Normal Anal Position Index in Thai Newborns

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Background: *The quantitative measurement of the normal anal position by anal position index (API) has been reported from various institutes. The existing API data appear to vary among the ethnic differences. To date, the normal anal position in Thai children has never been reported.*
Objective: *Aim of the present study was to establish the normal values of the API in Thai newborns.*
Material and Method: *A cross-sectional study of 403 normal newborn born at Srinakharinwirot University Hospital between November 2003 and September 2004 was performed. Demographic data and anal position index are reported separately for each gender split. Correlations between API and other anthropometric parameters were tested.*
Results: *There was significant difference of API between males (0.51 $\pm$ 0.07; 95% CI 0.50 to 0.52) and females (0.38 $\pm$ 0.08; 95% CI 0.37 to 0.39). API was not different between preterm and term newborn in each gender split. API had no significant correlation with gestational age (r = 0.018, p-value = 0.71), birth weight (r = 0.014, p-value = 0.79), birth length (r = 0.02, p-value = 0.69) and head circumference (r = 0.047, p-value = 0.35).*
Conclusion: *Anal position indexes in Thai newborn infants are 0.51 and 0.38 in male and female, respectively. API had no correlation with gestational age and other anthropometric parameters such as birth weight, length, and head circumference.*

Keywords: *Anal position index, Normal anal position, Newborn, Thai*

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Anterior displacement from the normal position of the anus is reported to be a common developmental abnormality of anorectal malformation[1]. It is recognized as a frequent cause of constipation during infancy and in early childhood[2-5]. According to the study of Leape and Ramenofsky[3], more than one third of patients who came for consultation for chronic constipation had anterior displacement of the anus. They defined "normal anal position" as the midway between the vaginal fourchette (scrotum) and the tip of the coccyx by relying on inspection only. However, in a less severe case, slight anterior displacement is very difficult to diagnose without using diagnosis measurement tools[6,7].

The quantitative measurement to define the normal position of the anus was first proposed in 1984. Reisner et al[1] presented a simple method using the anal position index (API), the ratio of anal-fourchette distance to coccyx-fourchette distance for females and the ratio of anal-scrotum distance to coccyx-scrotum distance for males, to define the normal position of the anus in the newborn. They suggested that API of less than 0.46 in boys and less than 0.34 in girls was indicative of anterior displacement. Although there were some reports of the anal position index from various countries, the normal values of API were different and varied among ethnic differences. Moreover, the normal values for the anal position index have never been reported from Thailand.

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The aim of the present study was to describe the simple quantitative technique for describing the normal anal position and to establish the normal values of the API in Thai newborn.

Materials and Method

Four hundred and three normal newborns born at Srinakharinwirot University Hospital between November 2003 and September 2004 were included into the cross-sectional study. Newborn, who had congenital malformations were excluded from the present study. At birth, demographic data and anthropometric parameters including gestational age, parental ages, birth weight, length, and head circumference were collected. Gestational age was determined by calculation from the last menstrual period (LMP). Weight was obtained on a table beam scale and length was measured in the recumbent (supine) position using a measuring board with a foot-board that did not wobble. Anal position index (API), the ratio of to coccyx-fourchette distance for the girls and anus-scrotum distance to coccyx-scrotum distance for the boys, were measured within the first week of life. To measure the distances, the newborn was held in the lying position with hips and knees flexed. A transparent adhesive tape was placed along the long axis of coccyx-fourchette distance or coccyx-scrotum distance. The positions of the coccyx, the center of the anus and the posterior fourchette (scrotum) were marked and the distances between them were measured on a plain surface (Fig. 1). Anal position index (API) was calculated by the ratio of anal-fourchette to coccyx-fourchette distance and anal-scrotum to coccyx-scrotum distance for girls and boys, respectively. Newborns born before 37 weeks, 37-42 weeks and after 42 weeks of gestational age were defined as preterm, term, and post-term newborns, respectively.

The study protocol was approved by the ethics committee of Faculty of Medicine, Srinakharinwirot University. Informed consent was obtained from the parents of the newborns in all cases. No parents refused to participate in the present study.

Statistical analysis

Demographic data, anal-fourchette (scrotum) distance, coccyx-fourchette (scrotum) distance, and anal position index were reported as the means and standard deviations. Anal position indexes for each gender split were shown as major percentiles, histograms, and distribution curves. Categorical data were analyzed using Chi-square or Fisher exact test. Continuous variables were compared by using a Student's t-test. Pearson's correlation coefficient was performed to test the correlation among gestational age, anthropometric parameters, and anal position index. Statistical analyses were performed using a SPSS 11.0 software package, and the differences were considered significant if p-value was less than 0.05.

Results

Among 403 newborn enrolled into the present study, 203 (50.4%) were males and 200 (49.6%) were females. The majority (88.1%) of newborns were term newborns and 10.9% were premature newborn; only 1.0% was post-term newborns. Incidence of prematurely born was not significantly different in which 20 (9.8%)

female male

Fig. 1 Measurement of anal position index in female and in male

Table 1. Demographic characteristics of 403 newborns

	All (n = 403)	Male (n = 203)	Female (n = 200)	p-value
Gestational age, years (SD)	38.3 (1.8)	38.4 (1.8)	38.2 (1.8)	0.44
Preterm, n (%)	44 (10.9)	20 (9.8)	24 (12.0)	0.49
Term newborn, n (%)	355 (88.1)	180 (88.7)	175 (87.5)	
Post term, n (%)	4 (1.0)	3 (1.5)	1 (0.5)	
Birth weight, g (SD)	2926.8 (458.5)	2983.9 (488.4)	2868.8 (419.3)	0.01
Birth length, cm (SD)	51.4 (2.9)	51.7 (2.9)	51.1 (2.9)	0.05
Head circumference, cm (SD)	32.9 (1.6)	33.1 (1.7)	32.6 (1.5)	0.002

were males and 24 (12.0%) were females. Males had significantly higher birth weight and head circumference and tended to be longer than female newborn. There were no significant differences of gestational age and parental ages between genders. Demographic characteristics of 403 newborns allocated by gender are shown in Table 1.

Anus-fourchette (scrotum) distance, coccyx-fourchette (scrotum) distance, and anal position indexes, allocated by gender and gestational age, were detailed in Table 2. Mean, median, and mode of API in male newborns were 0.51, 0.50, and 0.50, respectively. Mean, median, and mode of API in female newborn were 0.38, 0.37, and 0.33, respectively. There were significant differences of all anal parameters between genders in which male newborn had higher mean API than female newborn (p-value < 0.001). Compared to API in term newborn, API in preterm newborns had no statistically significant difference in each gender identity. Major percentiles of anus-fourchette (scrotum) distance, coccyx-fourchette (scrotum) distance, and API of each gender identity were demonstrated in Table 3. The distributions of API in 203 males and 200 females were separately detailed as histograms in Fig. 2 and 3.

Regarding the significant differences in birth weight, head circumference and anal position index between genders, the correlation among those anthropometric parameters including length and gestational age were measured by Pearson's correlation coefficients. There were significant positive correlations among gestational age, birth weight, length, head circumference, anus-fourchette (scrotum) distance, and coccyx-fourchette (scrotum) distance (p-value < 0.05). However, API had no statistically significant correlation with gestational age (r = 0.018, p-value = 0.71), birth weight (r = 0.014, p-value = 0.79), birth length (r = 0.02, p-value = 0.69), and head circumference (r = 0.047, p-value = 0.35) (Table 4).

Table 2. Anal position parameters of Thai newborns regarding to gender identity and gestational age

	Mean	SD	95% CI
Anus-fourchette (scrotum) distance, cm			
Males (n = 203)	2.38	0.57	2.30, 2.45
Preterm (n = 20)	2.22	0.49	1.99, 2.44
Term (n = 180)	2.39	0.58	2.31, 2.48
Females (n = 200)	1.23*	0.33	1.18, 1.27
Preterm (n = 24)	1.17*	0.34	1.03, 1.30
Term (n = 175)	1.23*	0.31	1.18, 1.27
Coccyx- fourchette (scrotum) distance, cm			
Males (n = 203)	4.67	0.79	4.56, 4.78
Preterm (n = 20)	4.28	0.60	4.00, 4.56
Term (n = 180)	4.70	0.79	4.58, 4.82
Females (n = 200)	3.21*	0.55	3.13, 3.29
Preterm (n = 24)	3.10*	0.52	2.88, 3.31
Term (n = 175)	3.21*	0.53	3.13, 3.29
Anal position index			
Males (n = 203)	0.51	0.07	0.50, 0.52
Preterm (n = 20)	0.51	0.06	0.48, 0.54
Term (n = 180)	0.51	0.08	0.49, 0.52
Females (n = 200)	0.38*	0.08	0.37, 0.39
Preterm (n = 24)	0.38*	0.08	0.34, 0.41
Term (n = 175)	0.38*	0.08	0.37, 0.39

* Significantly difference from males, p < 0.001

Discussion

The anal position was first described by Leape and Ramenofsky as the midway between the vaginal fourchette (scrotum) and the tip of coccyx[3]. In 1978, two separated reports, by Leape and Ramenofsky[3] and Hendren[2], described cases of slight anterior displacement of the anus who presented with chronic constipation. However, the diagnosis relied on inspection only. The measurement method of normal anal position was not stated until 1984. Reisner et al[1] were the first to report the simple method to measure the normal position of the anus as anal position index (API)

Table 3. Percentiles of anal position parameters of male and females Thai newborns

Percentiles	Anus-fourchette (scrotum) distance, cm		Coccyx-fourchette (scrotum) distance, cm		Anal position index	
	Males (n = 203)	Females (n = 200)	Males (n = 203)	Females (n = 200)	Males (n = 203)	Females (n = 200)
3	1.11	0.70	3.00	2.20	0.34	0.26
10	1.70	0.90	3.70	2.60	0.42	0.30
25	2.10	1.00	4.20	2.80	0.47	0.32
50	2.30	1.20	4.70	3.20	0.50	0.37
75	2.70	1.40	5.10	3.50	0.54	0.43
90	3.06	1.60	5.70	3.80	0.60	0.49
97	3.50	2.00	6.29	4.39	0.66	0.56

Table 4. Pearson's correlation coefficients (r) among gestational age, birth weight, length, head circumference and anal position index

	Gestational age (wk)	Birth weight (cm)	Birth length (cm)	Head circumference (cm)	Anus-scrotum (fourchette) distance	Coccyx-scrotum (fourchette) distance
Birth weight (g)	0.500*					
Birth length (cm)	0.398*	0.592*				
Head circumference (cm)	0.335*	0.623*	0.528*			
Anus-fourchette (scrotum) distance	0.106**	0.210*	0.149*	0.172*		
Coccyx-fourchette (scrotum) distance	0.153*	0.314*	0.212*	0.234*	0.893*	
Anal position index	0.018	0.014	0.020	0.047	0.838*	0.521*

* p-value < 0.01; ** p-value < 0.05

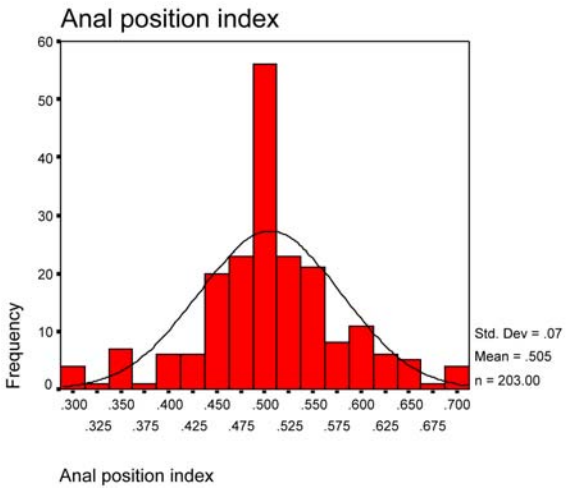

Fig. 2 Distribution of anal position index in 203 male newborns

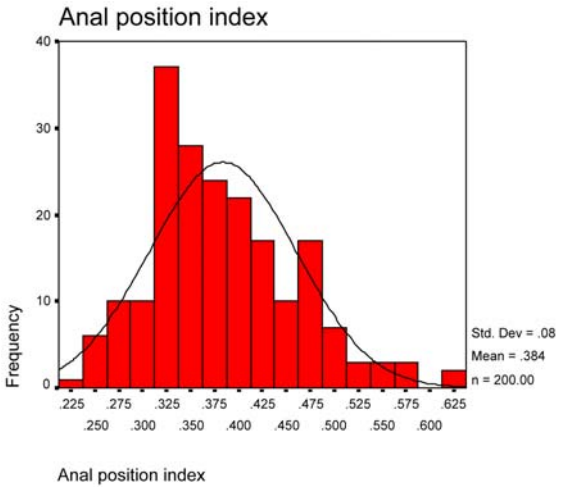

Fig. 3 Distribution of anal position index in 200 female newborns

Table 5. Anal position index from existing reports

Study	Country	Age group	n	Anal position index (SD)	
				Male	Female
Reisner 1984[1]	Israel	Newborn	200 (100 M*, 100 F**)	0.58 (0.06)	0.44 (0.05)
		4-18 months	30 (15 M, 15 F)	0.56 (0.4)	0.40 (0.06)
Bar-Maor and Eitan 1987[8]	Israel	3 days - 12 years	104 (74 M, 30 F)	0.56 (0.20)	0.39 (0.09)
Genc 2002[12]	Turkey	Newborn	60 (26 M, 34 F)	0.53 (0.05)	0.46 (0.08)
Mohta 2004[9]	India	Newborn - 3 years	387 (300 M, 87 F)	0.43 (0.05)	0.37 (0.06)
Davari 2006[13]	Iran	Newborn	400 (200 M, 200 F)	0.54 (0.07)	0.42 (0.08)
Present study	Thailand	Newborn	403 (203 M, 200 F)	0.51 (0.07)	0.38 (0.08)

* M = males, ** F = females

that was later called anogenital index by Bar-Moar and Eiton[8]. Reisner et al[1] described that the mean (SD) API in male newborns was 0.58 (0.06) and in female newborn was 0.44 (0.05) whereas, in infants aged 4-18 months they were 0.56 (0.40) and 0.40 (0.06) in male and female respectively. They found no significant differences between the values of newborn and infants. Although Bar-Maor[8] found no effect by age or ethnic differences on API, there were increased reports of the differences of API among studies. The existing reports on the normal anal position indexes from different institutes were varying (Table 5). The reports from Oriental countries, including the present study, were found to be different from the Western countries. Factors affecting the difference of API are poorly understood but may include the difference in age group and lower body weight in Eastern populations[9].

Anterior displacement of anal opening from the normal position is increasingly being recognized in the literatures as a cause of constipation[2,3,10]. An anal index of less than 0.34 in girls and less than 0.46 in boys was determined to be an anterior displacement of the anus (ADA). The measurement of anal opening in the young age infants will help early detect the abnormality, which is not easy to detect and to monitor the long-term outcomes. Therefore, the best group in which to study the anal position is in the newborn.

As reported previously, the normal anal opening in female children were more closure to the genitalia. Anal position indexes in the present study are compared with other studies that had significantly higher ratio in boys than in girls. The present study found the consistent differences of API between gender identity even in the sub-grouping analysis in premature newborn and in term newborns. In each gender identity, the present results did not show a significant difference in API between preterm and term newborn that was compatible with the previous study[8] in which there was no effect by age on anal position index.

At birth, male newborns had higher anthropometric parameters including birth weight, length and head circumference than female newborn the same as the data from the national surveillance. These parameters had positive correlations with gestational age. Moreover, anus-fourchette (scrotum) distance, and coccyx-fourchette (scrotum) distance also had positive correlation with other anthropometric parameters. However, the present study showed that the anal position index was not affected by birth weight, length, head circumference, or gestational age. This may be explained by the constant ratio of anus-fourchette (scrotum) distance to coccyx-fourchette (scrotum) distance in human subjects.

The correlation between anterior displacement of the anal opening and constipation has been demonstrated[2,3,10]. However, in recent studies by Herek et al[11] and Mohta et al[9], the incidence of constipation in children with normal anal index and those with low anal index indicative of anterior displaced anus was not significantly different. Malformation of the middle portion of the external sphincter and weakness of the corresponding segment of the anal canal has been postulated to be the cause of constipation in anterior abnormal opening of anus[10]. Clearly further studies are required to determine the magnitude of constipation problems in children with anterior displacement of the anus. The authors advocate that the long-term follow up of cohorts, in which the time point of constipation is known and no confounding factors of constipation exist, are required.

In conclusion, for the first time in Thailand, the present study offers the normal indexes of anal

position in both gender identities. It appears to be significantly different in anal position index between genders in the newborn in which there is a significantly higher API of male than API of female newborn. There were no significant effects of gestational age or anthropometric parameters on API in each gender identity. These API data may help pediatric surgeons to decide for the most accurate position of anus in case anorectoplasty is required. Moreover, it can prevent complications of incorrect anal placement such as fecal incontinence and constipation.

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ตำแหน่งปกติของรูเปิดของทวารหนักในเด็กไทย

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***ภูมิหลัง**: การประเมินตำแหน่งรูเปิดของทวารหนักเชิงปริมาณโดยใช้ดัชนีชี้วัดตำแหน่งทวารหนัก (anal position index; API) เป็นที่ยอมรับและมีรายงานอย่างแพร่หลาย จากข้อมูลที่ปรากฏพบว่าค่าดัชนีชี้วัดตำแหน่งทวารหนักมีความแตกต่างระหว่างเชื้อชาติ ในปัจจุบันยังไม่มีการรายงานค่าปกติในเด็กไทย*

***วัตถุประสงค์**: เพื่อที่จะหาค่าปกติของตำแหน่งรูเปิดทวารในเด็กทารกไทย*

***วัสดุและวิธีการ**: การศึกษาแบบตัดขวางในเด็กทารกจำนวน 403 คน ที่เกิด ณ ศูนย์การแพทย์สมเด็จพระเทพรัตนราชสุดาสยามบรมราชกุมารี คณะแพทยศาสตร์ มหาวิทยาลัยศรีนครินทรวิโรฒ ระหว่างเดือนพฤศจิกายน พ.ศ. 2546 ถึง กันยายน พ.ศ. 2547 โดยรายงานข้อมูลพื้นฐานประชากร และดัชนีชี้วัดตำแหน่งทวารหนักแยกตามเพศ และทดสอบความสัมพันธ์ระหว่างดัชนีชี้วัดตำแหน่งทวารหนักกับขนาดร่างกายของเด็ก*

***ผลการศึกษา**: ดัชนีชี้วัดตำแหน่งทวารหนักในเพศชายเท่ากับ 0.51 (ค่าเบี่ยงเบนมาตรฐาน 0.08, ค่าความเชื่อมั่น 95% ที่ 0.50 ถึง 0.52) มีความแตกต่างอย่างมีนัยสำคัญทางสถิติจากเพศหญิงที่ 0.38 (ค่าเบี่ยงเบนมาตรฐาน 0.08, ค่าความเชื่อมั่น 95% ที่ 0.37 ถึง 0.39) เมื่อเปรียบเทียบในทารกเพศเดียวกันระหว่างทารกที่เกิดก่อนกำหนด และทารกที่เกิดครบกำหนด พบว่าไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ ดัชนีชี้วัดตำแหน่งทวารหนักไม่มีความสัมพันธ์อย่างมีนัยสำคัญกับอายุครรภ์ ($r = 0.018$, p-value = 0.71) น้ำหนักตัวแรกเกิด ($r = 0.014$, p-value = 0.79) ความยาวแรกเกิด ($r = 0.02$, p-value = 0.69) และเส้นรอบศีรษะ ($r = 0.047$, p-value = 0.35)*

***สรุป**: ค่าเฉลี่ยของดัชนีชี้วัดตำแหน่งทวารหนักในเด็กทารกไทยเพศชายเท่ากับ 0.51 และในเพศหญิงเท่ากับ 0.38 และดัชนีชี้วัดตำแหน่งทวารหนักไม่มีความสัมพันธ์อย่างมีนัยสำคัญกับอายุครรภ์ น้ำหนักตัวแรกเกิด ความยาวแรกเกิด และเส้นรอบศีรษะ*