# The Length of Small Bowel in Thai Patients

Varut Lohsiriwat MD, PhD*,
Nattawadee Wiangphoem MD*, Supatra Lohsiriwat MD**

** Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*
*** Department of Physiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*

***Objective:*** *To Evaluate the length of small bowel (SB) in Thai patients.*
***Material and Method:*** *The present prospective study included Thai adults who underwent elective open laparotomy at the Department of Surgery, Faculty of Medicine Siriraj Hospital between August 2011 and May 2012. Patients who had previous laparotomy, intra-abdominal adhesions, or gross abnormality of SB were excluded. The length of SB was measured using an umbilical cord tape, from the duodeno-jejunal junction to the ileo-cecal valve.*
***Results:*** *Sixty-four patients were enrolled during the study period. According to the exclusion criteria, only 48 patients were eligible for study. There were 27 men and 21 women, with an average age of 60 years (range 28-88). The average length of SB (only jejunum and ileum) was 428±105 cm (range 169-745). Male adults had about 90 cm longer SB than female adults (468±105 cm vs. 376±81 cm; p<0.01), particularly of the jejunum (179±78 cm vs. 106±38 cm; p<0.01). The ileum accounted for about two-third of the total SB length. There was no association between SB length and age, body weight, height, or body mass index.*
***Conclusion:*** *Based on the present study, the total length of small bowel (jejunum and ileum) in Thai patients was approximately 430 cm. Male adults had significant longer SB than female adults, particularly the jejunal segment.*

***Keywords:*** *Small bowel, Jejunum, Ileum, Anatomy, Length, Thailand*

***J Med Assoc Thai 2014; 97 (5): 525-9***
***Full text. e-Journal:*** *http://www.jmatonline.com*

Knowing the length of small bowel (SB) prior to an intra-abdominal operation could be of great clinical importance, especially in patients requiring massive resection of SB and those having history of SB removal or SB diseases. Unlike the large bowel, the preoperative assessment of SB length is very difficult and somehow unreliable[1]. Currently, there is limited number of studies evaluating the length of normal SB. Such studies have clearly shown that the SB length greatly varies depending on many factors such as measurement technique used[2], alive, or postmortem studies[3,4]. For example, Hosseinpour and Behdad demonstrated that the SB length was 460 cm in alive subjects and 633 cm in cadavers[4]. A large review of eight studies including 1,010 necropsy specimens showed that average SB length in adults was 575 cm[5]. A recent cohort analysis in Argentineans revealed the SB length of 364 cm in living adults[6]. Moreover, the SB length was reported to be correlated with sex, age, weight, height, and ethnicity[3-5,7].

***Correspondence to:***
*Lohsiriwat V, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, 2 Wang-Lang Road, Bangkok 10700, Thailand.*
*Phone: 0-2419-8005, Fax: 0-2412-1370*
*E-mail: bolloon@hotmail.com*

Since there is no published data of SB length of individuals from Thailand or neighborhood countries, the aim of the present study is therefore to evaluate the length of small bowel (jejunum and ileum) in Thai adult patients by intra-operative measurement.

## Material and Method

After obtaining approval from the Siriraj Institutional Review Board (SIRB number 281/2554), the present prospective study was carried out in Thai adults (age ≥18 years) who underwent elective open laparotomy at the Department of Surgery, Faculty of Medicine Siriraj Hospital between August 2011 and May 2012. Patients who had previous laparotomy, intra-abdominal adhesions or gross abnormality of SB were excluded. A written informed consent was obtained from each patient prior to the operation.

After general anesthesia was introduced and midline laparotomy was performed, the length of SB was immediately measured using a sterile umbilical tape, applied to the anti-mesenteric border of non-stretching SB from the duodeno-jejunal junction (the ligament of Treitz) to the ileo-cecal valve. All the measurements were performed by the authors

**Fig. 1** Jejunum (one or two vascular arches with long vasa recta).

**Fig. 2** Ileum (multiple vascular arches with short vasa recta).

and colleagues who were in surgical resident training program. The jejunum was distinguished from the ileum by their gross anatomical features. The jejunum has single vascular arch in the mesentery with long vasa recta (Fig. 1), whereas the ileum contains multiple vascular arches with short vasa recta (Fig. 2). The umbilical cord tape is a hard non-elastic tape and its length is about seven meters long. This technique has been widely used for the intra-operative measurement of SB elsewhere[4,6].

Patient's characteristics (such as age, sex, weight, height and body mass index) and operative details as well as the length of jejunum, ileum and total small bowel (in this context did not include the length of duodenum) were recorded. All data were prepared and compiled using the Statistical Package for the Social Sciences program version 15.0 for Windows (SPSS Inc., Chicago, IL). The unpaired t-test analysis was used to compare the SB length between genders. The Pearson correlation was used to determine the correlation of SB length and patient's age, weight, height and body mass index. A *p*-value of less than 0.05 was considered statistically significant. Results were given as mean ± standard deviation (range), or a number (percentage).

## Results

Sixty-four patients were enrolled during the study period. According to the exclusion criteria, only 48 patients were eligible for studying. There were 27 men (56%) and 21 women (44%), with an average age of 60.2±10.6 years (range 28-88). Their average body weight, height and body mass index (BMI) were 58.7±12.4 kg (range 36-86), 160.3±8.4 cm (range 138-175), and 23.3±5.6 kg/m$^2$ (range 16-30), respectively.

The average length of SB was 428±105 cm (range 169-745). Male adults had about 90 cm longer SB than female (468±105 cm vs. 376±81 cm; $p<0.01$) partly due to significant greater length of jejunum in male (179±78 cm vs. 106±38 cm; $p<0.01$). The length of ileum was not significantly difference between genders (288±133 cm in male vs. 274±86 cm in female; $p = 0.65$). The ileum was accounted for about two-third of the total SB length (Table 1). There was no association between the length of SB and age, body weight, height, or BMI (Table 2).

## Discussion

The present study had demonstrated that the average length of SB in Thai adults was 4.28 meters (about 14 feet) and the jejunum accounted for

**Table 1.** The length of small bowel

| Length (cm) | All subjects (n = 48) | Male (n = 27) | Female (n = 21) |
|---|---|---|---|
| Jejunum | 147±73 (range 49-400) | 179±78 (range 77-400) | 106±38 (range 49-182) |
| Ileum | 282±114 (range 76-592) | 288±133 (range 105-592) | 274±86 (range 76-397) |
| Total small bowel (jejunum + ileum) | 428±105 (range 169-745) | 468±105 (range 322-745) | 376±81 (range 169-476) |

Data were given in centimeter (cm) as mean ± standard deviation (range)

**Table 2.** Pearson's correlations between the length of small bowel and age, body weight, height, and body mass index (BMI)

| Small bowel | Age | Body weight | Height | BMI |
|---|---|---|---|---|
| Jejunum | | | | |
| Pearson correlation | 0.098 | 0.077 | 0.210 | -0.026 |
| *p*-value | 0.508 | 0.601 | 0.152 | 0.860 |
| Ileum | | | | |
| Pearson correlation | 0.160 | 0.029 | 0.101 | -0.044 |
| *p*-value | 0.278 | 0.845 | 0.494 | 0.769 |
| Total | | | | |
| Pearson correlation | 0.249 | 0.099 | 0.264 | -0.052 |
| *p*-value | 0.087 | 0.502 | 0.069 | 0.725 |

one-third of total SB length. Further, the present study showed a significantly longer length of SB (jejunal part) in male, but there was no association between the SB length and patients' weight, height, or body mass index. To the best of our knowledge, this was the first series examining SB length of living adults in Thailand, the results may be used as a reference for Thai patients in the future. Moreover, the knowledge of SB length in Thai people could guide an endoscopist to determine the location of the enteroscopy[8], and it could help a surgeon managing patients with massive SB resection[9].

The length of SB in living Thai adults obtained in the present study was comparable to those reported from other countries (especially from Iran - an Asian country), but it was markedly shorter than those reported in necropsy specimens (Table 3)[3-6,10,11]. The significant longer SB length in cadavers had been reported by Hosseinpour and Behdad[4]. The lengthening of SB in cadavers could be explained by the fact that the SB smooth muscles tonicity disappeared after death[2].

Collectively, many published reports had demonstrated shorter SB length in Asian people when comparing with Caucasian. It is possible that this difference is due to racial or genetic background, lead to taller body figure of Caucasians. Dietary habits may play some role. Although the present study did not find any correlation between SB length and height, some authors reported a progressive correlation between increasing height and longer SB[5,10,12]. Meanwhile, the correlation between SB length and weight was less defined and the results remained controversial[12]. Herein, we found no correlation between SB length and weight or body mass index. Since Thai adults has a relatively short SB (average 428 cm, or about 14 feet), massive small bowel resection should be avoided because the short bowel syndrome could easily occur when less than 200 cm of functional intestine left[13].

The present study has demonstrated an approximately 90 cm longer SB, especially jejunum, in male. The longer SB in male has been widely reported with the magnitude of mean difference varied from 70 cm to 150 cm[3,10,11,14]. However, some investigators found no significant difference in SB length between genders[4]. It could be argued that the difference in average height between genders could be accounted for the difference in SB length.

Some limitations of the present study included a relatively small number of the subject. Since our unit nowadays moves toward minimally invasive surgery (laparoscopic surgery), fewer number of cases undergo open laparotomy and many of them are those with previous intra-abdominal surgery. Therefore, the eligible cases for the present study are limited. Moreover, the investigators were reluctant to recruit more subjects because it was reported that small bowel manipulation led to impaired postoperative bowel

**Table 3.** Comparison of small bowel (SB) length in the literature

| Author (year) | Country | Alive/dead (number of subject) | SB length in centimeter mean ± SD (range) |
|---|---|---|---|
| Lohsiriwat (Present) | Thailand | Alive (48) | 428±105 (169-745) |
| Nordgren (1997) | Sweden | Alive (77) | 564 (n/a) |
| Glehen (2003) | France | Alive (92) | 566 (350-826) |
| Hosseinpour (2008) | Iran | Alive (100) | 460±78 (285-620) |
| Gondolesi (2012) | Argentina | Alive (8) | 364±61 (290-469) |
| Weaver (1991) | Western | Dead (1,010) | 575 (a review of 8 papers) |
| Hounnoun (2002) | France | Dead (200) | 609±110 (280-1,000) |
| Hosseinpour (2008) | Iran | Dead (30) | 633±89 (n/a) |

n/a = not applicable

recovery[15], although such an adverse outcome was not evident in the present study. Statistically, if the case number would double with the same results of SB measurement, the outcome of SB length could have been similar except more precise standard deviation and 95% confidence interval. It is also possible that there are considerable effects of anesthetic agents and cold temperature on smooth muscle tone and SB length. Hence, the SB measurement in the present study was performed immediately after laparotomy in order to minimize the effect of anesthesia and cold exposure on bowels.

**Conclusion**

The present study showed that the total length of small bowel in Thai patients was approximately 430 cm. Male adults had significant longer SB than female adults. There was no association between the length of SB and age, body weight, height, or body mass index.

**What is already known on this topic?**

Knowing the length of small bowel (SB) prior to an intra-abdominal operation could be of great clinical importance, especially in patients requiring massive resection of SB and those having had history of SB removal or SB diseases. The preoperative assessment of SB length is very difficult and somehow unreliable. The SB length was reported to be correlated with sex, age, weight, height, and ethnicity.

**What this study adds?**

To the best of our knowledge, the present study was the first study examining the length of small bowel (SB) in living Thai adults. The total length of SB, excluding the duodenum, in Thai patients was approximately 430 cm. Male adults had significant longer SB than female adults, particular the jejunal segment. The ileum accounted for about two-third of the total SB length.

**Potential conflicts of interest**

None.

**References**


1. Shatari T, Clark MA, Lee JR, Keighley MR. Reliability of radiographic measurement of small intestinal length. Colorectal Dis 2004; 6: 327-9.
2. Ahrens EH Jr, Blankenhorn DH, Hirsch J. Measurement of the human intestinal length in vivo and some causes of variation. Gastroenterology 1956; 31: 274-84.
3. Hounnou G, Destrieux C, Desme J, Bertrand P, Velut S. Anatomical study of the length of the human intestine. Surg Radiol Anat 2002; 24: 290-4.
4. Hosseinpour M, Behdad A. Evaluation of small bowel measurement in alive patients. Surg Radiol Anat 2008; 30: 653-5.
5. Weaver LT, Austin S, Cole TJ. Small intestinal length: a factor essential for gut adaptation. Gut 1991; 32: 1321-3.
6. Gondolesi G, Ramisch D, Padin J, Almau H, Sandi M, Schelotto PB, et al. What is the normal small bowel length in humans? first donor-based cohort analysis. Am J Transplant 2012; 12 (Suppl 4): S49-54.
7. Teitelbaum EN, Vaziri K, Zettervall S, Amdur RL, Orkin BA. Intraoperative small bowel length measurements and analysis of demographic predictors of increased length. Clin Anat 2013 Mar 20. doi: 10.1002/ca.22238.
8. Prachayakul V, Deesomsak M, Aswakul P, Leelakusolvong S. The utility of single-balloon enteroscopy for the diagnosis and management of small bowel disorders according to their clinical manifestations: a retrospective review. BMC Gastroenterol 2013; 13: 103.
9. Thompson JS, Weseman R, Rochling FA, Mercer DF. Current management of the short bowel syndrome. Surg Clin North Am 2011; 91: 493-510.
10. Glehen O, Lifante JC, Vignal J, Francois Y, Gilly FN, Flourie B, et al. Small bowel length in Crohn's disease. Int J Colorectal Dis 2003; 18: 423-7.
11. Nordgren S, McPheeters G, Svaninger G, Oresland T, Hulten L. Small bowel length in inflammatory bowel disease. Int J Colorectal Dis 1997; 12: 230-4.
12. Slater G, Aufses AH Jr. Small bowel length in Crohn's disease. Am J Gastroenterol 1991; 86: 1037-40.
13. Buchman AL, Scolapio J, Fryer J. AGA technical review on short bowel syndrome and intestinal transplantation. Gastroenterology 2003; 124: 1111-34.
14. Underhill BM. Intestinal length in man. Br Med J 1955; 2: 1243-6.
15. Kalff JC, Schraut WH, Simmons RL, Bauer AJ. Surgical manipulation of the gut elicits an intestinal muscularis inflammatory response resulting in postsurgical ileus. Ann Surg 1998; 228: 652-63.

## *การวัดความยาวของลำไส้เล็กในผู้ป่วยชาวไทย*

*วรุตม์ โล่ห์สิริวัฒน์, ณัฏฐวดี เวียงเพิ่ม, สุพัตรา โล่ห์สิริวัฒน์*

***วัตถุประสงค์:*** *เพื่อประเมินความยาวของลำไส้เล็กในผู้ป่วยชาวไทย*

***วัสดุและวิธีการ:*** *ผู้นิพนธ์ได้ทำการวัดความยาวของลำไส้เล็กในผู้ป่วยชาวไทย (อายุตั้งแต่ 18 ปีขึ้นไป) ที่เข้ารับการผ่าตัด elective laparotomy ในโรงพยาบาลศิริราช ตั้งแต่เดือนสิงหาคม พ.ศ. 2554 ถึง เดือนพฤษภาคม พ.ศ. 2555 โดยผู้ป่วยไม่รวมผู้ป่วยที่เคยผ่าตัดช่องท้องมาก่อน หรือ พบพังผืดในช่องท้อง หรือ พบความผิดปกติของลำไส้เล็กในขณะผ่าตัด ผู้นิพนธ์ได้วัดความยาวลำไส้เล็กโดยใช้ umbilical cord tape วัดด้าน anti-mesenteric ตั้งแต่ duodeno-jejunal junction จนถึง ileo-cecal valve (ไม่รวมส่วนดูโอดีนั่ม)*

***ผลการศึกษา:*** *การศึกษานี้รวบรวมผู้ป่วยจำนวน 48 ราย (ผู้ชาย 27 ราย) อายุเฉลี่ย 60 ปี (ช่วงอายุ 28-88 ปี) พบว่าลำไส้เล็กยาว 428±105 เซนติเมตร (ช่วงความยาว 169-745) พบว่าผู้ชายมีลำไส้เล็กยาวมากกว่าผู้หญิง (468±105 vs. 376±81 เซนติเมตร; $p<0.01$) โดยเฉพาะส่วนของเจจูนั่ม (179±78 vs. 106±38 เซนติเมตร; $p<0.01$) การศึกษานี้ไม่พบความสัมพันธ์ของความยาวลำไส้เล็ก กับ เพศ น้ำหนัก ความสูง หรือ body mass index ของผู้ป่วย*

***สรุป:*** *การศึกษานี้พบว่าผู้ป่วยชาวไทยมีลำไส้เล็กยาวเฉลี่ย 428 เซนติเมตร (ประมาณ 14 ฟุต) และพบว่าผู้ชายมีลำไส้เล็กยาวมากกว่าผู้หญิงประมาณ 90 เซนติเมตร*