Dietary fibre and total fluid intakes are inversely associated with risk of constipation in Malaysian adolescents, adults and the elderly

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Introduction: Dietary fibre (DF) and fluid intakes have been reported elsewhere to reduce the risk of constipation. The association of these dietary components on Agachand's Constipation Score (CS) was investigated in the present study.

Methods: A total of 202 Malaysian participants comprising 50 adolescents (aged 12.4 ± 5.3 yrs), 50 adults (aged 46.3 ± 11.3 yrs), 52 women of child-bearing age (aged 29.1 ± 9.3 yrs) and 50 elderly persons (aged 70.0 ± 7.4 yrs) were recruited by convenience sampling from five venues - two communities in Cheras, one community in Klang, the IMU campus, Bukit Jalil and a private secondary school in Klang. All participants were interviewed with a previously-evaluated food frequency questionnaire (FFQ) and an Agachand's Constipation Score (CS) Questionnaire.

Results: Mean daily DF intakes were low across all age groups with means ranging from 10.0 – 15.6g. The percentage of subjects with daily DF intakes below the "deficient" cut-off of 20g was alarmingly high; 80% in adolescents, 45% in adults, 85% in women of child-bearing age and 70% in the elderly. About one-fifth or 20% of subjects in all age groups had CS values ≥15 which indicated a problem of constipation. Mean daily total fluid consumption (TFC) ranged from 2128 – 5490 ml in the four categories of subjects. Overall, both daily DF intakes and TFC were negatively associated with CS values. This inverse association was significant for DF vs CS scores in adolescents ($r = -0.500$, $p = 0.001$), adults ($r = -0.351$, $p = 0.013$), the elderly ($r = -0.392$, $p = 0.005$) and all subjects combined ($r = -0.366$, $p=0.001$). For TFC vs CS scores, the inverse association was only significant for the elderly ($r = -0.312$, $p = 0.027$) and all subjects combined ($r = -0.245$, $p = 0.001$).

Conclusion: The results of this study support the role of dietary fibre intake and TFC in reducing the risk of constipation, as well as reinforcing previous data for low DF intakes among the Malaysian population.

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Key words: Dietary fibre, fluid consumption, constipation score

Introduction

Constipation is reported to have a multiple etiology and is a common chronic problem across the globe. According to the World Gastroenterology Organisation (WGO), the different variations of the condition had made a simple definition or diagnosis for constipation problematic.[1] The introduction of the Rome II classification to diagnose constipation[2] had provided uniformity in the diagnosis and assessment of the severity of constipation. However, healthcare workers including nutritionists and dietitians require a simple tool to assess the prevalence and severity of constipation in the community. In this regard, a few constipation scoring systems had been developed which correlated well with objective physiologic findings in constipated patients.[3]

Dietary fibre (DF = soluble plus insoluble DF components) intake, total fluid consumption (TFC = moisture in food, drinks, beverages, soups) and physical activity had been reported as lifestyle factors associated with constipation.[1,4,5] In the local context, however, there is a paucity of studies on the association of these risk factors with constipation in the local population. Mazlin *et al.*[6] used the Chinese Constipation Questionnaire developed by Chan *et al.*[7] on 90 adults (12 males, 72 females; mean age= 31.8 ± 9.3 years) with a history of functional constipation and reported that stool consistency and output was positively correlated with DF and fluid intake, but not physical activity. However, the method used for quantifying stool output in the study was greatly vulnerable to subject recall bias and there is a need for further local studies on this topic.

Measurement of DF intake and TFC for local studies had been facilitated with the development of the nutrient calculator- DietPLUS.[8] We report here the daily DF and fluid intakes of 202 Malaysian subjects ranging from adolescents to the elderly and the association of

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these dietary components with Agachan's Constipation Scores (CS) which have been reported to simplify evaluation, and provide a uniform assessment of the severity of constipation.[9]

Methods

We used a cross-sectional study design involving a total of 202 Malaysians – 50 adolescents, 50 adults, 52 women of child-bearing age and 50 elderly persons were recruited by convenience sampling from five venues – two communities in Cheras, one community in Klang, the IMU campus at Bukit Jalil and a private secondary school in Klang. The characteristics of the participants are shown in Table 1. Exclusion criteria included non-Malaysians and individuals who could not comprehend either English, Malay or the Chinese language.

Sample size: The present sample size of 202 was estimated based on a weak Pearson correlation of r = 0.20 at α = 0.05 and power = 0.80.[10] We used the Lehr's equation[11,12] to determine the minimum sample size for between group comparisons, namely: n/group = 16/(effect size)^2 = 16/(10/15)^2 = 36, based on a rule of thumb estimate for standard deviation of 15% for the outcome variable and a 10% "minimum difference of scientific interest" between two group means.

Table 1: Characteristics of the participants (N=202)

Subject group	N	Gender		Ethnicity*			Age (years) Mean ± SD	Source of participants
		Males	Females	M	C	I		
Adolescents	50	28	22	9	37	4	14.8 ± 1.5	Beacon house Sri Lethia, Klang
Women of child-bearing age	52	0	52	9	34	9	29.1 ± 9.3	Pandamaran, Klang; Taman Mulia, Bandar Tun Razak (BTR), Kuala Lumpur
Adults	50	13	37	30	15	5	46.3 ± 11.3	Taman Mulia, BTR, IMU at Bukit Jalil
Elderly	50	25	25	11	39	0	70.0 ± 7.5	Rawang, BTR, IMU
Total	**202**	**66**	**136**	**59**	**125**	**18**	**39.9 ± 11.3**	

**M = Malay, C = Chinese, I = Indian*

Research tools:

Food Frequency Questionnaire (FFQ) **–** Food and fluid intakes of subjects were obtained using a single face-to-face interview with an evaluated semi-quantitative FFQ developed and evaluated at the International Medical University (IMU).[13] The FFQ consists of 30 types of food items with frequency of consumption as number of times per "day", "week", month", or year". Serving sizes were based on "S, M or L" with "M" being the usual serving size obtained from the Malaysian Food Composition database.[14] Dietary items consumed per day were all converted into grams.

DietPLUS Version 2 **–** DF and TFC were then quantified with the nutrient calculator developed by Ng TKW[8] at the International Medical University. This nutrient calculator was based largely on the Malaysian Food Composition database[14] with DF values of foods incorporated largely from the Food Composition Guide compiled by the Health Promotion Board Singapore.[15] Fluid intakes recorded approximated

total fluid intake since food items which contained negligible amounts of DF such as meats and seafoods in the FFQ were "skipped" to cut down subject interview time.

The Agachan Constipation Score questionnaire – This was based on the previously evaluated scoring system reported by Agachan *et al.* (1996)[9]. The questionnaire was based on 8 aspects connected with bowel movement with a possible minimum Constipation Score (CS) of zero ("0") and a maximum score of 30. The investigators reported that normal controls had CS below 8, constipated individuals or patients had CS scores >15, and 96% of 100 constipation cases were correctly predicted by the CS ($p<0.05$)[9]. The CS questionnaire was in the English Language and the participants in the study were interviewed face-to-face by members of the present research team. The stool form was not evaluated by the Bristol stool scale.[16]

Statistical analysis: All statistical analysis was performed with SPSS Version 18. Correlation analysis for numerical data was performed with Pearson's Correlation at $\alpha = 0.05$ and power = 0.80, and differences between subject groups were analysed by ANOVA at $p = 0.05$.

Results

The results of the DF intakes, total fluid consumption and CS of the subjects are shown in Table 2. Mean daily DF intakes were low across all age groups with means ranging from 10.0 – 15.6g. The percentage of subjects with daily DF intakes below the "deficient" cut-off of 20g was alarmingly high; 80% in adolescents, 45% in adults, 85% in women of child-bearing age and 70% in the elderly.

Mean daily total fluid intakes ranged from 2128 – 5490 ml in the four categories of subjects. Means for CS across all subject groups ranged from 6.86 to 8.84, with a combined mean for all subjects of 8.02 ± 5.56 and about 20% from all subjects groups having a CS of ≥15.

Table 2: DF intakes, Total Fluid Consumption (TFC) and Agachan Constipation Scores (CS) of the subjects in the study

Subject group	Number (N)	DF intake (g/day)*	Percentage with intakes <20g/day**	TFC (ml/day)	CS	Percentage with CS ≥ 15
Adolescents	50	12.40^{ab} 5.30	80	2367 ± 776	8.84 ± 4.50	22.0
Women of child-bearing age	52	9.97^{a} ± 5.14	85	2404 ± 956	8.62 ± 4.04	19.2
Adults	50	15.59^{b} ± 5.98	45	2524 ± 1050	6.86 ± 4.87	20.0
Elderly	50	14.36^{b} ± 7.41	70	2128 ± 896	7.72 ± 5.56	20.0
All subjects combined	202	13.05^{b} ± 7.41	70.3	2356 ± 1050	8.02 ± 5.56	20.3

** Values with different superscripts are significantly different at $p < 0.05$*
***Deficient DF intake cut-off = <20g/day*

The results of Pearson correlation analyses are shown in Table 3. Overall, both daily DF intakes and total fluid consumption were negatively associated with CS values.

Table 3: Correlation of DF intakes and TFC with CS

Subject group	N	Pearson's *r* (DF vs CS)	Pearson's *r* (TFC vs CS)
Adolescents	50	***r* = -0.500, p = 0.001***	*r* = -0.156, p = 0.290
Women of child-bearing age	52	*r* = -0.056, p = 0.691	*r* = -0.230, p = 0.100
Adults	50	***r* = -0.351, p = 0.013***	*r* = -0.263, p = 0.065
Elderly	50	***r* = -0.392, p = 0.005***	***r* = -0.312, p = 0.027***
All subjects combined	202	***r* = -0.366, p = 0.001***	***r* = -0.245, p = 0.000***

**Pearson correlation (r) values in bold type are significant.*

This inverse association was particularly evident for DF vs CS scores in adolescents (r = -0.500, p = 0.001), adults (r = -0.351, p = 0.013), the elderly (r = -0.392, p = 0.005) and all subjects combined (r = -0.366, p = 0.001) [Figure 1]. Compared to DF, the inverse association of total fluid intake vs CS scores was not as evident, being significant only in the elderly (for r = -0.312, p = 0.027) and all subjects combined (r = -0.245, p = 0.001) [Figure 2].

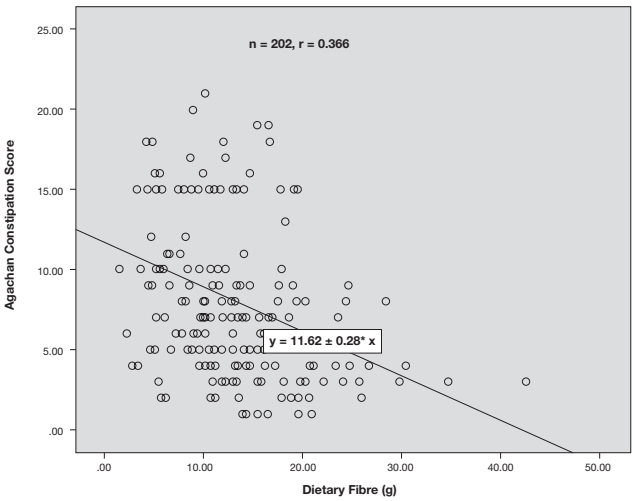

Figure 1: Inverse relation between daily Dietary Fibre intake and Agachan Constipation Score in the 202 participants

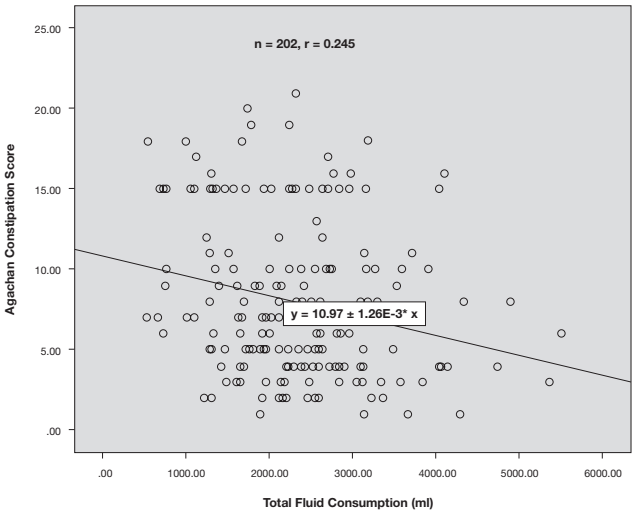

Figure 2: Inverse relation between daily Total Fluid Consumption and Agachan Constipation Score in the 202 participants

Discussion

We investigated the association of DF intake and total fluid consumption with Agachan's CS[9] which was used as an objective and simple evaluation of the problem of constipation among the subjects in the study. The Rome III diagnostic criteria[17] was not used as these could not distinguish between functional constipation and the constipation-subtype irritable bowel syndrome[18],

is complicated to diagnose, and would have needed the expertise of an experienced gastroenterologist. Besides, the Rome III diagnosis would generate categorical data instead of numerical data by the Agachan's CS.

Although physical activity was reported to be one of the lifestyle factors which affects the risk of constipation[19], it was considered to be of lesser importance than DF and fluid consumption and was not included in the present study because of the time constraint experienced by the present research team. To the best of our knowledge, we are reporting Agachan's CS for the first time amongst a Malaysian population consisting of adolescents, adults and the elderly. In Agachan *et al.*'s study[9], two groups of controls which were screened to exclude physiological symptoms of constipation had very low CS mean values of 2.1 and 3.4. In the present study, we included subjects from the general population who were expected to have higher mean CS values than those reported for Agachan's normal controls. In this regard, we recorded mean CS of 6.86 - 8.84 across all subject groups with an over mean ± SD of 8.02 ± 5.56. About one-fifth or 20% of subjects in all age groups had CS values ≥15 which indicated a problem of constipation.[3]

The systemic review of Higgins and Johanson (2004)[20] found an increasing trend of constipation with increasing age in North America. This phenomenon was not observed in the present study. Studies conducted elsewhere in Asian countries[21,22,23] had also indicated that the prevalence (7.3-25.0%) and risk of constipation were greater in women than men. This effect of gender on risk of constipation was not apparent in the present study although women-of-child-bearing age had the lowest DF intake which however, was not supported by the comparable means for TFC and CS across all subject groups.

We are aware that the FFQ method used has its limitations[24] but it is a well-accepted convenient and reliable dietary assessment tool to estimate macronutrient intakes without relying on multiple-day assessments of actual foods consumed.[25] In support of this, the FFQ method has been reported to be reproducible and adequate to determine macronutrient intakes in Singapore[26] and South Asians in the United Kingdom.[27]

Mean DF intakes were low across all subjects or age groups, ranging from 9.97 – 15.59 g/day with the women of child-bearing age having the lowest mean intake. The percentage of subjects with deficient daily DF intake (<20g/day) ranged from 45% to 85% across all groups. This overall unsatisfactory daily DF intakes agrees with an earlier report of low daily DF intakes by a group of healthcare workers by Ng *et al.*[28], as well as the estimated mean DF intake of 19.1g by the same author from data of the Malaysian Adult Nutrition Survey 2003.[29]

It is noteworthy that about 70% of all participants had daily dietary fibre intakes less than 20g, yet only 20% of all subjects had CS values ≥15 which indicated a problem of constipation. This discrepancy may be explained in part by the high minimum DF intake of 20g/day for Malaysians[31], which was previously questioned by Ng *et al.*[28]

Early recommendations for DF intake were obtained from western studies which investigated the effect of increasing amounts of non-starch polysaccharide (NSP) on stool output.[30] NSP is the main component of DF and in the absence of local data, the National Expert Group on Nutritional Guidelines had recommended a DF intake is 20-30 g/day for Malaysians.[30] Daily stool output by Malaysians from the limited data available indicates this might be at twice the amount recorded by Cummings (1993)[30] which put some doubt on the 20 – 30g recommended for Malaysians.[31]

Overall, both DF intake (Figure 1) and total fluid consumption (Figure 2) had a significant inverse association with CS which indicates that these dietary components are protective against the problem of constipation. These findings agree with that reported for the consumption of oat bran which significantly reduced by 59% the usage of laxatives among subjects with a serious problem of constipation.[32]

Mean daily TFC ranged from 2128- 5490 ml in the four categories of subjects in the present study which agree with the estimated 2.3L daily consumption by adults in the MANS 2003 study[29] and the 2.5L reported for a group of Malaysian adults diagnosed with constipation by the Rome II classification.[6] The findings of a significant inverse correlation of TFC with CS values in the elderly ($n = 50$; $r = -0.312$, $p = 0.027$) and all subjects combined ($n = 202$; $r = -0.245$, $p = 0.000$) in the present study support the role of fluid intake in helping DF to increase stool weight but also produce soft stools.[4]

Limitations of this study: These include the separation of women-of-child-bearing age as one of the groups studied when they could have been grouped together with the adult group investigated. It was also noted that the CS values obtained were not normally distributed (data not shown) in which case the non-parametric test, Spearman correlation, should ideally have been used instead for the association analysis. The present study was not able to distinguish women who had higher CS values due to problems of bowel movements arising from damage of the pelvic floor caused by multiple childbirth.[33] The present study was not designed to study differences in the variables measured across ethnic groups.

Conclusion

Both DF intake and total fluid consumption had significant inverse associations with CS used to indicate risk of constipation in the present Malaysian subjects comprising adolescents, adults and the elderly. The results of this study support the role of these dietary components in reducing the risk of constipation, as well as reinforcing previous findings for low DF intakes among the Malaysian population.

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