

Supplementary information S1. Colonic transit time, lactulose/glucose breath tests and wireless motility analysis.

1. The calculation of colonic transit time was made according to Metcalf *et al.* and Chaussade *et al.* methods^[30, 31]. Whole gut transit was defined as the interval between capsule ingestion, and the expulsion. Transit time was then calculated for each segment of the gastrointestinal tract. The interpretation was based on the identification of markers in three regions, based on body landmarks and gaseous outlines^[30, 31].
2. LBT and GBT (which use as substrate lactulose and glucose, respectively) were performed after a diet (260-kcal meal) including only fish, ham and rice, and excluding during the previous evening, slowly absorbed carbohydrates (i.e. bread or potato) and fibers, as they could interfere with hydrogen exhalation. Also, cigarette smoking and exercise were avoided two hours before and during the test, for the previously mentioned reason. Pro-motility and anti-motility drugs, antibiotics and other medications which may cause a small intestinal bacterial overgrowth, including proton pump inhibitors, were discontinued for about 14 days before performing breath tests^[25, 27]. Before the test, subjects were asked to fast, to brush their teeth, and rinse their mouths with antiseptic and then wash with tap water, in order to remove oral bacteria. End-expiratory breath samples were collected in a pocket. When the test started, fasting breath hydrogen was estimated 4 times and the average value was considered the basal value^[25, 27]. Thereafter, the subject ingested a fixed amount of 10 g lactulose or 75 g glucose^[25]. All samples of breath (for LBT) were tested for hydrogen and methane presence every 10 minutes for a period that lasted from 2 to 4 hours. Specific computer software recorded all breath tests values and finally oro-cecal transit time was estimated by the time interval required from the ingestion to the time when sustained rises (5-10 parts per million) of hydrogen content or a level of positivity for methane (≥ 10 parts per million) were detected by gas chromatography^[25, 27].
3. Wireless motility capsule test started with the consumption of a meal (260 kcal) following an overnight fast^[23]. Patients were asked to fast for 6 hours after capsule ingestion, after which they consumed a regular meal. The pH and temperature data

were then used to calculate the small-bowel transit time, which was defined by the time from arrival into the duodenum to the capsule migration into the caecum, which is defined by a constant pH drop of at least one pH unit^[23].

Supplementary information S2. Vitamin D serum levels measurement.

Fasted blood samples were left at room temperature until complete clot formation, and then were centrifuged at 1800 x g for 10 minutes. Then, serum samples were aliquoted and frozen at -70 °C until they were analyzed. Serum 25-(OH)-D was measured on thawed samples using the DiaSorin chemiluminescent immunoassay (CLIA) kit (DiaSorin, Stillwater, MN, USA). The DiaSorin is a direct competitive CLIA and consists of a two-step procedure. The first step, involves extraction of 25-(OH)-D from its binding serum protein and the subsequent bind to the specific antibody coated to the solid phase, consisting of magnetic particles.

After 10 minutes of incubation, 25-(OH)-D was added, linked to an isoluminol derivative as tracer. In the second step, the 25-(OH)-D tracer coated to solid phase was measured by adding a starter reagent that leads to a flash chemiluminescent reaction. The light signal is inversely proportional to the serum 25-(OH)-D amount in samples. The CLIA kit was compared by the constructor with the DiaSorin RIA 25-OH-D I¹²⁵ kit and gave a R²=0.9358. The intra-run coefficients of variation from quality control samples ranged between 4-8% and the inter-run coefficients of variation ranged between 9-13% in our Laboratory^[33, 34].

Supplementary Table 1. Demographic, clinical, quality of life/psychological parameters and laboratory characteristics of patients with intestinal motility disorders and controls.

Variables	Delayed cecal time (n=60)	oro-transit (or) STC (n=26)	Delayed cecal time (with) STC (n=86)
Age, mean (SD), years	51.5 (17) ^a	46.3 (18) ^a	50 (17.1) ^a
Sex, n (%)			
Male	8 (13.3)	5 (19.2)	13 (15.1)
Female	52 (86.7)	21 (80.8)	73 (84.9)
BMI, mean (SD), Kg/ m ²	24.3 (2.5) ^a	22.4 (3.1) ^a	24.6 (3.4) ^a
Education, n (%)			
Primary	2 (3.3)	3 (11.5)	5 (5.8)
Intermediate	25 (41.7) ^a	8 (30.8) ^a	14 (16.3) ^a
High school	26 (43.3)	12 (46.2)	37 (43)
Bachelor degree	7 (11.7) ^a	3 (11.5) ^a	28 (32.6) ^a
No data	0	0	2 (2.3)
Marital status			
Single	18 (30)	12 (46.2)	22 (25.6)
Married	41 (68.3)	12 (46.2)	58 (67.4)
Widower	1 (11.7)	2 (7.7)	4 (4.7)

Divorced	0	0	1 (1.2)
No data	0	2 (7.7)	1 (1.2)
Symptoms			
Constipation	52 (86.7) ^a	26 (100) ^a	3 (3.5) ^a
Abdominal pain	48 (80.0) ^a	25 (96.1) ^a	2 (2.3) ^a
Swelling	53 (88.3) ^a	26 (100) ^a	14 (16) ^a
IBS-QOL (total score)	102.5 (22) ^a	119.7 (23.1) ^a	39.8 (7.7) ^a
Dysphoria	22.3 (7.3) ^a	27.7 (7.5) ^a	8.7 (1.5) ^a
Interference	14.6 (4.5) ^a	18.5 (6.3) ^a	8 (1.6) ^a
Body image	14.5 (2.1) ^a	15.9 (1.9) ^a	4.8 (1.4) ^a
Anxiety health	13.4 (1.8) ^a	13.7 (2.0) ^a	3.7 (1.4) ^a
Food avoidance	13.4 (1.8) ^a	14.0 (1.1) ^a	3.7 (1.4) ^a
Social reaction	10.4 (3.2) ^a	11.5 (3.2) ^a	5 (1.1) ^a
Interpersonal relationships	5.6 (2.9) ^a	7.6 (3.6) ^a	3.3 (0.6) ^a
Sexuality	4.2 (1.9) ^a	5.3 (2.5) ^a	2 (0.1) ^a
HADS-14 A	13.9 (4.3) ^a	16 (4.2) ^a	2.4 (1.8) ^a
HADS-14 D	14.6 (3.0) ^a	14.7 (3.4) ^a	4.5 (2.6) ^a
SF12-PCS	40.4 (8.6) ^a	31.1 (9.2) ^a	47.2 (7.6) ^a
SF12-MCS	29.5 (7.4) ^a	28.3 (7.6) ^a	56 (7.1) ^a
Vitamin D, mean (SD), IU/ml	17.3 (7.5) ^a	8.4 (3.7) ^a	28.4 (8.8) ^a

^a $P < 0.01$ vs controls by t , F or X^2 . Values are absolute numbers and percentages (in parentheses) or average numbers and standard deviation (in parentheses). STC:

Slow Transit Constipation. BMI: Body mass index; IBS-QOL: Irritable Bowel Syndrome Quality of life; HADS-14 A: Hospital Anxiety and Depression Scale-14 for Anxiety; HADS-14 D: Hospital Anxiety and Depression Scale-14 for Depression; SF12-PCS: Short Form Health Survey12-Physical Component Summary; SF12-MCS: Short Form Health Survey12-Mental Component Summary; PTH: Parathyroid Hormone.

Supplementary Table 2. Demographic, clinical, quality of life life/psychological parameters and laboratory characteristics of patients with intestinal motility disorders.

Variables	Delayed oro-cecal transit time (n=32)	STC(n=28)	Delayed oro-cecal transit time (with) STC (n=26)
Age, mean (SD), years	51.2 (15.1)	51.8 (19.2)	46.3 (18)
Sex, n (%)			
Male	5 (15.6)	3 (10.7)	5 (19.2)
Female	27 (84.4)	25 (89.3)	21 (80.8)
BMI, mean (SD), Kg/m ²	24.2 (2.5) ^a	24.3 (2.5) ^a	22.4 (3.1) ^a
Education, n (%)			
Primary	1 (3.1)	1 (3.6)	3 (11.5)
Intermediate	13 (40.6)	12 (42.9)	8 (30.8)
High school	14 (43.8)	12 (42.9)	12 (46.2)
Bachelor degree	4 (12.5)	3 (10.7)	3 (11.5)
Marital status			
Single	7 (34.9)	11 (39.3)	12 (46.2)
Married	25 (61.6) ^a	16 (57.1)	12 (46.2) ^a
Widower	0	1 (3.6)	2 (7.2)
Symptoms			
Constipation	26 (81.2)	26 (92.8)	26 (100)
Abdominal pain	23 (71.9) ^a	25 (89.3) ^a	25 (96.1) ^a
Swelling	26 (81.2) ^a	27 (96.4) ^a	26 (100) ^a

IBS QOL (total score)	103.6 (23.3) ^a	101.1 (2.8) ^a	119.7 (23.1) ^a
Dysphoria	22.8 (7.7) ^a	21.6 (6.9) ^a	27.7 (7.5) ^a
Interference	15.0 (5.0) ^a	14 (3.8) ^a	18.5 (6.3) ^a
Body image	14.2 (2.6) ^a	14.9 (1.4) ^a	15.9 (1.9) ^a
Anxiety health	13.2 (1.8)	13.5 (1.8)	13.7 (2.0)
Food avoidance	13.7 (1.4)	13.1 (2.2)	14.0 (1.1)
Social reaction	10.2 (3.1)	10.6 (3.3)	11.5 (3.2)
Interpersonal relationships	5.7 (3.1)	5.5 (2.8)	7.6 (3.6)
Sexuality	4.5 (1.9)	3.9 (2.0)	5.3 (2.5)
HADS-14 A	14.0 (4.5)	13.8 (4.1)	16 (4.2)
HADS-14 D	14.5 (3.4)	14.6 (2.4)	14.7 (3.4)
SF12-PCS	40.5 (9.7) ^b	40.3 (7.4) ^b	31.1 (9.2) ^b
SF12-MCS	28.7 (9.0)	30.4 (4.9)	28.3 (7.6)
Vitamin D, mean (SD), IU/ml	17.08 (6.3) ^b	17.5 (8.8) ^b	8.4 (3.7) ^b
PTH, mean (SD), 10-70 pg/ml	48.3 (11.3) ^b	46.9 (13.5) ^b	59 (6.8) ^b

^a $P < 0.05$ and ^b $P < 0.01$ by t , F or X^2 . Values are absolute numbers and percentages (in parentheses) or average numbers and standard deviation (in parentheses). STC: Slow Transit Constipation; BMI: Body mass index; IBS-QOL: Irritable Bowel Syndrome Quality of life; HADS-14 A: Hospital Anxiety and Depression Scale-14 for Anxiety; HADS-14 D: Hospital Anxiety and Depression Scale-14 for Depression; SF12-PCS: Short Form Health Survey12-Physical Component Summary; SF12-MCS: Short Form Health Survey12-Mental

Component Summary; PTH: Parathyroid Hormone.