Original Article

Degree of transverse colon ptosis: an alternative surrogate for evaluation of slow transit constipation

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Background: Although transverse colon ptosis (TCP) is commonly diagnosed in patients with constipation, it has not attracted significant attention in the evaluation of constipation. Herein, we assessed the correlation between TCP-related radiological parameters and the severity of slow transit constipation (STC).

Methods: This study was a single-center retrospective cohort study, with participants enrolled between 2012 and 2020 in Zhongnan Hospital of Wuhan University, China. STC was diagnosed according to Rome IV criteria and results of colonic transit test (CTT); healthy volunteers were also recruited as controls. All participants were examined using abdominal X-rays (AXRs) to acquire the radiological parameters related to TCP. Among these parameters, the degree of TCP (DTCP) was defined as the vertical distance from the top of the splenic flexure to the lowest point of the reverse colon. The Wexner Constipation Score and Hospital Anxiety and Depression Scale were used to assess clinical severity. After multivariable linear regression, the correlations between radiological parameters and severity of STC were investigated. We also explored the differences in radiological parameters between the operation and the conservative group.

Results: The study included 139 patients with STC and 125 healthy people in as the normal control (NC). Patients with STC probably had larger DTCPs than those in the NC group (242.27±25.86 *vs.* 93.00±32.57 mm; P<0.001). Pearson correlation analysis showed that TCP-related parameters were consistent with the symptom severity of STC [e.g., parameter DTCP was strongly correlated with Wexner Constipation Score, with a β coefficient (95% CI) of 8.63 (8.24–9.02), P<0.001]. Multivariable linear regression models showed that patients with a larger DTCP were more likely to undergo surgery (23.67; 95% CI: 1.40–45.94; P=0.04).

Conclusions: TCP-related parameters, especially the DTCP, may serve as novel and feasible alternative indices for the assessment of STC. However, the potential value of DTCP in assisting the evaluation of STC

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needs to be confirmed in study with a larger sample size.

Keywords: Slow transit constipation (STC); colonic transit; abdominal X-ray (AXR); degree of transverse colon ptosis

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Introduction

Slow transit constipation (STC) is a clinical syndrome characterized by constipation and delayed colonic transit which accounts for 13–37% of all cases of constipation (1-4). The primary symptoms include reduced bowel movements, decreased or absent urge to defecate, difficulty in defecating, and dry stools (1,2). STC seriously affects the mental state and quality of life of patients.

Colonic transit is evaluated predominantly via radiopaque markers on plain film abdominal X-ray (AXR) [colonic transit tests (CTT)]. This is an inexpensive method of visualization that is widely applied in clinical settings and plays an important role in distinguishing different constipation subgroups, such as slow or normal transit constipation (5-7). Despite the high frequency at which AXR is applied, studies have suggested that the model shapes of the markers vary from hospital to hospital, and there is still no unified standard for the inspection and evaluation process (5-8). Further, the number of radiopaque markers remaining in the CTT may not necessarily correlate with the severity of constipation (9).

Gamma scintigraphy, magnetic tracking system approaches, and stool burden have also been introduced and have proven to be effective methods to identify colonic transit disorder (10-12). However, these methods are difficult to apply in areas with disadvantaged healthcare settings in the short term. Thus, it is important to explore concise and efficient STC evaluation methods.

Transverse colonic proptosis (TCP), defined as the abnormal downward displacement of the transverse colon without ptosis of other viscera, is a common phenomenon in patients with chronic constipation. As early as the 1920s, Cannon reported two cases of TCP and suggested that this anatomical anomaly was associated with constipation (13). It is speculated that the ptosis of transverse colon and the elevated splenic flexure are not conducive to the fecal propulsion in the upright state as stool accumulated in the transverse colon may further aggravate the degree of enteroptosis due to gravity and in turn, this vicious cycle relationship may be an important anatomic factor in intractable constipation (13-16). This suggests a potential relationship between TCP and the progression of constipation. However, the assessment of TCP has not yet gained attention, particularly in patients with STC. Given the paucity of research on the topic, whether there is a correlation between TCP and the severity of STC aroused our interest. Hence, this study aimed to investigate the correlation between TCP-related radiological parameters and the severity of STC, and to explore the usefulness of TCP in the diagnosis and treatment of patients with STC. We present this article in accordance with the STROBE reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-23-28/rc).

Methods

Participants

We retrospectively reviewed the files of patients with chronic constipation admitted to Zhongnan Hospital of Wuhan University between 1 January 2012 and 31 December 2020. The data were collected between 1 March 2021 and 31 March 2021.

The inclusion criteria were: (I) age >18 years; and (II) a confirmed diagnosis of simple STC according to the Rome IV criteria and CTT (17). Symptoms of constipation must be present for at least 6 months before the diagnosis, which was made based on the following criteria: no loose stools without the use of laxative, inadequate evidence for the diagnosis of irritable bowel syndrome, and the symptoms were not caused by opioids (17).

The exclusion criteria were: (I) evidence of obstructed defecation syndrome; (II) evidence of secondary causes of constipation; (III) known or suspected gastric or small bowel disorders, including dysmotility; and (IV) missing data (CTT was not performed).

A group of healthy participants (volunteers) who underwent plain abdominal radiography during the same

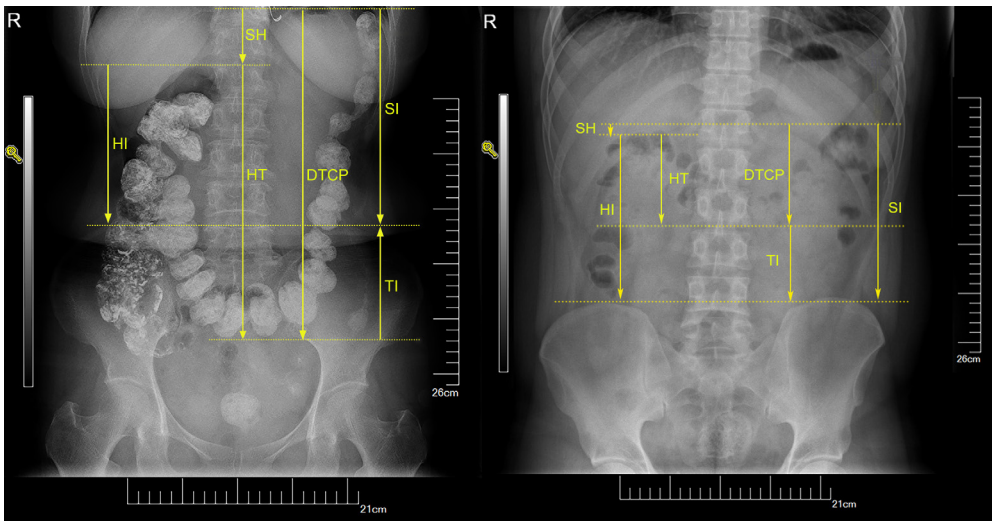

Figure 1 TCP-related indices measured on abdominal X-ray for STC group (left) and NC group (right). HI, the vertical distance from the hepatic flexure to the right iliac crest; SH, the vertical distance from the splenic flexure to the hepatic flexure; HT, the vertical distance from the hepatic flexure to the lowest point of transverse colon; DTCP, degree of transverse colon ptosis; SI, the vertical distance from the splenic flexure to the left iliac crest; TI, the vertical distance from the lowest point of transverse colon to the L4-L5 interspace; TCP, transverse colon ptosis; STC, slow transit constipation; NC, normal control.

period were also recruited as the normal control group (NC). The inclusion criteria were: (I) normal bowel function; (II) no digestive diseases; (III) no lower urinary tract or reproductive system diseases; (IV) no history of gastrointestinal (including anorectum) or urogenital surgery; (V) no history of pelvic trauma; (VI) no history of endocrine or metabolic diseases, including diabetes and thyroid diseases. We recorded data on the demographics, radiographic imaging data, and bowel movements for each participant (the bowel movements of healthy individuals were acquired via telephone follow-up). The severity of constipation, depression score, and therapeutic measures for patients with STC were also collected.

CTT

The CTT is an important method for the diagnosis of STC, and its procedure has been described in previous articles (6,11,18,19). Briefly, patients were prohibited from using laxatives, enemas, or other treatments that might affect gastrointestinal motility for the 3 days before the examination. Plain radiographs of the abdomen were taken 6, 24, 48, and 72 hours after a single ingestion of radiopaque markers [Sitzmarks capsule, Konsyl Pharmaceuticals, Easton, MD, USA (containing 24 markers)] or barium solution (50 mL, 20%) to reveal traces of markers/barium movement. Small bowel dysmotility was defined as the retention of two or more markers in the ileum after 6 hours, and a positive test for STC was considered if more than 20% of the markers were not eliminated after 3 days (11). The contour and position of the colon could be effectively identified by the scattered distribution of gas/markers/barium in the colon on AXR plain films.

Radiological parameters

Based on the abdominal plain films, the degree of TCP (DTCP) was defined as the vertical distance from the top of the splenic flexure to the lowest point of the transverse colon (*Figure 1*). To provide a more intuitive understanding of the TCP configuration, we defined the novel TCP-related indices, as shown in *Figure 1*. Based on abdominal plain films, the vertical distances from the hepatic flexure to the right iliac crest were recorded as HI; from the splenic flexure to the left iliac crest as SI; from the lowest point of transverse colon to the L4–L5 interspace [of the same height to the attachment of both sides of the iliac crest (20)] as TI; from the hepatic flexure to the lowest point of transverse colon as HT; and from the splenic flexure to the hepatic flexure as SH.

Assessment of symptom severity for STC

The severity of constipation was assessed according to the symptoms and bowel habits stated by patients during the initial visit. The Wexner Constipation Score (WCS) and the Hospital Anxiety and Depression Scale (HADS) were used to assess each patient with STC. The WCS is an eight-term measure of constipation severity scores; scores range from 0 to 30, with 0 indicating normal and 30 indicating severe constipation (21,22). Similarly, the HADS, a 14-term measure for the detection of anxiety and depression, was applied to determine the psychological condition (23). Scores ≥8/21 for both depression and anxiety are considered diagnostic with a sensitivity and specificity of approximately 0.80 (24). Symptoms related to constipation, including interval of bowel movement, length of time per attempt, and desire to defecate were also recorded.

Therapeutic measures

Conservative therapies, such as nonpharmacological interventions or systematic drug treatment, were recommended to patients with STC during their first visit to a doctor. The patients who opted for surgical treatment had to meet the following criteria (25-27): (I) at least 5 years of severe refractory STC (unresponsive to conservative treatment); (II) frequency of defecation less than two times per week; (III) no obvious obstructed defecation syndrome; (IV) no small bowel dysmotility; (V) no severe mental disease; and (VI) strong desire to undergo surgery.

Statistical analysis

Normally distributed variables were presented as the mean (standard deviation), and the independent-sample *t*-test was used to compare variables between the STC group and the NC group. Categorical variables were described as the frequency or percentage and examined by the Chi-squared test. Pearson correlations were applied to assess the correlations between the indices. Multivariable linear regression models were used to determine the linear regression coefficient (B) and 95% confidence intervals (CIs) of radiological parameters according to the STC group, severity of symptoms, operation group, and diseased colonic segments with adjustment for potential covariates. Receiver operating characteristic (ROC) curves were created, and an area under the ROC curve (AUC) was calculated. Subsequently, Youden's J statistic was used to determine an optimal cut-off point (maximizing both sensitivity and specificity) for the DTCP. Statistical significance was established when the two-tailed P value was <0.05. Statistical analyses were performed using R version 4.0.2 (R Foundation).

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the medical ethics committee of Zhongnan Hospital of Wuhan University. Written informed consent was obtained from the participants.

Results

Cohort characteristics

A total of 264 individuals were included in this cohort study: 139 patients with STC and 125 healthy people in the NC group (*Figure 2*) (the original data can be found in Table S1). The characteristics of these patients are presented in *Table 1*. Overall, the mean age of all participants was 55.03±13.75 years, and the majority were female (71.21%), with 76.26% and 65.60% female patients in the STC and NC groups, respectively. Compared with those in the NC group, patients in the STC group showed a longer interval of bowel movement (7.13±1.95 *vs.* 1.28±0.67 days), increased length of time per attempt (27.45±12.27 *vs.* 6.63±4.01 min), reduced defecation desire (75.54% *vs.* 0%), and higher WCS (17.51±2.12 *vs.* 0.53±0.78), all with P values <0.001.

TCP-related indices between STC and NC groups

Most patients (132 out of 139) in the STC group underwent CTT through barium solution. To rule out the effect of baseline information on the radiological parameters, multivariable linear regression models were applied after adjusting for sex, age, height, weight, and body mass index (BMI). As shown in *Table 2*, the HI (B, −39.43; 95% CI: −49.21 to −29.65; P<0.001) and TI (B, −155.81; 95% CI: −166.64 to −144.98; P<0.001) in the STC group were significantly lower than those in the NC group, and patients in the STC group had elevated DTCP (B, 147.29; 95% CI: 139.85–154.73; P<0.001), HT (B, 116.38; 95% CI: 107.27–125.49; P<0.001) and SH (B, 30.91; 95% CI: 22.10–39.72; P<0.001) compared to those in the NC group. However, the difference in the SI between the groups was not significant (P=0.07).

ROC curves were drawn for the groups, the results of

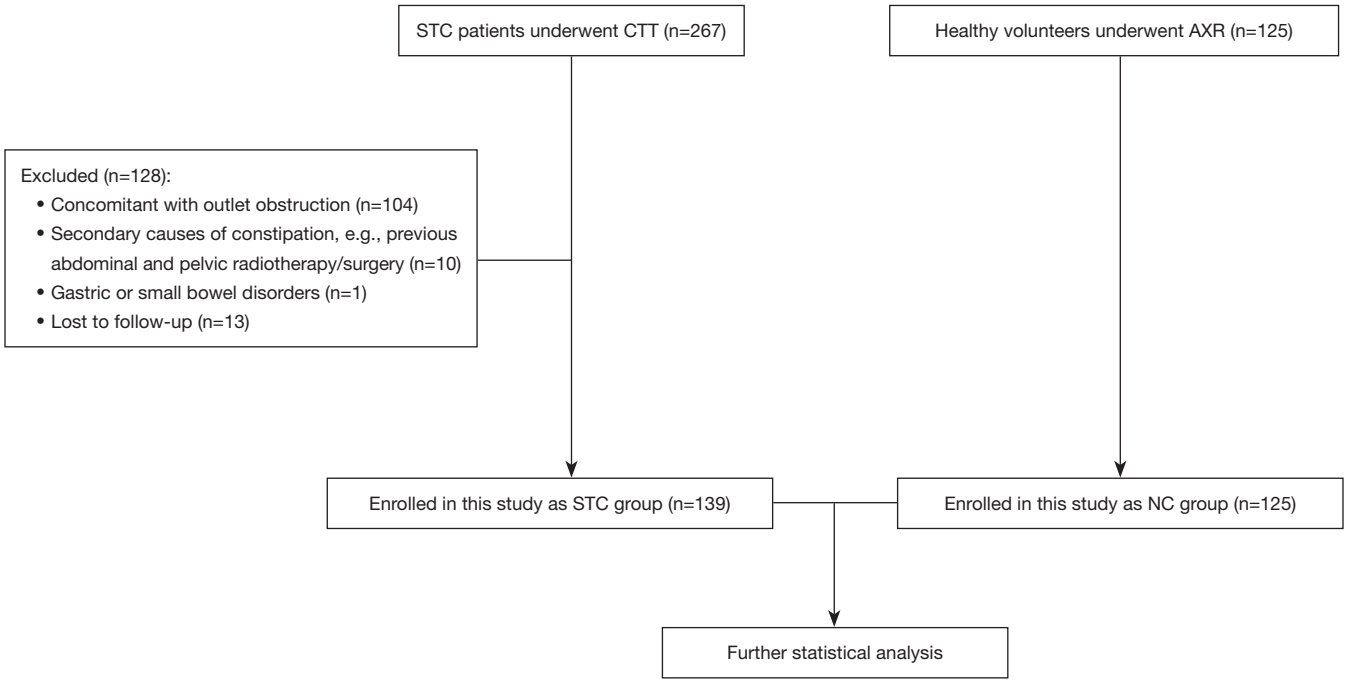

Figure 2 Patient selection flowchart. AXR, abdominal X-ray; CTT, colonic transit test; STC, slow transit constipation; NC, normal control.

which are shown in Figures S1-S7. A cutoff DTCP value of 165.17 mm could clearly segregate patients with STC from healthy people with high specificity and sensitivity (sensitivity 0.978 and specificity 0.984). TI (a cutoff value of –46.87 mm, with the sensitivity of 0.935 and the specificity of 0.984) and HT (a cutoff value of 109.45 mm, with the sensitivity of 0.942 and the specificity of 0.976) also achieved similar ideal results.

Correlation analysis between severity of STC and TCP-related indices

The correlations between TCP-related indices and clinical features after adjustment are listed in *Table 3*. The DTCP, TI, HT, HI and SH were well correlated with WCS, while the DTCP, TI, and HT exhibited good linear correlations with HADS.

Correlation analysis between the therapeutic regimen and TCP-related indices

A total of 72 patients with STC who underwent systematic treatment in our single medical group were screened for further investigation. Among them, 43 patients (38 females, mean age 54.77±11.30 years) underwent surgical treatment (operation group) and 29 patients (27 females, average age 56.21±12.37 years) underwent conservative treatment (conservative group). Patients with STC who required surgical intervention often had more severe symptoms of constipation. In this subgroup analysis, the WCS in the operation group was significantly higher than that in the conservative group (17.67±3.30 *vs.* 16.21±2.09; P=0.03). After adjustment, multivariable linear regression models revealed that the DTCP (B, 23.67; 95% CI: 1.40–45.94; P=0.04) and TI (B, 23.95; 95% CI: 1.15–46.74; P=0.04) in the operation group were significantly higher than those in the conservative group (*Table 4*).

Discussion

In patients with chronic constipation, particularly those with STC, it is common for TCP to be identified on AXR (13-16). This was first reported in 1922 by Cannon *et al.* (13), who concluded that a pendulous transverse colon assumed a "V" shape in the pelvis, with angulations at the hepatic and splenic flexures that were closely related to the symptoms. However, no related studies followed. In 2012, Sawa *et al.* recruited 43 healthy volunteers and reported that ptotic transverse colons were partially located below the fifth lumbar vertebra in four female volunteers (16). In

Table 1 Comparison of baseline information, bowel habits and radiological parameters between STC group and NC group

Variables	Total (n=264)	Groups		P
		NC (n=125)	STC (n=139)	
Sex				0.08
Male	76 (28.79)	43 (34.40)	33 (23.74)	
Female	188 (71.21)	82 (65.60)	106 (76.26)	
Age (years)	55.03±13.75	53.98±15.25	55.99±12.23	0.24
Height (m)	1.62±0.06	1.63±0.07	1.62±0.06	0.47
Weight (kg)	61.63±8.69	64.92±8.05	58.66±8.18	<0.001
BMI (kg/m^2)	23.40±3.36	24.58±3.21	22.33±3.13	<0.001
Interval of bowel movement (days)	4.36±3.28	1.28±0.67	7.13±1.95	<0.001
Length of time per attempt (min)	17.59±13.96	6.63±4.01	27.45±12.27	<0.001
WCS	9.47±8.65	0.53±0.78	17.51±2.12	<0.001
Desire to defecate				<0.001
Reduced	105 (39.77)	0 (0)	105 (75.54)	
Normal	159 (60.23)	125 (100.00)	34 (24.46)	
HI (mm)	99.57±42.86	121.28±42.37	80.05±32.82	<0.001
SI (mm)	148.02±36.12	154.26±38.41	142.42±33.08	0.008
TI (mm)	–23.57±90.96	61.25±47.70	–99.85±36.67	<0.001
HT (mm)	123.15±69.49	60.03±24.53	179.90±42.54	<0.001
SH (mm)	48.45±37.07	32.97±30.42	62.36±37.07	<0.001
DTCP (mm)	171.59±80.17	93.00±32.57	242.27±25.86	<0.001

Data are shown as n (%) or mean ± SD. STC, slow transit constipation; NC, normal control; BMI, body mass index; WCS, Wexner Constipation Scale; HI, the vertical distance from the hepatic flexure to the right iliac crest; SI, the vertical distance from the splenic flexure to the left iliac crest; TI, the vertical distance from the lowest point of transverse colon to the L4-L5 interspace; HT, the vertical distance from the hepatic flexure to the lowest point of transverse colon; SH, the vertical distance from the splenic flexure to the hepatic flexure; DTCP, degree of transverse colon ptosis; SD, standard deviation.

the study of Chen *et al.* in 2020 (15), TCP was considered as one of three crucial criteria in the diagnosis of superior mesenteric artery compression syndrome secondary to chronic constipation. To date, however, the relationship between chronic constipation and TCP has not been systematically studied.

The DTCP, a value that can be conveniently obtained from the AXR, represents the height difference between the uppermost and lowermost regions of the transverse colon in the standing position that can intuitively reflect its degree of decline. After adjustments for age, sex, height, weight, and BMI, the DTCP, as well as the values of HI, HT, TI, and SH in patients with STC, were significantly different from those in patients without STC. More importantly, ROC curve analysis showed that the DTCP may have the potential to distinguish STC patients from healthy individuals. However, large sample multi-center data are still required to confirm the effectiveness of DTCP in evaluating STC.

Some results suggest that TCP is more pronounced in patients with STC, and one possible explanation for this might be due to the gravity of feces. When the colon's motor function is impaired, stool accumulates. Because the transverse colon is not anchored to the retroperitoneum, it is more susceptible to the effects of gravity, and is thus more prone to colonic ptosis (13). In contrast, the splenic flexure of the colon, which is connected to the diaphragm and the tail of the pancreas by the phrenic colon ligament

Table 2 Comparisons of TCP-related indexes between STC and NC groups

Variables	Unadjusted			Adjusted†	
	N	β coefficient (95% CI)	P	β coefficient (95% CI)	P
HI (mm)					
NC	125	0 (reference)		0 (reference)	
STC	139	−41.23 (−50.32 to −32.14)	<0.001	−39.43 (−49.21 to −29.65)	<0.001
SI (mm)					
NC	125	0 (reference)		0 (reference)	
STC	139	−11.84 (−20.46 to −3.21)	0.008	−8.52 (−17.77 to 0.73)	0.07
TI (mm)					
NC	125	0 (reference)		0 (reference)	
STC	139	−161.11 (−171.32 to −150.90)	<0.001	−155.81 (−166.64 to −144.98)	<0.001
HT (mm)					
NC	125	0 (reference)		0 (reference)	
STC	139	119.88 (111.38 to 128.38)	<0.001	116.38 (107.27 to 125.49)	<0.001
SH (mm)					
NC	125	0 (reference)		0 (reference)	
STC	139	29.39 (21.16 to 37.63)	<0.001	30.91 (22.10 to 39.72)	<0.001
DTCP (mm)					
NC	125	0 (reference)		0 (reference)	
STC	139	149.27 (142.21 to 156.33)	<0.001	147.29 (139.85 to 154.73)	<0.001

†, adjusted model includes sex, age, height, weight and BMI. Data are presented as 95% CI. TCP, transverse colon ptosis; STC, slow transit constipation; NC, normal control; HI, the vertical distance from the hepatic flexure to the right iliac crest; SI, the vertical distance from the splenic flexure to the left iliac crest; TI, the vertical distance from the lowest point of transverse colon to the L4-L5 interspace; HT, the vertical distance from the hepatic flexure to the lowest point of transverse colon; SH, the vertical distance from the splenic flexure to the hepatic flexure; DTCP, degree of transverse colon ptosis; BMI, body mass index.

Table 3 Correlation analysis between severity of STC and TCP-related indexes

Variables	Unadjusted		Adjusted†	
	β coefficient (95% CI)	P	β coefficient (95% CI)	P
HI (mm)				
Interval of bowel movement (days)	−5.65 (−7.08 to −4.22)	<0.001	−5.28 (−6.77 to −3.78)	<0.001
Length of time per attempt (min)	−1.20 (−1.54 to −0.85)	<0.001	−1.10 (−1.46 to −0.74)	<0.001
WCS	−2.36 (−2.88 to −1.83)	<0.001	−2.24 (−2.81 to −1.68)	<0.001
Desire to defecate	34.47 (24.74 to 44.20)	<0.001	31.40 (21.15 to 41.65)	<0.001
HADS-A	0.54 (−2.23 to 3.30)	0.71	0.52 (−2.30 to 3.35)	0.72
HADS-D	−1.85 (−4.96 to 1.26)	0.25	−1.72 (−4.94 to 1.50)	0.30
SI (mm)				
Interval of bowel movement (days)	−1.59 (−2.91 to −0.27)	0.02	−1.11 (−2.49 to 0.27)	0.12
Length of time per attempt (min)	−0.54 (−0.85 to −0.24)	0.001	−0.44 (−0.77 to −0.11)	0.009

Table 3 (*continued*)

Table 3 (*continued*)

Variables	Unadjusted		Adjusted[†]	
	β coefficient (95% CI)	P	β coefficient (95% CI)	P
WCS	−0.65 (−1.14 to −0.15)	0.01	−0.45 (−0.99 to 0.08)	0.10
Desire to defecate	11.10 (2.28 to 19.92)	0.01	7.89 (−1.41 to 17.18)	0.10
HADS-A	−1.26 (−3.94 to 1.41)	0.36	−0.99 (−3.71 to 1.73)	0.48
HADS-D	−3.52 (−6.49 to −0.55)	0.02	−3.22 (−6.29 to −0.16)	0.04
TI (mm)				
Interval of bowel movement (days)	−23.24 (−25.07 to −21.41)	<0.001	−22.04 (−23.90 to −20.19)	<0.001
Length of time per attempt (min)	−4.54 (−5.10 to −3.97)	<0.001	−4.18 (−4.77 to −3.60)	<0.001
WCS	−9.40 (−9.97 to −8.83)	<0.001	−9.08 (−9.69 to −8.48)	<0.001
Desire to defecate	125.05 (108.46 to 141.64)	<0.001	113.33 (96.28 to 130.39)	<0.001
HADS-A	−7.39 (−10.29 to −4.50)	<0.001	−7.12 (−10.04 to −4.19)	<0.001
HADS-D	−7.73 (−11.05 to −4.40)	<0.001	−7.18 (−10.60 to −3.76)	<0.001
HT (mm)				
Interval of bowel movement (days)	17.59 (16.16 to 19.02)	<0.001	16.76 (15.29 to 18.23)	<0.001
Length of time per attempt (min)	3.34 (2.90 to 3.79)	<0.001	3.08 (2.62 to 3.55)	<0.001
WCS	7.04 (6.57 to 7.51)	<0.001	6.84 (6.34 to 7.34)	<0.001
Desire to defecate	90.58 (77.39 to 103.78)	<0.001	81.93 (68.27 to 95.59)	<0.001
HADS–A	7.93 (4.49 to 11.37)	<0.001	7.64 (4.12 to 11.16)	<0.001
HADS–D	5.88 (1.81 to 9.95)	0.005	5.45 (1.24 to 9.67)	0.01
SH (mm)				
Interval of bowel movement (days)	21.65 (20.27 to 23.02)	<0.001	4.17 (2.83 to 5.51)	<0.001
Length of time per attempt (min)	3.99 (3.49 to 4.49)	<0.001	0.66 (0.33 to 0.99)	<0.001
WCS	8.75 (8.39 to 9.12)	<0.001	1.79 (1.28 to 2.30)	<0.001
Desire to defecate	−113.96 (−128.15 to −99.76)	<0.001	−23.51 (−32.70 to −14.33)	<0.001
HADS-A	−1.80 (−4.94 to 1.35)	0.27	−1.51 (−4.72 to 1.69)	0.36
HADS-D	−1.67 (−5.23 to 1.90)	0.36	−1.50 (−5.18 to 2.18)	0.43
DTCP (mm)				
Interval of bowel movement (days)	21.65 (20.27 to 23.02)	<0.001	20.93 (19.55 to 22.32)	<0.001
Length of time per attempt (min)	3.99 (3.49 to 4.49)	<0.001	3.74 (3.22 to 4.26)	<0.001
WCS	8.75 (8.39 to 9.12)	<0.001	8.63 (8.24 to 9.02)	<0.001
Desire to defecate	−113.96 (−128.15 to −99.76)	<0.001	−105.45 (−120.12 to −90.78)	<0.001
HADS-A	6.13 (4.27 to 7.99)	<0.001	6.13 (4.24 to 8.02)	<0.001
HADS-D	4.21 (1.89 to 6.53)	0.001	3.95 (1.55 to 6.36)	0.002

Data are presented as 95% CI. [†], adjusted model includes sex, age, height, weight and BMI. STC, slow transit constipation; TCP, transverse colon ptosis; WCS, Wexner Constipation Scale; HADS-A, Hospital Anxiety and Depression Scale subscales of Anxiety; HADS-D, Hospital Anxiety and Depression Scale subscales of Depression; HI, the vertical distance from the hepatic flexure to the right iliac crest; SI, the vertical distance from the splenic flexure to the left iliac crest; TI, the vertical distance from the lowest point of transverse colon to the L4–L5 interspace; HT, the vertical distance from the hepatic flexure to the lowest point of transverse colon; SH, the vertical distance from the splenic flexure to the hepatic flexure; DTCP, degree of transverse colon ptosis; BMI, body mass index.

Table 4 Comparisons of TCP-related indexes between conservative group and operation group

Variables	Unadjusted			Adjusted[†]	
	N	β coefficient (95% CI)	P	β coefficient (95% CI)	P
HI (mm)					
Conservative group	29	0 (reference)		0 (reference)	
Operation group	43	5.45 (–12.04 to 22.94)	0.54	7.33 (–9.93 to 24.59)	0.41
SI (mm)					
Conservative group	29	0 (reference)		0 (reference)	
Operation group	43	3.02 (–16.04 to 22.09)	0.76	7.05 (–11.43 to 25.53)	0.46
TI (mm)					
Conservative group	29	0 (reference)		0 (reference)	
Operation group	43	26.30 (4.08 to 48.53)	0.02	23.95 (1.15 to 46.74)	0.04
HT (mm)					
Conservative group	29	0 (reference)		0 (reference)	
Operation group	43	–20.85 (–45.74 to 4.03)	0.11	–16.62 (–40.83 to 7.59)	0.18
SH (mm)					
Conservative group	29	0 (reference)		0 (reference)	
Operation group	43	–2.43 (–17.29 to 12.44)	0.75	–0.27 (–15.30 to 14.76)	0.97
DTCP (mm)					
Conservative group	29	0 (reference)		0 (reference)	
Operation group	43	23.88 (2.21 to 45.54)	0.03	23.67 (1.40 to 45.94)	0.04

Data are presented as 95% CI. [†], adjusted model includes sex, age, height, weight and BMI. TCP, transverse colon ptosis; HI, the vertical distance from the hepatic flexure to the right iliac crest; SI, the vertical distance from the splenic flexure to the left iliac crest; TI, the vertical distance from the lowest point of transverse colon to the L4-L5 interspace; HT, the vertical distance from the hepatic flexure to the lowest point of transverse colon; SH, the vertical distance from the splenic flexure to the hepatic flexure; DTCP, degree of transverse colon ptosis; BMI, body mass index.

and the transverse mesocolon, respectively, is a relatively fixed part of the colon (28). Therefore, compared with patients without STC, patients with STC have higher DTCP, TI, HT and SH values, but a lower HI value. Another explanation could relate to the characteristics of colonic propulsion. In addition to high-propagating contractions (HAPCs), colonic propulsion also includes retrograde propulsion (24), which may return intestinal contents back to the transverse colon from the descending colon. Interestingly, the frequency of propulsive HAPCs was decreased or even absent in patients with STC, leading to increased fecal accumulation in the transverse colon. In turn, ptosis of transverse colon resulted in a significantly greater fecal climb distance and higher potential energy difference in the standing position, which increased the static energy needed for fecal evacuation and further aggravated intestinal transmission function (15). Briefly, this indicates that the ptosis transverse colon may be both the result of colonic motor dysfunction and the cause of aggravated constipation.

Previous research studies that predominantly focused on the relationship between radiological parameters and severity scales had unsatisfactory results (28,29). Rao *et al.* reported a moderate correlation between barium distribution through CTT and quality of life (29), whereas similar research by Staller *et al.* revealed no such correlation (9). Overall, our data showed that the DTCP, TI and HT, which directly reflect ptosis of the transverse colon, were significantly associated with the WCS (the crucial comprehensive scale developed for severity assessment of constipation), and the

depression indices (HADS-A and HADS-D). Since ptosis of the transverse colon may be caused by gravity, colonic movement disorder, neurasthenia, and other factors (13,25), it may become more obvious over time, which is consistent with the aggravating progression of STC to some extent. In addition, HI and SH also correlated well with WCS. As previously mentioned, the ligaments in the hepatic flexure are not as strong as those in the splenic flexure (28), which may result in hepatic flexure being more susceptible to the gravity of transverse colon and secondary ptosis, and be the cause of the lower HI value. This results in a greater gravitational potential energy difference between the splenic flexure and the hepatic flexure, which is a secondary result of the TCP. Hence, individuals with lower HI or higher SH values may have more severe constipation and a higher WCS.

In the present study, we further explored the relationships between treatment methods and TCP. In our center, all patients with STC received standard treatment regimens, and only those who had failed systematic drug therapy were considered for surgical treatment. It appeared that patients with STC who underwent surgery may have more severe symptoms and poorer responses to conservative treatment. The DTCP and TI values of patients in the surgical group were significantly higher than those of patients in the conservative group, indicating that greater DTCP or TI values may indicate severe constipation.

Our study contained several limitations. First, this was a single-center retrospective study, which inevitably contains selection biases. Second, our cohort included more severe cases of constipation meaning the results may be less generalizable to the population at large. Third, the DTCP and other indices were based on a small-sample study, and large-sample clinical trials are needed to verify this system. Fourthly, the radiopaque markers used for CTT in this study were not completely uniform. Despite these limitations, our novel study preliminarily discussed the causes of TCP and the relationships between the degree of ptosis and severity of constipation. More importantly, our study revealed that the DTCP could be regarded as an alternative sensitive indicator to assess the severity of constipation and may provide a reference for the clinical diagnosis of constipation.

Conclusions

In this novel study, we systematically evaluated the relationship between TCP and STC. Overall, we found that some TCP-related indicators show good correlation with the severity of STC. Among them, as a dependable and intuitive index that reflects the distance from the splenic flexure to the lowest point of the transverse colon, the DTCP has unique value in the auxiliary diagnosis of STC and definition of the severity of STC. Thus, we propose that the DTCP may be a novel and feasible alternative index in the assessment of constipation. However, data from a larger sample, that includes patients with and without constipation, are required to verify and optimize the value of these ptosis-related indices in the diagnosis and treatment of STC.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://qims.amegroups.com/article/view/10.21037/qims-23-28/rc

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-23-28/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the medical ethics committee of Zhongnan Hospital of Wuhan University. Written informed consent was obtained from the participants.

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References

1. Drossman DA. Functional Gastrointestinal Disorders: History, Pathophysiology, Clinical Features and Rome IV. Gastroenterology 2016. [Epub ahead of print]. doi: 10.1053/j.gastro.2016.02.032.
2. Xi C, Hong Y, Chen B, Xie X, Liu W, Qian Q, Jiang C, Ren X. Characterization of Circular RNA Expression Profiles in Colon Specimens of Patients with Slow Transit Constipation. Dis Markers 2022;2022:3653363.
3. Lembo A, Camilleri M. Chronic constipation. N Engl J Med 2003;349:1360-8.
4. Hong Y, Ren X, Liu W, Sun K, Chen B, Liu B, Yu X, Chen Q, Qian Q, Xie X, Jiang C. miR-128 participates in the pathogenesis of chronic constipation by regulating the p38 /M-CSF inflammatory signaling pathway. Am J Physiol Gastrointest Liver Physiol 2021;321:G436-47.
5. Sharif H, Devadason D, Abrehart N, Stevenson R, Marciani L. Imaging Measurement of Whole Gut Transit Time in Paediatric and Adult Functional Gastrointestinal Disorders: A Systematic Review and Narrative Synthesis. Diagnostics (Basel) 2019;9:221.
6. Xu HM, Han JG, Na Y, Zhao B, Ma HC, Wang ZJ. Colonic transit time in patient with slow-transit constipation: comparison of radiopaque markers and barium suspension method. Eur J Radiol 2011;79:211-3.
7. Grønlund D, Poulsen JL, Sandberg TH, Olesen AE, Madzak A, Krogh K, Frøkjaer JB, Drewes AM. Established and emerging methods for assessment of small and large intestinal motility. Neurogastroenterol Motil 2017;29.
8. Cangemi DJ, Flanagan R, Barshop K, Kuo B, Staller K. Colonic Stool Burden a Useful Surrogate for Slow Transit Constipation as Determined by a Radiopaque Transit Study. Am J Gastroenterol 2019;114:519-23.
9. Staller K, Barshop K, Ananthakrishnan AN, Kuo B. Number of retained radiopaque markers on a colonic transit study does not correlate with symptom severity or quality of life in chronic constipation. Neurogastroenterol Motil 2018;30:e13269.
10. Bonapace ES, Maurer AH, Davidoff S, Krevsky B, Fisher RS, Parkman HP. Whole gut transit scintigraphy in the clinical evaluation of patients with upper and lower gastrointestinal symptoms. Am J Gastroenterol 2000;95:2838-47.
11. Kim ER, Rhee PL. How to interpret a functional or motility test - colon transit study. J Neurogastroenterol Motil 2012;18:94-9.
12. Mark EB, Poulsen JL, Haase AM, Espersen M, Gregersen T, Schlageter V, Scott SM, Krogh K, Drewes AM. Ambulatory assessment of colonic motility using the electromagnetic capsule tracking system. Neurogastroenterol Motil 2019;31:e13451.
13. Cannon GE. Ptosis of the Transverse Colon. J Natl Med Assoc 1922;14:227.
14. Prandota J, Iwańczak F, Pytrus T. Changes of the position and length of the transverse colon causing abdominal pain and chronic constipation during adolescence. Pol Merkur Lekarski 2003;15:47-50.
15. Chen QY, Tian HL, Yang B, Lin ZL, Zhao D, Ma CL, Chen X, Jiang J, Qin HL, Li N. Diagnosis and treatment of superior mesenteric artery compression syndrome secondary to chronic constipation (Lee's triad syndrome). Zhonghua Wei Chang Wai Ke Za Zhi 2020;23:44-50.
16. Sawa K, Mizushima T, Matsushita K, Shirahige A, Ochi K, Koide N. New large bowel segmentation on plain abdominal radiography in comparison with the conventional method. Acta Med Okayama 2012;66:239-44.
17. Drossman DA, Hasler WL. Rome IV-Functional GI Disorders: Disorders of Gut-Brain Interaction. Gastroenterology 2016;150:1257-61.
18. Bouchoucha M, Devroede G, Bon C, Raynaud JJ, Bejou B, Benamouzig R. How many segments are necessary to characterize delayed colonic transit time? Int J Colorectal Dis 2015;30:1381-9.
19. Remes-Troche JM, Rao SS. Diagnostic testing in patients with chronic constipation. Curr Gastroenterol Rep 2006;8:416-24.
20. Borghi B, Tognù A, White PF, Paolini S, Van Oven H, Aurini L, Mordenti A, Spada S, Bosco M. Soft tissue depression at the iliac crest prominence: a new landmark for identifying the L4-L5 interspace. Minerva Anestesiol 2012;78:1348-56.
21. Agachan F, Chen T, Pfeifer J, Reissman P, Wexner SD. A constipation scoring system to simplify evaluation and management of constipated patients. Dis Colon Rectum 1996;39:681-5.

22. Ren XH, Yaseen SM, Cao YL, Liu WC, Shrestha S, Ding Z, Wu YH, Zheng KY, Qian Q, Jiang CQ. A transanal procedure using TST STARR Plus for the treatment of Obstructed Defecation Syndrome: 'A mid-term study'. Int J Surg 2016;32:58-64.
23. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983;67:361-70.
24. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. J Psychosom Res 2002;52:69-77.
25. Camilleri M, Ford AC, Mawe GM, Dinning PG, Rao SS, Chey WD, Simrén M, Lembo A, Young-Fadok TM, Chang L. Chronic constipation. Nat Rev Dis Primers 2017;3:17095.
26. Jiang CQ, Qian Q, Liu ZS, Bangoura G, Zheng KY, Wu YH. Subtotal colectomy with antiperistaltic cecoproctostomy for selected patients with slow transit constipation-from Chinese report. Int J Colorectal Dis 2008;23:1251-6.
27. Xie XY, Sun KL, Chen WH, Zhou Y, Chen BX, Ding Z, Yu XQ, Wu YH, Qian Q, Jiang CQ, Liu WC. Surgical outcomes of subtotal colectomy with antiperistaltic caecorectal anastomosis vs total colectomy with ileorectal anastomosis for intractable slow-transit constipation. Gastroenterol Rep (Oxf) 2019;7:449-54.
28. Meyers MA. Roentgen significance of the phrenicocolic ligament. Radiology 1970;95:539-45.
29. Rao SS, Seaton K, Miller MJ, Schulze K, Brown CK, Paulson J, Zimmerman B. Psychological profiles and quality of life differ between patients with dyssynergia and those with slow transit constipation. J Psychosom Res 2007;63:441-9.

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Table S1 The original data of participants' characteristics

Subgroup	Subject number	Sex	Age(years)	Height (m)	Weight (kg)	BMI (kg/m2)	Interval of bowel movement (days)	Length of time per attempt (mins)	WCS	HADS-A	HADS-D	Desire to defecate	HI (mm)	SI (mm)	TI (mm)	HT (mm)	SH (mm)	DTCP (mm)
STC	1	Female	71	1.58	67	26.84	9	45	18	13	14	Reduced	57.43	112.83	-142.66	200.09	55.4	255.49
STC	2	Male	84	1.67	77	27.61	7	30	15	10	12	Reduced	28.18	82.1	-123.57	151.75	53.92	205.67
STC	3	Female	46	1.61	66	25.46	8	30	17	12	11	Normal	52.77	95.53	-138.57	191.34	42.76	234.1
STC	4	Male	54	1.68	58	20.55	8	35	18	15	14	Normal	45.46	143.64	-118.09	163.55	98.18	261.73
STC	5	Female	61	1.65	58	21.30	5	25	16	13	12	Reduced	57.54	134.02	-99.07	156.61	76.48	233.09
STC	6	Female	46	1.58	50	20.03	6	20	17	13	12	Normal	86.66	133.64	-114.15	200.81	46.98	247.79
STC	7	Male	72	1.74	68	22.46	7	15	17	14	13	Normal	68.74	140.9	-112.44	181.18	72.16	253.34
STC	8	Male	69	1.68	79	27.99	10	20	16	11	10	Reduced	72.77	133.98	-93.28	166.05	61.21	227.26
STC	9	Female	68	1.5	53	23.56	11	30	22	14	13	Reduced	139.46	175.24	-114.32	253.78	35.78	289.56
STC	10	Female	51	1.62	50	19.05	3	45	15	12	14	Reduced	101.39	131.44	-99.65	201.04	30.05	231.09
STC	11	Female	54	1.63	45	16.94	7	35	16	11	12	Reduced	110.07	144.03	-89.6	199.67	33.96	233.63
STC	12	Female	58	1.62	43	16.38	4	30	16	12	10	Reduced	83.51	140.3	-86.86	170.37	56.79	227.16
STC	13	Male	46	1.7	60	20.76	8	40	15	9	9	Reduced	119.1	135.44	-81.78	200.88	16.34	217.22
STC	14	Female	41	1.62	58	22.10	10	35	18	15	14	Reduced	79.12	135.99	-118.74	197.86	56.87	254.73
STC	15	Female	50	1.64	70	26.03	7	20	17	14	13	Normal	113.96	148.27	-94.25	208.21	34.31	242.52
STC	16	Female	72	1.62	59	22.48	7	45	18	14	14	Reduced	60.26	138.13	-116.21	176.47	77.87	254.34
STC	17	Female	44	1.59	52	20.57	5	20	17	13	13	Reduced	82.76	137.24	-102.51	185.27	54.48	239.75
STC	18	Male	71	1.78	63	19.88	7	30	19	14	13	Normal	90.58	146.82	-104.55	195.13	56.24	251.37
STC	19	Male	69	1.72	65	21.97	5	45	16	12	11	Reduced	62.28	131.97	-94.49	156.77	69.69	226.46
STC	20	Male	31	1.7	60	20.76	12	60	19			Reduced	41.45	146.27	-121.37	162.82	104.82	267.64
STC	21	Female	43	1.64	50	18.59	6	45	18	14	12	Reduced	93.89	132.26	-117.76	211.65	38.37	250.02
STC	22	Female	66	1.59	58	22.94	7	30	17			Reduced	58.6	137.17	-98.38	156.98	78.57	235.55
STC	23	Female	65	1.62	65	24.77	6	30	18	13	11	Reduced	67.2	146.25	-102.45	169.65	79.05	248.7
STC	24	Female	56	1.57	63	25.56	7	45	16			Reduced	74.92	145.56	-86.81	161.73	70.64	232.37
STC	25	Female	31	1.6	55	21.48	3	30	16	12	12	Reduced	69.21	138.02	-80.24	149.45	68.81	218.26
STC	26	Female	45	1.53	57	24.35	7	30	17	13	13	Reduced	113.23	149.04	-90.87	204.1	35.81	239.91
STC	27	Female	47	1.65	59	21.67	9	40	18			Normal	80.98	148.18	-107.48	188.46	67.2	255.66
STC	28	Female	44	1.56	49	20.13	9	30	18	14	12	Normal	93.79	147.31	-105.02	198.81	53.52	252.33
STC	29	Female	43	1.57	45	18.26	8	45	16	15	10	Reduced	87.58	140.27	-87.15	174.73	52.69	227.42
STC	30	Female	64	1.54	55	23.19	4	30	16			Reduced	110.18	131.65	-90.18	200.36	21.47	221.83
STC	31	Male	52	1.65	51	18.73	9	75	18	15	16	Reduced	108.88	116.19	-137.64	246.52	7.31	253.83
STC	32	Male	83	1.67	66	23.67	7	45	13	8	7	Reduced	41.36	116.25	-59.63	100.99	74.89	175.88
STC	33	Female	48	1.57	48	19.47	8	60	23	17	13	Reduced	37.51	125	-168.08	205.59	87.49	293.08
STC	34	Male	60	1.68	62	21.97	7	25	23			Reduced	11.12	3.9	-150.98	162.1	-7.22	154.88
STC	35	Female	59	1.6	50	19.53	10	30	17	13	13	Reduced	55.54	146.61	-100.38	155.92	91.07	246.99
STC	36	Male	71	1.67	57	20.44	9	45	19	14	12	Reduced	102.19	131.29	-133.1	235.29	29.1	264.39
STC	37	Female	47	1.58	49	19.63	7	45	14	12	14	Reduced	41.72	73.52	-143.3	185.02	31.8	216.82
STC	38	Female	43	1.63	59	22.21	10	20	24	16	14	Reduced	47.39	143.18	-151.6	198.99	95.79	294.78
STC	39	Male	65	1.67	64	22.95	6	45	16	13	14	Reduced	109.06	160.14	-66.47	175.53	51.08	226.61
STC	40	Female	58	1.5	62	27.56	10	30	22	10	11	Reduced	92.65	188.91	26.47	66.18	96.26	162.44
STC	41	Female	47	1.66	72	26.13	7	30	18	13	12	Reduced	80.11	136.66	-110.42	190.53	56.55	247.08
STC	42	Female	49	1.64	50	18.59	7	10	25	17	15	Reduced	86.73	167.42	-164.65	251.38	80.69	332.07
STC	43	Female	62	1.67	57	20.44	10	45	18	12	12	Reduced	91.79	136.17	-103.56	195.35	44.38	239.73
STC	44	Female	66	1.54	42	17.71	8	45	16	12	12	Reduced	10.05	74.1	-155.53	165.58	64.05	229.63
STC	45	Female	53	1.62	63	24.01	3	10	13	10	11	Reduced	37.57	175.74	-10.27	47.84	138.17	186.01
STC	46	Female	64	1.55	59	24.56	7	20	15	12	12	Normal	70.71	106.32	-102.83	173.54	35.61	209.15
STC	47	Female	65	1.63	72	27.10	3	45	11	18	17	Reduced	97.37	94	-71.34	168.71	-3.37	165.34
STC	48	Female	68	1.51	56	24.56	10	30	19	15	13	Reduced	76.68	120.87	-145.37	222.05	44.19	266.24
STC	49	Female	61	1.54	53	22.35	6	15	17	14	14	Reduced	29.13	143.28	-103.68	132.81	114.15	246.96
STC	50	Female	52	1.62	57	21.72	5	30	16	11	12	Reduced	76.06	143.06	-86.58	162.64	67	229.64
STC	51	Female	67	1.6	60	23.44	6	20	21	10	11	Reduced	35.97	83.46	-65.2	101.17	47.49	148.66
STC	52	Male	60	1.72	70	23.66	9	20	23	16	15	Normal	80.63	167.14	-126.12	206.75	86.51	293.26
STC	53	Female	69	1.55	59	24.56	8	15	17	8	10	Reduced	88.01	174.89	-69.24	157.25	86.88	244.13
STC	54	Female	63	1.64	49	18.22	8	30	17			Reduced	60.44	123.68	-124.27	184.71	63.24	247.95
STC	55	Female	56	1.68	70	24.80	8	30	16	10	8	Reduced	140.31	191.76	-38.11	178.42	51.45	229.87
STC	56	Female	62	1.62	64	24.39	6	30	21	16	12	Reduced	114.43	162.5	-108.77	223.2	48.07	271.27
STC	57	Female	58	1.61	64	24.69	6	10	16	8	10	Reduced	148.23	205.81	-25.29	173.52	57.58	231.1
STC	58	Female	58	1.56	70	28.76	8	25	18	12	10	Reduced	118.73	236.11	-21.71	140.44	117.38	257.82
STC	59	Male	75	1.73	77	25.73	7	30	15	13	8	Reduced	107.23	171.29	-28.66	135.89	64.06	199.95
STC	60	Female	48	1.67	68	24.38	7	15	21	16	14	Normal	40.89	145.34	-140.58	181.47	104.45	285.92
STC	61	Female	64	1.55	55	22.89	10	20	17			Normal	82.35	140.73	-105.22	187.57	58.38	245.95
STC	62	Male	76	1.68	63	22.32	7	45	17	16	15	Normal	97.77	160.28	-75.69	173.46	62.51	235.97
STC	63	Female	58	1.6	61	23.83	10	30	19	14	10	Reduced	190.43	247.34	-19.04	209.47	56.91	266.38
STC	64	Male	62	1.69	70	24.51	6	20	18	13	9	Normal	99.49	201.03	-47.41	146.9	101.54	248.44
STC	65	Female	58	1.61	58	22.38	5	25	18			Normal	137.52	173.64	-67.64	205.16	36.12	241.28
STC	66	Female	62	1.53	57	24.35	8	15	23			Normal	97.93	172.04	-118.44	216.37	74.11	290.48
STC	67	Female	53	1.6	45	17.58	6	20	16			Reduced	45.96	104.98	-127.66	173.62	59.02	232.64
STC	68	Female	64	1.54	56	23.61	7	20	17			Normal	83.7	180.63	-57.82	141.52	96.93	238.45
STC	69	Male	58	1.7	63	21.80	6	15	12	10	11	Reduced	103.4	202.43	33.18	70.22	99.03	169.25
STC	70	Female	53	1.62	62	23.62	9	25	22	15	9	Reduced	134.85	187.83	-95.73	230.58	52.98	283.56
STC	71	Male	65	1.74	65	21.47	10	20	18			Reduced	92.09	161.75	-93.54	185.63	69.66	255.29
STC	72	Female	57	1.65	60	22.04	8	15	16	10	11	Reduced	33.48	155.02	-82.22	115.7	121.54	237.24
STC	73	Female	56	1.5	70	31.11	3	10	13	8	8	Reduced	117.42	194.25	-18.84	136.26	76.83	213.09
STC	74	Female	22	1.52	42	18.18	10	20	17	11	12	Normal	85.5	113.15	-141.38	226.88	27.65	254.53
STC	75	Female	48	1.66	50	18.14	7	25	16	10	15	Reduced	64.71	167.94	-69.74	134.45	103.23	237.68
STC	76	Female	58	1.69	53	18.56	4	15	17	13	12	Reduced	108.56	151.45	-85.59	194.15	42.89	237.04
STC	77	Female	63	1.58	58	23.23	7	30	18	14	15	Reduced	39.02	106.16	-145.97	184.99	67.14	252.13
STC	78	Male	45	1.57	58	23.53	9	20	17	15	13	Reduced	66.51	134.64	-110.47	176.98	68.13	245.11
STC	79	Male	64	1.65	68	24.98	8	45	17	13	11	Reduced	121.74	157.1	-76.44	198.18	35.36	233.54
STC	80	Female	66	1.7	58	20.07	7	45	16	13	11	Reduced	35.98	112.02	-105.56	141.54	76.04	217.58
STC	81	Female	22	1.67	60	21.51	4	30	16	14	14	Reduced	92.2	110.99	-118.91	211.11	18.79	229.9
STC	82	Female	53	1.65	50	18.37	5	15	17	11	10	Reduced	32.29	186.66	-63.67	95.96	154.37	250.33
STC	83	Male	66	1.63	49	18.44	7	20	18	12	12	Reduced	129.69	165.43	-86.6	216.29	35.74	252.03
STC	84	Male	70	1.7	49	16.96	3	15	16	16	13	Normal	121.27	123.42	-100.63	221.9	2.15	224.05
STC	85	Female	64	1.58	68	27.24	10	30	18	10	12	Reduced	98.56	128.95	-124.97	223.53	30.39	253.92
STC	86	Male	65	1.57	65	26.37	10	30	20	15	13	Reduced	80.84	107	-165.64	246.48	26.16	272.64
STC	87	Female	55	1.65	62	22.77	5	25	17	15	12	Normal	60.76	189.4	-53.89	114.65	128.64	243.29
STC	88	Female	65	1.64	68	25.28	9	20	18	14	11	Normal	87.04	117.61	-141.21	228.25	30.57	258.82
STC	89	Female	65	1.67	62	22.23	8	30	18	13	11	Reduced	50.43	153.97	-102.77	153.2	103.54	256.74
STC	90	Female	45	1.55	60	24.97	5	20	18	12	14	Normal	129.35	150.52	-91.92	221.27	21.17	242.44
STC	91	Female	50	1.58	58	23.23	5	15	17	13	12	Reduced	64.34	127.57	-117.71	182.05	63.23	245.28
STC	92	Female	29	1.69	67	23.46	7	20	17	12	11	Reduced	37.56	127.43	-119.36	156.92	89.87	246.79
STC	93	Female	50	1.64	62	23.05	6	30	17	12	10	Reduced	90.42	113.83	-130.41	220.83	23.41	244.24
STC	94	Male	62	1.55	62	25.81	5	30	19	15	14	Reduced	104.28	148.31	-118.98	223.26	44.03	267.29
STC	95	Female	63	1.61	68	26.23	7	45	18	13	12	Reduced	56.52	180.42	-73.03	129.55	123.9	253.45
STC	96	Female	58	1.6	65	25.39	5	30	21	14	12	Reduced	40.12	126.3	-148.99	189.11	86.18	275.29
STC	97	Female	68	1.58	46	18.43	5	60	18	11	13	Normal	90.2	97.55	-148.13	238.33	7.35	245.68
STC	98	Female	48	1.62	68	25.91	8	30	19			Normal	33.15	153.07	-106.76	139.91	119.92	259.83
STC	99	Female	59	1.58	57	22.83	8	10	18	12	13	Normal	89.58	135.67	-122.29	211.87	46.09	257.96
STC	100	Female	47	1.7	50	17.30	8	45	18	14	16	Reduced	126.23	129.93	-129.76	255.99	3.7	259.69
STC	101	Female	54	1.67	46	16.49	8	60	17	12	12	Reduced	53.39	92.75	-136.04	189.43	39.36	228.79
STC	102	Female	51	1.59	63	24.92	4	20	17	12	12	Normal	31.12	141.41	-96.93	128.05	110.29	238.34
STC	103	Male	71	1.57	46	18.66	6	25	16	15	10	Reduced	115.16	100.68	-136.96	252.12	-14.48	237.64
STC	104	Female	54	1.69	70	24.51	8	25	16	11	10	Reduced	81.84	93.33	-136.95	218.79	11.49	230.28
STC	105	Female	57	1.64	66	24.54	9	20	17	16	14	Reduced	64.69	128.62	-123.89	188.58	63.93	252.51
STC	106	Female	63	1.61	50	19.29	8	30	17	11	15	Reduced	35.89	152.56	-87.33	123.22	116.67	239.89
STC	107	Female	44	1.65	50	18.37	7	15	16	12	16	Reduced	109.97	140.92	-85.28	195.25	30.95	226.2
STC	108	Female	32	1.68	47	16.65	5	25	17			Reduced	109.66	162.29	-76.7	186.36	52.63	238.99
STC	109	Female	65	1.6	59	23.05	9	20	19	12	11	Reduced	33.14	142.9	-122.35	155.49	109.76	265.25
STC	110	Female	41	1.6	52	20.31	10	20	16	13	13	Normal	80.59	130.12	-95.68	176.27	49.53	225.8
STC	111	Female	38	1.64	62	23.05	5	45	18	10	16	Reduced	42.39	135.41	-123.75	166.14	93.02	259.16
STC	112	Male	76	1.55	64	26.64	9	30	16	8	11	Reduced	53.4	131.01	-95.34	148.74	77.61	226.35
STC	113	Male	64	1.69	49	17.16	5	25	17			Reduced	64.91	180.56	-52.87	117.78	115.65	233.43
STC	114	Female	67	1.64	64	23.80	7	15	17	15	10	Reduced	115.34	189.59	-60.49	175.83	74.25	250.08
STC	115	Female	32	1.64	47	17.47	4	20	17	15	11	Normal	53.48	94.68	-140.33	193.81	41.2	235.01
STC	116	Female	55	1.62	68	25.91	10	25	18	12	16	Normal	128.42	145.28	-109.98	238.4	16.86	255.26
STC	117	Male	39	1.56	70	28.76	7	15	17	13	14	Normal	54.07	183.01	-55.66	109.73	128.94	238.67
STC	118	Female	34	1.64	58	21.56	7	30	16	11	13	Reduced	35.63	189.34	-47.34	82.97	153.71	236.68
STC	119	Female	31	1.67	66	23.67	6	15	17	12	12	Reduced	128.08	102.51	-132.35	260.43	-25.57	234.86
STC	120	Female	32	1.66	69	25.04	7	15	17	14	12	Reduced	74.92	103.95	-137.73	212.65	29.03	241.68
STC	121	Male	65	1.56	63	25.89	6	20	18	14	14	Reduced	49.53	110.73	-140.39	189.92	61.2	251.12
STC	122	Male	56	1.57	45	18.26	10	20	19	16	14	Reduced	83.87	134.78	-121.69	205.56	50.91	256.47
STC	123	Female	71	1.62	69	26.29	6	15	17	15	13	Normal	129.79	127.97	-121.87	251.66	-1.82	249.84
STC	124	Female	54	1.56	67	27.53	6	20	18	16	13	Normal	32.34	168.05	-78.98	111.32	135.71	247.03
STC	125	Female	47	1.55	52	21.64	3	20	17	12	12	Reduced	45.19	153.73	-84.36	129.55	108.54	238.09
STC	126	Female	63	1.59	63	24.92	8	20	18	13	12	Reduced	118	155.07	-86.2	204.2	37.07	241.27
STC	127	Female	56	1.63	48	18.07	7	25	16	15	12	Reduced	41.34	167.79	-64.33	105.67	126.45	232.12
STC	128	Female	62	1.67	52	18.65	7	20	18	14	15	Reduced	66.75	182.95	-65.43	132.18	116.2	248.38
STC	129	Female	56	1.59	49	19.38	9	15	18	12	12	Reduced	67.31	145.02	-107.73	175.04	77.71	252.75
STC	130	Female	49	1.59	58	22.94	8	15	17	10	11	Reduced	127.19	127.59	-108.56	235.75	0.4	236.15
STC	131	Female	39	1.67	55	19.72	7	10	18	14	12	Reduced	74.31	103.43	-151.43	225.74	29.12	254.86
STC	132	Male	72	1.69	49	17.16	6	30	18	12	12	Normal	124.03	187.52	-58.61	182.64	63.49	246.13
STC	133	Female	43	1.56	56	23.01	6	25	18	13	14	Normal	97.21	145.56	-95.96	193.17	48.35	241.52
STC	134	Female	31	1.59	53	20.96	6	25	19	16	13	Reduced	63.65	174.87	-94.23	157.88	111.22	269.1
STC	135	Female	67	1.57	46	18.66	10	10	19	15	14	Reduced	106.26	96.01	-160.33	266.59	-10.25	256.34
STC	136	Female	56	1.63	61	22.96	9	20	19	14	14	Reduced	105.79	146.67	-118.68	224.47	40.88	265.35
STC	137	Female	47	1.66	54	19.60	8	15	19	14	14	Reduced	70.73	189.44	-72.31	143.04	118.71	261.75
STC	138	Male	68	1.69	70	24.51	10	10	18	14	12	Reduced	96.51	113.64	-131.51	228.02	17.13	245.15
STC	139	Female	73	1.6	53	20.70	7	20	16	9	10	Reduced	66.59	157.86	-66.98	133.57	91.27	224.84
NC	140	Male	25	1.78	85	26.83	1	5	0			Normal	133.52	129.17	40.82	92.7	-4.35	88.35
NC	141	Female	51	1.55	54	22.48	4	20	3			Normal	138.72	167.04	47.89	90.83	28.32	119.15
NC	142	Male	24	1.67	66	23.67	1	5	0			Normal	151.64	168.66	99.29	52.35	17.02	69.37
NC	143	Male	33	1.66	75	27.22	1	10	1			Normal	210.69	227.01	156.68	54.01	16.32	70.33
NC	144	Female	46	1.5	65	28.89	0.5	15	2			Normal	163.61	193.55	113.77	49.84	29.94	79.78
NC	145	Male	46	1.64	65	24.17	1	5	0			Normal	154.72	131.45	78.73	75.99	-23.27	52.72
NC	146	Male	33	1.68	58	20.55	2	10	2			Normal	115.52	115.32	46.48	69.04	-0.2	68.84
NC	147	Male	42	1.77	89	28.41	0.5	5	0			Normal	90.94	153.68	57.66	33.28	62.74	96.02
NC	148	Female	34	1.64	55	20.45	2	10	1			Normal	7.21	95.92	-44.36	51.57	88.71	140.28
NC	149	Female	49	1.55	62	25.81	1	5	0			Normal	37.7	116.49	-14.42	52.12	78.79	130.91
NC	150	Female	42	1.63	59	22.21	1	10	1			Normal	114.88	173.5	51.01	63.87	58.62	122.49
NC	151	Female	66	1.6	60	23.44	1	10	1			Normal	48.8	58.77	-44.36	93.16	9.97	103.13
NC	152	Female	28	1.62	50	19.05	1	5	0			Normal	-19.41	73.19	-77.07	57.66	92.6	150.26
NC	153	Female	48	1.62	60	22.86	1	5	0			Normal	169.14	197.68	132.81	36.33	28.54	64.87
NC	154	Female	44	1.6	70	27.34	3	10	2			Normal	84.24	129.03	20.74	63.5	44.79	108.29
NC	155	Male	52	1.76	75	24.21	1	5	0			Normal	84.89	105.63	35.64	49.25	20.74	69.99
NC	156	Male	25	1.7	75	25.95	0.5	5	0			Normal	82.95	124.48	53.79	29.16	41.53	70.69
NC	157	Female	26	1.58	42	16.82	0.5	5	0			Normal	36.94	48.61	-36.94	73.88	11.67	85.55
NC	158	Male	54	1.7	80	27.68	1	5	0			Normal	178.23	206.38	93.66	84.57	28.15	112.72
NC	159	Female	30	1.63	66	24.84	1	10	1			Normal	117.63	151.44	72.54	45.09	33.81	78.9
NC	160	Female	56	1.6	54	21.09	2	10	1			Normal	150.19	178.94	73.24	76.95	28.75	105.7
NC	161	Male	51	1.65	61	22.41	0.5	3	0			Normal	63.38	143.03	12.7	50.68	79.65	130.33
NC	162	Female	54	1.63	63	23.71	1	2	0			Normal	80.28	179.68	-28.88	109.16	99.4	208.56
NC	163	Female	46	1.6	50	19.53	1	3	0			Normal	11.27	61.27	-59.15	70.42	50	120.42
NC	164	Male	30	1.67	87	31.20	1	5	0			Normal	126.13	256.33	126.13	0	130.2	130.2
NC	165	Male	34	1.52	56	24.24	0.5	5	0			Normal	151.4	167.2	136.4	15	15.8	30.8
NC	166	Male	51	1.51	59	25.88	1	3	0			Normal	178.6	186	106	72.6	7.4	80
NC	167	Female	57	1.74	58	19.16	2	2	0			Normal	108.7	198.4	62.3	46.4	89.7	136.1
NC	168	Male	60	1.7	59	20.42	1	4	0			Normal	187.6	234.7	158.6	29	47.1	76.1
NC	169	Male	71	1.53	68	29.05	1	5	1			Normal	145.9	166.9	85.8	60.1	21	81.1
NC	170	Male	51	1.69	70	24.51	1	10	1			Normal	117.3	138.9	70.5	46.8	21.6	68.4
NC	171	Female	53	1.66	64	23.23	2	5	0			Normal	147.5	204.1	44.1	103.4	56.6	160
NC	172	Male	59	1.71	68	23.26	1	5	0			Normal	143.9	132	101.1	42.8	-11.9	30.9
NC	173	Male	80	1.63	55	20.70	2	10	1			Normal	104.7	146	71.6	33.1	41.3	74.4
NC	174	Female	44	1.58	60	24.03	1	3	0			Normal	120.4	144.4	60.5	59.9	24	83.9
NC	175	Female	43	1.74	68	22.46	3	15	3			Normal	135.9	187.2	54.8	81.1	51.3	132.4
NC	176	Male	72	1.63	66	24.84	1	5	0			Normal	145.1	138.3	84.1	61	-6.8	54.2
NC	177	Female	60	1.59	55	21.76	2	3	0			Normal	82.8	118.4	-29.3	112.1	35.6	147.7
NC	178	Female	50	1.54	67	28.25	1	5	0			Normal	139.3	167.6	95.2	44.1	28.3	72.4
NC	179	Female	72	1.72	59	19.94	0.5	3	0			Normal	168.3	175.5	156	12.3	7.2	19.5
NC	180	Male	76	1.56	71	29.17	1	4	0			Normal	115	84.9	66.4	48.6	-30.1	18.5
NC	181	Female	46	1.58	63	25.24	2	5	0			Normal	74.4	66.9	-22.5	96.9	-7.5	89.4
NC	182	Male	55	1.66	60	21.77	1	3	0			Normal	174.3	230.9	127.1	47.2	56.6	103.8
NC	183	Male	87	1.63	74	27.85	2	5	1			Normal	73.1	128.3	23.2	49.9	55.2	105.1
NC	184	Female	53	1.65	57	20.94	1	5	0			Normal	140.1	168.7	82.8	57.3	28.6	85.9
NC	185	Male	32	1.51	61	26.75	2	3	0			Normal	59.6	155.3	28.1	31.5	95.7	127.2
NC	186	Female	67	1.63	58	21.83	1	3	0			Normal	134.1	192.5	100.5	33.6	58.4	92
NC	187	Male	82	1.68	56	19.84	1	5	0			Normal	141.4	153.3	63.1	78.3	11.9	90.2
NC	188	Male	46	1.71	72	24.62	1	10	1			Normal	112.2	133.4	34.9	77.3	21.2	98.5
NC	189	Male	69	1.63	65	24.46	1	5	0			Normal	110.8	153	61.6	49.2	42.2	91.4
NC	190	Male	27	1.64	59	21.94	1	3	0			Normal	82.7	104.8	48.9	33.8	22.1	55.9
NC	191	Male	59	1.53	79	33.75	2	3	0			Normal	60.9	103.1	-21.6	82.5	42.2	124.7
NC	192	Female	89	1.55	62	25.81	1	10	1			Normal	99.9	111.6	35.6	64.3	11.7	76
NC	193	Male	73	1.71	66	22.57	0.5	5	0			Normal	138.9	125.9	72.6	66.3	-13	53.3
NC	194	Male	65	1.55	62	25.81	1	10	1			Normal	167.6	133.7	74.6	93	-33.9	59.1
NC	195	Female	49	1.75	78	25.47	1	15	2			Normal	106.4	156	66.4	40	49.6	89.6
NC	196	Male	54	1.73	68	22.72	3	20	3			Normal	77.4	115.5	-39.8	117.2	38.1	155.3
NC	197	Female	63	1.59	61	24.13	2	20	2			Normal	152.6	147.2	49.3	103.3	-5.4	97.9
NC	198	Female	76	1.52	69	29.86	2	5	0			Normal	155.6	149.3	74.4	81.2	-6.3	74.9
NC	199	Female	45	1.63	59	22.21	3	10	2			Normal	57.4	92.9	-46.4	103.8	35.5	139.3
NC	200	Female	65	1.5	67	29.78	1	5	1			Normal	101.5	118.8	70.1	31.4	17.3	48.7
NC	201	Male	62	1.63	78	29.36	1	3	0			Normal	71.9	101.9	25.3	46.6	30	76.6
NC	202	Male	28	1.64	70	26.03	1	4	0			Normal	124.5	201.1	100.5	24	76.6	100.6
NC	203	Female	45	1.55	62	25.81	1	5	0			Normal	212.1	211.5	141.6	70.5	-0.6	69.9
NC	204	Male	69	1.67	78	27.97	2	10	1			Normal	124.4	190.6	108.1	16.3	66.2	82.5
NC	205	Male	47	1.74	77	25.43	1	5	0			Normal	97.9	98.6	38.9	59	0.7	59.7
NC	206	Female	68	1.65	57	20.94	2	5	0			Normal	105.4	143.4	44.9	60.5	38	98.5
NC	207	Female	38	1.6	66	25.78	1	10	1			Normal	97.2	162.2	62.3	34.9	65	99.9
NC	208	Female	55	1.65	65	23.88	2	15	2			Normal	98.2	154.9	40.9	57.3	56.7	114
NC	209	Male	83	1.59	59	23.34	1	10	1			Normal	104.2	147.9	71.4	32.8	43.7	76.5
NC	210	Female	76	1.61	80	30.86	1	5	0			Normal	93.4	136.4	70.4	23	43	66
NC	211	Female	45	1.67	71	25.46	0.5	10	2			Normal	99.2	132.1	75.3	23.9	32.9	56.8
NC	212	Female	54	1.57	62	25.15	3	5	1			Normal	133.7	183	42.6	91.1	49.3	140.4
NC	213	Male	41	1.75	73	23.84	2	5	0			Normal	152.6	214.9	100.6	52	62.3	114.3
NC	214	Female	49	1.64	57	21.19	1	10	1			Normal	141.7	217.8	99.2	42.5	76.1	118.6
NC	215	Male	84	1.64	67	24.91	1	3	0			Normal	140	132.8	71.6	68.4	-7.2	61.2
NC	216	Female	44	1.65	64	23.51	3	10	2			Normal	63.7	180	-41.1	104.8	116.3	221.1
NC	217	Female	39	1.56	65	26.71	2	5	0			Normal	88.3	151.9	49.9	38.4	63.6	102
NC	218	Male	76	1.61	65	25.08	1	10	1			Normal	143	165	104.1	38.9	22	60.9
NC	219	Female	29	1.54	71	29.94	1	5	0			Normal	134.1	169.7	76.2	57.9	35.6	93.5
NC	220	Male	53	1.71	70	23.94	1	15	2			Normal	153.2	194.1	124.6	28.6	40.9	69.5
NC	221	Female	73	1.51	58	25.44	1	3	0			Normal	39.3	93.5	-35.9	75.2	54.2	129.4
NC	222	Male	65	1.53	64	27.34	1	5	0			Normal	97.2	154	58.8	38.4	56.8	95.2
NC	223	Male	29	1.62	61	23.24	2	10	1			Normal	83.9	176.6	46.3	37.6	92.7	130.3
NC	224	Female	55	1.65	72	26.45	1	3	0			Normal	132.8	162	78.5	54.3	29.2	83.5
NC	225	Male	46	1.7	59	20.42	1	5	0			Normal	166.3	183.2	74.2	92.1	16.9	109
NC	226	Female	49	1.59	60	23.73	0.5	5	0			Normal	153.9	170.9	110.3	43.6	17	60.6
NC	227	Female	50	1.64	74	27.51	1	10	1			Normal	142.9	186.3	110.3	32.6	43.4	76
NC	228	Female	40	1.7	74	25.61	1	5	0			Normal	172.1	196	113.2	58.9	23.9	82.8
NC	229	Female	31	1.56	76	31.23	1	3	0			Normal	195.1	197.2	132.7	62.4	2.1	64.5
NC	230	Female	62	1.61	79	30.48	1	5	0			Normal	134.7	155.9	93.7	41	21.2	62.2
NC	231	Female	69	1.57	67	27.18	2	10	1			Normal	140.9	166.9	87.5	53.4	26	79.4
NC	232	Female	78	1.64	71	26.40	1	5	0			Normal	146.7	169.9	105.8	40.9	23.2	64.1
NC	233	Female	38	1.64	61	22.68	2	5	0			Normal	111.4	165.5	64.8	46.6	54.1	100.7
NC	234	Female	38	1.58	68	27.24	2	3	0			Normal	81.8	159.9	35.6	46.2	78.1	124.3
NC	235	Female	56	1.72	80	27.04	1	10	1			Normal	115.4	159.4	51.7	63.7	44	107.7
NC	236	Female	66	1.56	59	24.24	2	15	2			Normal	123.6	183.5	43.5	80.1	59.9	140
NC	237	Female	66	1.68	62	21.97	1	10	1			Normal	130.8	158.2	72.6	58.2	27.4	85.6
NC	238	Female	70	1.66	62	22.50	0.5	5	0			Normal	118	137	76.9	41.1	19	60.1
NC	239	Female	70	1.55	66	27.47	1	3	0			Normal	105.5	136.4	36.2	69.3	30.9	100.2
NC	240	Female	51	1.5	62	27.56	1	10	1			Normal	152	161.3	93.7	58.3	9.3	67.6
NC	241	Female	66	1.6	67	26.17	1	5	0			Normal	122.7	173.7	75.9	46.8	51	97.8
NC	242	Female	61	1.7	57	19.72	1	3	0			Normal	205.1	209.4	143.1	62	4.3	66.3
NC	243	Female	66	1.68	57	20.20	1	3	0			Normal	164.2	166.9	88.3	75.9	2.7	78.6
NC	244	Female	43	1.69	57	19.96	1	10	1			Normal	92.7	118.8	43	49.7	26.1	75.8
NC	245	Female	56	1.51	61	26.75	1	5	1			Normal	171	184.8	87.5	83.5	13.8	97.3
NC	246	Female	49	1.68	63	22.32	1	10	1			Normal	156.7	202.3	112.7	44	45.6	89.6
NC	247	Female	50	1.65	56	20.57	1	5	0			Normal	161.3	158.6	74.6	86.7	-2.7	84
NC	248	Female	82	1.66	62	22.50	2	5	0			Normal	66.4	157.4	30.3	36.1	91	127.1
NC	249	Female	55	1.65	63	23.14	1	3	0			Normal	196.1	175.4	114	82.1	-20.7	61.4
NC	250	Female	44	1.72	57	19.27	1	2	0			Normal	169.6	163.3	74.4	95.2	-6.3	88.9
NC	251	Female	51	1.58	64	25.64	1	10	1			Normal	103.5	146.3	63.1	40.4	42.8	83.2
NC	252	Female	54	1.63	62	23.34	1	3	0			Normal	133.7	164.1	54.2	79.5	30.4	109.9
NC	253	Female	67	1.61	58	22.38	1	2	0			Normal	82.4	114.3	39.2	43.2	31.9	75.1
NC	254	Female	69	1.52	70	30.30	2	10	1			Normal	137.1	122.9	37.8	99.3	-14.2	85.1
NC	255	Female	55	1.61	61	23.53	1	15	2			Normal	75.8	114	21.3	54.5	38.2	92.7
NC	256	Female	67	1.65	72	26.45	3	10	2			Normal	177.3	213.5	48.5	128.8	36.2	165
NC	257	Female	47	1.72	57	19.27	1	5	0			Normal	133.8	150.9	57.9	75.9	17.1	93
NC	258	Female	82	1.58	76	30.44	1	3	0			Normal	109.8	121	12.7	97.1	11.2	108.3
NC	259	Female	54	1.54	65	27.41	1	3	0			Normal	163.7	192.3	98.4	65.3	28.6	93.9
NC	260	Female	51	1.62	61	23.24	1	4	0			Normal	130.7	144.9	46.2	84.5	14.2	98.7
NC	261	Female	49	1.68	58	20.55	1	2	0			Normal	124.6	134.1	30.3	94.3	9.5	103.8
NC	262	Female	65	1.55	55	22.89	0.5	3	0			Normal	118.1	160.8	72.5	45.6	42.7	88.3
NC	263	Female	52	1.63	77	28.98	1	5	0			Normal	169.8	193.3	95.5	74.3	23.5	97.8
NC	264	Female	55	1.6	62	24.22	0.5	3	0			Normal	124	117.7	62.3	61.7	-6.3	55.4

BMI, body mass index; DTCP, degree of transverse colon ptosis; HADS-A, Hospital Anxiety and Depression Scale subscales of Anxiety; HADS-D, Hospital Anxiety and Depression Scale subscales of Depression; HI, the vertical distance from the hepatic flexure to the right iliac crest; HT, the vertical distance from the hepatic flexure to the lowest point of transverse colon; SH, the vertical distance from the splenic flexure to the hepatic flexure; SI, the vertical distance from the splenic flexure to the left iliac crest; TI, the vertical distance from the lowest point of transverse colon to the L4-L5 interspace; WCS, Wexner Constipation Scale.

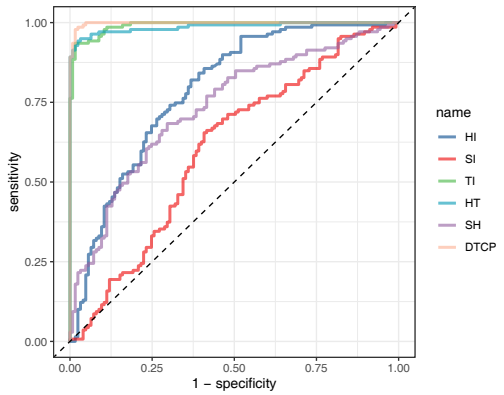

Figure S1 ROC analysis of TCP-related radiological parameters to distinguish STC and healthy individuals. A ROC analysis predicted scores with the area under the curve (AUC) and the corresponding specificity and sensitivity that maximized the Youden Index. AUC, area under the curve; DTCP, degree of transverse colon ptosis; HI, the vertical distance from the hepatic flexure to the right iliac crest; HT, the vertical distance from the hepatic flexure to the lowest point of transverse colon; ROC, receiver operating characteristic; SH, the vertical distance from the splenic flexure to the hepatic flexure; SI, the vertical distance from the splenic flexure to the left iliac crest; STC, slow transit constipation; TCP, transverse colon ptosis; TI, the vertical distance from the lowest point of transverse colon to the L4-L5 interspace.

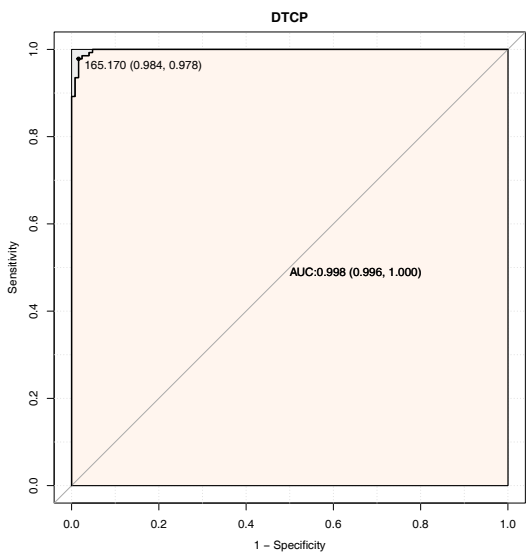

Figure S2 ROC curve revealed a cutoff DTCP value of 165.17 mm to segregate patients with STC from healthy individuals. (AUC =0.998, with sensitivity 0.978 and specificity 0.984). AUC, area under the curve; DTCP, degree of transverse colon ptosis; ROC, receiver operating characteristic; STC, slow transit constipation.

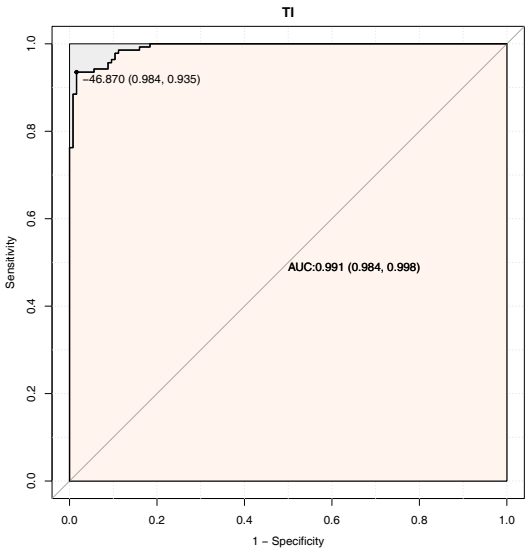

Figure S3 ROC curve revealed a cutoff TI value of -46.87 mm to segregate patients with STC from healthy individuals. (AUC =0.991, with sensitivity 0.935 and specificity 0.984). AUC, area under the curve; ROC, receiver operating characteristic; STC, slow transit constipation; TI, the vertical distance from the lowest point of transverse colon to the L4-L5 interspace.

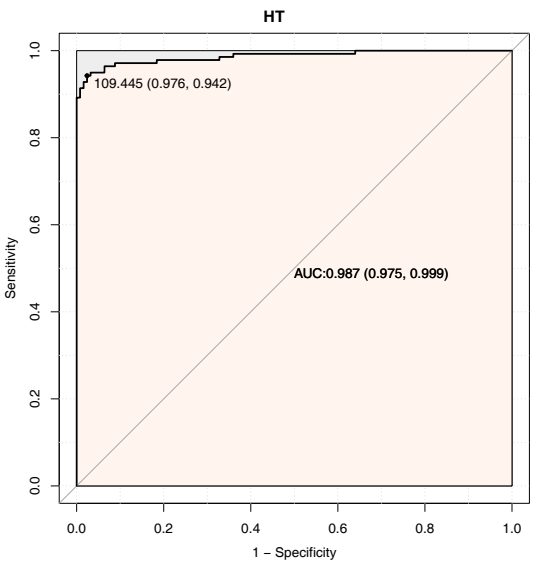

Figure S4 ROC curve revealed a cutoff HT value of 109.45 mm to segregate patients with STC from healthy individuals. (AUC =0.987, with sensitivity 0.942 and specificity 0.976). AUC, area under the curve; ROC, receiver operating characteristic; SH, the vertical distance from the splenic flexure to the hepatic flexure; STC, slow transit constipation.

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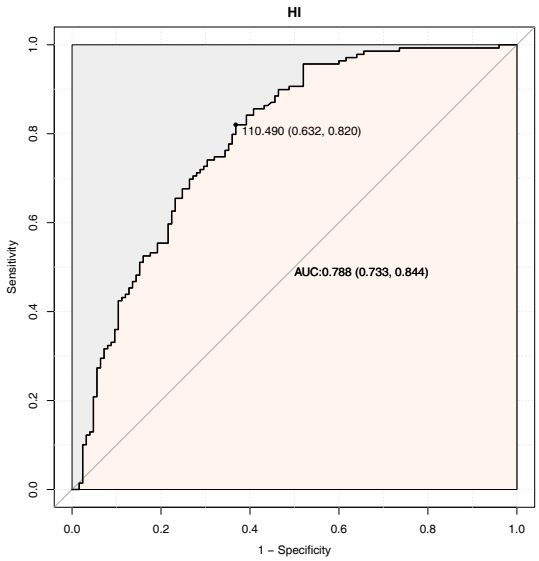

Figure S5 ROC curve revealed a cutoff HI value of 110.49 mm to segregate patients with STC from healthy individuals. (AUC =0.788, with sensitivity 0.820 and specificity 0.632). AUC, area under the curve; HI, the vertical distance from the hepatic flexure to the right iliac crest; ROC, receiver operating characteristic; STC, slow transit constipation.

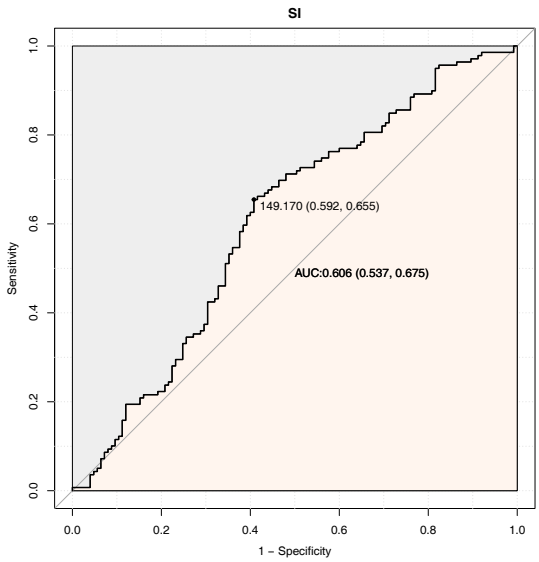

Figure S6 ROC curve revealed a cutoff SI value of 149.17 mm to segregate patients with STC from healthy individuals. (AUC =0.606, with sensitivity 0.655 and specificity 0.592). AUC, area under the curve; ROC, receiver operating characteristic; SI, the vertical distance from the splenic flexure to the left iliac crest; STC, slow transit constipation.

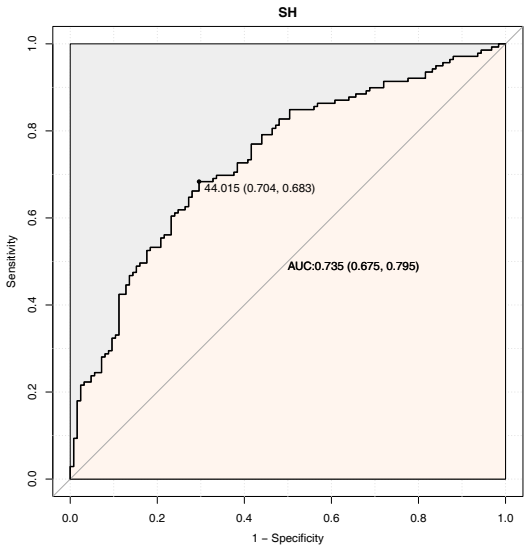

Figure S7 ROC curve revealed a cutoff SH value of 44.02 mm to segregate patients with STC from healthy individuals. (AUC =0.735, with sensitivity 0.683 and specificity 0.704). AUC, area under the curve; ROC, receiver operating characteristic; SH, the vertical distance from the splenic flexure to the hepatic flexure; STC, slow transit constipation.

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