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Lactose Intolerance in Persistent Diarrhoea During Childhood: The Role of A Traditional Rice-Lentil (Khitchri) and Yogurt Diet in Nutritional Management

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Abstract

Lactose intolerance is frequently encountered in children with persistent diarrhoea (PD). Selection of an appropriate milk-based formulation is a major management problem in the developing world. In a consecutive series of studies, we evaluated the role of feeding a traditional rice-lentil (khitchri) diet alone (KY) or in combination with either soy formula (KY-Soy) a dilute buffalo milk (KY-B), in children (age 6 months-3years) with PD. Serial observations of stool output, caloric intake and weight gain of these children over a 14 day period indicated satisfactory tolerance of the KY diet with adequate weight gain. The weight gain and stool output was however higher in lactose intolerant children, with the worst results seen with K-Y and buffalo milk combination, While lactose intolerant children with PD do have higher. rates of therapeutic failure, our data indicates that a traditional diet and yogurt combination can be used satisfactorily for nutritional rehabilitation in over 80% of such children (JPMA 47:20, 1997).

Introduction

Persistent diarrhoea is widely recognized as a leading cause of diarrhoea associated mortality in childhood[1] and appropriate nutritional rehabilitation is considered a cornerstone of rnanagement[2,3]. A large proportion of children with PD are seen in the wake of lactation failure and following the introduction of animal milk feeds[4]. The selection of a suitable diet for rehabilitation is tints crucial. Although cow's milk protein intolerance has also been suggested as of major etiological importance in PD. the most common clinical problem encountered in dietary selection is one of possible lactose intolerance.

Intestinal lactase is one of the most vulnerable disaccharidase enzymes in the intestine and can be adversely effected by infectious diarrhoea[6,7]. The consequence of lactose malabsorption and continued milk feeding include osmotic diarrhoea and increased stool output. While several studies have failed to find a clear correLation between intestinal mucosal histopathological findings arid disaccharidase levels[8,9], Nichols et al have demonstrated a close relationship between enterocvte damage and lactase/isomaltose activity[10]. Malnourished children ma have a comparative higher incidence of lactase deficiency and although satisfactory tolerance of milk containing feeds has been shown in several feeding regimens[12,13], such malnourished children with PD may behave differently. Although potential lactose intolerance in children with chronic diarrhoea has been recognized fora long time[14]. definitive evidence of adverse effects of lactose or milk feeding in PD has only been shown relatively re-cently[15,16]. In a randomized controlled trial of administering lactose containing feeds or hydrolvsed lactose to well tioufished children with PD. Penny et al demonstrated an increased stool output and faecal carbohydrate excretion[15]. Current recommendations of feeding children with PD thus suggests a reduction of lactose intake[17].

Such reduction of lactose intake in children with PD who are not receiving significant amounts of breast milk. creates considerable practical problems in the developing world. Special lactose-reduced or soy-based formulas are not onh prohibitively expensive. but also not freely available. Alternative dietary regimen not containing sufficient amounts of milk or milk- substitutes, are frequently unpalatable and not consumed in sufficient quantities by young infants. The challenge is therefore, to identify a suitable milk-based dietary regimen for malnourished children with PD which are well tolerated and nutritionally adequate. In a consecutive series of studies between 1987 and 1991, we evaluated the role of a traditional rice-lentil (Khitchri) diet and yogurt (KY) in feeding malnourished children with PD and found itto be well tolerated[18-19]. While the overall efficacy of this form of dietary intervention in PD is well established, the role of the KY diet and its various combinations in lactose intolerant children is unknown. In this report, we present an evaluation of this dietary regimen in children with PD and varying degrees of lactose-intolerance based on a reanalysis of data from the aforementioned two studies.

Patients and Methods

In two consecutive randomized controlled trials, malnourished children with PD were allocated to receive the KY diet, either singly, or in combination with isocaloric amounts of soy formula (KY-S) or dilute buffalo milk (KY-B) and compared with a control diet of standard soy fonnula. The overall study design, nutritional and diarrheal outcome have been previously described[18-19]. Briefly, malnourished children with PD (diarrhoea lasting >14 days with growth faltering). were recruited from outpatient services at the National Institute of Child Health and admitted to the Diarrhoea Research Ward. Following stabilization and informed consent, these children were allocated to their respective dietary regimen with constant monitoring and documentation of caloric intake, stool and urinary output for 14 days. During this period these children were constantly attended by a research medical officer and nurse, with continuous monitoring of clinical status. weight gain and anthropometric status. In all cases the dietary protocol was standardized to provide a minimum of 100 kcal/kg/day by day 3 of therapy. In addition, breath hydrogen concentrations were measured in the subset of children receiving KY and buffalo milk at admission and days 7 and 14 of dietary therapy. Expired breath samples were obtained via a sealed face mask. collected and sealed in disposable syringes and analyzed on a Quintron breath hydrogen analyzer (Quintron Ltd. USA) for quantification of breath hydrogen content[20]. Metabolic balance studies were also performed on a subset of these children using modified metabolic cots[21]. Protein and fat content of diet, stool and urine were measured by the rnicrokjeldahl method[22] and Van de Ka.mer procedure[23]. respectively. Total metabolizable energy of dietary intake and excreta was estimated by a diabatic bomb calorimetry. The fecal carbohydrate content was estimated by substracting energy content due to pmtein and fat from total metabolizable energy.
Lactose intolerance was defined as the presence of > 0.5% reducing substances in the stools on testing with Benedict's reagent, alongwith a stool pH <5 during the first 72 hours after initiation of dietary therapy. Several outcome variables were evaluated, including caloric intake, stool volume, frequency as well as the average daily weight gain over the two weeks of rehabilitation. Success of therapy was defined as reduction in stool volume and frequency to less than 50% of admission values alongwith documentation of weight gain for atleast three consecutive days. The data was analyzed for comparison of outcome by univariatc analysis of dichotomous variables and analysis of variance for continuous data. Significance was set at 0.05.

Results

A total of 126 children were consecutively selected for the study on the traditional KY diet, either singly or in combination with equal volumes of soy formula or dilute (50%) buffalo milk. Of these. 16 were prematurely removed by the parents for inability to stay for the entire 14 days of therapy and 14 dropped out for reason of intercurrent infections. There were 4 deaths and thus overall 92 (73%) of the children randomized to therapy, were able to complete 14 days of nutritional rehabilitation. The KY diet was found to be satisfactorily tolerated in the vast majority of children with a comparable19 or better18 nutritional outcome to the soy formula. The overall results of feeding the soy formula have been described previously18"9 In order to evaluate the role of the traditional KY diet in relation to lactose intolerance, the main focus was on children with PD placed on the KY diet or its combinations during the course of the study.

Table I. Composition of study diets.
(Estimated on feeding a 10 kg child at 100 kcal/kg/day)

Diets	Amount (g)	Protein (g)	Carbohydrate (g)	Fat (g)
KY	1000	34	133	37
KY-B	1000	35	88	56
KY-S	1000	32	116	46

KY Rice-lentil and yogurt diet
KY-B Rice-lentil+yogurt+dilute buffalo milk diet
KY-S Rice-lentil+yogurt+isocaloric Soy formula.

Table I indicates the composition of various diets for these children, The estimated daily lactose intake on these dietary combinations was 1.3,3.4 and 1.3 g/kg/day respectively.

Table II. Comparison of clinical characteristics on admission.

	KY	KY-Soy (KY-S)	KY-Buffalo (KY-B)
Number	51	49	26
Age (mths)	17.2±7.8	11.9±5.8	13.7±5.8
Weight (kg)	7.34±1.78	6.53±1.47	6.02±1.14
Wt z-score	-3.3±1.4	-3.1±1.1	-3.9±0.8
Height z-score	-2.2±1.6	-1.9±1.2	-2.9±1.1
Diarrhoea duration (days)	44.3±44.6	57.3±58.9	75.6±86.6
Stool frequency (n/day)	10.2±5.1	9.5±3.7	8.1±2.5
Admission Hb (g/dl)	9.4±1.9	9.8±1.9	8.8±1.4

All differences are non-significant.

between the groups for any admission parameters. The overall caloric intake, stool output and nutritional outcome for these therapeutic groups is given in Table III.

Table III. Comparison of overall outcome of feeding groups completing study protocol for 14 days.

	KY	KY-Soy (KY-S)	KY-Buffalo milk (KY-B)
Number	37	36	22
Caloric intake (kcal/kg/day)	114.2±21.5	120.5±25.3	136.1±26.4
Stool frequency (n/day)	3.9±1.8	5.9±3.2	6.0±3.9
Stool volume (g/kg/day)	40.1±16.6	56.9±60.7	61.3±48.0
Overall weight gain (g/kg/day)	6.9±5.1	7.6±5.7	3.9±5.9
Success of therapy	34 (92%)	31 (86%)	17 (77%)
Deaths	1 (3%)	-	3 (14%)

Systematic tests for analysis of variance did not suggest any major differences between the therapeutic groups for overall nutritional and diarrhoeal outcome. While the differences did not reach significance, there was a trend towards lower weight gain in the group receiving the KY-B combination.

In all 32 (25%) children were found to have evidence of lactose intolerance on the basis of stool pH and reducing substances. No correlation could be demonstrated between stool reducing substances or pH and breath hydrogen excretion (BH).

BREATH HYDROGEN EXCRETION
SEVERE PEM WITH PERSISTENT DIARRHEA

··· ⊙ ··· day 1
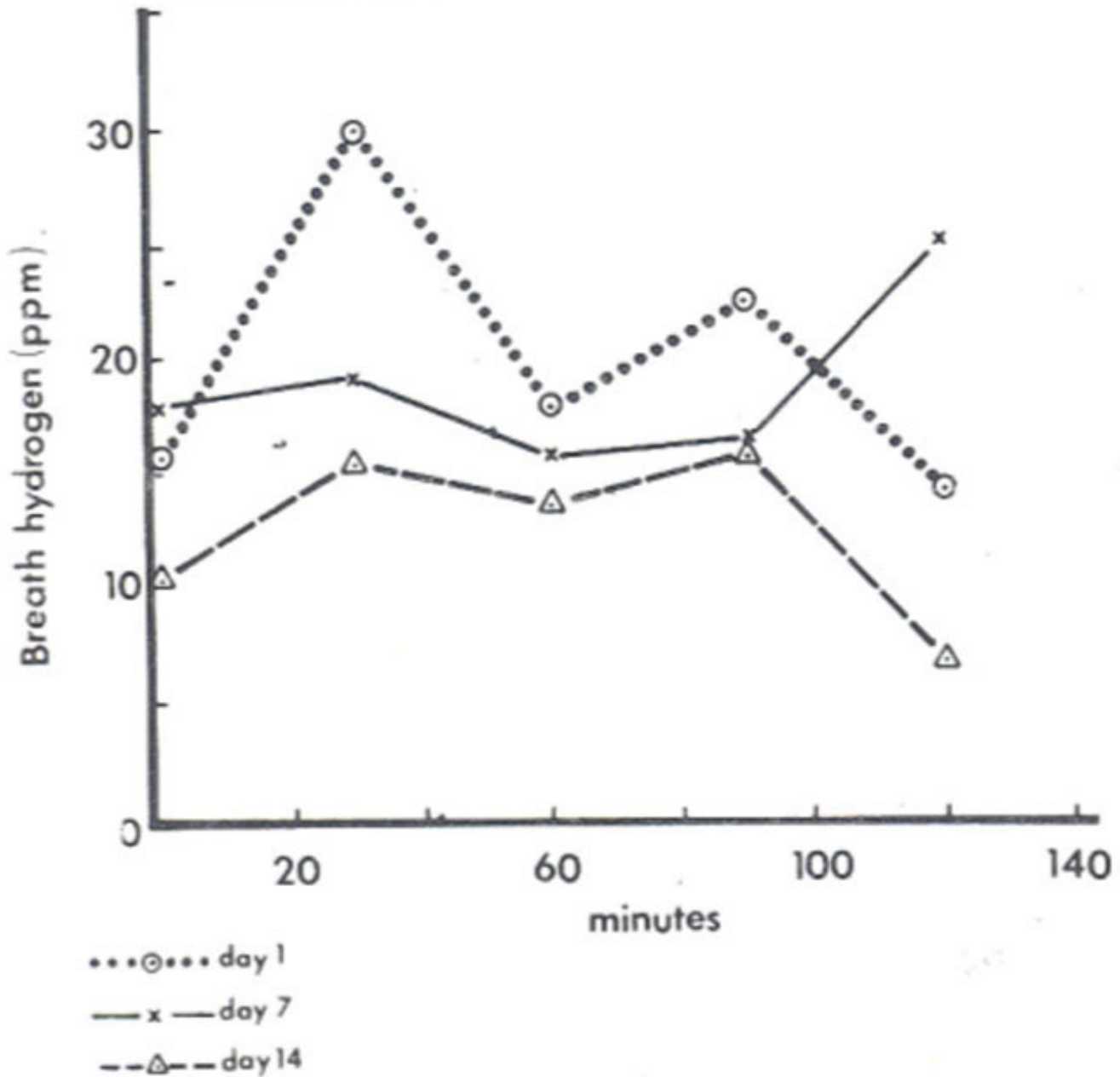—— x —— day 7
— — △ — — day 14

Figure 1. Sequential breath hydrogen excretion values on K Y- Buffalo milk feeds.

Figure 1 shows the sequential BH excretion for the study cohort. While a delayed peak was observed in 5 (19%) children, only 6 (2 1%) demonstrated a classical early peak of breath hydrogen excretion in excess of 20 ppm.

Table IV presents the comparison of the dietary groups and outcome according to the presence or absence of lactose intolerance. The highest rates of stool output were seen in lactose intolerant children receiving the KY-B and KY-S diet.

The lowest weight gain was seen in the lactose-intolerant group receiving the KY-B combination, whereas, lactose-intolerant children on the KY diet tolerated it well and exhibited satisfactoiy weight
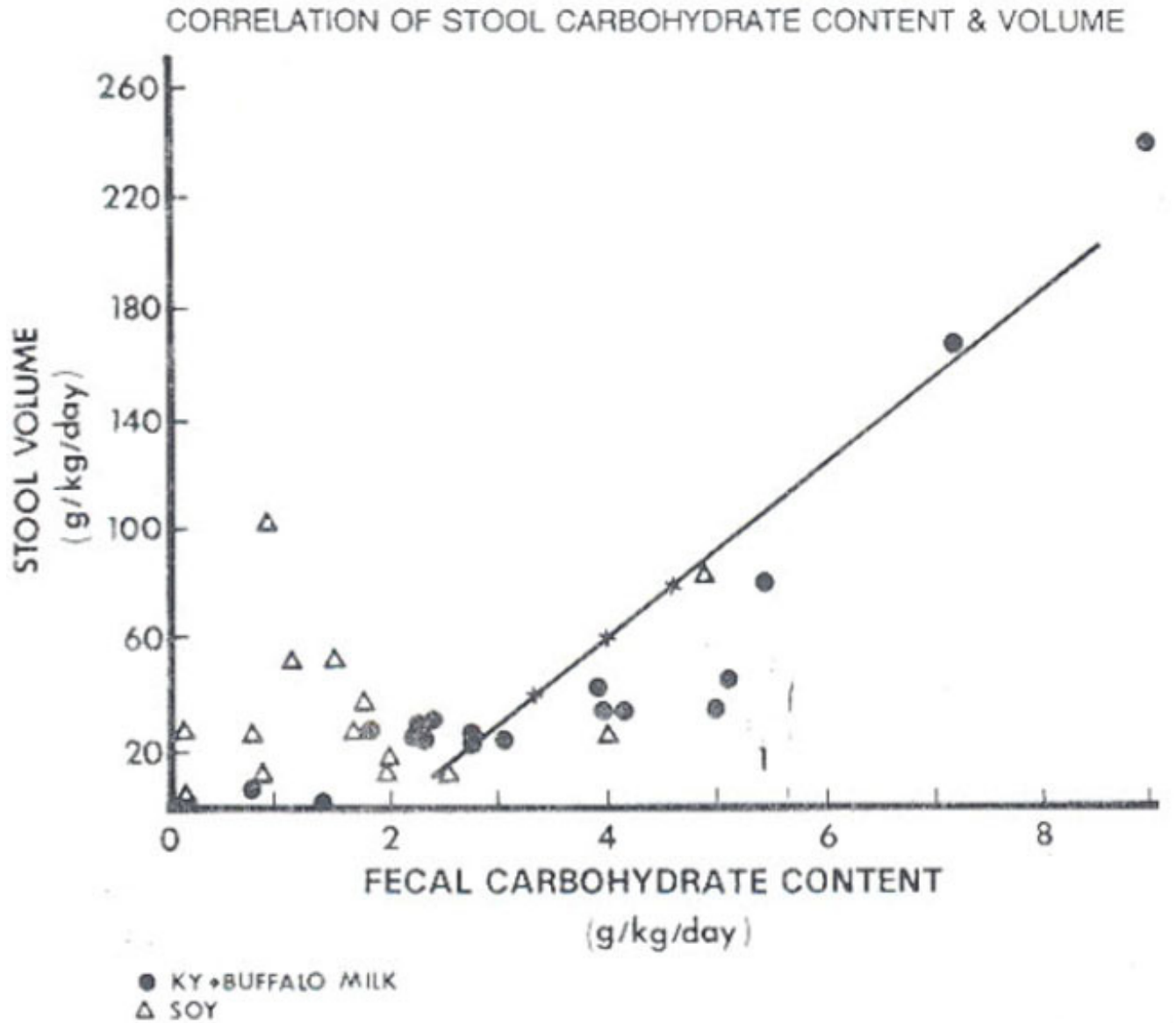
gain.

Figure 2. Relationship of stool carbohydrate content and volume.

Figure 2 shows the correlation of stool carbohydrate content and volume in the group of children receiving the KY-B diet who underwent metabolic balance studies, in comparison corresponding values for children receiving a lactose-free soy formula.

Discussion

The 25% incidence of lactose intolerance as assessed by stool reducing substances and pH, found in this group of children is consistent with currently held views on the prevalence of lactose intolerance in PD[15,16]. Baseline investigations of lactose intolerance including stool reducing substances and pH, failed to identify most of the children who subsequently failed dietaiy therapy. There was very poor correlation between breath hydrogen excretion rates and clinical or stool evidence oflactose intolerance. Such findings have also been reported by Penny et al[15] and Lifschitz et al[9] and may reflect greater colonic salvage of carbohydrate in this group of infants.

While several definitions of lactose intolerance have been proposed[24]. it is also recognized that several such "lactose- intolerant" malnourished children[25] or those followmg diarrhoea[26], may tolerate physiological amounts of milk. Brown et al studied the nutritional outcome of lactose malabsorbing children in Bangladesh on low dose milk supplements and found that most children gained more weight with improved nitrogen retention on milk-containing diets[23,25]..While similar intact cow's milk feeding to malnourished Guatemalan children resulted in higher rates of diarrhoea, the rates of nutritional recovery was comparable to those receiving hydrolyzed-lactose feeds[27]. It seems however, that children with persistent diarrhoea may behave differently with higher rates of lactose intolerance, although other complex carbohydrate intolerance are possible[27]., Most feeding regimen, therefore, recommend a reduction in lactose and carbohydrate intake[29]. This is an extremely difficult proposition however, in deprived populations as young infants and children deriving a major proportion of their daily energy intake from milk[4]. Given the unacceptable risk of malnutrition with milk removal or dilution, it is recommended that milk-cereal mixtures[30] or fermented milk products be used[31,32]

The most widely used fermented milk preparation is ogurt. Live yogurt is widely used in most parts of South Asia and is recognized to contain an autodigestible form of lactose due to the J3-galactosidase activity of lactobacillus bulgaricus and Streptococcus thermophilus[33]. The lactase activity of yogurt has been shown to be preserved in the small intestine due to the relatively high local pH as well as slow orocaecal transit time[34]. Several studies of feeding yogurt to children with diarrhoea[35] and giardiasis[36] have shown significant clinical beneflt of doing so, Our analysis reveals that although lactose intolerance is seen ma significant numberof children with PD, most are able to tolerate upto 2 gfkg/day lactose in the form of yogurt. However, the addition of even half-strength buffalo milk and a daily intake of nearly 3.5-4 g/kg/day lactose in these children resulted in persistently high stool output as well as a poor weight gain. While the contribution of milk protein allergy to the adverse outcome observed on the KY-B diet, is uncertain, the strong correlation between faecal carbohydrate content and volume suggests that carbohydrate, most likely lactose intolerance, was an important factor. No significant benefit was observed with the addition of soy milk to the KY diet and the overall weight gain was comparable to that observed with KY feeds alone. Quite interestingly, the failure rate of therapy was highest among lactose-intolerant children receiving the KY-S combination. Similar findings of poor clinical outcome with soy feeds, have been observed in our studies of feeding lactose-intolerant children with acute diarrhoea on either soy formula or KY diet. We believe that given the satisfactory nutritional response and tolerance of the KY diet in children with PD, that this inexpensive and culturally acceptable dietary combination can be used safely in such children irrespective of lactose intolerance.

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