

# Lactose intolerance in Peruvian children: effect of age and early nutrition<sup>1</sup>

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Low levels of intestinal lactase activity are found in many otherwise healthy adults and children. Attention in recent years has focused on this problem in American Negroes (1-4), Asians (5-9), Bantu tribes (10), South American Indians (11), Thais (12-14), and other groups. Current evidence further indicates that low lactase levels are the norm in the majority of adults in most populations of the world (15).

Increasing consideration is being given to this problem in children and its implications for continued milk consumption (3, 12, 16). It has been suggested that continued milk intake is responsible for persistent enzyme activity (7). It is also possible that nutritional insults in early childhood may result in an inability to hydrolyze lactose (17).

We undertook a study of lactose intolerance in Peru to determine: 1) the prevalence of lactose malabsorption in Mestizo children; 2) the effect of a previous episode of marasmus or kwashiorkor; 3) the effect of being reared in a controlled environment, with an adequate milk-based diet; and 4) the influence of breast feeding and continued milk consumption.

## Materials and methods

### Subjects

Ninety impoverished Mestizo children ranging in age from 10 months to 17 years were studied: 48 males and 42 females with a mean age of 7.0 years. Eighty-three of the children were drawn from 13 families who have been under our care for as long as 10 years. The index case of each family was originally admitted because of marasmus or kwashiorkor (previously malnourished cases); there were 16 such cases and all tolerated exclusive milk diets during significant periods of their hospital stay. However, lactose tolerance tests were not carried out at that time. Even though their height was below the 3rd percentile at 2 years of age, most were between the 3rd and 10th percentile for height (Boston-Stuart Standards) (18)

at the time of the study. The oldest was discharged 8 years ago; the most recent, 1 year ago.

Twenty-two were well-nourished siblings. This group was made up of the next-born siblings of the malnourished index cases. They were raised in a protected environment for the first 18 to 27 months of life and then returned to their homes. During this initial period, they were given ideal diets, with approximately one-half their calories and protein derived from milk. Their height at the time of discharge ranged between the 3rd and 90th percentile, with the mean at the 25th. When studied, they were all between 10 months and 5 years of age. Another 50 children in the study were other siblings from the same poor households.

An additional seven children have been studied in our Unit: two had been malnourished and were rehabilitated, and are included with the index cases; five, including one set of twins, have been cared for by our Unit since birth, and are included with the well-nourished siblings. All of the children were in good health, nondiabetic, and free of intestinal parasites when studied.

We have detailed information of their past nutritional habits: duration of breast feeding, type of milk consumed during infancy, continued consumption or nonconsumption of milk, and the availability of milk at home.

### Lactose tolerance tests

Lactose tolerance tests were performed in the morning after an overnight fast. A load of 50 g/m<sup>2</sup> of body surface as a 20% suspension in water was

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given orally. A 0.2-ml microcapillary blood sample was obtained at 0, 15, 30, 60, and 90 min. True glucose was determined by the ortho-toluidine method (Dow Diagnostest, the Dow Chemical Company, Midland, Michigan) (19). A blood sugar rise of less than 26 mg/100 ml was considered a flat lactose tolerance curve (lactose malabsorption) (10, 20).

Symptoms provoked by the ingestion of the lactose load, such as abdominal discomfort, cramps, flatulence, bloating, loose stools, and diarrhea, which occurred during the test were noted and recorded by trained observers. Symptoms occurring during the 24 hr following the test were noted and recorded by the parents.

A blood sugar rise below 26 mg/100 ml coupled with symptoms was used to define an intolerant subject (4, 21). These two events occurring together accurately reflect a lactase level below 1 to 2 units/g wet wt mucosa (lactose intolerant) (4, 21, 22).

## Results

Blood sugar rises were abnormally low in 76 of the 90 children (84%). Flat tolerance curves became more prevalent with increasing age (Fig. 1); 73% of those below 3 years had normal tests, with a sharp drop in tol-

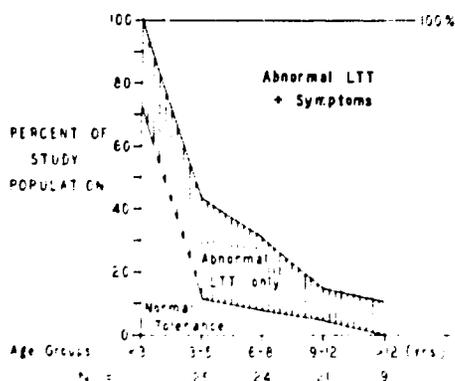


FIG. 1. Percentage of study population with normal and abnormal lactose tolerance tests (LTT).

TABLE 1  
Mean blood sugar rises, grouped by age

Age, years	Mean blood rise, mg/100 ml	Standard deviation
<3	32.0	±14.2
3-5	10.9	±9.2
6-8	10.3	±10.1
9-12	8.1	±8.5
>12	6.0	±4.1

erance thereafter. The progressive loss of the ability to adequately utilize lactose appeared complete by 12 years of age, with the values of all subjects over this age exhibiting a flat curve (Table 1).

Symptoms were noted in 75% of the children whose test results when plotted were flat curves; these symptoms tended to be multiple and included diarrhea, bloating, abdominal pain, and flatulence. They were usually noted 45 min after ingestion of the load, and they occurred with increasing regularity as age advanced. Those younger than 3 years of age did not indicate or manifest symptoms.

In the previously malnourished, no intolerance was observed in the two cases below 3 years of age. In the three children between 3 and 5 years, all children had an abnormal lactose tolerance test with only one having symptoms. Six of the eight children between 6 and 8 years of age had an abnormal test with symptoms. All five children above 8 years of age had an abnormal test with symptoms.

The 22 well-nourished siblings did not have a significantly different prevalence of lactose intolerance than the malnourished cases or other household siblings; 68% had an abnormal tolerance, with 60% of these symptomatic. Only one of the five below 3 years of age had an abnormal test. None were symptomatic (Table 2).

The decreasing lactose tolerance noted in all children was paralleled by decreasing consumption of milk. Greater milk consumption (more than 4 oz/24 hr) was reported in those children with normal tolerance ( $P < 0.001$ ) (Fig. 2).

A relationship between the duration of breast feeding, which ranged from zero to 48 months, and the individual's subsequent ability to consume milk or tolerate a lactose load was not apparent.

## Discussion

A high prevalence of lactose malabsorption in the Peruvian Mestizo children studied is consistent with data published on other groups of non-Caucasian children. Analysis of the data by age stratification points up the

TABLE 2  
Results of lactose tolerance tests and associated symptoms, grouped by age<sup>a</sup>

Age, years	Total	Normal		Abnormal (lactose malabsorption)		Abnormal with symptoms (lactose intolerant)	
		No.	%	No.	%	No.	%
All cases <sup>b</sup>							
<3	11	8	73	3	27	0	
3-5	25	3	12	22	88	14	64
6-8	24	2	8	22	92	17	77
9-12	21	1	5	20	95	18	85
>12	9	0		9	100	8	89
Totals	90	14	16	75	84	57	75
Previously malnourished cases <sup>b, c</sup>							
<3	2	2	100	0			
3-5	3	0		3	100	1	33
6-8	8	1	13	7	87	6	86
9-12	5	0		5	100	5	100
>12	0	0		0		0	
Totals	18	3	17	15	83	12	80
Well-nourished siblings <sup>b, d</sup>							
<3	5	4	80	1	20	0	
3-5	17	3	18	14	82	9	64
6-8	0	0		0		0	
9-12	0	0		0		0	
>12	0	0		0		0	
Totals	22	7	32	15	68	9	60
Other siblings <sup>b</sup>							
<3	4	2	50	2	50	0	
3-5	5	0		5	100	4	80
6-8	16	1	6	15	94	11	73
9-12	16	1	6	15	94	13	87
>12	9	0		9	100	8	89
Totals	50	4	8	46	93	36	78

<sup>a</sup> Children were categorized as previously malnourished cases, well-nourished siblings, and other siblings within the household. <sup>b</sup> No statistical significance (chi-square) demonstrated in lactose tolerance test results between previously malnourished cases, well-nourished siblings, and other siblings within the household. <sup>c</sup> Includes two other children under study at the Malnutrition Research Unit. <sup>d</sup> Includes five other children under study at the Unit.

progressive inability of this population to hydrolyze lactose.

The two index cases who had a past history of either marasmus or kwashiorkor did not perform differently from the other children younger than 3 years of age who were studied. Our results suggest that the lactase enzyme loss that has been observed with the insult of severe third degree malnutrition and diarrhea may be a short-term phenomenon,

with subsequent lactase production possible after rehabilitation (23).

The well-nourished siblings who had been afforded an optimum environment and were fed milk regularly did not demonstrate any prolonged ability to tolerate a lactose load. It was anticipated that this group, not subject to their usual hostile environment, would show a greater tendency toward lactose tolerance; this, however, was not the case. In

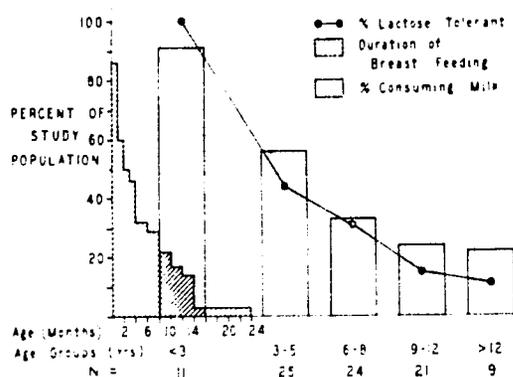


FIG. 2. The relationship of lactose tolerance and milk consumption; duration of breast feeding is noted.

fact, no difference was seen between this group and the other siblings, regardless of their nutritional history. As these well-nourished siblings had only an 18- to 27-month experience with optimum nutrition, the possible effect of continued good nutrition and an adequate intake of milk on the onset of intolerance cannot be predicted by this study.

Continued milk consumption is often considered a critical variable in maintaining lactase production (2, 7). We analyzed milk consumption (more than 4 oz/day) in all children tested. A significant difference was noted in milk drinking habits, with the normally tolerant children consuming more milk. This consumption, however, did not appear to retard the increasing intolerance. In fact, the abandonment of milk, even though available, by the children as they grew older, paralleled the increasing prevalence of lactose intolerance.

Age appeared to be the most pertinent variable in identifying a subject's ability to hydrolyze and absorb lactose. Comparisons of several variables, such as length of breast feeding, continued milk consumption, or previous malnutrition were not significant contributors to the subject's ability to tolerate lactose.

The etiology of "acquired" lactase deficiency is yet to be elucidated. Opinions range from a genetic etiology to an adaptive decline in intestinal lactase activity after weaning. It may be that groups genetically destined to manifest lactase enzyme deficiency as adults may still be subject to environ-

mental influence as children (7). It is clear from published reports (12, 15) that the number of non-Caucasian children in developing areas with normal lactose tolerance declines rapidly after the age of two. This contrasts with the much slower rate of decline in the United States non-white population. Although all groups reach a similar endpoint in early adult life the rate of achieving this is markedly different. It is suggested that the United States non-white population, in contrast to those groups in developing areas, are better nourished and consume greater quantities of milk. These different nutritional, environmental, and possible genetic circumstances may account for the difference in timing of the clinical expression of this problem.

Our data on an impoverished Peruvian population suggest that, irrespective of the youngster's very early nutritional experience, be it nutritional reinforcement with milk as in our well-nourished siblings, or the deficiencies experienced by our malnourished children, the expression of this problem appears to be independent of these early nutritional events.

It may be premature to make any hard and fast recommendations as to the continued emphasis on milk consumption and distribution programs to school-age populations evidencing lactose intolerance. We should, however, reflect on the possible implications of a high prevalence of lactose malabsorption and intolerance in such populations and reconsider the wisdom of attempting to reinforce the nutritional status of these children by heavy reliance on milk programs. ☞

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