

# Prevalence of Lactase Deficiency in Turkey

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**Summary:** In 1123 normal cases with ages ranged between 3 and 80 years, a lactose load of 1 g/Kg (with a max. of 50 g) was administered, then the hydrogen breath test was performed. A rise in breath hydrogen concentration of greater than 20 ppm over the base line values was accepted as the evidence of lactase deficiency. A lactulose load of 20 g was administered to 76 cases with lactase deficiency and 123 cases with lactase normal as diagnosed by the hydrogen breath test. An increase less than 20 ppm in breath hydrogen concentration over fasting level after the ingestion of 20 g lactulose was considered as low hydrogen production.

The prevalence of lactase deficiency was 31.4% in the age group of 3 to 6 (13.8% for 3 years old), 59% in the age group of 7 to 9 years, 71% in the age group of 10 to 12 years, 71% in the age group of 13 to 15 years, 75.4% in the age group of 16 to 18 years, 75.3% in the age group of 19 to 21 years, 84% in the age group of 22 to 80 years. In the breath tests carried out with lactulose, low hydrogen production was observed in 14.6% of lactase normal cases and 5% of lactase deficiency cases.

It was established that the lactase deficiency started at the age of 3 and was around 80% in adults. Since the hydrogen breath tests with the lactose load may produce some false negative results, it is necessary to determine the hydrogen production after lactulose loading. In case with lactase deficiency, the lactulose caused higher productions of hydrogen.

**Key Words:** Breath hydrogen tests (BHT); Lactase deficiency; Turkey

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Primary lactase deficiency is common throughout the world in adult population with 60-90 percent of American Indians, black Americans and Asians, Africans, Arabs, Israelis being deficient. In 5 to 15 percent of central and northern Europeans and their descendants world wide and some African, Arab tribes lactase activity remains high during their adulthood (1-6).

At birth, humans have abundant lactase activity in the small intestine, but lactase activity start to decrease at different ages in different ethnic groups. The majority of susceptible individuals develop lactase deficiency by adolescence (12). Determining in various ethnic groups is important in developing countries because of its nutritional implications.

Many investigators have shown that the breath hydrogen tests (BHT) after an oral lactose load is a simple, accurate, sensitive and non-invasive indirect test for detecting lactase deficiency in large populations (8).

Primary lactase deficiency occurs in 71.3-81% of Turkish adults (9,10). However, there is no data indicating at what age Turkish population starts to be lactase deficient. For these reasons we used the breath hydrogen test to determine the prevalence and age of on set of lactase deficiency in Turkish population.

## MATERIALS and METHODS

1123 normal subjects between the ages of 3 to 80, of which 613 were female and 510 male,

were included in this study. 16 other subjects who showed higher than 20 ppm H<sub>2</sub> concentration during fasting were excluded from the study.

The subjects were admitted from a kindergarten, two primary schools, two junior high schools, a nurse training college, a university, a medical school, a military garrison and relatives of subjects. The reason of this large selection of subjects was to bring together a population which would be approximately representative of all regions of Turkey and a large age spectrum.

An informed written consent was obtained from the subjects or their parents. All the subjects were seemingly healthy, had not taken any antibiotics recently, and had had no gastrointestinal disease.

The diet prior to test day was not controlled. The subjects were prohibited to eat, drink and smoke in the morning of the test day. All patients were requested to sit during the test in the clinic's library.

After the overnight fast, a lactose dose of 1 g/Kg (maximum 50g) was administered to each subject as a 10% solution in H<sub>2</sub>O. Breath samples were obtained before ingestion of lactose and every 30 min. for 3 hrs. A commercially available dual bag system was used for collection of the end expiratory air (Quintron Products). H<sub>2</sub> concentration in the samples was measured immediately by using H<sub>2</sub> chromatograph (Quintron clinical microlyzer). This instrument was standardized with a gas of known H<sub>2</sub> concentration (100 ppm). An increase in breath H<sub>2</sub> of more than 20 ppm over fasting level of breath H<sub>2</sub> was accepted as the evidence of lactase deficiency.

199 of the 1123 subjects were selected for a lactulose-H<sub>2</sub> Breath test. These subjects were between the ages of 3 to 60 years. 76 of them

were lactase deficient whereas the rest 123 of them were lactase normal. The hydrogen breath tests were performed by ingestion of 20g lactulose diluted with 250 ml tap water after an overnight fast. This lactulose-H<sub>2</sub> Breath test was carried out 1-2 weeks after lactose H<sub>2</sub> breath test, to find out the prevalence of low H<sub>2</sub> producers. An increase less than 20 ppm in breath H<sub>2</sub> concentration over fasting level was considered as low H<sub>2</sub> production.

Prior to the test, subjects were asked whether they were aware of having experienced abdominal discomfort, colicky pain, abdominal distention, flatulence or diarrhea after having drunk fresh milk. Subjects confirming the above stated discomforts were classified as milk intolerant. Also the subjects were asked to report the occurrence of abdominal pain, distention, flatulence, borborygmi and diarrhea during three hours after lactose administration. Subjects presenting one or more of these symptoms were considered lactose intolerant.

The weekly milk consumption of the subjects was calculated, based on the information obtained from the parents of the children, nursery officials and adults themselves.

Two statistical methods were used in our study. The paired comparison test and variance analysis were employed to assess the significance of different subject groups.

## RESULTS

Lactase deficiency according to Lactose-Breath H<sub>2</sub> tests: The results of this study is summarized in Table 1. The prevalence of lactase deficiency was 13.8% in 3 years, 30% in 4 years, 28.6% in 5 years and 63.2% in 6 years old children. The difference in the weights of the children in the same age group was not statistically significant ( $p > 0.001$ ). The rate of

**Table I:** Prevalence of Lactase Deficiency in Turkish Population in 1123 subjects.

Age group (years)	Number of Subjects	Lactase Deficiency number and (%)	Lactase normal number and (%)
3-6	88	28(31%)	61(68%)
7-9	237	140(59%)	97(41%)
10-12	230	163(71%)	67(29%)
13-15	97	69(71%)	28(29%)
16-18	118	89(75%)	29(24%)
19-21	166	125(75%)	41(24%)
22-80	186	156(84%)	30(16%)
Total	1123	770	353

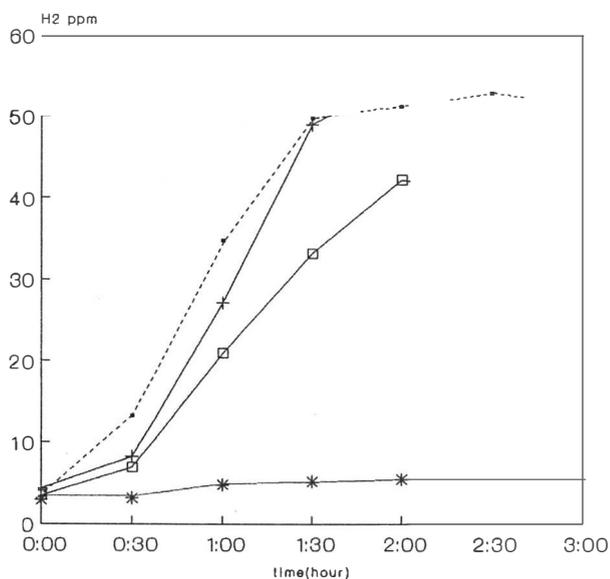
lactase deficiency increases steadily with age from 31.4% in 3-6 years age groups to 84% in 22-80 age groups, as illustrated in Table 1.

#### Prevalence of Low Hydrogen Producers:

18 of 123 lactase normal subjects (14.6%) and 4 of 76 lactase deficient subjects (5%) were found to be low hydrogen producers with lactulose H<sub>2</sub> Breath test. The low hydrogen production was not observed in 3-6 years age group.

The mean values  $\pm$  SEM of Breath H<sub>2</sub> for 105 lactase normal subjects and 72 lactase deficient subjects, who all (177) were normal hydrogen producers, were given a lactose load of 1 g/Kg (maximum 50g) and a lactulose load 20 g separately, are expressed graphically in Figure 1 and in Table 2.

In all 177 subjects, the difference between the mean fasting levels of BHT and the breath hydrogen levels after 30 min. following administration of lactulose were insignificant. However, this difference was statistically significant at 60 min ( $5p < 0.05$ ), 90,120,150, 180 min ( $p < 0.01$ ) after lactulose administration. Lactase normal-normal hydrogen producers subjects extracted significantly less breath H<sub>2</sub> than lactase deficient-normal hydrogen producers.



**Figure 1:** Breath hydrogen concentration in lactase normal and deficient subjects after loading with lactose 1 g/Kg (max. 50 g) and lactulose 20 g. as mean  $\pm$  SEM low producers excluded. Lactulose BHT in lactase normal subjects (n:105) (—□—). Lactulose-BHT in lactase deficient (n:72) (—■—). Lactose-BHT in lactase normal subjects (n:105) (—×—). Lactose-BHT in lactase deficient subjects (n:72) (—\*—)

#### Milk intake, prevalence of milk intolerance and incidence of lactose intolerance during the test:

The consumption of fresh milk in Turkey is very low. The weekly milk consumption is shown in Table 3. In the 3-to-6 year old group the weekly milk consumption in lactase normal group was observed to be higher than lactase deficient group. The difference between

**Table I I:** Lactase normal (n:105) and deficient (n:72) between 3-60 years old after giving Lactose 1g/kg (max.50g.) and lactulose 20 g. Breath hydrogen concentrations as mean  $\pm$  SEM. Low producers excluded.

Time (min.)	Lactase Deficient H <sub>2</sub> (ppm $\pm$ SEM)		Lactase Normal H <sub>2</sub> (ppm $\pm$ SEM)	
	Lactose	Lactulose	Lactose	Lactulose
0	3.33 $\pm$ 0.50	4.39 $\pm$ 0.58	2.95 $\pm$ 0.32	3.52 $\pm$ 0.42
30	13.24 $\pm$ 1.88	8.28 $\pm$ 0.92	3.16 $\pm$ 0.35	6.93 $\pm$ 0.82
60	34.67 $\pm$ 3.56	27.10 $\pm$ 2.73	4.83 $\pm$ 0.61	20.88 $\pm$ 1.82
90	49.71 $\pm$ 3.87	48.94 $\pm$ 3.55	5.22 $\pm$ 0.63	33.18 $\pm$ 2.50
120	51.28 $\pm$ 4.40	55.08 $\pm$ 3.64	5.46 $\pm$ 0.62	42.15 $\pm$ 2.77
150	52.79 $\pm$ 4.25	56.26 $\pm$ 4.02	5.60 $\pm$ 0.54	40.73 $\pm$ 2.50
180	51.25 $\pm$ 4.23	53.68 $\pm$ 3.88	5.63 $\pm$ 0.60	36.98 $\pm$ 2.20

these two groups is significant ( $p < 0.05$ ). Lactase normal subjects in the 7-to-80 year old group consumed more milk than lactase deficient subjects. The difference between those two groups is not significant.

On the other hand, in the 3-to-6 year old lactase normal group, the lactose intolerance during tests and the history of milk intolerance were not observed. But lactose intolerance gradually increases from 7 years of age onwards and reaches 56% in 22-80 years age groups.

In lactase deficient group, lactose intolerance increase gradually and reaches 82.1% in the 22 to 80 year-old group.

Awareness of milk intolerance was not frequent in lactase normal and deficient groups. All data about prevalence of milk intolerance and incidence of lactose intolerance during the test is given in Table 4.

## DISCUSSION

This study showed that lactase deficiency starts at an early age, with a prevalence of 13.79% in three years old, increasing to 63.16% in 6 years old and 71% in 10-12 years old which is almost the same rate is in the adults (75.4-84%).

**Table II I:** Weekly Milk Consumption (It/week) in 1123 subjects

Age group (years)	Lactase Deficient Group (in 770 subjects) It/week	Lactase Normal Group (in 353 subjects) It/week
3-6	1.51±0.22	2.25±0.80
7-9	0.79±0.10	0.74±0.08
10-12	0.47±0.04	0.65±0.10
13-15	0.36±0.05	0.36±0.10
16-18	0.28±0.05	0.42±0.10
19-21	0.63±0.11	0.64±0.15
22-80	0.54±0.07	0.62±0.19
7-80	0.54±0.03	0.62±0.05

In a previous lactase measurement study carried out in our clinic on a small group of adult subjects with Dahlquist method, lactase deficiency was found to be 81 percent (10).

The incidence of lactose intolerance during the test in the lactase deficient subjects as expressed by the subjects themselves is low in the 3-6 years age group (14.2%) and in the 7-9 years age group (17%), but after the age of 10 it reaches almost the same percentage as indicated by lactose H<sub>2</sub> breath test results.

The incidence of lactose intolerance in the lactase normal subjects as expressed by the subjects themselves is 13.4% in the age group of 7-9, 45% in the age group 10-12, and reaches 56.6% in the age group of 22-80. This data which indicates lactose intolerance during the test doesn't confirm lactase deficiency.

**Table IV:** Awareness of milk intolerance and incidence of lactose intolerance during Lactose loading

Age group (years)	Lactase Deficient (n:770)		Lactase Normal (n:353)	
	Milk Intolerance Reported (%)	Lactose Intolerance During Test(%)	Milk Intolerance Reported (%)	Lactose Intolerance During test(%)
3-6	7.1	14.2		
7-9	4.3	17.0	8.2	13.4
10-12	22.0	65.0	16.4	45.0
13-15	11.6	69.6	17.8	50.0
16-18	4.5	73.0	10.3	40.0
19-21	17.0	82.4	7.3	46.4
22-80	26.0	82.1	10.0	56.6

In the 3-6 lactase normal age group milk intolerance was not expressed. Awareness of milk intolerance was less frequent in lactase normal subjects in the 7-80 years age group, ranging between 8.2% -17.8%. However in the lactase deficient subjects the milk intolerance varied between 4.3%-26%. These low milk intolerance levels are due to very low fresh milk consumption in Turkish population. The milk consumption of subjects is shown in Table 3.

Turks who have historically high milk intolerance due to lactase deficiency, may have developed *yoğurt* which is more tolerable.

In the 3-6 years age group of lactase normal group, the weekly milk consumption was higher than the lactase deficient group. The above finding indicates that lactase normal subjects intake more milk because they have normal lactase levels, or more milk intake delays lactase deficiency.

In the breath H<sub>2</sub> tests carried out with lactulose, low hydrogen producers were observed in 14.6% of lactase normal group and 5% of lactase deficient group. The incidence of low H<sub>2</sub>

producers were not studied in lactase normal and deficient subjects by other researchers. Lactase normal and lactase deficient group were identified by using Lactose-BHT. The lactose-breath hydrogen test for detecting lactose deficiency gives no false positive results but may give negative results (6). False negative results might occur in subjects with inefficient colonic flora incapable of generating greater than 20 ppm of breath H<sub>2</sub> over fasting level. The reported incidence of low producers has varied from 0 to 21% (11,12).

14.6 percent of lactase normal subjects of this study producing low H<sub>2</sub>, may include some lactase deficient subjects. When the low producers are excluded from the study, it was found that lactase deficient subjects produced more H<sub>2</sub> after lactulose loading. The differences of hydrogen production between lactase normal group and lactase deficient group may reflect differences in colonic metabolism of lactulose.

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