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## INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/19086  
DOI URL: <http://dx.doi.org/10.21474/IJAR01/19086>



### ORIGINAL RESEARCH ARTICLE

#### A CROSS-SECTIONAL CADAVERIC STUDY OF THE PREVALENCE AND MORPHOMETRY OF PSOAS MINOR MUSCLE IN WESTERN MAHARASHTRA

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#### Manuscript Info

##### Manuscript History

Received: 15 May 2024  
Final Accepted: 18 June 2024  
Published: July 2024

##### Key words:-

Psoas Minor Muscle, Psoas Minor  
Morphometry, Psoas Minor Syndrome

#### Abstract

**Introduction:** The Psoas minor muscle is a long, elongated, spindle-shaped muscle that is rarely present in the human body. Despite its relatively minor role in human biomechanics, understanding its prevalence and morphology can be crucial in certain surgical and diagnostic contexts.

**Aim:** The primary aim of this cross-sectional cadaveric study is to investigate the prevalence and describe the morphometry of the Psoas minor muscle in a population from western Maharashtra.

**Materials and Methods:** 63 well-preserved formalin-fixed and soft-embalmed human cadavers were examined during routine dissection. The prevalence, sexual dimorphism, morphology, morphometry, and laterality of Psoas minor muscle were assessed. Digital vernier calipers and tape measure were used to measure the psoas minor muscle morphometry.

**Result:** The study reveals a prevalence rate of 33.33% for the Psoas minor muscle in the studied population. The muscle was present in 21 cadavers out of 63 cadavers. It was bilateral in 17.46% (11/63) cadavers and unilateral in 15.87% (10/63) cadavers. In all the examined cases muscle took origin from a T12-L1 vertebra, and was distally connected to the iliopubic eminence. The muscle was found unilaterally in 05 males and 05 female cadavers, and bilaterally in 07 males and 04 female cadavers.

**Conclusion:** The study provides valuable insights into the presence and anatomical characteristics of the Psoas minor muscle among the population of Western Maharashtra. The prevalence as well as morphometry and morphology of this muscle is of significant academic interest for anatomists, surgeons, radiologists, kinesiologists, and physiotherapists for diagnostic purposes.

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#### Introduction:-

The Psoas minor is a long, elongated, spindle-shaped muscle rarely present in the human body. It is generally found in front of the Psoas major muscle, arising from the bodies of the T12-L1 vertebra including the intervertebral

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disc, and ends in a long sheet-like tendon inserting into the iliopubic eminence<sup>1</sup>. The Psoas minor muscle is considered to play a small role in human biomechanics, mainly acting on the spine and sacroiliac joint as a minor trunk flexor and stabilizer of the lumbar spine<sup>2</sup>. The muscle is innervated by the anterior ramus of L1 spinal nerve.

The main function of the Psoas minor muscle is to flex the hip joint<sup>3</sup>. With evolution, humans have developed an upright posture and eventually, the muscle is observed to become rudimentary. Despite its limited functional significance, the Psoas minor can be of clinical importance in certain surgical procedures, diagnostic imaging, and anatomical research. The Psoas minor muscle, in high-speed animals like leopards, is fully grown and well developed<sup>4</sup>.

Previous anatomical studies have reported varying prevalence rates of the Psoas minor muscle across different populations. However, there is limited data available on the morphometry and prevalence of the Psoas minor muscle in the western Maharashtrian population. Understanding the prevalence and anatomical variations of the muscle under study in this region is essential for accurate diagnosis, surgical planning, and research purposes. This cross-sectional cadaveric study aims to investigate the dimensions, morphology, and prevalence of the Psoas minor muscle in a western Maharashtrian population.

### **Methodology:-**

The present cross-sectional study was conducted on 63 well-embalmed formalin-fixed and soft embalmed adult human cadavers during routine dissection in the Department of Anatomy at a Medical College. Each cadaver was carefully dissected as per standard dissection techniques<sup>3</sup>, to expose the lumbar region and identify the Psoas minor muscle. The presence of the Psoas minor muscle was noted, and its morphology, dimensions, laterality, and variations were documented. The length, width, and thickness of both the muscle and tendon at its greatest width were measured using a tape measure and a digital vernier caliper (Figure 1).

The details collected were analyzed concisely using statistics to describe the morphological characteristics of the muscle and to find out its prevalence rate. Adult well-embalmed formalin-fixed human cadavers, both males and females of different age groups of Indian ethnicities from the Department of Anatomy of a Medical College, which had been utilized for undergraduate training purposes, were included in the study. However, cadavers with evidence of previous surgery, trauma, or significant pathological changes affecting the lumbar region were factored out from the study. The sample size was 63 cadavers, which was calculated as per prevalence mentioned in studies by Bose P et al<sup>5</sup> using the formula  $(n) = [ Z^2 p (1-p) ] / d^2$ , where n is the sample size, Z is Confidence Interval (90%), p is the proportion of cases with the outcome of interest according to previous studies (36.67%), d is the margin of error (10%).

### **Results:-**

Out of the 63 cadavers examined, the Psoas minor muscle was identified in 21 cadavers, resulting in a prevalence rate of 33.33% in the studied population. In all the cases, the muscle had a slender and elongated appearance, originating from the bodies of T12-L1 vertebrae and inserted into the iliopubic eminence. The muscle was observed unilaterally in 10 cases and bilaterally in 11 cases. The Psoas minor muscle was present on the right side in 06 (9.52%) cadavers as shown in Figure 2 and on the left side in 04 (6.35%) cadavers as shown in Figure 3, while in 11 (17.46%) cadavers, Psoas minor was present bilaterally. The average length of the Psoas minor muscle belly was found to be 11.05 cm on the right side and 11.68 cm on the left side. The average width of the muscle belly was 3.01 cm on the right side and 3.05 cm on the left side. The average length of the Psoas minor tendon was 12.90 cm on the right side and 12.53 cm on the left side. The average width of the muscle tendon was 2.03 cm on the right side and 2.09 cm on the left side (Table 1). In the studied population, the male-to-female ratio for the prevalence of the Psoas minor was 4:3. The prevalence rate of the Psoas minor muscle in the population of Western Maharashtra (33.33%) was consistent with the findings of previous studies conducted in other populations. However, variations in the morphometric parameters of the Psoas minor muscle were observed and compared with previous literature (Table 2).

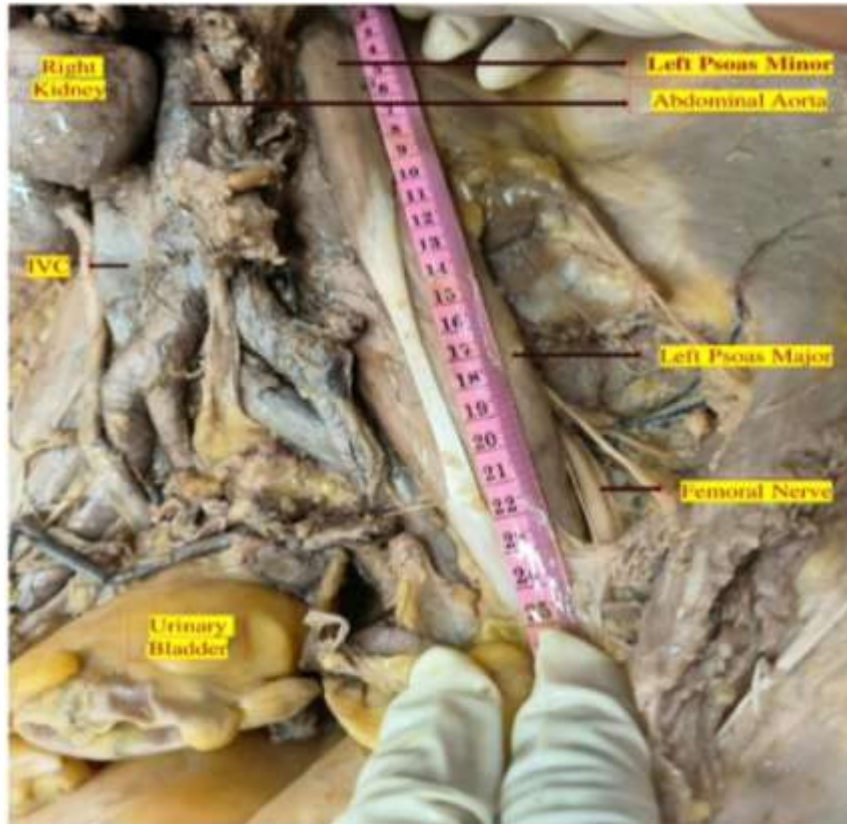


Fig. 1:-Shows measurement of the total length of Psoas Minor muscle.

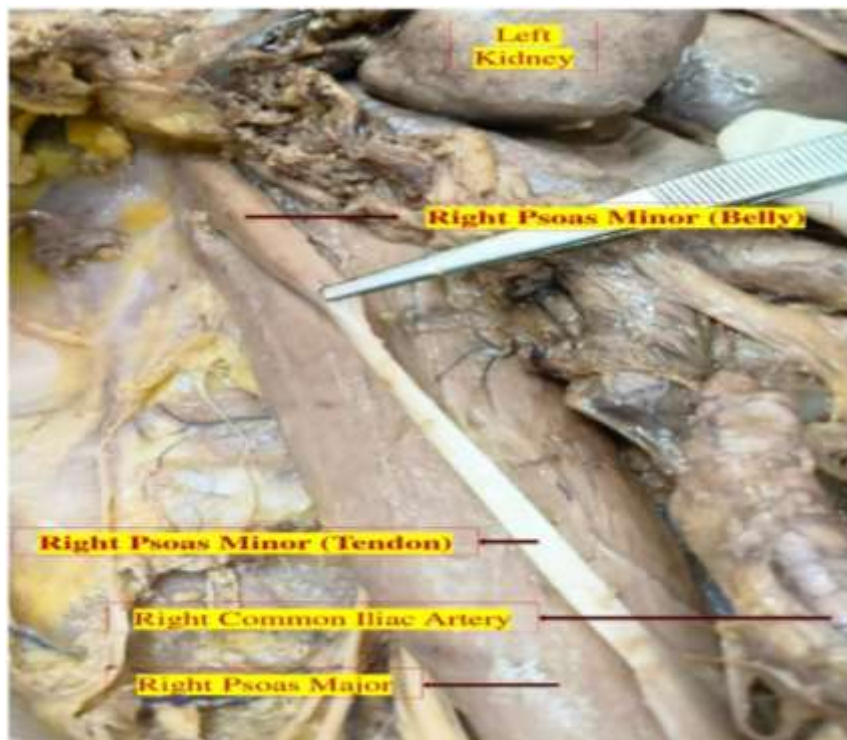


Fig. 3:-Shows Psoas Minor muscle on the left side.

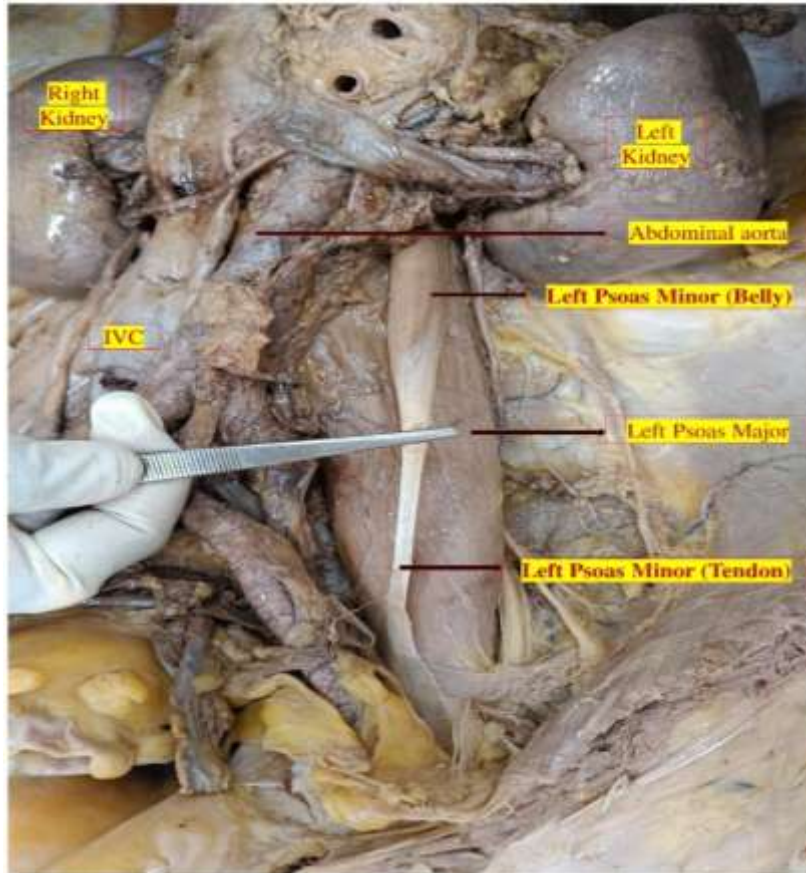


Fig. 2:-Shows Psoas Minor muscle on the right side.

Table 1:-Morphometric data on the length and diameter of the psoas minor muscle belly and tendon.

Psoas Minor			Length (in cm)						Maximum width (in cm)			
			Right-hand side			Left-hand side			Right-hand side		Left-hand side	
Cases	Gender	Laterality	Tendon	Belly	Total length	Tendon	Belly	Total length	Belly	Tendon	Belly	Tendon
1	Female	Bilateral	10.48	11.25	21.73	10.34	11.85	22.19	2.6	2.1	2.7	2.2
2	Male	Unilateral	-	-	-	11.14	12.39	23.53	-	-	3.1	2.0
3	Male	Bilateral	10.65	14.52	25.17	10.88	14.74	25.62	2.7	2.0	2.4	1.9
4	Female	Bilateral	9.48	10.12	19.60	9.34	10.20	19.54	2.1	1.8	2.3	2.0
5	Male	Unilateral	11.67	10.09	21.76	-	-	-	3.0	2.1	-	-
6	Female	Unilateral	10.02	9.24	19.26	-	-	-	2.6	1.9	-	-
7	Female	Bilateral	11.13	9.39	20.52	10.45	10.53	20.98	2.6	2.0	2.4	2.1
8	Male	Unilateral	-	-	-	12.22	10.68	22.90	-	-	3.1	2.4
9	Male	Bilateral	14.16	10.37	24.53	12.35	11.56	23.91	3.2	2.1	3.4	2.2
10	Male	Bilateral	15.17	11.25	26.42	14.34	11.52	25.86	3.6	2.0	3.4	2.2
11	Male	Bilateral	14.97	10.26	25.23	13.37	12.05	25.42	3.2	2.2	3.3	2.0
12	Female	Unilateral	-	-	-	13.00	11.12	24.12	-	-	3.0	2.1
13	Male	Unilateral	15.10	13.23	28.33	-	-	-	3.6	2.2	-	-
14	Female	Bilateral	13.33	10.72	24.05	12.34	11.50	23.84	2.9	1.9	3.1	2.0
15	Male	Bilateral	14.77	11.29	26.06	14.37	11.64	26.01	3.3	2.0	3.4	2.0
16	Female	Unilateral	13.57	11.20	24.77	-	-	-	3.1	2.1	-	-
17	Male	Unilateral	-	-	-	15.12	11.87	26.99	-	-	3.4	2.0
18	Male	Bilateral	14.98	11.51	26.49	14.46	12.12	26.58	3.4	2.0	3.2	2.2

19	Female	Unilateral	13.11	10.16	23.27	-	-	-	3.0	2.0	-	-
20	Female	Unilateral	12.88	11.27	24.15	-	-	-	2.9	1.9	-	-
21	Male	Bilateral	13.76	11.97	25.73	14.24	11.39	25.63	3.3	2.2	3.5	2.0

**Table2:-**Comparison of prevalence and morphometric parameters of Psoas minor of previous studies with the current study. (R- right, L- left).

Sl no	Authors	Place of Study	Psoas minor muscle		
			Prevalence (%)	Mean length (cm) (belly+tendon)	Mean width (cm)
1	Dragieva P et al. <sup>6</sup> , 2018	Bulgaria	60	19.66	1.73
2	Drakshayini B Kokati et al. <sup>7</sup> , 2022	India (Karnataka)	33.33	R – 20.81 L – 20.17	R – 1.88 L – 1.88
3	Farias MCG et al. <sup>8</sup> , 2012	Brazil	59	23.93	1.71
4	Ojha P et al. <sup>9</sup> , 2016	India (Rajasthan)	36.67	22.12	-
5	Joshi SD et al. <sup>10</sup> , 2010	India (Maharashtra)	30	23.75	1.32
6	Neumann DA et al. <sup>11</sup> , 2015	USA	65.6	23.85	-
7	<b>Present study (2024)</b>	<b>India</b>	<b>33.33</b>	<b>R-23.94 L-24.21</b>	<b>R- 3.01 L- 3.05</b>

### Discussion:-

The Psoas minor muscle exhibits variations in length, width, and circumference across different populations. The Psoas minor muscle is a very seldom discussed muscle in anatomical literature due to its variable presence and limited functional significance. This muscle can be present unilaterally or bilaterally with its caudal insertion at different anatomical points. However, in our present study, the psoas minor muscle takes origin from the bodies of the T12-L1 vertebra including the intervertebral disc and ends in a long sheet-like tendon inserting into the iliopubic eminence in all the cadavers. The muscle is fully grown in cursorial animals which enables them to run faster<sup>12</sup>.

In our present study, the prevalence rate of the Psoas minor muscle in the western Maharashtrian population came out to be 33.33%. The recognized prevalence of the muscle ranges from 33.4% to 52%<sup>15</sup>. The average length of the psoas minor muscle is calculated to be 23.94 cm on the right side and 24.21 cm on the left side in our study. In a study on the Brazilian population, the average length of 23.93cm was reported while in a study by Neumann et al., the average length of this muscle was reported to be 23.85 cm in the US population<sup>8,11</sup>. In the Indian population, the average length of the Psoas minor muscle was reported to be 22.12 cm and 23.75 cm in a study conducted by Ojha et al and Joshi et al. Guerra DR et al, reported that the length of the psoas minor tendon constitutes approximately 57% of its total length<sup>14</sup>. In our study, the muscle belly and tendon together comprised 46% and 54% respectively of the total extent of the Psoas minor muscle on the right side and 48% and 52% of the total extent of the Psoas minor muscle on the left side.

Jeyanthi M et al. noted in their study that the muscle belly of the psoas minor is longer than its tendinous portion. However, in our study, the tendinous portion was longer than the muscle belly on both sides. The presence of a long muscle belly in the psoas minor increases the risk of compressing neurovascular structures, which can disrupt activities such as jogging, hopping, jumping, and leaping, thereby affecting an athlete's performance<sup>13</sup>.

Increased tension in the psoas minor muscle, a tight tendon, and compression of retroperitoneal neurovascular structures can lead to psoas minor syndrome. In this syndrome, patients may experience pain in the iliac fossa, and chronic lower abdominal or lumbar pain, which worsens upon palpation<sup>16</sup>. When the psoas minor inserts into the femur, it is more susceptible to overstrain, resulting in a 50% reduction in hip joint flexion. This can cause chronic back pain, discomfort in the iliac fossa, and difficulty standing upright, which may be alleviated through surgical intervention such as tenotomy.<sup>17</sup>

**Conclusion:-**

The importance of the psoas minor muscle in sports medicine has increased due to reported instances of muscle spasms presenting as lower back pain in athletes. This cross-sectional cadaveric study conducted among the population of western Maharashtra revealed a prevalence rate of 33.33% for the Psoas minor muscle. The muscle shows sizeable variations in its insertion, ethnic differences, and morphometry, as documented in previous studies. Variations in its dimensions were observed, highlighting the anatomical complexity of this muscle, and emphasizing the importance of individualized assessment and careful evaluation in clinical and surgical settings.

The role of the Psoas minor is often ignored by the clinicians and researchers due to the lack of thorough anatomical knowledge. These significant findings will attain spur in evolutionary aspects contributing to the existing literature on the Psoas minor muscle and provide valuable insights for clinicians, surgeons, physiotherapists, and researchers.

**Acknowledgment:-**

The authors extend our heartfelt appreciation to those who generously donated their bodies to advance anatomical research. Through their contributions, we aim to enhance our understanding, ultimately benefiting patient care and advancing scientific knowledge. We honor these donors and their families for their profound generosity.

**Source of Funding:**

None.

**Conflict of Interest:**

None.

**Author Contribution:**

All authors have approved the final version of the manuscript.

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