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ORIGINAL ARTICLE

Low-dietary fiber intake as a risk factor for recurrent abdominal pain in children

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Objective: To evaluate dietary fiber intake in children with recurrent abdominal pain.
Design: Cross-sectional study with control group.
Setting: Outpatients of the Pediatric Gastroenterology public health clinic of the Darcy Vargas Children's Hospital, Brazil.
Subjects: Forty-one patients with recurrent abdominal pain were evaluated and 41 children, as a control group.
Interventions: Macronutrients and fiber intake evaluation by the Daily Food Intake method. Two tables of fiber composition in foods were used.
Results: According to the Brazilian table the mean intake of fiber (g/day) by the children of the recurrent abdominal pain groups with chronic constipation or not, and the control group was, respectively, 18.2, 16.6 and 23.7 for total fiber ($P=0.001$), 7.5, 6.9 and 9.5 for soluble fiber ($P=0.001$) and 10.7, 9.7 and 14.1 for insoluble fiber ($P=0.002$). According to the AOAC table, the recurrent abdominal pain group with chronic constipation or not (10.6 and 9.9 g/day) also had lower intake of total fiber than the control group (13.4 g/day) ($P=0.008$). The intake of fiber was lower than the minimum recommended value (age + 5 g) and statistically associated ($P=0.021$) with the recurrent abdominal pain group (78%) in comparison with the control one (51.2%). The odds ratio was 3.39 (95% CI, 1.18–9.95).
Conclusion: fiber intake below the minimum recommended value is a risk factor for recurrent abdominal pain in children.
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Keywords: abdominal pain; child; dietary fiber

Introduction

Recurrent abdominal pain (RAP) is one of the most common incidences in pediatrics because it affects 4–25% of school-age children (Huertas-Ceballos *et al.*, 2002; Hyams *et al.*, 2002). Recurrent abdominal pain has been defined by Apley and Naish (1958) as at least three episodes of abdominal pain over a period longer than three months in children aged three years or above. The pain is severe enough to affect daily activities of the child. At least three incidences must have taken place in the last 12 months.

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According to Apley's referential definition <10% of the patients with recurrent abdominal pain have organic disease (Boyle, 2000). The following symptoms are considered warning signs for the evaluation of organic diseases in patients with chronic abdominal pain: weight loss, blood in the stools, fever, anemia or inflammatory conditions, vomiting and nightly painful episodes which wake up the patient (Campo *et al.*, 2004). Therefore, more than 90% of recurrent abdominal pains are accessorial to functional bowel abnormality (Boyle, 1997). That's why recurrent abdominal pain was included in Rome II pediatric criteria, which formulates definitions and approaches of functional digestive system disorders for the pediatric age bracket. According to Rome's criteria, patients with recurrent abdominal pain should fall into three categories: functional RAP *per se*, RAP associated with functional dyspepsia and RAP with abnormal bowel movements (Irritable Bowel Syndrome) (Rasquim-Weber *et al.*, 1999). However it is worth mentioning that not every RAP patient falls into these categories (Christensen, 2004).

The pathogenesis of recurrent abdominal pain is unknown. It is believed to be the result of the interaction of biopsychic and social issues (Rasquim-Weber *et al.*, 1999; Campo *et al.*, 2004). Somatic and visceral hypersensitivity are being biologically appraised in patients with recurrent abdominal pain as compared to control ones (Duarte *et al.*, 2000; Di Lorenzo *et al.*, 2001). A recent study in the psychological field has established a relation between recurrent abdominal pain, anxiety and depression (Campo *et al.*, 2004). Presumably these individuals manifest painful symptoms developed by bowel peristalsis, especially when additional physical effort is required to evacuate. It should also be noticed that recurrent abdominal pain might be linked to constipation. In this context, the prescription of a diet rich in fiber might result in an improvement for those patients, probably because it reduces bowel movement time span (Feldman *et al.*, 1985). Nevertheless, a systematic literature review does not clearly indicate that dietary fibers favorably contribute towards the treatment of recurrent abdominal pain. Nonetheless authors point out that there are few studies assessing the effectiveness of a dietary prescription for the treatment of recurrent abdominal pain (Huertas-Ceballos *et al.*, 2002). On the other hand, there are no researches carried out to correlate insufficient dietary fiber intake and abdominal pain, whereas there are works that established the connection between inadequate dietary fiber intake and constipation (Morais *et al.*, 1999; Rome *et al.*, 1999).

Therefore, the purpose of this study was to evaluate the dietary fiber intake in children with recurrent abdominal pain as compared to a control group without abdominal pain.

Methods

A cross-sectional study (consecutive sample) with 41 patients, 27 female, aged 4.8 up to 13.7 years, of the Pediatric Gastroenterology public health clinic, of the Darcy Vargas Children's Hospital, Sao Paulo, SP, Brazil, with RAP were evaluated by a pediatric gastroenterologist. The diagnosis of RAP was based on the Apley and Naish criteria (1958).

According to bowel movement, these patients were grouped into children with constipation or not. Chronic intestinal constipation was defined by painful or difficult evacuation of hardened stools during 3 or more months, regardless of time span between bowel movements, soiling, and blood in the stools (Rasquim-Weber *et al.*, 1999).

The control group consisted of 41 healthy children, 27 female, and their ages ranging from 4. 4 to 13. 8 years, from a public kindergarten and primary school located in the same region as the Hospital. The inclusion criteria were to be without any abdominal pain or constipation, evaluated by a pediatric gastroenterologist. Lack of constipation was determined by daily painless evacuation of soft feces (Morais *et al.*, 1999).

Previous written consent was obtained from parents or guardians, and the Research Ethics Committees of both the Federal University of Sao Paulo and the Darcy Vargas Children's Hospital approved the study.

Dietary evaluation

The Daily Food Intake method (Thompson and Byers, 1994) was used for dietary evaluation. Macronutrients and dietary fiber intake were calculated by the validated and standardized Nutritional Support System (Anção *et al.*, 1995) software. Dietary fiber data from the table of the Association of Official Analytical Chemists – AOAC (Shils *et al.*, 1994) and the Brazilian table (Mendez *et al.*, 1992) which distinguishes between soluble and insoluble parts of the dietary fiber, were inputted into the computer program.

Dietary fiber was expressed in percentage of the minimum daily fiber intake recommended by the American Health Foundation, which is 5 g of fiber plus age in years (age + 5 g) (Willians, 1995). It was also expressed in g/4186 kJ (1000 kcal) (Hansen and Wyse, 1980).

Statistical analysis

Statistics tabulation was sorted by software computer programs EPI-INFO version 6.0 and Jandel Sigma-Stat (Fox, 1995), using whatever required parametrical analysis, according to the nature of the variables. The odds ratio were calculated as an estimate of relative risk of low-dietary fiber for recurrent abdominal pain using the cutoff of age + 5 g as the minimum acceptable daily fiber intake. An alpha confidence level of 5% was adopted.

Results

There was no significant statistical difference between RAP without constipation, RAP with constipation and the control groups as to average age ($P = 0.358$); gender distribution ($P = 0.988$), and in relation to body mass index ($P = 0.264$) (Table 1).

According to the analysis of the inquiries relating to regular eating habits, there was no striking discrepancy among the three groups in relation to the number of meals per day, amount of food and consumption of calories, carbohydrates, lipids and proteins (Table 2).

Regardless of the table used to calculate dietary fibers and the results shown for fiber consumption, values were significantly smaller in groups with recurrent abdominal pain in relation to control group and with no statistical difference among groups with recurrent abdominal pain, constipated or not (Table 3).

Notwithstanding bowel movement, 32 (78%) out of the 41 children with recurrent abdominal pain revealed dietary fiber intake below minimum recommended values, whereas

Table 1 Demographic characteristics of the studied children

	RAP		*Control* n = *41*	P-*value*
	No constipation n = *27*	*Constipation* n = *14*		
Male:female	9:18	5:9	14:27	0.988[1]
Age (years)	10.2±2.5 (5.5–13.7)	9.1±2.7 (4.3–11.6)	9.3±2.8 (4.4–13.8)	0.358[2]
Peso (kg)	31.8 (24.3–38.7)	27.7 (23.0–34.6)	27.5 (21.0–33.7)	0.686[3]
Estatura (m)	1.35 (1.22–1.50)	1.30 (1.22–1.42)	1.32 (1.13–1.43)	0.302[3]
BMI	16.10 (15.11–17.40)	15.88 (14.8–18.13)	17.22 (15.3–20.80)	0.264[3]

Abbreviations: BMI, body mass index.
[1]*P* descriptive level of χ^2 test.
[2]*P* descriptive level of one way analysis of variance.
[3]*P* descriptive level of Kruskal–Wallis test.

Table 2 Data of food intake, determined by the daily food intake method in children with recurrent abdominal pain-RAP

Data of food intake	*RAP*		*Control* n = *41*	P-*value*
	No constipation n = *27*	*Constipation* n = *14*		
Meals/day	5 (5–5.75)	5 (4–6)	5 (4–5.25)	0.653[1]
Quantity of food (g)	1420.5 (1069.5–1721.4)	1317.0 (1156.0–1473.0)	1368.2 (1232.0–1618.8)	0.760[1]
Calories/day	1750.0 (1266.3–2152.5)	1713.5 (1510.0–1868.0)	1702.0 (15300–2002.7)	0.904[1]
Carbohydrates (% of TCV)	56.2 (53–62)	58.8 (55.5–61.1)	56.8 (54.5–60.0)	0.648[1]
Lipid (% of TCV)	26.6 (23.9–29.9)	26.6 (25.4–29.5)	26.9 (23.8–28.9)	0.985[1]
Protein (% of TCV)	15.9 (14.3–19.6)	16.3 (12.0–18.5)	14.7 (13.2–20.4)	0.718[1]
Carbohydrates (g/day)	261.0±98.9 (118.4–414.8)	249.4±65.5 (139.0–409.6)	257.7±61.5 (157.3–429.7)	0.800[2]
Lipid (g/day)	56.0±26.9 (26.3–90.9)	54.0±16.7 (16.2–80.5)	52.2±16.2 (16.9–83.9)	0.800[2]
Protein (g/day)	70.0 (53.5–91.9)	60.3 (55.5–72.4)	69.2 (53.6–83.8)	0.513[1]

Abbreviations: TCV total caloric value.
[1]*P* descriptive level of Kruskal–Wallis test.
[2]*P* descriptive level of one way analysis of variance.

Table 3 Mean daily total dietary fiber intake and fractions by children with recurrent abdominal pain (RAP), with or without constipation and control group, assessed by the daily food intake method

	RAP		*Control* n = *41*	P-*value*
	No constipation n = *27*	*Constipation* n = *14*		
Brazilian table[1] Total fiber (g)	18.2±6.9[a]	16.6±6.5[a]	23.7±7.2[b]	0.001
Soluble fiber (g)	7.5±2.8[a]	6.9±2.7[a]	9.5±2.9[b]	0.002
Insoluble fiber (g)	10.7±4.1[a]	9.7±3.8[a]	14.1±4.3[b]	0.001
AOAC table[2] Total fiber (g)	10.6±9.8[a]	9.9±5.0[a]	13.4±4.1[b]	0.008
Percentage of the reference value[3]	72.2±29.9[a]	70.7±32.1[a]	100.9±31.2[b]	0.001
Total fiber g/4186 kj (1000 kcal)	5.9±2.2[a]	5.7±2.5[a]	7.7±2.6[b]	0.005

[1]Mendez *et al.* (1995).
[2]Association of Official Analytical Chemists (Shils *et al.*, 1994).
[3]American Health Foundation (Willians, 1995).
P descriptive level of one way analysis of variance complemented by Tukey multiple comparison test.
Lines with different superscript letters: whit statistical difference ($P<0.05$).

in the control group 21 children (51.2%) also revealed fiber intake below minimum ($P=0.021$). The odds ratio was equal to 3.39 with a confidence interval of 95% from1.18 to 9.95 (Table 4).

Discussion

The average age of children with recurrent abdominal pain was 9.9±2.6 years, and 65.9% were female. Higher incidence

Table 4 Distribution of children with RAP and control group according to minimum recommended dietary fiber intake

Minimum recommended dietary fiber intake[1]	*RAP*	*Control*	*Total*
<age +5 g	32	21	53
⩾age +5 g	9	20	29
Total	41	41	82

[1]American Health Foundation (Willians, 1995).
$X^2 = 5.33$, $P = 0.021$.
Odds ratio = 3.39; 95% CI: 1.18–9.95.

of feminine gender is also reported in other studies (Hyams *et al.*, 1995; Croffie *et al.*, 2000).

It could be noticed a functional chronic constipation in 34.1% of the children with recurrent abdominal pain, a higher incidence than that found by Croffie *et al.* (2000) – 3.7% and by Stordal *et al.* (2001) – 16%. The constipation issue as a cause of recurrent abdominal pain is very controversial. As well as this, there are a large number of children who complain about RAP without having the presence of constipation. In this study, this fact was observed in 65.9% of the children. Considering that the incidence of constipation among children with abdominal pain is quite variable and the constipation criteria has not yet reached a consensus in literature, these two elements would explain divergent results obtained through different studies, which could lead one to infer that further studies are required to better explain this issue.

As to the scale of the diverging results concerning the association between RAP and constipation, one has to consider that disturbances of gastrointestinal motility show a relationship with RAP in children. Thus it was in 1967, that Kopel *et al.* related a large increase in the activity of the rectum-sigmoid that consequently retards movement posterior to evacuations, and can cause abdominal pain. Later, Dimson (1972), making use of the crimson rose colored test, observed a lateness in the time of intestinal transit. Other studies have shown an increase in intestinal transit; an exacerbated motor response to pharmacological stimulation and duodenal contractions of large amplitude (Dimson, 1972; Piñeiro-Careiro *et al.*, 1988; Christensen, 1994). In this context, recent studies have been showing that children with RAP present visceral hyper-sensibility (Di Lorenzo *et al.*, 2001; Van Ginkel *et al.*, 2001) and peripheral hyper-sensibility (Duarte *et al.*, 2000) that is currently considered one of the most important factors in the physiopathology of functional disturbances of the digestive system.

Both recurrent abdominal pain as well as its implication with constipation do not seem to influence the intake of macronutrients as well as the amount of food, since the ingestion was adequate according to age (NRC, 1989; WHO, 1990) and similar to the control group. Evaluation of these results in relation to literature is jeopardized because studies on recurrent abdominal pain are restricted only to clinical evidences. The Bogalusa population study of American children verified that greater intake of fiber is associated with a greater role of carbohydrates in the total caloric intake, while the lower intake of fiber is associated with a greater intake of lipids (Nicklas *et al.*, 1995). These data differ from those obtained in this study, in which daily quantities of carbohydrates and lipids ingested by children of various groups were not significantly different.

Food fiber is classified as soluble and insoluble, taking as a basis its property of solubility on water (Southgate, 1978). The main action of insoluble fiber within the organism is to bring about an increase in the fecal digestive mass and to diminish the time of intestinal transit, whilst the action of the soluble fiber is verified in the metabolism of the lipids and glucose. The soluble fibers form a gel, increasing the viscosity of the content in the gastrointestinal tract, a phenomenon that explains the retarding of the gastric draining. (Slavin, 1987; Hunt *et al.*, 1993; Spiller, 1994).

In general, the higher consumption of food fiber is associated with the elimination of feces that are softer and heavier, and there is also the observation of a shortening of the time of permanence of the fecal material in the large intestine (Hillemeier, 1995).

The amount of dietary fiber varies according to the method used for its analysis. Since there are a wide variety of methods for analysis in the literature, the existing different tables for food nourishing components differ considerably on fiber content. (Southgate, 1978; Sabioni, 1989; Schneeman and Tietyen, 1995; American Dietetic Association, 1998). A study that evaluated children dietary fiber intake using 5 different tables confirmed striking discrepancies in the estimate of fiber intake, depending on the applied table. (Vítolo *et al.*, 1998). In this current work, the use of the Brazilian table as well as the AOAC also revealed distinct values for total fiber, respectively 18.2 and 10.6 g for the abdominal pain group (no constipation); 16.6 and 9.9 g for the constipated group and 23.7 and 13.4 g for the control group. These results are similar to those found in the evaluation of dietary fiber intake by constipated children using the same tables (Morais *et al.*, 1999).

Although it has not been extensively studied so far, dietary fiber intake by children with recurrent abdominal pain was significantly smaller in relation to control group, regardless of the intake evaluation method, the table and the adopted reference frame (Hyams *et al.*, 1995).

According to the AOAC table, the median intake of fiber by the control group, 13.4 g/day, was similar to that discerned in children in the United States which consume approximately 12.4 g/day (Nicklas *et al.*, 1995).

The low ingestion of fibers by children with RAP probably results in these children not benefiting from the possible favorable effects of food fibers upon gastrointestinal motility. As well as this, the fiber intake showed that 32 (78%) of the children with recurrent abdominal pain had a fiber intake below the minimum recommended value. This finding, along with an odds ratio of 3.39, indicates that a low-fiber diet is a risk factor for recurrent abdominal pain. Based on

current study data, the minimum recommended daily fiber intake (age + 5 g) was effective in determining the risk of recurrent abdominal pain.

Conclusions

Low-fiber intake is a risk factor for recurrent abdominal pain in children. Further researches are required to determine the role of constipation in recurrent abdominal pain.

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