Papers on Anthropology XXI, 2012, pp. 147–154

FEMALE PELVIC TYPES AND AGE DIFFERENCES IN THEIR DISTRIBUTION

OKSANA KOLESOVA, JĀNIS VĒTRA

Institute of Anatomy and Anthropology, Riga Stradiņš University, Latvia

ABSTRACT

The aim of this study was a statistics-based exploration of a typology of the female pelvis. The research sample included 172 females aged from 18 to 69. For measurements, the three dimensional CT images of pelvis were used. A cluster analysis was performed on anteroposterion and transverse diameters of the pelvic inlet and the midplane. The results revealed three clusters representing gynecoid, "narrow", and intermediate types of female pelvis. The distribution of pelvic types in age groups indicates a tendency for the "narrow" pelvis to be presented more frequently in the group of younger females.

Variability and typology of the female pelvis is a traditional topic in anthropological studies [3, 4, 13, 17]. The best known classification of the female pelvis was suggested by Caldwell and Moloy in 1933 [3] and it was based on the pelvic inlet shape. In the frame of this classification, four main pelvic types were suggested: gynecoid, android, anthropoid, and platypelloid. The development of this classification resulted in the identification of the mixed types and subtypes based on the width of the pelvic outlet [3]. As a result, more than twenty subtypes were suggested that complicated their analytical implication. In addition, the critics of this classification addressed the subjective impression in the judgments of pelvic shapes without a well established statistical base [19].

A tendency of increase in cesarean section is observed in the last decades [2, 5, 9, 15]. In Latvia, the number of cesarean section delivery is growing from 3.9% in 1980 to 23.7% in 2010 [18]. A narrow pelvis is one of the factors increasing the risk for cesarean section [12]. On the one hand, there is a solution for the narrow pelvis problem from the obstetric perspective. On the other hand, a more detailed analysis is needed from the anthropological perspective because of possible evolutionary trends in the human body in general

and in the pelvic shape in particular. The aim of this study was a statistics-based exploration of a typology of the female pelvis.

A well recognized anthropological tendency of the last century is the secular trend in growth. Previous studies demonstrate an increase in the mean height about 1–2 cm per decade in different European countries [6, 8]. An investigation of external body parameters of Latvian women also demonstrated significant changes in the period of 70 years. The women's height increased for 6 cm, shoulder breadth increased for 0.6 cm, and the hip breadth increased for 2.9 cm [8]. Based on the relationship between the lesser pelvic parameters and height observed in previous studies [7, 11, 13], it is possible to expect that parameters of the lesser pelvis also changed during the last 6–7 decades.

It should be noted that the female pelvic cavity has a cylindrical shape with the narrowest place in the midplane between two ischial spines (the bispinous diameter). The obstetric importance of the pelvic inlet and the midplane was emphasized in anthropological studies [3, 4, 16, 17]. In a typical female pelvis, a longer diameter of the inlet (the transverse diameter) and a longer diameter of the midplane (the anteroposterior diameter) are placed perpendicularly. Therefore, a fetal head rotates from a transverse position in the pelvic inlet to a sagittal position in the midplane. A narrowing of the pelvic cavity in the midplane causes this rotation. Stalberg at al. [12] demonstrated that a narrow pelvic midplane is an important reason for the emergency cesarean section. In addition, an inadequate proportion of the pelvic inlet also causes cesarean section [1].

Therefore, both the pelvic inlet and the midplane are highly important from the anthropological perspective and need to be included in a statistics-based exploration of the female pelvic typology. Changing body parameters allow to expect age differences in a distribution of pelvic types between younger and older females. As a result, two research questions were posed for the present study:

1. What female pelvic types could be detected on the basis of the measures of the inlet and the midplane of the lesser pelvis?
2. How does the distribution of female pelvic types among age groups differ?

Key words: *pelvic typology, narrow pelvis, pelvimetry*

MATERIAL AND METHODS

The study was based on the archive data of the Department of Radiology, "Gaiļezers" Hospital, Latvia, in the period from October of 2009 to November of 2010. Archive data were available according to legal requirements. The

research sample included 172 females aged from 18 to 69 (the mean age=42.9, SD=14.7 years). For measurements, three dimensional CT images of pelves (performed on 1.25 mm slices) were used. Exclusion criteria were bones' fractures, osteoporosis, scoliosis, transitional vertebras, and polytraumas.

For each pelvis anteroposterion and the transverse diameters of the inlet and the midplane were measured:

(1) The anteroposterior diameter of the inlet – the distance between the posterosuperior border of the pubic simphysis and the promontory of the sacrum;
(2) The transverse diameter of the inlet – the widest distance between iliopectineal lines;
(3) The anteroposterior diameter of the midplane – the distance between the lower border of the pubic simphysis and the anterior point between the fourth and the fifth sacral vertebrae;
(4) The transverse diameter of the midplane (the bispinous diameter) – narrowest distance between two ischial spines.

RESULTS

In order to answer the first research question, a cluster analysis was performed on the pelvic measures of 172 females. Taking into account the exploratory nature of the study, the number of clusters was not specified before the analysis. The identification of clusters was based on TwoStep Cluster procedure in the IBM SPSS 19.0 program. Three clusters were suggested as the cluster solution. The average silhouette coefficient of cohesion and separation was 0.4 that indicates the acceptable level of cluster quality. Table 1 demonstrates the descriptive statistics of selected clusters.

Post-hoc pair comparisons (Tukey HSD) revealed significant differences between clusters. The anteroposterior diameter of the midplane and the transverse diameter of the inlet demonstrated significant differences among all the pairs of clusters. There were no differences on the bispinous diameter in Cluster 2 and Cluster 3. The anteroposterior diameter of the inlet was similar in Cluster 1 and Cluster 2.

Table 1. Descriptive statistics of three clusters based on the measures of the lesser female pelvis (n=172)

	Cluster 1 (n=51)	Cluster 2 (n=62)	Cluster 3 (n=59)
Measures (Importance)	Mean (SD), cm	Mean (SD), cm	Mean (SD), cm
Anteroposterior diameter of midplane (1,0)	12.0[a] (0.6)	13.1[b] (0.6)	11.7[c] (0.5)
Transverse diameter of inlet (0,88)	12.6[a] (0.5)	14.0[b] (0.7)	13.7[c] (0.6)
Bispinous diameter (0,79)	10.3[a] (0.6)	11.7[b] (0.9)	11.6[b] (0.5)
Anteroposterior diameter of inlet (0,21)	12.8[a] (0.9)	13.0[a] (0.8)	12.1[b] (1.0)

[a, b, c] Different letters indicate significant differences between clusters.

Cluster 1 has the lowest means of the pelvic midplane. For this cluster, both diameters of the inlet are near equal, the longer diameter of the midplane is the anteroposterior diameter, and the bispinous diameter is the smallest among three groups. Therefore, this cluster represents a "narrow" female pelvis with the inlet shape close to round. Cluster 2 has the highest means of the midplane and of the inlet. The longer diameter of the inlet is the transverse diameter, but the longer diameter of the midplane is the anteroposterior diameter. Having the anteroposterior diameter of the inlet similar to Cluster 1, Cluster 2 has a significantly "wider" inlet. The parameters of Cluster 3 are between of t Cluster 1 and Cluster 2. The longer diameter of the inlet was the transverse diameter, and both diameters of the midplane are near to be equal. Therefore, this cluster represents the female pelvis with the midplane shape close to round.

To answer the second research question, the observed occurrence of each pelvic type was detected in three age groups (18–25, 26–49, and 50–69). Table 2 represents the absolute and relative frequencies of clusters observed in each age group. The Chi-square test confirmed a tendency for pelvic types to be distributed differently in three groups, $\chi^2(4, N=172)=13.12$, $p<.05$.

Table 2. Distribution of female pelvic types within age groups

Age group	Cluster 1	Cluster 2	Cluster 3
18–25 (n=34)	17 (50%)	8 (24%)	9 (26%)
26–49 (n=74)	22 (30%)	31 (42%)	21 (28%)
50–69 (n=64)	12 (19%)	23 (36%)	29 (45%)

Further exploration of this tendency revealed a significant variation of Cluster 1 among age groups, $\chi^2(2, N=172)=10.39$, $p<.01$. The distributions of Cluster 2 and Cluster 3 were without significant differences, $\chi^2(2, N=172)=3.41$, $p=.18$ and $\chi^2(2, N=172)=5.52$, $p=.06$, respectively.

DISCUSSION

In general, the results of this study demonstrate a relatively simple classification of female pelvic types using parameters of the pelvic inlet and midplane. Three pelvic types were detected as statistically significant clusters, and their distribution among three age groups was tested. The most significant difference among age groups addresses the distribution of the "narrow" pelvis. As Caldwell and Moloy [3, 4] demonstrated, the pelvic type effects the biomechanics of labor and obstetric complications. Therefore, the observed differences should be discussed in greater details.

As it is observed, there is no agreement between the number of pelvic types in the present study and in the typology suggested by Caldwell and Moloy [3]. This finding is in accordance with the early critics of pelvic classification [19].

Cluster 1 represents a "narrow" female pelvis with the inlet diameters near to equal. According to Yong and Ince [19], these proportions of the inlet are similar to the pelvic inlet in males. Parameters of this cluster are similar to the pelvic diameters of the females who had the emergency cesarean section due to dystocia [12, 10]. Therefore, this cluster is potentially problematic from an obstetrical perspective.

Cluster 2 has the highest means of the midplane and of the inlet and has the wider transverse the oval inlet. It is presented in the 36% of the research sample (the most frequent pelvic type). According to Caldwell and Moloy, the female pelvis with a wide transverse oval inlet is a typical – gynecoid – female pelvis (about 40% of females). Females with this pelvic type usually do not have difficulties in labor [3, 4]. Therefore, Cluster 2 is near to the gynecoid type in the most known classification.

The inlet of Cluster 3 is similar to the gynecoid type, but equal parameters of the midplane indicate that the pelvis may have a narrow posterior segment of the midplane. This feature can negatively effect fetal passing through the pelvic midcavity and fetal rotation in the midplane.

It should be noted that the android pelvic type ("heart-shaped" inlet), the anthropoid type (longitudinal oval inlet with a longer anteroposterior dia-

meter), and the platypelloid type (the flattened pelvis) were not identified as independent types. A possible reason for this change is the inclusion of the pelvic midplane in the analysis. As the results demonstrated, the most important measure in the classification is the anteroposterior diameter of the midplane.

Testing of differences among age groups leads to a conclusion that the distribution of the "narrow" pelvis significantly differs in these groups. The "narrow" pelvis is observed more frequently in the younger age group (18–25), but less frequently in the older age group (50–69). Three points seem important for the explanation of observed differences.

First, according to the secular trend in growth confirmed in an earlier study in Latvia [8] and on a positive correlation between the anteroposterior diameter of the inlet and the stature [7], it is possible to expect that pelvic sizes in the younger group are larger, but in the older group, pelvic sizes might be smaller. However, the results of this study support the opposite view. Younger females have a narrow pelvis more often than older females. These results concur with a Tague's discussion on pelvic sizes of "big females" [13]. Tague concludes that a degree of correlation between the female's height and the pelvic size is low, and more important predictors of the pelvic size are clavicular length and the femoral head diameter.

Second, pelvic midplane parameters were added to the inlet parameters in the cluster analysis. The relationship between the pelvic midplane and the stature differs from the relationship between the pelvic inlet and the stature. The measures of the midplane area have significant negative partial correlation with femoral length [13]. In addition, the bispinous diameter has no correlation with height [11, 16]. Therefore, the females with a shorter stature can have a wider pelvic midplane and on the contrary.

Third, pelvic parameters are changing with age. The parameters of the pelvic inlet increase till 25 years [14]. Therefore, the parameters of the pelvic inlet can be larger in females over 25. This tendency of growth is in question for a further research focused on the pelvic type distribution and individual parameters' trajectories trough the age of 18–25.

An important limitation for this study concerns the research sample. The number of younger females in the age group under 26 is relatively small. It should be noted that the sample represents proportionally age distribution of the female population in Latvia. However, indications for the pelvic computer tomogrpahy are not applicable to the whole population. Therefore, a further study can be focused on a wider group of young females. Non-pelvic body

parameters can be included in the analysis. An additional dose of radiation needs to be taken into account during the CT investigation.

In summary, this study suggests a relatively easy pelvic typology based on the important measures of the lesser female pelvis. Three clusters represent gynecoid, "narrow", and intermediate types of female pelvis. The distribution of the identified pelvic types in age groups indicates a tendency for the "narrow" pelvis to be presented more frequently in the group of younger females.

REFERENCES

1. Adadevoh S. W. K., Hobbs C., Elkins T. E. (1989). The relation of the true conjugate to maternal height and obstetric performance in Ghanaians. Int J Gynecol Obstet, 28, 243–251.
2. Bregar A. T., Cerar V. M., Slavec Z. Z., Verdenik I. (2008). Indication for caesarean delivery between 1955 and 2005. Wien Klin Wochenschr, 120, 23–24, 761–765.
3. Caldwell W. E., Moloy H. C. (1933). Anatomical variation in the female pelvis and their effect in labor with a suggested classification. 58th Annual Meeting of the American Gynecological Society, 479–504.
4. Caldwell W. E., Moloy H. C. (1938). Anatomical variations in female pelvis: their classification and obstetrical significance. Proceeding of the royal society of medicine, 32, 1, 1–30.
5. Eskew P. N. J., Saywell R. M. J., Zollinger T. W., Erner B. K., Oser T. L. (1994). Trend in the frequency of cesarean delivery. A 21-year experience, 1970–1990. J Reprod Med, 39, 10, 809–817.
6. Gohlke B., Woelfle J. (2009). Growth and puberty in German children. Deutsches Ärzteblatt International, 106, 23, 377–382.
7. Holland E. L., Cran G. W., Elwood J. H., Pinnkerton J. H. M., Thompson W. (1982). Associations between pelvic anatomy, height and year of birth of men and women in Belfast. Annals of human biology, 9, 2, 113–120.
8. Kažoka D., Vētra J. (2008). Secular trends in basic body transversal parameters in adult Latvian women between 1929–1930 and 2001–2005. Papers on Anthropology, 17, 158–168.
9. Krychowska A., Kosinska K., Karwan-Plonska A. (2004). Comparison of indication for cesarean section in 1985–86 and 2000–01. Analysis of changes. Ginekol Pol, 75, 12, 926–931.
10. Lenhard M. S., Johnson T. R. C., Weckback S., Friese K., Hasbargen U. (2010). Pelvimetry revisited: Analyzing cephalopelvic disproportion. Europien Journal of Radiology, 74, 107–111.

11. Ridgeway B., Arias B. E., Barber M. D. (2011). The relationship between anthropometric measurements and the bony pelvis in African American and European American women. Int Urogunecol J, 22, 1019–1024.
12. Stalberg K., Bodestedt A., Lyrenas S., Axelsson O. (2006). A narrow pelvic outlet increases the risk for emergency cesarean section. Acta Obstetrica et Gynecologyca, 85, 821–824.
13. Tague R. G. (2000). Do big females have big pelves? American Journal of physical anthropology, 112, 377–393.
14. Tague R. G. (2011). Fusion of coccyx to sacrum in humans: prevalence, correlates, and effect on pelvic size, with obstetrical and evolutionary implications. American Journal of Physical Anthropology, 145, 426–437.
15. Tampakoudis P., Assimakopoulos E., Grimbizis G., Zafrakas M., Tampakoudis G., Mantalenakis S., Bontis J. (2004). Cesarean section rates and indications in Greece: data from a 24-year period in a teaching hospital. Clin Exp Obstet Gynecol. 31, 4, 289–292.
16. Walrath D. E., Glantz M. M. (1996). Sexual dimorphism in the pelvic midplane and its relationship to Neandertal reproductive patterns. American Journal of Physical Anthropology, 100, 89–100.
17. Walrath D. (2003). Rethinking pelvic typologies and the human birth mechanism. Current Anthropology, 44, 1, 5–30.
18. WHO/Europe, European HFA Database. Caesarean section per 1000 live births in Latvia (Line chart), June 2012// http://data.euro.who.int/hfadb/linecharts/linechart.php?w=1024&h=600
19. Young M., Ince J. G. H. (1940). A radiographic comparison of the male and female pelvis. Journal of Anatomy, 74, 3, 374–385.

Address for correspondence:
Oksana Kolesova
Institute of Anatomy and Anthropology
Riga Stradiņš University
16 Dzirciema Street, LV-1007, Riga, Latvia
Postal address: Lacplesa iela, 43/45-10, Riga, LV-1011, Latvia
E-mail: oksana-kolesova@inbox.lv