

Lactose intolerance and associated factors in a population group in northeastern Brazil

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Abstract

INTRODUCTION: The prevalence of lactose intolerance (LI) is still unknown, especially in multi-ethnic populations.

AIM: Evaluate the prevalence of LI and its associated factors in a population in northeastern Brazil.

METHODS: Ninety-one students and staff at a public university, who were residents in the Northeast of Brazil and who were otherwise healthy and over 18 years of age, were selected for convenience. A hydrogen breath test (HBT) was performed at a dose of 25 grams lactose 10%, by collecting baseline sample fasted 12 hours, and consecutive samples 60, 90, 120, 150 and 180 minutes after administration of lactose. Increased hydrogen concentrations greater than 20 parts per million (ppm) of the basal sample was considered positive. HBT positive individuals, in the presence of at least one of the symptoms indicative of LI, were considered intolerant. The semi-structured questionnaire with information about demographics (gender, age and ethnicity), clinical (gastrointestinal complaints, LI self-perceived) and dietary (dietary restrictions and consumption of dairy products) was applied.

RESULTS: The prevalence of LI was 34.1% and was higher among those individuals who self-identified as black ($p = 0.005$). There was a poor correlation between self-perceived LI and diagnosed LI (Kappa index = 0.1615). Individuals with self-perceived LI, independent of diagnostic confirmation, had a lower intake of lactose compared with individuals without self-perceived LI ($p = 0.00$).

CONCLUSION: The prevalence of LI was significant and was associated with ethnicity, even in a multi-racial population. Understanding the actual number of individuals affected by LI can assist in the proper management of this syndrome.

Keywords: lactose intolerance, prevalence, dairy products.

1. INTRODUCTION

The lactose malabsorption (LM) is a common condition worldwide and can be defined as the inability to hydrolyze lactose, resulting in decreased activity of lactase or primary hypolactasia [1a]. It is estimated that 70% of the population have LM [2]. However, this condition is occasionally asymptomatic, which reduces their clinical importance.

Lactose intolerance (LI) has recently been defined as the development of gastrointestinal (GI) symptoms, such as pain, bloating, flatulence, intestinal noises, nausea, vomiting and diarrhea, following the ingestion of a lactose load in individuals with LM. Most people with LM have no clinical LI, and many individuals who think they have LI do not have LM [3]. The development of symptoms depends on the amount of lactose consumed, the colon microflora, individual sensitivity and subjective expectations. Thus, LI is not synonymous and cannot be confused with LM [4].

Discomforts GI reported by LI carriers often cause the reduction in the consumption of dairy products, which can result in nutrient deficiencies such as calcium, phosphorus, magnesium, riboflavin, vitamin D and protein, predisposing to serious public health problems, such as bone disease [5].

Although LI is an important clinical syndrome, its prevalence remains difficult to discern, as studies have varied in interpreting what symptoms comprise this condition [3]. Considering the new definition of LI, the present study aims to determine the prevalence of LI and its associated factors in a population in northeastern Brazil.

2. METHODS

Cross-sectional study conducted from December 2013 to January 2015, by a trained team of nursing students and nutritionists.

2.1 Population

The sample consisted of 91 students and staff at Federal University of Bahia, who were residents in the Northeast of Brazil and who were otherwise healthy and over 18 years of age, were selected for convenience.

We excluded pregnant women, individuals with diseases related to food allergy or intolerance (celiac disease, allergy to cow's milk protein) and bowel diseases (irritable bowel syndrome, inflammatory bowel disease, diverticular disease of the colon, hemorrhoidal disease) and diabetes mellitus, people in use of antibiotics, enemas, laxatives, probiotics and/or prebiotics in the month before the study, with previous bowel resection or patients with lung diseases.

2.2 Lactose malabsorption

All individuals included in the study underwent the breath hydrogen test (HBT) for the diagnosis of LM. The HBT was performed with hydrogen monitor of the Gastrolyzer® brand, at a dose of 25 grams of lactose at 10% (equivalent to 500 ml milk). The collection of baseline samples was taken after fasting for 12 hours, and consecutive samples of 60, 90, 120, 150 and 180 minutes after the administration of lactose. Participants were instructed on the preparation to perform the HBT: in the day before the examination not to eat fermentative diet with full restriction of lactose, no smoking or performing of physical exercises. An increase in hydrogen concentration greater than 20 parts per million (ppm) of the basal sample was considered positive [6].

2.3 Lactose intolerance

Those individuals with a positive result in HBT and that progressed with at least one of the indicative GI symptoms for LI (diarrhea, flatulence, intestinal noises, abdominal pain and / or abdominal distension, nausea and/or vomiting) during the examination performance were considered with diagnosed LI [7].

2.4 Dietary assessment

Following the LI evaluation, the participants completed a structured questionnaire on the consumption of dairy products and other products containing lactose, previous dietary counseling, use of dietary supplements (e.g., prebiotics and probiotics), dietary restriction of dairy products, and additional food intolerances.

The frequency of consumption of dairy products (foods and quantities), which was calculated in reference to the *United States Department of Agriculture* (USDA) standards, was used to evaluate daily lactose intake.

2.5 Demographic assessment

Demographic data were obtained from the data collection questionnaire and included gender, age and ethnicity. Race was defined by self-classification as proposed by the Brazilian Institute of Geography and Statistics (IBGE) [8] for the Brazilian population and included white, black, brown, yellow and indigenous.

2.6 Statistical analysis

The means and standard deviations for continuous variables and absolute and relative frequencies for discrete variables were estimated. The prevalence of LI in all strata of demographic variables was estimated. The association between the groups with and without LI was tested by X^2 and Fisher's exact tests and the

difference between the daily amounts of intake lactose (measured in grams) by the Student's t-test for independent samples. To check the correlation between self-perceived LI and diagnosed LI, the Kappa index was applied, assuming the criteria of Landis & Koch [9]. The level of significance in this study was 5%. Data were analyzed using the *Statistical Package for the Social Science* program (SPSS, Chicago, IL, USA, version 21.0, 1999).

2.7 Ethical aspects

The study protocol and the informed consent were approved by the Research Ethics Committee of the School of Nutrition at the Federal University of Bahia with number 495.567. All participants signed informed consents and were informed about the study objectives. The test results were given to the participants and those with confirmed diagnosis of LI received nutritional advice and were referred for specific medical and nutritional monitoring.

3. RESULTS

3.1 Characteristics of the sample

The majority of the sample was female (76.9%). Approximately 35.0% of participants were between 19-23 years of age, and the majority self-identified as mixed race (53.8%) (Table 1).

Table 1. Demographic characteristics of a population group in northeastern Brazil (n=91).

Characteristics	n (%)
Sex	
Male	21 (23.1)
Female	70 (76.9)
Age, years	
19 – 23	32 (35.2)
24 – 27	16 (17.6)
28 – 40	21 (23.1)
41 – 61	22 (24.2)
Race*	
White	13 (14.3)
Black	25 (27.5)

Brown	49 (53.8)
Yellow	04 (4.4)

n = number of observations in the sample.

* Self-reported race proposed by the Brazilian Institute of Geography and Statistics (IBGE) classification (2000).

3.2 Prevalence of lactose intolerance and lactose malabsorption

The prevalence of LI and LM was 34.1% and 48.4%, respectively (Table 2). Up to 70% of individuals with LM were

diagnosed with LI. The most common GI complaint during the examination was flatulence (49.5%), followed by abdominal distension (18.7%).

Table 2. Prevalence of lactose intolerance and lactose malabsorption in a population group in northeastern Brazil

	n	Prevalence (%)
Lactose malabsorption	44	48.4
Lactose intolerance	31	34.1

n = number of observations in the sample.

3.3 Lactose intolerance versus demographic characteristics

Males demonstrated a higher prevalence of LI (38.1%) compared with females (32.9%), but the difference was not statistically significant ($p < 0.05$). Similarly, the prevalence of LI was higher among individuals 24-27 years of age (50.0%) compared with other age groups,

but the difference was not statistically significant ($p < 0.05$). Individuals who declared themselves black had a higher prevalence of LI (56.0%) compared with other ethnic groups, with the exception of whites who were not intolerant, and the difference was statistically significant ($p = 0.005$) (Table 3).

Table 3. Prevalence of lactose intolerance versus secondary demographic characteristics of a population group in northeastern Brazil.

Characteristics	LACTOSE TOLERANCE			p value*
	Total n (%)	Tolerant n (%)	Intolerant n (%)	
Sex				
Female	70 (76.9)	47 (67.1)	23 (32.9)	0.657
Male	21 (23.1)	13 (61.9)	08 (38.1)	
Age, years				
19 – 23	32 (35.2)	22 (68.8)	10 (31.2)	0.522
24 – 27	16 (17.6)	08 (50.0)	08 (50.0)	
28 – 40	21 (23.1)	15 (71.4)	06 (28.6)	
41 – 61	22 (24.2)	15 (68.2)	07 (31.8)	
Race**				
White	13 (14.3)	13 (100.0)	0 (0.0)	0.005
Black	25 (27.5)	11 (44.0)	14 (56.0)	

Brown	49 (53.8)	34 (69.4)	15 (30.6)
Yellow	04 (4.4)	02 (50.0)	02 (50.0)

* statistical tests: Chi-square / Fisher exact - $p \leq 0.05$ (significant)

** Self-reported race proposed by the Brazilian Institute of Geography and Statistics (IBGE) classification (2000).

3.4 Diagnosed lactose intolerance versus self-perceived lactose intolerance

Only 35.5% of individuals who were diagnosed with LI reported a self-perception of LI after evaluation for

intolerance. The correlation between a LI diagnosis and self-perceived LI was considered poor and not statistically significant (Kappa index = 0.1615; p-value Kappa index = 0.1072) (Table 4).

Table 4. Concordance between individuals diagnosed with lactose intolerance and individuals with self-perception of lactose intolerance.

Lactose intolerance self-perceived	Lactose intolerance diagnosed		Total n (%)
	Yes n (%)	No n (%)	
Yes	11 (35.5)	12 (20.0)	23 (25.3)
No	20 (64.5)	48 (80.0)	68 (74.7)
Total n (%)	31 (34.1)	60 (65.9)	91 (100)

Kappa index = 0.1615; p-value Kappa Index = 0.1072.

3.5 Lactose intolerance versus lactose intake

Only 4.4% of the study population reported restricting milk consumption. The average intake of lactose was 10.8 ± 13.1 g/day.

The average consumption of lactose was lower among individuals who were diagnosed with LI (7.8 ± 8.3 g/day) compared with individuals with self-

perceived LI (12.4 ± 14.8 g/day), but the difference was not statistically significant ($p = 0.06$). Individuals with self-perceived LI, regardless of diagnostic confirmation, had a lower average intake of lactose (5.0 ± 5.4 g/day) compared with individuals who did not have self-perceived LI (12.8 ± 14.3 g/day), but the difference in consumption between the groups was not statistically significant ($p=0.00$) (Table 5).

Table 5. Lactose intake among individuals with second diagnosis of lactose intolerance and self-perceived lactose intolerance.

	Lactose intake (g) μ (SD*)	p-value **
Diagnosed LI		
Yes (n=31)	7.8 (8.3)	0.063
No (n=60)	12.4 (14.8)	
Self-perceived LI		

Yes (n=23)	5.0 (5.4)	0.000
No (n=68)	12.8 (14.3)	

n = number of observations in the sample.

** SD = Standard Deviation*

*** T-test for independent samples*

4. DISCUSSION

More than a one-third of the analyzed sample was diagnosed with LI. Among individuals with LM, the majority were diagnosed with LI. Despite its clinical relevance, the prevalence of LI in the world remains unknown [3]. This lack is because the available data differ in their definitions of LI and the choice of a diagnostic method. However, evidence suggests that ethnicity affects the frequency of this condition [2]. In populations of mixed ethnicity, such as in Brazil and even Northeastern Brazil, identifying the true prevalence of LI is not an easy task due to the intersection between people with high and low frequencies of this disorder.

The differences in the frequency of LI in different populations around the world are explained by genetic inheritance. In general, lower LM rates are found among Americans, Australians and people from Northern Europe, ranging from 5%-17%. In South America, Africa and Asia, more than 50% of the population can be characterized as lactase non-persistent. In some Asian countries, this rate reaches almost 100%. Researchers point to the fact that ethnic mixing favors a lower prevalence of lactase non-persistence, while in homogeneous groups the opposite occurs [2]

Similarly to LM, LI is directly related to ethnicity. In this study, LI was more frequent among those individuals who declared themselves black, consistent with another study in which the occurrence of LI varied among different ethnic groups, reaching approximately 75% among individuals with black ancestry [10]. In this sample, no individual who identified as white was diagnosed with LI. Previous studies that have sought to evaluate the

frequency of LI among Caucasians (whites), have found a lower frequency compared with other racial groups (Northern Asian and African ancestry), ranging from 36.4% to 47.5% [10,11].

In this study, it was not possible to determine the relationship between age and the development of LI. Other studies in the literature have not demonstrated a clear association. It is known that the decline in the expression of intestinal disaccharidase usually occurs during childhood, becoming more evident in adolescence [12,13]. Some studies have shown that higher concentrations of hydrogen and an increased incidence of LM are more common in older adults and elderly patients [14,15,16]. Only one study that aimed to evaluate the relationship between LI and age was found, and the association was only marginal [17].

Often women have stronger GI symptoms than men after a dose of 50 g of lactose, despite demonstrating lower levels of hydrogen excretion [18]. A study of 205 healthy adults that aimed to determine the factors affecting the LI state demonstrated that women had a higher risk of developing LI, suggesting that gender may be associated with the development of this disease [17]. In this study, males were more intolerant than females, but the small percentage of men in the sample hampered analysis of the actual association between gender and LI.

Self-perceived LI was frequent in this study, but there was a poor correlation between self-perceived LI and diagnosed LI. The association between diagnosed LI and self-perceived LI is poorly investigated. Casselas et al [19] evaluated 353 individuals who self-reported LI to investigate whether the GI symptoms reported after the intake of dairy products

at home were consistent with the symptoms reported after the oral administration of lactose (50 g). The researchers observed that the perception of symptoms was more frequent at home than in the controlled trial, and a complete symptom record is not sufficient to establish a diagnosis of LI. Thus, specific testing should be performed to confirm the diagnosis.

Self-perceived LI and diagnosed LI often entail a reduction in the intake of calcium and other nutrients caused by the exclusion of dairy products from the diet, with a consequent reduction in bone mineral density and an increased risk of fractures [20]. In this work, we found that, although few participants totally excluded dairy from the diet, the daily intake of lactose by those with LI was well below the minimum dose of lactose recommended, that is 12 to 15 g/day (equivalent to 240 mL of milk) [21]. In the case of those individuals who believed themselves to be intolerant independent of a diagnostic confirmation, lactose consumption was also lower than recommended for healthy individuals, resulting in an unnecessary health risk, as the LM for the most part was not the cause of the GI symptoms reported.

The main strengths of this study include the use of a differential definition between LM and LI, the adoption of a gold standard method for identifying LM, using a dose of lactose that reflects the normal ingestion during a single meal (25 g), the determination of the frequency of LI in a little-studied and heterogeneous population and the analysis of the distribution of the disease in different age groups, ethnic groups and between genders. However, this study has some limitations such as the sample size and the absence of a double-blind test to increase the specificity of the diagnosis of LI.

The prevalence of LI found in the sample was significant. Gender and age

were not associated with the development of LI; however, the data presented suggest that ethnicity may be associated with LI even in a multiracial population. Corroborating the literature, there was a discrepancy between self-perceived LI and diagnosed LI, suggesting that GI symptoms that are often attributed to causes such as LM may have other clinical conditions, and cannot therefore by themselves be used to determine LI. In this study, there was a low intake of lactose, and consequently of dairy products, by intolerant individuals as well as by those who reported self-perceived LI, which represents a possible health hazard. These findings demonstrate the need for health professionals to deepen their knowledge on this issue and to better understand the frequency and characteristics of patients with this disorder to consequently guide their patients in the proper management of diet, avoiding unnecessary dietary restrictions and reducing major health problems.

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