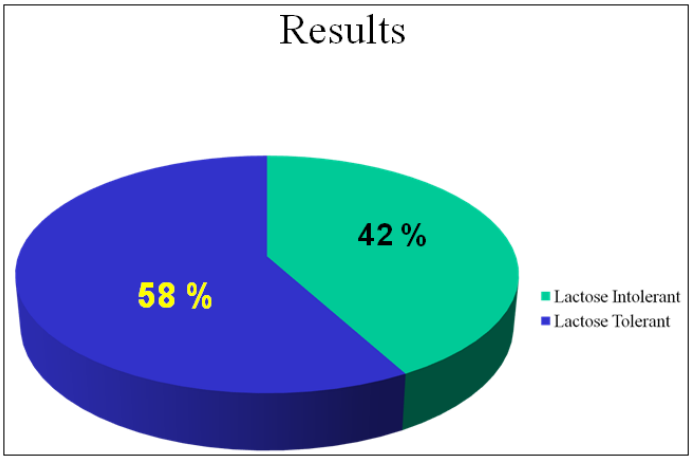
Informed consent was taken from the participants. These students were subjected to Lactose Hydrogen Breath Test using 25 gm lactose. Gastrolyzer UK Bedfont Hydrogen Breath Analayser was used. Baseline three breath samples were noted and later 25 gm lactose was administered , six breath samples were recorded at 20 ,40,60,80,100 and 120 minutes.

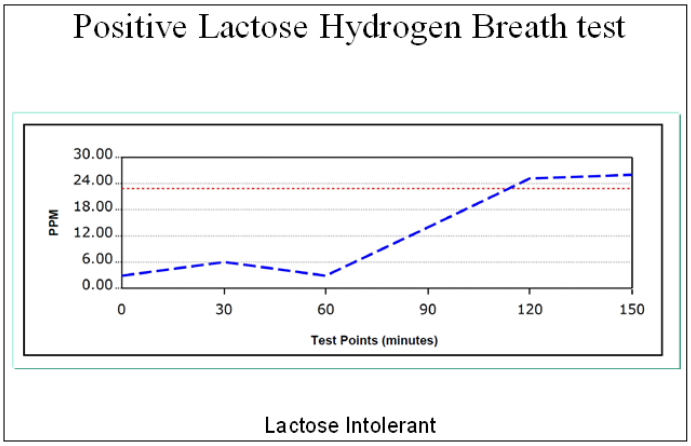
A rise of 20 ppm above baseline was taken as positive hydrogen breath test. Abdominal Symptoms like pain, discomfort, bloating and diarrhoea after lactose ingestion was also noted. Appropriate measures like overnight fasting were ensured and subjects with any ailments or antibiotics were excluded.

RESULTS

Fifty eight were males and 42 were females, age range was between 17 years to 21 years. Fourty two (42 percent) were positive, that is lactose intolerant and Fifty eight (58 percent) were negative, i.e. lactose tolerant. Sixteen subjects had crampy abdominal pain and two had bloating post lactose ingestion all of them were lactose intolerant.

Among 42 subjects who are Lactose intolerant 17 subjects had Constipation.



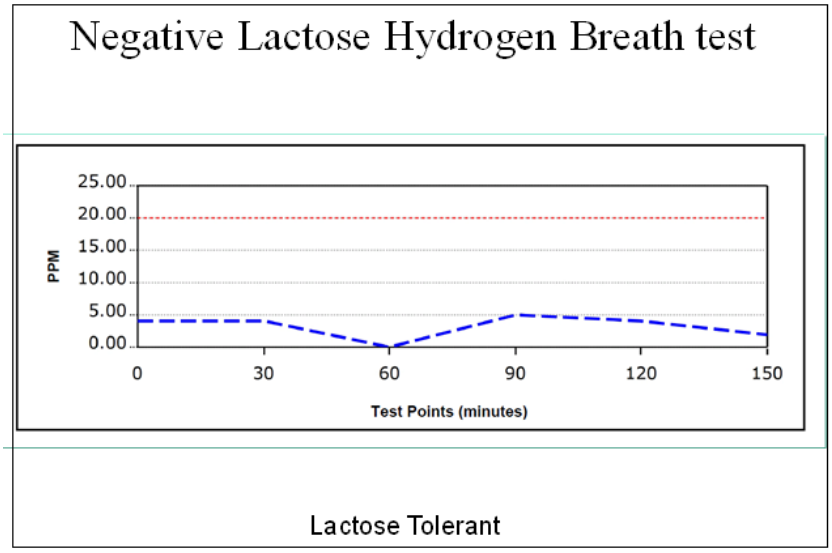


Positive Lactose Hydrogen Breathe test:
Recordings
Base line recordings: Before Lactose ingestion, in fasting.

7.00 AM : 5 PPM
7.15AM : 6 PPM
7.30AM : 6 PPM

After lactose ingestion:

7.50AM : 2 PPM
8.10AM : 25 PPM
8.30AM : 36 PPM
8.50AM : 50 PPM
9.10AM : 46 PPM
9.30AM : 51 PPM



Negative Lactose Hydrogen Breathe test Recordings

Base line recordings: Before Lactose ingestion, in fasting

7.00 AM : 19 PPM
7.15AM : 15 PPM
7.30AM : 18 PPM

After lactose ingestion:

7.50AM : 13 PPM
8.10AM : 17 PPM
8.30AM : 14 PPM
8.50AM : 18 PPM
9.10AM : 14 PPM
9.30AM : 15 PPM

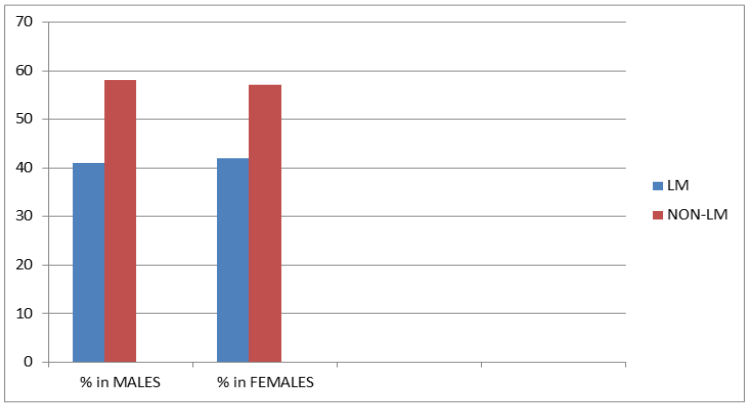
A total of 42(42%) subjects were found to be lactose malabsorbers (LM). Lactose intolerance was found to be equally prevalent in both sexes (male = 58, 24% and female = 42, 18%, P=0.656) Commonest symptoms experienced by the lactose malabsorber participants of this study was diarrhea 30(30%).

Other common symptoms were abdominal pain and flatulence experienced by 26 and 25 persons respectively. The sensitivity, specificity of individual symptoms are presented. Diarrhea has the highest sensitivity (66.0%) and a positive predictive value of 86.9%. Regression analysis showed among the symptoms, borborygmi and Diarrhea were mostly associated with LM (OR 1.957 & 1.872).

Any symptoms did not develop in 25(14.62%) patients during the monitoring period and among these 8(32%) had a negative lactose tolerance test. Lactose malabsorption prevalence was found to increase from subjects developing no symptom (68.0%) to subjects developing up to 3 symptoms (92.2%) following lactose load. Subjects developing 2 (16.7% vs. 41.8%, P=0.031) or 3 {2(6.7%) vs. 22(15.6%)} symptoms following lactose load mostly belonged to LM group.

Demographic distribution among Lactose Malabsorbers (LM) and Non Lactose Malabsorbers (NON-LM)

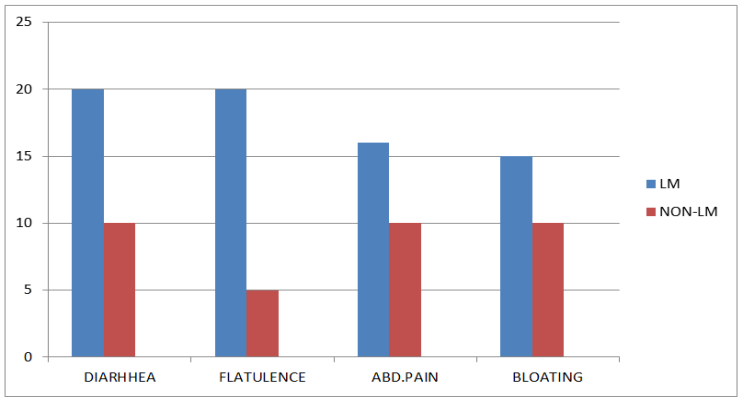
	LM NO (%)	NON-LM NO (%)	TOTAL (%)	P VALUE
Volunteers	42(42%)	58(58%)	100(100%)	
Male	24(41%)	34(58%)	58	0.656
Female	18(42%)	24(57%)	42	



Bar diagram showing prevalence of LM between Males and Females

Symptom Prevalence among LM and NON-LM

SYMPTOMS	LM	NON LM	TOTAL (%)	P VALUE
Diarrhea	20	10	30(30%)	0.69
Flatulence	20	5	25(25%)	0.65
Abdominal Pain	16	10	26(26%)	0.61
Bloating	15	10	25(25%)	0.62



Bar diagram showing incidence of symptoms in LM and NON LM

Association of Major Symptoms with Lactose Malabsorption

	Crude Odds Ratio	Significance(P)
Abdominal Pain	0.228	0.677
Borborygmi	0.672	0.118
Flatulence	0.310	0.568
Diarrhea	0.627	0.137

Sensitivity and Specificity of Major Symptoms after Lactose intake

Symptoms	Sensitivity	Specificity
Diarrhea	66%	53.3%
Borborygmi	56.7%	63.3%
Flatulence	22.7%	83.3%
Abdominal Pain	22%	83.3%
Nausea	5.0%	93.3%

DISSCUSSION

Lactose intolerance is a genetically programmed decrease of lactase level in adult. Reports from southern part of India [3] shows that its prevalence is between 60-70%, but it is lower (20-30%) in northern part of India. There is no cure to the lactose intolerance [27]. In our study the prevalence of lactose intolerance was 42%.Degree of Indo-Aryan migration and intermixing with the native population is the possible cause of this dissimilarity in prevalence [7].

A milk allergy is related to the proteins in milk rather than the lactose..Adult patients with lactose intolerance should maintain a calcium intake of 1,200 to 1,500 mg per day. Patients should consider drinking lactose-reduced milk or taking calcium supplements.Patient education is usually highly useful in patients with lactose intolerance. Patients with mild lactose malabsorption may benefit from using lactase enzyme supplements, such as Dairy Ease and enzyme supplementation should be an adjunct. Soya milk and rice milk are also well-tolerated[19]. Patients with

secondary lactose intolerance require further investigation to identify the primary problem. Effective treatment of the underlying condition, such as administration of metronidazole for treatment of giardiasis or a gluten-free diet for management of celiac disease, may not only ameliorate symptoms but also improve lactose intolerance.

Management

The goal of treatment is to improve symptoms while maintaining an adequate intake of calcium, thus preventing secondary bone disease caused by a milk-restricted diet. The main pharmacological measures in use include lactase supplements, lactose-hydrolyzed or lactose-reduced milk, probiotics, colonic adaptation, and rifaximin. Ingestion of probiotics containing lactase may have the potential to aid lactose digestion in intolerant patients, but studies that have investigated this have published conflicting results.

Therefore, the role of probiotics in lactose intolerance management is currently uncertain. Yoghurt containing live cultures providing endogenous beta galactosidase are an alternative source of calories and calcium, and are well tolerated by many lactose-intolerant patients. Well designed, randomized, placebo-controlled trials are still required before strong clinical recommendations can be made for the management of patients who are intolerant of lactose-hydrolyzed milk and yoghurt. Patients with bacterial overgrowth may benefit from antibiotics such as tetracycline, metronidazole, or ciprofloxacin.

CONCLUSION

In our study the prevalence of lactose intolerance was 42%, the degree of Indo-Aryan migration and intermixing with the native population is the possible cause of this dissimilarity in prevalence.

The lactose breath test, although considered the best method, may be influenced by confounding factors.

Patients developing two or more symptoms following lactose load are likely to have LM. Diarrhoea and borborygmi appeared to be the most prevalent symptoms among the lactose malabsorbers.

REFERENCES

1. Matthews SB, Wand JP, Roberts AG, Campbell AK. Systemic lactose intolerance: a new perspective on an old problem. Postgrad Med J. 2005;81:167-73.
2. Holzel A, Schwarz V, Sutchiffe KW. Defective lactose absorption causing malnutrition in infancy. Lancet. 1959;1:1126-8.
3. Durand P. Lactose intolerance (incapacity tohydrolyse lactose). Minerva Paediatr. 1960; 12:951-3.
4. Cox TM. Dissacharidase deficiency. In: Warrel DA, Cox TM, Firth JD, Benz EJ Jr. Eds. Oxford University Press. 2003; 503-7.
5. Chitkara DK, Scheick AM, Grand RJ. Disorder of epithelial transport in small intestine. In: Yamada T, Alpers DH, Kaplowitz N, Laine L, Owyang C, Powel DW. Eds. Textbook of Gastroenterology. 4th edn. London, Lippincott Williams & Wilkins. 2003; 1599-602.
6. Cook GC, Kajubi SK. Tribal incidence of lactase deficiency in Uganda. Lancet. 1966;1:725-9.
7. Gilat T, Kuhu R, Gelman E, Mizrahy O. Lactase deficiency in Jewish communities in Israel. Am J Dig Dis. 1979;15:895-904.
8. Davis AE, Bolin T. Lactose intolerance in Asians. Nature. 1967;216:1244-5.
9. Huang SS, Bayless TM. Milk and lactose intolerance in healthy orientals. Science. 1968;160:83-4.
10. Suarez F, Levitt M. Lactose malabsorption and diarrhea. Nutrition. 1997;13:53-4.
11. Hertzler SR, Savaiano DA. Colonic adaptation to daily lactose feeding in lactose maldigesters reduces lactose intolerance. Am J Clin Nutr. 1996;64:232-6.
12. Hertzler SR, Huynn VC, Savaiano DA. How much lactose is low lactose? J Am Diet Assoc. 1996;96:243-6.
13. Masud MA, Hasan M, Khan AK. Irritable bowel syndrome in rural community in Bangladesh: prevalence, symptoms pattern and health care seeking behavior. Am J Gastroenterol. 2001;96:1547-52.
14. Alam MM, Kabir MA, Saha M, Hasan M. Assessment of symptom based criteria (Rome II) for the diagnosis of irritable bowel syndrome. Bangladesh Journal of Medicine. 2004;15(1):5-8.
15. Baksha S. Lactose malabsorption in a population with irritable bowel syndrome prevalence, symptoms and effect of lactose restriction. MD thesis, Bangabandhu Sheikh Mujib Medical University, 2006.
16. Brown KH, Parry L, Khatun M, Ahmed G. Lactose malabsorption in Bangladeshi village children: relation with age, history of recent diarrhea, nutritional status, and breast feeding. The American journal of clinical nutrition. 1979 Sep 1;32(9):1962-9.
17. Vesa TH, Korpela RA Sahi T. Tolerance to small amounts of lactose in lactose maldigesters. Am J Clin Nutr. 1996;64:197-201.
18. Hovde O, Farup PG. A comparison of diagnostic tests for lactose malabsorption-which one is the best? BMC Gastroenterology. 2009;9:82.
19. Beyerlein L, Pohl D, Delco F, Stutz B, Fried M, Tutuian R. Correlation between symptoms developed after the oral ingestion of 50gm lactose and results of hydrogen breath testing for lactose intolerance. Aliment Pharmacol Ther. 2008;27:659-65.

20. Gupta D, Ghoshal UC, Mishra A, Choudhury G, Singh K. Lactose intolerance in patients with irritable bowel syndrome from northern India: a case control study. J Gastroenterol Hepatol. 2007;22:2261-5.
21. Lwanga SK, Lameshow S. Sample size determination in health studies. WHO. PPI-25. 1991. Available at: http://www.whqlibdoc. who.int/publications/9241544058 (p1-p22) pdf
22. Enck P, Whitehead WE. Lactase deficiency and lactose malabsorption. A review. Z Gastroenterol. 1986;24:125-34.
23. Rana SV, Bashin DK, Naik N, Subhiah M, Ravinder P. Lactose maldigestion in different age groups of north Indians. Trop Gastroenterol. 2004;25:18-20.
24. Zheng JJ, Gong ZL, Xue LS, Zhu XS, Luo JY. Lactose malabsorption and its ethnic differences in Hans and Uyghurs. Chin Med J (Engl). 1988;101:284-6.
25. Simon FJ. The geographic hypothesis and lactose malabsorption. A weighing of the evidence. Am J Dig Dis. 1978;23:963-80.
26. Paige DM, Bayless TM, Ferry GD, Graham GG. Lactose malabsorption and milk rejection in Negro children. John Hopkins Med J. 1971;129:163-9.
27. Sahi T. Genetics and epidemiology of adult type hypolactasia. Scand Journal Gastroenterol Suppl. 1994;202:7-20.
28. Babu J, Kumar S, Bahu P, Prasad JH, Ghoshal UC. Frequency of lactose malabsorption among healthy southern and northern Indian population by genetic analysis and lactose hydrogen and tolerance test. Am J Clin Nutr. 2010 Jan;91(1):140-6.
29. Peter MB. Lactose tolerance and intolerance in Malaysians. IeJ SME. 2012;6(Supple):S12-S23.
30. Drossman DA. Rome III: the functional Gastrointestinal disorders. Mclean, VA: Degnon Associates Inc, 2006.
31. Drossman DA, Camilleri M, Mayer EA, Whitehead WE. AGA technical review on irritable bowel syndrome. Gastroenterology. 2002;123:2108-31.
32. Dey UC. Epidemiology of irritable bowel syndrome in a rural community in Bangladesh. MD thesis Bangabandhu Sheikh Mujib Medical University, 2008.
33. Parveen I, Hasan M, Masud MA, Bhuiyan MM, Rahman MM. Irritable bowel syndrome in a Bangladeshi urban community: Prevalence and health care seeking pattern. Saudi Journal Gastroenterol. 2009;15:239-43.
34. Eswaran S, Tack J, Chey WD. Food: the forgotten factor in the irritable bowel syndrome. Gastroenterol Clin N Am. 2011;40:141-62.