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Marina Coletta, Laura Di Palma, Tomba Carolina, Guido Basilisco. EXPLORING THE DISCREPANCY BETWEEN RECALLED AND RECORDED BOWEL HABITS IN PATIENTS WITH IRRITABLE BOWEL SYNDROME. *Alimentary Pharmacology and Therapeutics*, 2010, 32 (2), pp.282. 10.1111/j.1365-2036.2010.04322.x . hal-00552559

HAL Id: hal-00552559

<https://hal.science/hal-00552559>

Submitted on 6 Jan 2011

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Journal:	<i>Alimentary Pharmacology & Therapeutics</i>
Manuscript ID:	APT-0089-2010.R1
Manuscript Type:	Original Scientific Paper
Date Submitted by the Author:	30-Mar-2010
Complete List of Authors:	Coletta, Marina; Fondazione IRCCS Ca Granda Policlinico, Gastroenterology Di Palma, Laura; Fondazione IRCCS Ca Granda Policlinico, Gastroenterology Carolina, Tomba; Fondazione IRCCS Ca Granda Policlinico, Gastroenterology Basilisco, Guido; Fondazione IRCCS Ca Granda Policlinico, Gastroenterology
Keywords:	Functional GI diseases < Disease-based, Irritable bowel syndrome < Disease-based, Large intestine < Organ-based, Motility < Topics

**EXPLORING THE DISCREPANCY BETWEEN RECALLED AND
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IRRITABLE BOWEL SYNDROME**

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Running head: Bowel habit subtypes in IBS

Key words: Irritable bowel syndrome; Rome III criteria; bowel habit; diary cards; stool form;
colonic transit time

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SUMMARY

Background: A discrepancy between recalled and recorded bowel habit subtypes has been reported in irritable bowel syndrome (IBS), but the reasons for it are unclear. **Aim:** To assess: 1) the agreement between recalled and recorded bowel habit subtypes; 2) whether any discrepancy is related to stool form variability or psychological factors; and 3) the correlations of recalled and recorded stool form with colonic transit time. **Methods:** Bowel habit subtype was established in 54 IBS patients at the enrolment visit (recalled) and with the aid of diary cards (recorded). Colonic transit time, the variability of stool form, and the patients' psychological profiles were also recorded. **Results:** Recalled and recorded bowel habit subtypes agreed in only 54% of the patients ($\kappa=0.28$). Stool form variability was greater among the patients whose recalled and recorded bowel habit subtypes were discordant ($P=0.03$), whereas the psychological profiles were not different. Colonic transit time significantly correlated with stool form only when it was recorded on diary cards. **Conclusions:** The discrepancy between recalled and recorded bowel habits in IBS patients is related more to stool form variability than an altered psychological profile. Diary cards should be used to ensure that stool form reflects colonic transit time.

INTRODUCTION

Irritable bowel syndrome (IBS) is defined as a functional bowel disorder in which abdominal pain or discomfort improve with defecation and are associated with a change in form or frequency of stool [1]. IBS patients often complain of erratic bowel habits, and previous studies have confirmed the objective variability in their stool form and stool frequency [2-5]. However, despite this inherent variability, the patients are classified on the basis of bowel habit subtypes, with approximately 1/3 having diarrhea, 1/3 constipation, and 1/3 the mixed or undefined bowel subtype [3,5,6]. This classification is clinically relevant because constipation and diarrhea can be specifically treated, and the efficacy of drugs such as alosetron and tegaserod has been demonstrated in subgroups of patients with a specific bowel habit subtype [7].

The Rome II criteria classified bowel habit subtypes on the basis of a retrospective combination of stool frequency, stool form, and the absence or presence of defecation straining or urgency. The more recent Rome III criteria state that a stool form scale should be used to assess bowel habit prospectively and define the different bowel subtypes [1] because both healthy subjects and IBS patients consider diarrhea and constipation more in terms of stool form than stool frequency [8,9] and because there is a physiological correlation between colonic transit time and stool form, but not stool frequency [10]. Previous studies have revealed poor agreement between the Rome III and Rome II criteria [6] in terms of bowel subtyping, and a discrepancy between recalled and recorded bowel habits [11] in patients with functional bowel disorders [4,12].

The aim of this study was to investigate the reasons for the discrepancy between recalled and recorded bowel habits in patients with IBS. We hypothesised two possible factors: 1) the objective variability in bowel habit might affect its recall over time; and 2) the altered psychological profile of patients might affect both recall [13,14] and the reporting of bowel-

related words or symptoms [15]. To explore these hypotheses, we assessed: 1) the agreement between bowel habit subtypes when stool form is recalled at the time of clinical evaluation or recorded by means of a diary card; 2) whether any discrepancy in subtype is related to stool form variability or psychological factors; and 3) the strength of the association between recalled or recorded stool form and colonic transit time.

METHODS

Subjects

Between January 2008 and December 2009, 54 IBS patients (33 females) with a mean age of 35 ± 12 years were consecutively recruited at a first appointment from a cohort of 300 patients referred to the outpatient functional bowel disorder clinic of the Gastroenterology Unit of Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico (Milan, Italy). The exclusion criteria were abdominal surgery (other than appendectomy), pregnancy, and the use of medications that may affect colonic transit and bowel habit during the previous six months. The patients met the Rome III criteria for the diagnosis of IBS [1] and showed no signs of organic disease on the basis of their medical history, physical examination, blood chemistry (including the measurement of thyrotropin levels and serological testing for celiac disease), stool examination (including Salmonella culture and a search for parasites in five samples), abdominal ultrasound and proctosigmoidoscopy.

All of the patients gave their informed consent to the study, which was performed in accordance with the Declaration of Helsinki and approved by our local Ethics Committee.

A control group of 23 healthy subjects (15 females) with a mean age of 30 ± 6 years was recruited by means of a public advertisement and screened by means of the taking of a clinical and gastrointestinal history, and a physical examination. None of them complained of chronic gastroenterological or psychiatric symptoms, and none were receiving chronic treatment. All

of them were administered the psychological symptoms checklist (SCL-90), and 17 (mean age 31 ± 9 years; 10 females) were randomly assigned to complete the ten-day bowel habit diary cards (see Methods).

The mean BMI of the healthy subjects and IBS patients was respectively 21.83 ± 4.56 and BMI 20.45 ± 2.03 ; none of the healthy subjects and only one of the IBS patients had a body mass index of more than 24.9 kg/m^2 [16].

Enrolment questionnaire and recalled bowel habit

During the enrolment visit, the patients were shown a picture illustrating the Bristol stool form scale [17], and indicated the stool form they had in the majority of their bowel movements (recalled bowel habit). Mushy or watery stools (scores 6-7) defines IBS patients with diarrhea (IBS-D); hard or lumpy stools (scores 1-2) IBS patients with constipation (IBS-C); and scores of 3-5 patients with unsubtyped IBS (IBS-U). Previous epidemiological studies of the general population have validated these subgroups of stool form, and shown that they are a good surrogate of fast, slow and normal colonic transit times [18].

Ten-day diary cards and recorded bowel habit

Using a ten-day diary card, the patients recorded the timing and stool form of each defecation, starting one week of the clinical evaluation. Stool form was evaluated with the aid of the Bristol scale (recorded bowel habit). The subjects were not allowed to take any medication influencing bowel function during the period in which they completed the diary cards.

In accordance with the Rome III criteria and the data recorded on the diary cards, the patients were defined as having IBS with diarrhea (IBS-D) if $\geq 25\%$ of their bowel movements were characterised by loose (mushy) or watery stools, and $< 25\%$ by hard or lumpy stools; IBS with constipation (IBS-C) if $\geq 25\%$ of their bowel movements were characterised by hard or lumpy stools, and $< 25\%$ by loose (mushy) or watery stools; IBS mixed (IBS-M) if $\geq 25\%$ of their bowel movements were characterised by hard or lumpy stools, and $\geq 25\%$ by loose (mushy) or

watery stools; and IBS unsubtyped (IBS-U) if stool consistency was insufficiently abnormal to meet the criteria for IBS-C, D or M [1]. Given the small number of patients with IBS-M (1%) and the impossibility of identifying this subtype when stool form was recalled, the patients with IBS-M and IBS-U were grouped together as IBS-U.

Concordant and discordant bowel habit subtypes

On the basis of the results of the enrolment questionnaire (recalled bowel habit) and the ten-day diary cards (recorded bowel habit), two groups of patients were defined: those with concordant bowel habits at the two evaluations, and those with discordant bowel habits.

Stool variability

Stool frequency and stool form were assessed using the ten-day diary cards. Stool form variability was assessed by computing: 1) the range of stool forms for all defecations recorded in the ten-day diary cards; 2) the coefficient of variation (CV) of stool form as the standard deviation/mean Bristol stool form values x 100; and 3) the CV for the time interval between stools as the standard deviation/mean value of the interval between stools x 100 [19]. As they are affected by the frequency of an event, the CVs in each patient were calculated using the last five defecations (the minimum number of defecations recorded in ten days in healthy subjects) [19]. One defecated fewer than five times in the ten days covered by the diary cards, and was excluded from the CV calculations.

Psychological profiles

All of the patients completed a psychological symptoms checklist (SCL-90) designed to assess symptom severity in nine primary symptom dimensions [20]. The global severity index (GSI) was calculated, together with the somatisation, depression and anxiety dimensions, are thought to be specifically related to IBS. The scale scores are given as normalised t scores based on a non-psychiatric patient sample [20].

Reproducibility of stool form in different time periods

In order to investigate the reproducibility of stool form during different time periods, and whether this might explain the discrepancy between recalled and recorded stool form, the mean stool form during the last three days of the diary card (also used to assess colonic transit) was compared with that recorded during the first three days and with that recalled at the time of the first evaluation, using the Bland and Altman method [21].

Colonic transit time

Total colonic transit time was assessed according to Metcalf *et al.* [22] in the last 30 consecutive patients (19 females; mean age 33 ± 8 years). Abdominal X-rays were recorded at 9:00 a.m. on the eleventh day, after three days' ingestion of 20 differently shaped radio-opaque markers at 9:00 a.m. each day (Marquat Genie Biomedichal, Boissy-St Léger, France), using a rapid high-kilovoltage technique in order to reduce radiation exposure to less than 0.5 mSv. Total colonic transit time was calculated using the formula: colonic transit (hours) = $1.2 \times$ the number of markers. The healthy subjects did not undergo this assessment because the European Commission's "Guidance on Medical Exposure in Medical and Biomedical Research" does not allow the exposure of healthy subjects to X-rays for research purposes.

Statistical analysis

The data are given as mean values \pm standard deviation (SD), and were compared using Mann–Whitney U tests and the χ^2 test. A P value of 0.05 (2-sided) was considered statistically significant. Agreement between the recalled and recorded subtypes was assessed using Cohen's kappa statistics, for which values of >0.81 indicate very good agreement, $0.61-0.80$ good agreement, $0.41-0.60$ moderate agreement, $0.21-0.40$ fair agreement, and <0.21 poor agreement. Spearman's rank correlation test was used to explore the correlations

between colonic transit time and the stool form recalled by the patients or recorded during the first and last three days of the diary cards.

RESULTS

Agreement between recalled and recorded IBS subtypes

The frequencies of IBS subtypes when the predominant stool form was recalled during the enrolment visit were significantly different from those obtained when it was recorded using a ten-day diary card ($P < 0.01$) (Tab. 1). The recalled and recorded subtyping of the IBS patients agreed in only 29 (54%) of the patients (Fig. 1). The change in subtype was generally from IBS-U to IBS-D or IBS-C and *vice versa*, and was from IBS-D to IBS-C or *vice versa* in less than 5% of the cases. Cohen's linearly weighted kappa statistic also showed poor agreement between the recalled and recorded subtypes ($\kappa = 0.28$).

Characteristics of bowel habit

Table 2 shows the characteristics of bowel habit assessed by the healthy subjects and IBS patients using a ten-day diary card. Stool frequency, stool form variability, and the variables reflecting bowel habit variability (range of stool form, CV of stool form, CV of the interval between stools) were all significantly greater in the IBS patients. When the IBS patients were divided on the basis of the discordant or concordant subtyping of bowel habit, the CV of stool form was significantly greater ($P = 0.03$) in the patients with discordant subtyping (Fig. 2), whereas the range of stool form and the CV of the interval between stools were not significantly different between the two groups ($P > 0.20$ for all comparisons).

Psychological profiles (SCL-90)

Table 3 shows the normalised t scores for somatisation, depression, anxiety and GSI in healthy subjects and IBS patients. The patients had higher scores than the healthy subjects, but there were no differences in the psychological profiles of the patients with discordant or

concordant bowel habit subtypes ($P>0.40$ for all comparisons), or between the patients with different recorded subtypes ($P>0.20$ for all comparisons).

Reproducibility of stool form in different time periods

Stool form was not not significantly different when calculated during the last or first three days of the diary cards (mean difference in stool form during the last or first three days: 0.075 ± 1.21 ; $P=0.68$) or when recalled during the enrolment visit (mean difference between stool form during the last three days and that recalled during the enrolment visit: 0.13 ± 1.49 ; $P=0.52$). The absolute value of the differences was greater in the latter (1.23 ± 0.91) than the former comparison (0.94 ± 0.76), but this difference was not statistically significant ($P=0.13$).

Colonic transit time

Colonic transit time was abnormal in 10 out of 30 patients (33%), being accelerated in five (17%) and delayed in five (17%). It did not significantly correlate with stool form when stool form was recalled at the enrolment visit ($r=-0.20$, $P>0.20$), but the correlation was significant when stool form was recorded with the aid of a ten-day diary card (Fig. 3). In particular, the correlation was stronger when stool form was assessed on the same days as those used for the colonic transit evaluation ($r=-0.53$, $P=0.003$) than when it was addressed during the first three days ($r=-0.42$, $P=0.04$). There was no significant correlation between total colonic transit time and the anxiety or depression scores ($P>0.40$).

DISCUSSION

The findings of this study confirm the poor agreement between recalled and recorded bowel habits in patients with IBS and, for the first time, suggest that this discrepancy might be explained more by the objective variability of stool form than the patients' altered psychological profiles. They also show that stool form correlates with colonic transit time only when stool form is prospectively recorded with the aid of a diary card.

1
2
3 In line with the results of previous studies of IBS patients [5,6,23], only 54% of our patients
4 recalled and recorded concordant bowel habit subtypes. The change between the recalled and
5
6 the recorded evaluations were mainly from IBS-U to IBS-D or IBS-C and *vice versa*, and
7
8 rarely involved extreme alterations (directly from IBS-D to IBS-C or *vice versa*). This pattern
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10 of misclassification has previously been noted in longitudinal studies, which have rarely
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12 reported direct changes between constipation and diarrhea [4-6].
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17 We hypothesised that the discrepancy between recalled and recorded bowel habit subtypes
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19 might be related to stool form variability or the patients' altered psychological profiles. We
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21 therefore divided our series of IBS patients into two groups based on whether their recalled
22
23 and recorded IBS subtypes were concordant or discordant, and investigated whether the two
24
25 altered factors were more represented in one group than the other.
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29 The role of stool form variability was assessed by considering a number of variables. We
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31 confirmed that the bowel habits of IBS patients are objectively erratic, as found in previous
32
33 studies [2,4-6], but also established that the CV of stool form was significantly higher in
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35 patients discordant recalled and recorded subtypes, which suggests that objective variability in
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37 bowel habit might negatively affect patient reports.
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40
41 In a previous study of the role of altered psychological profiles, Ashraf *et al.* [12] found that a
42
43 history of psychiatric illness was five time more frequent in a series of patients reporting
44
45 constipation but who were not objectively constipated upon prospective evaluation. The
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47 psychological profiles of IBS patients are often altered: they are hypervigilant for information
48
49 regarding gastrointestinal symptoms and tend to selectively recognise emotionally negative
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51 words [13], and depression affects their cognitive and memory function [24]. Our findings
52
53 confirm that IBS patients have altered psychological profiles [25,26] but contrary to our
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55 expectations, the somatisation, depression and anxiety scores of our patients with discordant
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57
58 bowel habit subtypes were not significantly higher than those of the other patients.
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Finally, we assessed the strength of the association between colonic transit time and the stool form recalled during the clinical evaluation and recorded on diary cards. O'Donnell *et al.* [10] have previously found a significant ($r=-0.77$) correlation between colonic transit time measured using radio-opaque markers and the mean score of six consecutive defecations evaluated by IBS patients using diary cards, and Saad *et al.* [27] reported a weaker correlation in constipated patients ($r=-0.45$) that improved ($r=-0.62$) when colonic transit was assessed using a wireless motility capsule. We found a weaker correlation ($r=-0.53$) than that found by O'Donnell *et al.* [10], which may be related to the different series of patients. In addition, we found that the correlation between stool form and colonic transit time was only statistically significant when stool form was recorded with the aid of diary card, and not when it is recalled. Moreover, the correlation improved when stool form was evaluated at the same time as colonic transit time. These observations are relevant as they demonstrate the need for a prospective stool form evaluation with diary cards if stool form is to represent an acceptable surrogate of colonic transit time.

Interestingly, comparison of the individual values of the stool form recalled by the patients (Fig. 3a) with those recorded with the aid of a diary card during the last three days of the diary period (Fig. 3b), and analysis of the reproducibility of stool form when comparing these time periods, suggest that patients tend to recall the more extreme forms as those most representative of their bowel habit, but without any systematic bias towards diarrhea or constipation.

In conclusion, it may be misleading to rely on IBS patients' recall of their bowel habits because these are objectively erratic and this might influence the patients' apparent recall bias. As indicated by the Rome III criteria, the prospective recording of stool form with the aid of diary cards is essential to ensure that stool form reflects colonic transit time and that the subtyping of patients reflects objective pathophysiological differences.

Statement of interests:

This study was funded in full by the Associazione amici della Gastroenterologia del Padiglione Granelli.

Acknowledgement

We would like to thank Kevin Smart for reviewing the English text.

For Peer Review

Table 1: Rome III subtyping of IBS patients when bowel habit was evaluated at the time of the enrolment visit (recalled) or with the aid of ten-day diary cards (recorded). Given the small number of patients with IBS-M (1%) and the impossibility of identifying this subtype when stool form was recalled, the patients with IBS-M and IBS-U were grouped together as IBS-U. Number of patients (%).

(n = 54)	Recalled	Recorded
IBS-D	20 (37%)	26 (48%)
IBS-C	9 (17%)	16 (30%)
IBS-U	25 (46%)	12 (22%)

Table 2: Characteristics of bowel habits in healthy subjects and IBS patients assessed using a ten-day questionnaire. CV = coefficient of variation, calculated on the basis of the last five evacuations of each subject.

* $P < 0.01$; ** $P < 0.05$

	Healthy subjects (n=17)	IBS patients (n=54)
Stool frequency (n/day)	1.0 ± 0.3	$1.7 \pm 1.1^*$
Stool form (Bristol score)	3.5 ± 0.9	$4.4 \pm 1.1^*$
Range of stool form (Bristol score)	2.1 ± 1	$3.1 \pm 1.3^*$
CV for interval between stools (%)	54.2 ± 23.1	$77.4 \pm 37.2^{**}$
CV of Bristol stool form score (%)	21.2 ± 14.7	$30.2 \pm 16.7^{**}$

Table 3: Normalised global severity index (GSI), somatisation, depression and anxiety t scores in healthy subjects (HS) and IBS patients as a whole, and divided into those with discordant and concordant bowel habit subtypes.

	HS (n=23)	IBS		
		Total (n=54)	Discordant (n=25)	Concordant (n=29)
GSI	47.1 ± 9.6	*61.8 ± 7.7	61.6 ± 7.9	61.9 ± 7.6
Somatisation	46.6 ±9.0	*61.1 ± 8.3	62.2 ± 7.3	60.2 ± 9.1
Depression	49.4± 7.9	*60.8 ± 9.1	60.8 ± 7.9	60.9 ± 10.1
Anxiety	49.5 ±8.2	*62.1 ± 9.3	61.6 ± 9.7	62.6± 9.1

* P<0.001 vs healthy subjects. The differences between the IBS patients with discordant and concordant bowel habits were not significant (P>0.40).

FIGURE LEGENDS

Figure 1. Differences in bowel habit subtypes based on recalled and recorded assessments of stool form in IBS patients. The total height of the columns indicates the number of patients by subtype (D=diarrhea, C=constipation, U=unsubtyped) based on the recorded evaluations. The shaded portion of each column indicates the number of patients with concordant recorded and recalled subtypes. The white portions indicate the number of patients with discordant subtypes; the letters inside the white boxes specify the recalled subtype.

Figure 2. Coefficient of stool form variation (CV%) in patients with discordant or concordant recalled and recorded bowel habits. Mean values \pm SD.

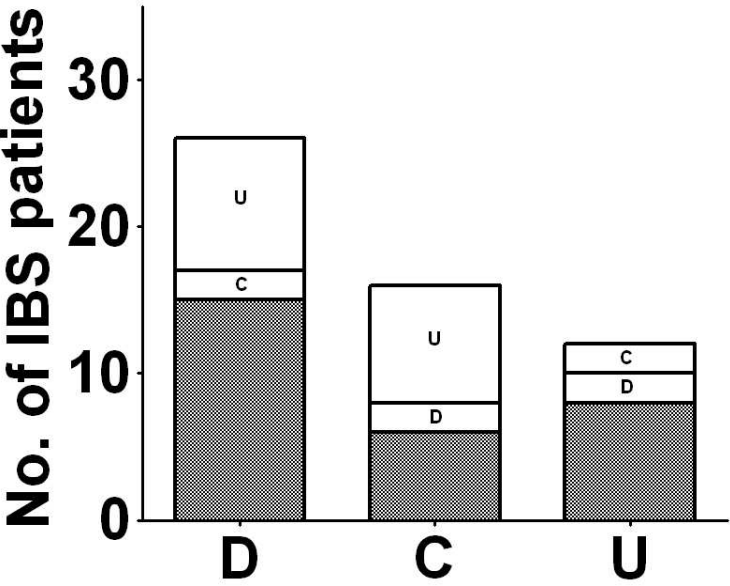
Figure 3. Correlation between colonic transit time and recalled stool form [a] or the stool form recorded on the last three days of the diary cards [b]. Stool form was assessed using the Bristol stool form score. The continuous line is the regression line; the dotted lines show the 95% confidence intervals.

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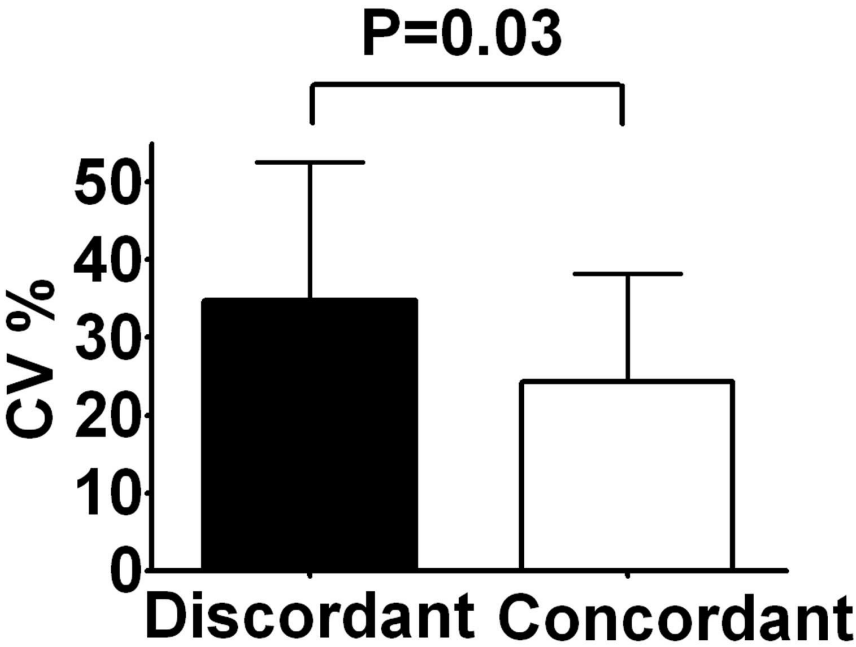
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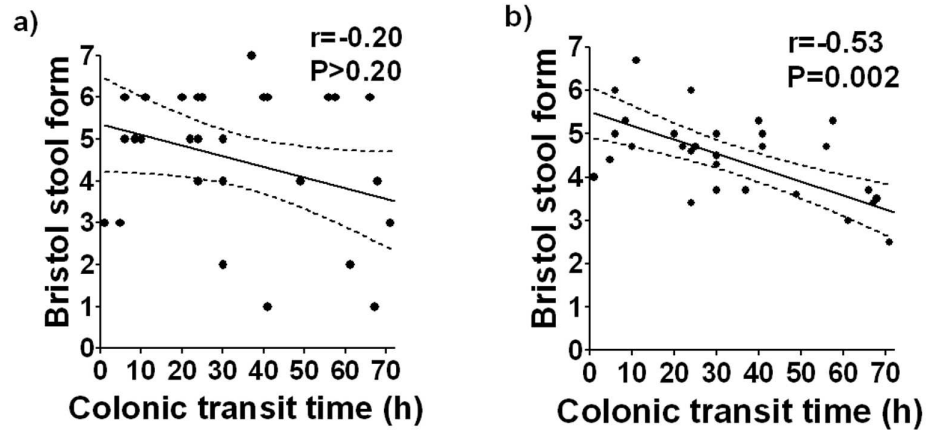
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Review



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Review



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