



Research Paper

## Occurrence of the Psoas Minor Muscle: A Literature Review

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**ABSTRACT** Over the course of evolution, various structures in the human body have varied in size and presence from one population to another, tending to regress and disappear in the species. For this reason, the psoas minor muscle has been the subject of studies in recent years. In some cases, variations in morphology and frequency of appearance have been noted. These variants are important in that they may result in muscular dysfunction causing pain, leading clinicians to suspect abdominal organ syndromes such as acute appendicitis and diverticulitis. Therefore, this study sought to review data from recently published studies on the patterns of occurrence of the psoas minor muscle. It was searched Semantic Scholar, Medline and PubMed using the terms "psoas minor morphology" and "psoas minor variations." The discovered articles should present information on the morphology of the muscle and data on its prevalence. Case reports and those that did not include anatomical dissections in humans were excluded. It was founded 5071 articles. After applying inclusion and exclusion criteria, five articles remained to be analyzed in this review, totaling 97 cadavers. The psoas minor muscle is present in 46.39% of individuals, of which 32.98% were observed bilaterally and 13.41% were unilateral. The psoas minor muscle presents great variability in terms of occurrence in the general population, and can still be observed unilaterally in some individuals.

**KEYWORDS:** psoas minor muscles; occurrence; agenesis.

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### I. INTRODUCTION

The posterior abdominal wall is formed by the psoas major, lumbar square, iliac muscles and the psoas minor [1]. The latter has a very variable size in the human population, and agenesis has been frequently reported. For these reasons, it can also be considered a vestigial muscle [2]. Its occurrence has been reported unilaterally, bilaterally, or even absent according to anatomical dissections and other study methods [3] and [4].

The psoas minor muscle is located laterally to the lumbar region of the spine, anteriorly to the psoas major muscle [5]; it is short, but has a large tendon that averages 13 cm in length [6], with a belly averaging 8 cm in width [7]. Its origin is located on the lateral portion of the bodies of the 12<sup>th</sup> thoracic and 1<sup>st</sup> lumbar vertebrae in addition to the intervertebral disc positioned between them [8].

This muscle has a descending and oblique path towards the iliopubic eminence, the pectineal line and the iliac fascia, where its insertion is located; this can be located in the arcuate line and in the pectineus ligament [5]. The fascia and the muscle itself are prone to being involved in infections, hematomas and neoplasms of the retroperitoneal plane [9].

It is worth mentioning that some pathological alterations in the fascia of the psoas minor muscle may permit access to the endothoracic cavity. This occurs, in some anatomical variations, because of the positioning of its upper portion after the insertion of the diaphragm [10].

The psoas minor muscle is innervated by the first lumbar nerve that passes ventromedially to the surface of the psoas major muscle [11]. One of its functions is aiding flexion of the lumbar spine, stabilizing the hip joint and serving as a tensor of the iliac fascia [12] and [13]. Its unilateral contraction performs spinal

column flexion [7]. When highly tensioned, it causes pain in the inguinal region and abdominal wall, causing reduction in hip movements [4]. This occurs more commonly in athletes such as golfers and soccer players, impairing running and jumping [4] and [14].

Clinically, patients with the psoas minor muscle may develop a disorder called psoas minor syndrome, which is characterized by a deficit in the growth of the muscle. The syndrome is characterized by reduction in movement, generating substantial pain, as it is more easily overly subject to tension. The importance of the phenomenon is that the symptoms are similar to those of acute appendicitis, because of the location of pain in the lower quadrant of the abdomen [4] and [15], and to those of diverticulitis localized in the iliac fossae [3]. This can lead to misdiagnosis. The symptoms are due to compression of retroperitoneal neurovascular structures [16].

In view of its clinical importance, and considering the scarcity of studies with a significant number of anatomical dissections in cadavers, we aimed to conduct a literature review regarding the prevalence of the psoas minor muscle, as well as to relate these data to factors such as antimeres, sex and age.

Among the hypotheses we entertained, we speculated that the prevalence of the psoas minor muscle would be low, and would therefore become an anatomical variation of clinical interest for health professionals.

## **II. MATERIALS AND METHODS**

According to local ethical regulations, studies involving sources of data of public origin, or data extracted from previously published articles (reviews), are exempt from approval by research ethics committees involving human beings. The present study meets these conditions.

A bibliographic search was performed in the databases PubMed, Medline and Semantic Scholar in March 2019, in which the terms psoas minor morphology and psoas minor variations were used. We limited the search to publications from 2000 to 2019, and limited the language to English.

The inclusion criteria of the selected studies were as follows: (I) presence of morphological information about the psoas minor muscle, and (II) presentation of data related to the prevalence or occurrence of that muscle. The exclusion criteria were (I) case report type studies and (II) absence of anatomical dissection in humans.

The selection of articles was carried out independently among the authors and divided into three stages. In the first stage, articles that did not meet the inclusion criteria or that fit the exclusion criteria and duplicates were eliminated by reading the titles. For those selected at this stage, the authors read their respective abstracts (second stage), followed by full reading of the studies considering the inclusion and exclusion criteria (third stage).

At each stage of the process, meetings were held between the authors to resolve possible differences in the selection of studies. We recorded prevalence of the psoas minor muscle, sample size, demographic data of the studied sample (age and sex), and bibliographic data related to publications. The collected data were tabulated, and the relative and absolute frequencies of muscle occurrence were calculated, as well as those of demographic data.

## **III. RESULTS**

A total of 5071 articles were found in the three databases: 5044 in Semantic Scholar, 23 in PubMed and four in Medline. One article that was not found in the database was added manually. Of this total, 5058 studies were excluded after reading the titles, when we identified duplicates, or when there was absence of information on the prevalence of the muscle. We read the abstracts of 14 articles, of which six were excluded; eight studies were read fully (Fig. 1).

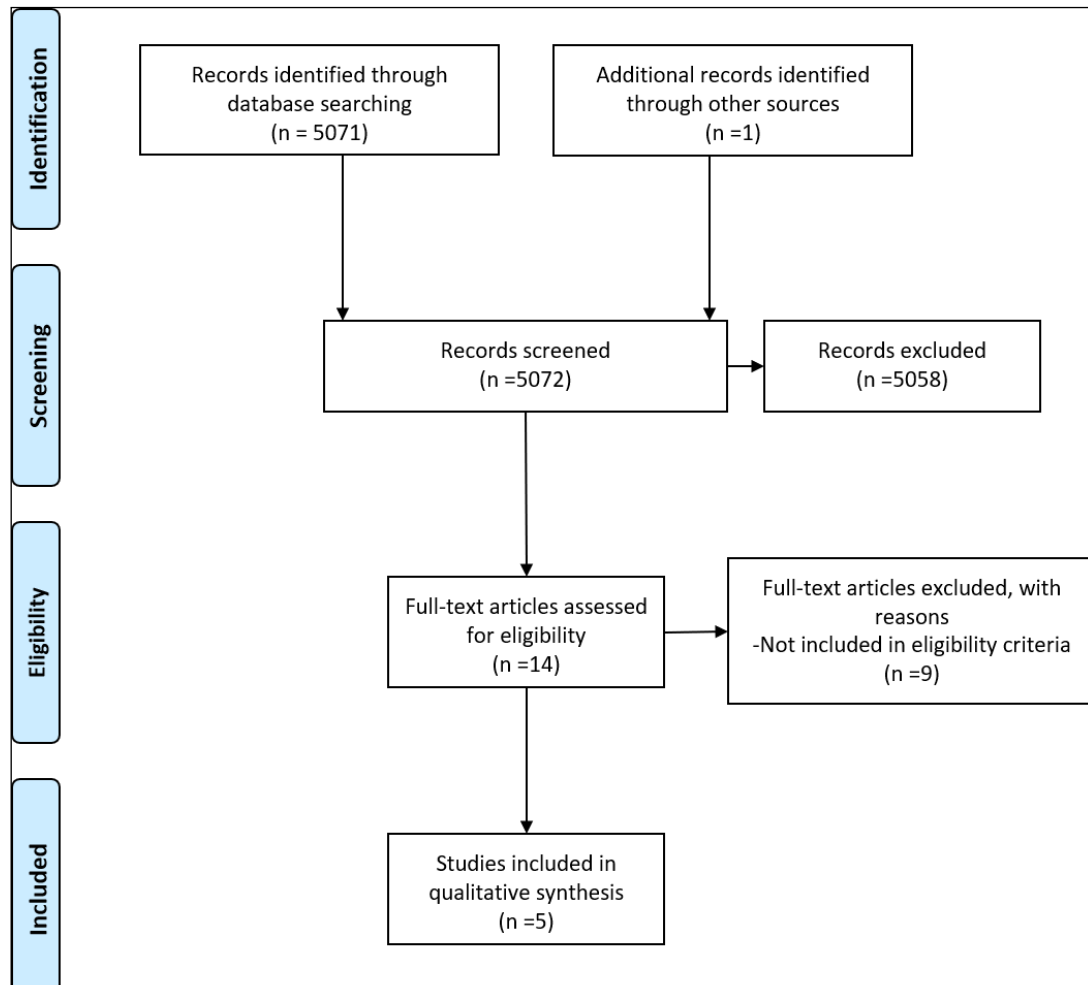


Figure 1. PRISMA diagram

After full reading, three more articles were excluded, two of which were case reports and one that did not present the information necessary to carry out this review, leaving five articles in the analysis.

In these articles, a total sample of 97 cadavers were included. Among these, 52 had bilateral agenesis of the psoas minor muscle, while 45 had the muscle (Table 1).

Table 1. Occurrence of the psoas minor muscle, after dissection in embalmed corpses

| Author                    | Subjects (n) | Muscle Occurrence |       | Muscle Agenesis |       |
|---------------------------|--------------|-------------------|-------|-----------------|-------|
|                           |              | f                 | %     | f               | %     |
| Joshi et al. (2010) [17]  | 30           | 9                 | 30.00 | 21              | 70.00 |
| Guerra et al. (2012)[18]  | 22           | 13                | 59.09 | 9               | 40.91 |
| Sachin et al. (2015)[2]   | 20           | 7                 | 35.00 | 13              | 65.00 |
| Zhang et al. (2017)[12]   | 15           | 10                | 66.67 | 5               | 33.33 |
| Dragieva et al. (2018)[7] | 10           | 6                 | 60.00 | 4               | 40.00 |
| Total                     | 97           | 45                | 46.39 | 52              | 53.61 |

Demographically, 66 (68.04%) male corpses and 31 (31.96%) female corpses were observed; 22 fetuses and 35 adults were reported, excluding the data presented by [7] and [17], who did not present this information (Table 2).

Table 2. Demographic variables analyzed in embalmed corpses

| Author                                | Subjects (n) | Sex  |       |        |       | Age           |        |        |        |
|---------------------------------------|--------------|------|-------|--------|-------|---------------|--------|--------|--------|
|                                       |              | Male |       | Female |       | Human Fetuses |        | Adults |        |
|                                       |              | f    | %     | f      | %     | f             | %      | f      | %      |
| Joshi et al. (2010) [17] <sup>1</sup> | 30           | 24   | 80.00 | 6      | 20.00 | -             | -      | -      | -      |
| Guerra et al. (2012)[18]              | 22           | 11   | 50.00 | 11     | 50.00 | 22            | 100.00 | 0      | 0      |
| Sachin et al. (2015)[2]               | 20           | 16   | 80.00 | 4      | 20.00 | 0             | 0      | 20     | 100.00 |
| Zhang et al. (2017)[12]               | 15           | 10   | 66.67 | 5      | 33.33 | 0             | 0      | 15     | 100.00 |

|  |    |    |       |    |       |    |       |    |       |
|--|----|----|-------|----|-------|----|-------|----|-------|
| Dragieva et al. (2018)[7] <sup>1</sup> | 10 | 5  | 50.00 | 5  | 50.00 | -  | -     | -  | -     |
| Total                                  | 97 | 66 | 68.04 | 31 | 31.96 | 22 | 22.68 | 35 | 36.08 |

<sup>1</sup> The age in which the study was conducted, was not presented.

The data regarding antimeres can be seen in Table 3, where the unilateral presence of the muscle was reported in nine cases, five on the right side and four on the left side; the antimer in which the muscle was present wasn't characterized [12]. There were also 32 cases of bilateral presence and 52 cases of bilateral agenesis of this muscle.

**Table 3.** Distribution of the occurrence of the psoas minor muscle according to antimer in embalmed corpses.

| Author                                 | Subjects (n) | Unilateral |       |      |       |       |       | Bilateral |       |        |       |
|--|--------------|------------|-------|------|-------|-------|-------|-----------|-------|--------|-------|
|  |              | Right      |       | Left |       | Total |       | Present   |       | Absent |       |
|  |              | f          | %     | f    | %     | f     | %     | f         | %     | f      | %     |
| Joshi et al. (2010) [17] <sup>1</sup>  | 30           | 0          | 0.00  | 2    | 6.70  | 2     | 6.70  | 7         | 23.30 | 21     | 70.00 |
| Guerra et al. (2012)[18]               | 22           | 2          | 9.09  | 1    | 4.50  | 3     | 13.60 | 10        | 45.50 | 9      | 40.90 |
| Sachin et al. (2015)[2]                | 20           | 1          | 5.00  | 0    | 0.00  | 1     | 5.00  | 6         | 30.00 | 13     | 65.00 |
| Zhang et al. (2017)[12]                | 15           | -          | -     | -    | -     | 4     | 26.67 | 6         | 40.00 | 5      | 33.33 |
| Dragieva et al. (2018)[7] <sup>1</sup> | 10           | 2          | 20.00 | 1    | 10.00 | 3     | 30.00 | 3         | 30.00 | 4      | 40.00 |
| Total                                  | 97           | 5          | 5.15  | 4    | 4.12  | 13    | 13.41 | 32        | 32.98 | 52     | 53.61 |

<sup>1</sup> The antimer in which the presence of the muscle was observed was not presented.

Two case reports were found [1] and [3] who demonstrated the bilateral presence of the muscle using a cadaver in each study, aged between 55 and 60 years. However, these were not included in the analysis of absolute and relative frequency of the study because they are characterized as case reports.

#### IV. DISCUSSION

The psoas minor muscle has been documented with respect to its morphological and functional aspects [2], [7], [12], [17] and [18]. Nevertheless, regarding anatomical variation, the findings related to its agenesis remain limited.

The anatomical knowledge of the posterior abdomen wall, as well as the understanding of anatomical variations related to the psoas minor muscle is important for understanding physiological and pathological aspects, perception of location and the spread of diseases in the retroperitoneal region [3].

Occurrence of the psoas minor varied between 30.00% [17] and 66.67% [12]; considering the total sample examined in this literature review, including 97 reports, a percentage of 46.39% of muscle occurrence was found, which is within the range reported by the literature, and below 50.00% of muscle occurrence [2] and [17]. Nevertheless, the literature lacks studies large sample sizes to obtain robust statistical data; therefore, further investigation is necessary to determine the pattern of appearance of this muscle.

Considering the findings of this study, it was not possible to establish a direct relationship between the racial characteristics of the cadavers on the occurrence or agenesis of the psoas minor muscle. By contrast, [3] and [4] reported differences in this regard; nevertheless, their findings should be analyzed with caution, because statistical tests of racial associations were not reported in these studies.

In the present study, the total sample included 97 fixed cadavers studied using dissection. Among them, 68.04% were male and 31.96% female. These data demonstrate a certain disparity between male and female corpses, probably due to the reduced availability of female corpses for study. Therefore, the establishment of a relationship between sex and muscle agenesis is impracticable in the context of this type of study. Clinical studies or dissection studies with larger sample numbers are required to obtain this type of information.

Comparing our results presented to [17], the distribution of occurrence and bilateral agenesis were quite different, as were those of unilateral presence. However, when analyzing the study [18] there was a similarity with the unilateral occurrence rate found by our study (13.60%), although bilateral occurrence did not match. Reported cadavers with psoas minor muscles present unilaterally only on the left side, with their proportional value (5.00%) similar to the result of this study [2].

When considering the study [12], it is useful to compare only the data of total bilateral and unilateral presence, because the authors did not detail whether the presence was right or left. This is different from [7], the most recent study found, who reported bilateral presence similar to that of our study (32.98%).

#### V. CONCLUSION

Considering the limitations with respect to the sample number and accuracy of data in the literature, as well as in terms of demographic and racial aspects, we conclude that the psoas minor muscle presents a great variability in terms of occurrence in the general population, and can still be observed unilaterally in individuals.

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