Prospective Evaluation of Dietary Treatment in Childhood Constipation: High Dietary Fiber and Wheat Bran Intake Are Associated With Constipation Amelioration

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ABSTRACT

Objectives: The aim of the study was to evaluate, over 24 months, the intake of dietary fiber (DF) and the bowel habit (BH) of constipated children advised a DF-rich diet containing wheat bran.

Patients and Methods: BH and dietary data of 28 children with functional constipation defined by the ''Boston criteria'' were obtained at visit 1 (V1, n = 28) and at 4 follow-up visits (V2–V5, n = 80). At each visit the BH was rated BAD (worse/unaltered; improved but still complications) or RECOVERY (REC) (improved, no complications; asymptomatic), and a food intake questionnaire was applied. DF intake was calculated according to age (year)+5 to 10 g/day and bran intake according to international tables. Nonparametric statistics were used.

Results: Median age (range) was 7.25 years (0.25–15.6 years); 21 children underwent bowel washout (most before V1/V2), and 14 had the last visit at V3/V4. DF intake, bran intake, and the BH rate significantly increased at V2 and remained higher than at V1 through V2 to V5. At V1, median DF intake was 29.9% below the minimum recommended and at the last visit 49.9% above it. Twenty-four children accepted bran at 60 visits, at which median bran intake was 20 g/day and median proportion of DF due to bran 26.9%. Children had significantly higher DF and higher bran intake at V2 to V5 at which they had REC than at those at which they presented BAD BH. DF intake >age+10 g/day was associated with bran acceptance and REC. At the last visit 21 children presented REC (75%); 20 of them were asymptomatic and 18 were off washout/laxatives.

Conclusions: High DF and bran intake are feasible in constipated children and contribute to amelioration of constipation.

Key Words: bowel habit, children, constipation, dietary fiber, wheat bran

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Increase in dietary fiber (DF) intake is widely recommended as a first treatment step for childhood constipation (1–7). However, sustained compliance with treatment is considered difficult (3,5), and there are conflicting data about its role in maintenance therapy (8). Reported studies thus far have included children whose diets contained their usual foods (4,9–11) or supplementation with mainly soluble (12–14) or insoluble fibers (wheat bran [1,2,4,7], cocoa husk [6]). In theory, insoluble fiber is better for laxation than soluble fiber (15,16), and wheat bran, a predominantly insoluble fiber with a high pentose content, seems better than cocoa husk, whose main component is cellulose (15). In fact, wheat bran has been shown to ameliorate the bowel habit (BH) of constipated adults (17–19) and has been included in the American Gastroenterological Association recommendations (20). This recommendation, however, has also been disputed (21).

Rarely have diets including wheat bran been advocated for children (22,23). Therefore, scarce information about its acceptance and effect in children with constipation is available (1,2,4,7,24). Taking into account the widespread high prevalence of childhood constipation (25,26), affordable, feasible, and effective dietary recommendations are necessary. Wheat bran is cheap, can be mixed into usual foods, and, in Brazil, is tested by governmental entities for food security. The standardized treatment applied to children with constipation in the Botucatu Medical School pediatric gastroenterology unit emphasizes DF intake (27). Nonrefined cereals are included in the advice, but are relatively expensive in Brazil. Therefore, considering the low economic background of most people attending public hospitals, and that whole-grain food is not included in their usual diet, plain wheat bran has been introduced in the constipation treatment protocol. A previous retrospective report of 100 children with constipation followed in our unit showed good DF intake, bran acceptance, and BH recovery (28). At that time, however, intake was only grossly estimated (27). Therefore, the aim of the present study was to prospectively evaluate DF/wheat bran acceptance and its effect on the BH of children with functional constipation.

PATIENTS AND METHODS

Twenty-eight children with chronic functional constipation were followed prospectively up to 24 months. The study was conducted in a weekly pediatric gastroenterology outpatient service run by 1 of the authors. The first patient with constipation complaints for at least 2 months, not being breast-fed and not previously attending the unit, was enrolled at visit 1(V1) and, after attendance, sent to the dietitian. Follow-up visits occurred at intervals relative to V1: 0.5 to 3.5 months (V2), >3.5 to 9.0 months (V3), >9 to 15 months (V4), >15 to 24 months (V5). Whenever more visits occurred during the intervals, that nearest to 2.0, 6.0, 12, and 24 months after V1 was included in the study. Visits to the clinician and the dietitian were on the same days, but data were blind to each other.

Bowel Habit Evaluation

Constipation was defined according to the slightly modified ''Boston criteria'' (29) as the presence of 2 or more of the items:

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passage of hard scybalous/pebble-like/cylindrical deeply cracked stools; straining or painful defecation; large stools that may clog the toilet; <3 stools per week; presentation as a possible complication (recurrent abdominal pain, enuresis, nonstructural urinary tract infections, and/or fecal soiling, the latter defined as the involuntary passage of stool due to rectal impaction). Occult constipation was suspected by presentation as a complication in the absence of other constipation signs; it was confirmed by physical examination (abdominal mass, impacted stools in rectum), plain abdominal radiograph analyzed with the Barr score (30), and at least temporary response to treatment. Structural, metabolic, or endocrine causes of constipation were excluded when necessary. At each follow-up visit, the BH in the previous 4 weeks (2–4 weeks at V2) was recalled, with questions about the items listed in definition. Information about bowel washout/laxatives and possible effects of DF overconsumption (flatulence, abdominal pain/distension, and diarrhea) was obtained. The BH was classified, relative to basal data (and rated 1–4 for comparison between visits), as BAD: worse/unaltered = 1, improved but still complications = 2; or RECOVERY (REC): improved, no complications = 3, asymptomatic = 4. The BH was considered improved when the proportion of scybalous/pebble-like stools and/or the frequency of straining/pain at defecation at least halved and stool frequency increased from <3 to ≥3/week, or from 3 to 5/week to ≥5 to 7/week. Children with a recent visit to other units of the medical school hospital, before V1, had their data obtained from that visit by maternal recall and from their medical files, to verify possible interventions on constipation and changes of the BH during the interval previous to V1. Had the BH improved at V1, constipation data of the previous visit were considered their baseline.

Dietary Evaluation

The dietitian applied a food intake questionnaire (31) covering the previous 4 weeks (2–4 weeks at V2). It contained 123 food items, with details about domestic food preparations and DF intake, plus industrialized items and a question about ''other'' foods. A photographic register helped with the portion sizes (32). A nutrition support software (version 2.5) from UNIFESP (Federal University of São Paulo) was adapted to calculate DF intake: a full list of foods was obtained combining a food composition table from the United Kingdom (33) with tables from the United States, Australia, and Brazil (34–36), the latter only for a few foods not found in the other tables. DF data are presented according to the intake recommended by the American Health Foundation: age (year)+5 to 10 g/day (37); because it is a function of age, percentage of the minimum recommended (ingested DF − age[years] + 5 × 100 / age[years] + 5) and proportion of children with DF intake > age (year) + 10 g/day were used.

Treatment

The standardized protocol included a short bowel washout series (3–10 disimpaction enemas, initially intermingled and then followed by laxatives in decreasing frequency for 1–2 months), whenever complications of constipation were present and/or an abdominal mass was palpable (25). This scheme (or part of it, depending on clinical grounds) was reintroduced when complications recurred and no response to dietary reinforcements was obtained. The diet was oriented according to the Food Guide Pyramid for all food groups (38), with emphasis on fruits with peel/bagasse, full corn grain (maize, popcorn, bread, pasta, rice), pulses, vegetables, seeds, and nuts. Wheat bran, containing 39.5 g% DF, was recommended in approximate amounts: 5 to 10 g/day for age younger than 1 year, 10 to 20 g/day for 1 to 2 years, and 20 g/day for older children. Bran was added to a humid constituent of the food, or it was used—in the proportion 1 bran:2 refined flour—to prepare bread, desserts, cakes, pancakes, and ''farofa'' (manioc flour roasted with varied ingredients, popular in Brazil). If this approach was not effective, then children and families were directed to a session with the dietitian, during which they tasted foods containing wheat bran and prepared simple foods, such as ''paçoca'' (powder milk, sugar, bran, water to give a purée consistency). Decrease in protein intake was advised when excess was reported.

Statistical Analysis

Nonparametric tests were used: the χ^2 test for associations among proportions; the Wilcoxon matched-pairs signed rank test for data at different visits of the same children; the Mann-Whitney *U* test for age differences and for dietary data at visits with BAD BH or REC; and the Kruskal-Wallis test for differences among the last visits (39). Significance was accepted at the 5% level.

The study was approved by the research ethics committee of Botucatu Medical School and informed consent was obtained from mothers/caregivers in charge of the studied children.

RESULTS

Visits Flow

Ten children (35.7%) came to all planned visits, 4 came to V5 but failed some visits, 9 had their last visit at V3, and 5 had it at V4. Thus, 108 visit pairs constitute the study: 28 at V1 and 80 follow-up visits, respectively, 23, 27, 16, and 14 at V2, V3, V4, and V5. Twenty-four children had a recent visit to other university hospital units, after which 16 followed some constipation treatment.

Clinical Baseline Characteristics

Children's median age (range) at V1 was 7.2 years (0.25–15.6 years); 3 were younger than 1 year, and 60.7% were male. At baseline, 9 children presented <3 weekly defecations, 5 had no complications (3 younger than 1 year), and 23 had retentive fecal soiling (11 boy:1 girl, $P < 0.02$), recurrent abdominal pain (n = 11), enuresis (n = 3), and/or urinary tract infections (n = 3). Three children had complications of occult constipation for 0.2 to 6.5 years. Duration of constipation for the 25 children with overt symptoms was median (range) 2.0 years (0.25–11.0 years), onset being during the first year of life in 13 (52%). All of the children, except for 2 (younger than 1 year), failed previous treatments.

Washout Procedures

Twenty-one children (75%) underwent bowel washout series (10 more than once), and had received at least 1 series before V1 (12 = 42.9%) and V2 (13 = 56.5%); these proportions decreased to 22.2% at V3, 6.2% at V4, and 21.4% at V5.

Dietary Treatment and Bowel Habit Classification at V1 to V5

DF intake (% of age+5), bran intake (g/day), and BH rate were significantly higher at V2, V3, V4, and V5 than at V1. No differences between V2 and V3, V3 and V4, and V4 and V5 occurred for these parameters ($P > 0.30$), except for a worsened BH at V3 and a subsequent improvement at V4, V2 and V4 being similar ($P = 0.12$) (Fig. 1). Thus, the 80 V2 to V5 were combined to present the data.

Dietary Data

Twenty-four children (85.7%) ingested more DF than the maximum recommended (>age+10 g/day) at least once: 5 children at V1 (17.9%); 23 at 46 of 80 V2 to V5 (57.5%). Twenty-four children (85.7%) accepted bran at 60 of 108 visits: 4 at V1 (14.3%); 24 at 56 of 80 V2 to V5 (70%). Bran acceptance, beginning before V1/V2, was continuous for 13 children and intermittent for 7; 1 child delayed acceptance (V4–V5) and 3 ingested bran only during 1 interval. Four children never accepted bran. Bran acceptance and DF >age+10 g/day were associated ($P < 0.001$). At the 60 visits with bran, median (interquartile range [IQR]) bran intake was 20 g/day (6–20 g/day), and median (IQR) proportion of DF due to bran was 26.9% (16.7%–43.0%), both being nearly constant along V1 to V5. No child younger than 1 year ingested >6 g/day bran and the youngest to receive bran was 6.7 months of age. No particular trend between age and amount of ingested bran emerged (Fig. 2), but the 4 children who never accepted bran concentrated at ages 3.1 to 5.5 years.

Bowel Habit Classification

Children presented REC at 67 visits: 9 at V1 (32.1%); 26 at 58 of 80 V2 to V5 (72.5%). Children with REC at V1 had a recent visit to other hospital units and were younger than the 19 with BAD BH (median age 4.2 × 9.2 years, $P < 0.05$). The proportion of asymptomatic children (rate 4) among those with REC increased from 33.3% (3/9) at V1 to 82.8% (48/58) at V2 to V5.

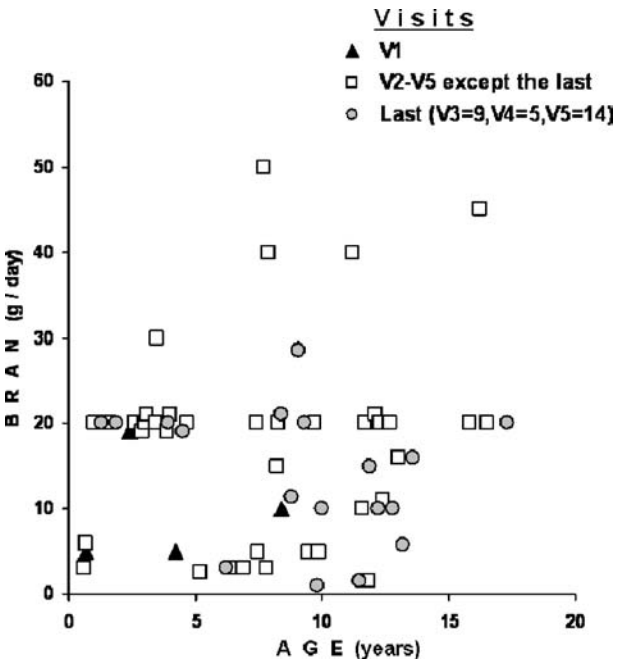

FIGURE 2. Amount of ingested bran according to age (n = 60 visits of 24 children with bran acceptance).

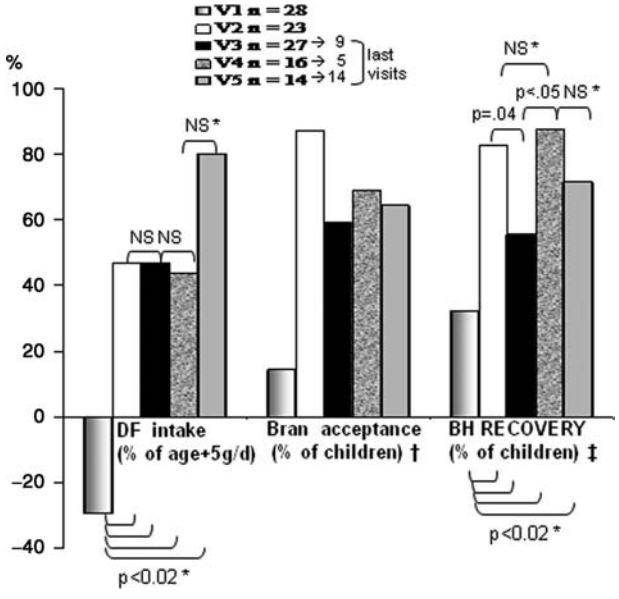

FIGURE 1. Median DF intake relative to the minimum recommended (age [year]+5 g/day), percentage of children with bran acceptance and of children with BH RECOVERY, at visits 1 to 5 (V1–V5). *Wilcoxon test; NS = nonsignificant. †For statistical analysis bran intake (g/day), including ''no acceptance'' (0.0 g/day), was used. Median bran intake at V1 to V5 was 0.0; 20.0; 3.0; 15.5; and 7.9 g/day, respectively, and intake was higher at each follow-up visit than at V1 ($P < 0.002$). Differences between subsequent follow-up visits were NS. ‡Statistical analysis was based on the BH rated 1 to 4: BAD BH 1 to 2; BH RECOVERY 3 to 4 (see text for explanations). BH = bowel habit; DF = dietary fiber.

Data at the Last Visit

Median follow-up from V1 to the last visit at V3, V4, and V5 was 6.0, 11.3, and 19.6 months, respectively. Last visits data at V3 versus V4 versus V5 were similar for DF ($P = 0.52$), bran ($P = 0.69$), and for BH rate ($P = 0.75$) (Kruskal-Wallis test). Thus, they were grouped and analyzed apart from the 80 V2 to V5. Results were significantly better at the last visit than at V1 (Table 1). Most of the 21 children with BH REC at the last visit had consistent REC: it was continuous from V1/V2 for 12 children, intermittent for 8, and only at the last visit for 1 child. Also 5 of the 7 children with BAD BH at the last visit presented REC at some or all previous visits; in 4 of these 5 children there was recurrence of BAD BH after bran discontinuance. Only 2 children, both with the last visit at V3, never had REC.

Dietary Data Versus Bowel Habit Classification

Children had a higher DF intake (% of age+5) at visits at which they had REC than at those at which they had BAD BH (Mann-Whitney test): at V1 (9 REC vs 19 BAD), it was median (IQR) −3.2% (−34.4%–47.6%) versus −45.1% (−80.5%–39.4%) ($P = 0.05$), and at V2 to V5 (58 visits REC vs 22 BAD), it was 56.7% (14.3%–139.2%) versus 46.4% (−23.8%–61.5%) ($P < 0.03$). DF >age+10 g/day and REC were associated ($P < 0.01$). Bran intake, analyzed apart from total DF intake, was, respectively, 15.5 g/day (0.5–20 g/day) versus 3.0 g/day (0–17.5 g/day) ($P = 0.02$) for REC versus BAD BH at V2 to V5, and nonsignificant at V1 ($P < 0.13$).

BH outcome was similar for the 4 children who never took bran (8 visits REC:5 BAD) versus the 24 children with bran at 1 visit at least (59 REC:36 BAD). REC was 25.0% versus 33.3% at V1 and

TABLE 1. Dietary data and bowel habit at entrance in the study (V1) and at the last visit*

	V1, n = 28	Last, n = 28	P†
DF intake (median % of age +5)	−29.9‡	49.9§	0.00003
Interquartile range	−64.8 to 37.7	12.9–139.7	
DF intake <age + 5 g/day, n (%)	17 (60.7)	5 (17.9)	
DF intake >age +10 g/day, n (%)	5 (17.9)	17 (60.7)	
Bran acceptance, n (%)	4 (14.3)	18 (64.3)	
Median bran intake, g/day	0.0	7.9	0.0005
Interquartile range	0.0–0.0	0.0–20.0	
BH RECOVERY, n (%)	9 (32.1)	21 (75.0)‖	0.0015¶
Bowel washout, n (%)	12 (42.9)	4 (14.3)#	

BH = bowel habit; DF = dietary fiber.
* Last visits at V3 (n = 9), V4 (n = 5), and V5 (n = 14).
† Wilcoxon test.
‡ Equivalent to 8.4 g/day DF intake by a 6.9-year-old child (<age + 5 g/day).
§ Equivalent to 24.6 g/day DF intake by an 11.4-year-old child (>age + 10 g/day).
‖ 66.7% (V3), 100.0% (V4), 71.4% (V5); 20 of 21 were asymptomatic (92.5%).
¶ Statistics were based on BH rates 1 to 4.
# Mainly laxative use, 3 with RECOVERY, 1 with BAD bowel habit.

75% versus 75% at the last visit. Also, DF intake (% of age+5) was similar: at visits with REC (8 vs 59), it was median 54.6% versus 46.9% ($P = 0.47$) and at visits with BAD BH (5 vs 36) median −41% versus 9.9% ($P = 0.11$). Symptoms that could be attributed to adverse effects of DF/bran intake were not reported during visits of children with REC.

DISCUSSION

The children studied had severe constipation, as indicated by the presence of many complications, a long clinical course, and previous treatment failures. Two problems were difficult to avoid. First, children already submitted to treatment were enrolled because the flow to reach the specialist usually is via the emergency unit, where often a bowel washout is needed and a DF-rich diet is prescribed. Thus, 9 children had BH REC already at V1. Had we excluded them, a bias would have been introduced because they were younger and perhaps those with the greatest potential to accept and respond to treatment. Second, children failed a part of the planned visits, most because they did not return after achieving BH remission at V3/V4. Anyway, 80 visits constitute a good proportion of the planned 112 follow-up visits (71.4%), mainly if one considers that 22 children (78.6%) came from distant cities and/or rural areas.

Children had adhered to the diet already at V2 and maintained this at subsequent visits. These results are in accordance with previous studies with shorter observation periods (1,2,4,7,24) and contradict the usual impression of bad compliance. Ongoing support, however, was necessary because only 13 children accepted bran continuously, and acceptance was important, because it significantly contributed to high DF intake. Bran was not essential, as attested to by the 4 children who never took bran: they achieved a good DF intake at visits with REC, even higher than the other children (but not significantly). Yet, high DF intake with a good proportion of insoluble fiber could be difficult to attain without the approximate 39% of DF in bran; moreover, high DF intake exclusively due to other food sources is more expensive.

Also, the BH was significantly better already at V2, REC being consistent for most children. There was, however, a decrease in the proportion of children with REC at V3 and one cannot exclude the influence of bowel washout on the BH because it was less frequent between V2 and V3 than before V2. Bowel washout further decreased at V4 and at V5 and the overall influence of the diet could show up better. Thus, at follow-up visits at which children presented REC, DF, and bran intake were each significantly higher than at visits of children with BAD BH, REC being associated with DF >age+10 g/day. DF intake above the maximum recommended, at 51 visits, could raise concern about micronutrient bioavailability and children's growth. It was, however, in accordance with the Food Guide Pyramid (37,38) and with the new recommendation by the Institute of Medicine (40). Moreover, anthropometric data of our children (data not shown) did not depict a negative influence of the high DF/bran amounts, but instead there was a slight increase in height/age score after the intervals with bran (41). This is supported by other studies (2,24). One must also consider that DF intake recommendations for children are based on an estimate for healthy children, and constipated children may require more DF, at least for some time after starting treatment.

Symptoms that could be attributed to adverse effects of excessive DF/bran intake can be mistaken for those of constipation complications, and therefore interpretation can be difficult when they occur simultaneously with BAD BH. Because the cited symptoms were not present when there was REC, which was associated with high DF intake, one can infer that adverse effects were rarely present or even absent.

Overall results at the last visit can be considered good, because 82.1% of the children ingested more than the minimum recommended DF for age, 64.3% accepted bran, and 75% presented BH REC. It is difficult to sort out which factor(s) were responsible for REC at each visit, whether bowel washout (mainly at initial visits), or soluble or insoluble DF/wheat bran. The interplay between these factors seems important; the significantly higher bran intake at visits with REC than at those with BAD BH may indicate that bran inclined the balance toward insoluble fiber, which is important for laxation.

In conclusion, a DF-rich diet containing bran is a feasible and cheap tool for treating constipated children in everyday clinical attendance. However, frequent reinforcements to ensure adherence to the diet are necessary. Bran acceptance significantly contributed to high DF intake and each significantly contributed to amelioration of constipation.

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