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Evaluation of the Association between Pelvic Diameters and Pelvic Types on Computed Tomography Images in Healthy Turkish Females

Evaluación de la Asociación entre Diámetros Pélvicos y Tipos de Pelvis en Imágenes de Tomografías Computarizadas en Mujeres Turcas Sanas

Sema Polat[1]; Emir Ibrahim Isık[2]; Duygu Vuralli[1]; Mahmut Öksüzler[3]; Fatma Yasemin Öksüzler[4]; Esin Özsahin[5] & Pınar Göker[1]

POLAT, S.; ISIK, E. I.; VURALLI, D.; ÖKSÜZLER, M.; ÖKSÜZLER, F. Y.; ÖZSAHIN, E. & GÖKER, P. Evaluation of the association between pelvic diameters and pelvic types on computed tomography images in healthy Turkish females. *Int. J. Morphol., 41(6)*:1781-1788, 2023.

SUMMARY: Pelvis contributes to both human locomotion and obstetrics, and normal vaginal delivery is associated with a spacious inlet, a large interspinosus diameter. This paper aimed to measure crucial diameters of pelvic ring, and to determine both the prevalence of pelvic types, and labor types including normal vaginal delivery or caesarean section in Turkish healthy females. Additionally, it was aimed to evaluate presence of relationship between pelvic types and pelvic diameters. Labor shape of subjects was obtained from hospital records. This retrospective study was carried out on 165 healthy subjects aged between 18 and 45 years. Anteroposterior diameter of the pelvic inlet (APDI), anteroposterior diameter of the pelvic outlet, sacrum length (SL), sacrum depth, conjugata vera, obstetrical conjugate, the diagonal conjugate, diameter transversa, diameter bispinous, intertuberous diameter were measured. From these measurements, brim index was calculated and decided to gynecoid, anthropoid and platypelloid type. Also, the andoid type was calculated to the ratio of posterior sagittal diameter of the inlet to conjugata obstetrica. 50.91 % of participants has gynecoid type pelvis, followed by 24.85 % anthropoid type, 14.55 % platypelloid, and 9.70 % android type pelvis. There was a significant difference in APDI, SL, SD, Conjugata vera, Conjugata obstetrica, Conjugata diagonalis, Conjugata transversa, diameter bispinous, diameter intertubercularis and Brim index measurements according to pelvic types. the first degree of narrowing (conjugata vera from 11 to 9) was found in 18 pelvises and 12 pelvises with the pathological degree of narrowing bellonged to the platypelloid type followed by android type pelvis with 6 pelvices. The android type pelvis is not appropriate for natural labor and a good assessment of birth canal can reduce the labor risks. Also, only 7 females who delivered with cesarean have gynecoid type pelvic type. The APDI and SL were significantly lower in subjects having pathological narrowing according to conjugata obstetrica values.

KEY WORDS: Pelvis diameter; Pelvic shape; Conjugate obstetrica; Caserean or natural labor; Brim index.

INTRODUCTION

The pelvis is the inferior part of the trunk and reaches to the abdomen. The pelvic ring is formed by the articulation of both hip bones anteriorly at the symphysis pubis, and posteriorly with the sacrum at the sacroiliac joint. An oblique plane passing through the sacral promontory, the arcuate line of the ilium, the pectineal line of the pubis, and the superior margin of the symphysis pubic limits the terminal line or pelvic brim which separates the pelvis in two parts as the greater or false pelvis, and the lesser or true pelvis. Also, superior pelvic aperture (SPA) or pelvic inlet, and the inferior pelvic aperture (IPA) or pelvic outlet are associated with lesser pelvis. Three main pelvic measurements called as anteroposterior, transverse, and oblique and having obstetric significance are related to the pelvic inlet (Caldwell & Moloy, 1938; Gökmen, 2003; Arıncı & Elhan, 2014; Kotarinos, 2016; Paulsen *et al*., 2018; Pieroh *et al*., 2021; Vucinic *et al*., 2022). Because of the the natural birth canal function of pelvis, the sex related changes are seen. According to the most commonly used classification based on dimensions and appearance of the pelvic inlet, four main pelvic types are defined: Gynecoid, android, anthropoid and platypelloid (Arıncı & Elhan, 2014;

[1] Cukurova University Faculty of Medicine, Department of Anatomy, Adana, Turkey.
[2] Cukurova University, Abdi Sütcü Vocational School of Health Services, Adana, Turkey.
[3] Bozyaka Education and Research Hospital, Department of Radiology, Izmir, Turkey.
[4] Izmir Democracy University Buca Seyfi Demirsoy Training and Research Hospital, Departament of Radiology, Izmir, Turkey.
[5] Baskent University Faculty of Medicine, Departament of Anatomy, Adana, Turkey.

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Aubry *et al*., 2018; Yücel, 2018; Paulsen *et al*., 2018; Vucinic *et al*., 2022).

Natural delivery may be significantly prolonged, difficult or even impossible if the pelvis shape is not compatible with the fetus head. Although the gynecoid pelvic type has an ideal shape for delivery, it is also very important to know the bi-spinous diameter before labor, as it serves as a passage for the width of the fetus head (Bull, 1949; Arıncı & Elhan, 2014). SPA is the major trouble faced by the fetus during labor, because it is limited by bones, and challenging to expand. For this reason, the SPA measurement has a special clinical importance (Kim *et al*., 2011; Çiftçioglu *et al*., 2022). Normal vaginal delivery is associated with a broad inlet, an extensive interspinosus diameter and suprapubic arch (Kim *et al*., 2011).

Several radiological methods of pelvis including ultrasonography (US), computed tomography (CT), magnetic resonans imaging (MRI) have been used commonly in evaluation of the pelvic type for pelvimetry (Lenhard *et al*., 2009; Daghighi *et al*., 2013; Korhonen *et al*., 2014; Arıncı & Elhan, 2014; Vázquez-Barragán *et al*., 2016; Bazira, 2021). CT can be considered the most accurate and reliable measurement for high-quality pelvimetry (Vázquez-Barragán *et al*., 2016; Çiftçioglu *et al*., 2022).

Hypothesis of this paper is that gynecoid pelvic type is the most common, and gross narrowing is seen frequently in android, anthropoid, and platypelloid types. For this reason, this paper aimed to measure crucial diameters of pelvic ring, and to determine both the prevalence of pelvic types, and labor types including normal vaginal delivery or caesarean section in Turkish healthy females. Additionally, it was aimed to evaluate presence of relationship between pelvic types and pelvic diameters.

MATERIAL AND METHOD

This retrospective observational study was carried out on 165 healthy subjects aged between 18 and 45 years. All CT scans were obtained using a 64×2-slice multidetector CT (Siemens Somatom Definition AS, Siemens Healthcare). Subjects who had a history of trauma or fracture regarding to the pelvis (i.e., acetabulum), vertebrae lumbales or sacrum, undergone surgery on the pelvis, scoliosis and diseases associated with severe bone tissue loss, or metabolic disease, or tumour causing deterioration of pelvic bone. This study was approved by the Institutional Review Ethics Committee at Çukurova University (2022/122:55). The statistical analysis was done using SPSS 22.0 programme. Test to be used were decided according to normality distribution with the Shapiro-Wilks test. Alos, the Pearson Correlation Analysis was used. P value <0.05 was accepted as significant.

The measurements were made on the computer screen with an electronic caliper and estimations were expressed as millimeters. Measurements are as follows (Kim *et al*., 2011; Arıncı & Elhan, 2014; Aubry *et al*., 2018; Çiftçioglu *et al*., 2022; Vucinic *et al*., 2022):

- Anteroposterior diameter of the pelvic inlet (APDI): The distance between the pubic symphysis's upper side to the promontory was recorded.
- Anteroposterior diameter of the pelvic outlet (APDO): The axis from the inferior aspect of the pubic symphysis to the tip of the coccyx was measured.
- Sacrum length (SL): Total sacrum length measured at mid sagittal plane.
- Sacrum depth: The distance was measured from promontory to the coccyx tip.
- Conjugata vera: The distance was taken from the pubic symphysis's upper level to the promontory (ideal degree is 11.5cm in females).
- Obstetrical conjugate: The shortest distance was taken from the most protruding point of the back of the pubic symphysis to the promontory' tip (The ideal value is 11cm in females).
- The diagonal conjugate: The distance was taken from the symphysis pubis inferior edge to the promontory.
- Diameter transversa: A line across the largest distance of the pelvic inlet connecting the two most distant points on the iliopectineal lines.
- Diameter bispinous: The distance between the two ischial spines was accepted.
- Intertuberous diameter: The distance between the inner aspects of the ischial tuberosities was recorded.

Four decades were determined according to ages. According to the most commonly classification method based on size and shapes of the pelvic inlet, four types was determined (Caldwell & Moloy, 1938; Arıncı & Elhan, 2014; Paulsen *et al*., 2018; Yücel, 2018).

Gynecoid type means broad and large pelvic inlet-pubic arch, and spaced ischial spines and tuberosities.

Android type resembling male pelvis has a triangular entry and funnel-shaped pelvis.

Anthropoid type is characterized by a distinctly oval pelvic enter with a long obstetric conjugation (conjugata vera) or a narrow maximum transverse diameter. The sacral and pubic arches are also narrow. The pelvis is generally very deep.

Platypelloid type is defined as oval pelvis. There are shorter sagittal diameters, and a longer transverse diameter. The pelvis is generally shallower.

The Brim Index is calculated by multiplying a ratio of conjugata vera to diameter transversa with 100 [(Conjugata vera/transversa diameter)*100] (Arıncı & Elhan, 2014; Yücel, 2018; Vucinic *et al.*, 2022). According to reference values for the brim index, If the value are between 85 % and 100 %, the type is accepted as gynecoid type; >100 %, anthropoid type; <85 %, platypelloid type (Bull, 1949; Arıncı & Elhan 2014; Vucinic *et al.*, 2022). Android type can be accepted as designed anthropoid type (Bull, 1949). For this reason, there is a modified formula to establish android pelvic type. This formula is determined by multiplying posterior sagital diameter of the inlet to conjugata vera with 100 [(Posterior sagittal diameter of the inlet/conjugata vera) *100)]. Android pelvic type changes between 24 % and 40 %. Additionally, the values of obstetric conjugation were also used to calculate the pelvic ring gross narrowing degree (from first degree to fourth degree). First degree of narrowing states that conjugata vera diameter is between 11.0 cm and 9 cm; second degree defines between 9.0 cm and 8 cm; third degree, 8.0 cm and 6 cm; and fourth degree means conjugata vera shorter than 6 cm (Bull, 1949; Arıncı & Elhan, 2014; Vucinic *et al.*, 2022). The illustrations were constituted with Macromedia Flash 8 (Figs. 1 and 2).

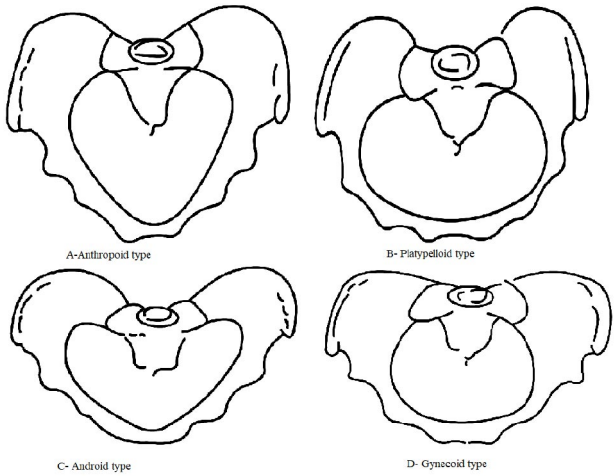

Fig. 1. The pelvic types of female according to apertura pelvis superior's shape.

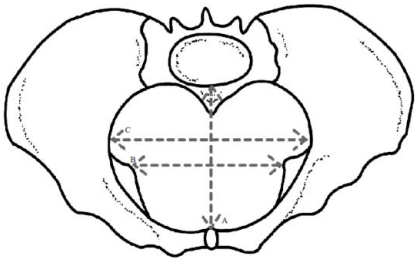

Fig. 2. Pelvis diameters of female. A. Conjugata obstetrica; B. Conjugata bispinous; C. Conjugata transversa.

RESULTS

The 165 healthy females participated in this retrospective cross sectional study. The females' age means, standard deviation, minimum and maximum values were 33.18years, 7.85 years, 18 years and 45 years, respectively (Table I). The linear measurements of pelvic diameters and indexes in midsagital and axial CT images were shown in Figures 1 and 2. The evaluation of the pelvic diameter in 165 healthy females were given in Table I. Moreover, The means and SDs of the APDI, APDO, SL, SD, conjugata obstetrica, conjugata vera, conjugata diagonalis, conjugata transversa, diameter interspinosus, diameter intertubecularis, and Brim index were as 120.76±10.48 mm, 116.84±9.16 mm, 105.62±10.12 mm, 17.70±4.91 cm, 120.85±10.41 mm, 122.99±11.16 mm, 132.77±10.96 mm, 126.32±8.41 mm, 107.71±9.30 mm, 101.36±11.35 mm, and 96.07±10.13 in healthy subjects, respectively (Table I). Additionally, in Table II, the mean values of pelvic diameter were shown according to age related changes. APDI, APDO, conjugata vera, conjugata obstetrica, congugata transversa, and Brim index were found as significance according to decades. Moreover, the measurements of APDI, Conjugata vera, conjugata obstetrica, conjugata diagonalis, diameter intertubercularis, and Brim index decreased with increasing age. Furthermore, 50.91 % of participants has gynecoid type pelvis, followed by24.85 % anthropoid type, 14.55 % platypelloid, and 9.70 % android type pelvis (Table II). The mean values of pelvic measurements according to pelvic types were shown in Table III. There was a significant difference in APDI, SL, SD, Conjugata vera, Conjugata obstetrica, Conjugat diagonalis, Conjugata transversa, diameter bispinous, diameter intertubercularis and Brim index measurements according to pelvic types. APDO value showed no significance between pelvic types. Especially, the data obtained from APDI, SL, and SD parameters provided valuable clinical findings that there was a significant difference between gynecoid type and android type. Additionally, the correlation and significance was very strong between APDI and Diameter conjugata obstetrica, Diameter conjugata vera, Conjugata diagonalis. There was strong correlation with Brim index of APDI. SL parameter showed moderate correlation with Diameter conjugata obstetrica, Diameter conjugata vera, Conjugata diagonalis (Tables III to V). In this paper, some parameters showed very strong and significant while a significant correlation was no found in some parameters (Table V).

Moreover, there were no significant correlation between decades and SL, SD, diameter bispinous, diameter intertubercularis, however, the other measurements such as APDI, APDO, Conjugata vera, Conjugata obstetrica, Conjugata diagonalis, conjugat transversa, and Brim index measurements showed significant correlation range from weak to very strong. Also, the striking findings were of SL. A significant and moderate positive correlation was found between SL and APDI; A significant weak negative correlation between SL and SD; a significant moderate positive correlation between SL and Conjugata Vera, Conjugata obstetrica and Conjugata diagonalis.

Table I. The means of pelvic diameter measurements.

Measurements	Mean	SD	Minimum	Maximum
Age	33.18	7.85	18	45
APDI	120.76	10.483	90	146
APDO	116.84	9.159	91	139
SL	105.62	10.12	77	130
SD	17.70	4.906	5	30
Diameter conjugata obstetrica	120.85	10.41	90	146
Diameter conjugata vera	122.99	11.16	89	149
Conjugata diagonalis	132.77	10.96	101	159
Conjugata transversa	126.32	8.41	99	149
Diameter bispinous	107.71	9.30	81	135
Diameter tubercularis	101.36	11.35	73	192
Brim Index	96.07	10.13	70.31	121.10

APDI: Anteroposterior diameter of the pelvic inlet; APDO: anteroposterior diameter of the pelvic outlet; SL:Sacrum length; SD:Sacrum diameter; SD:Standard deviation; Min.: Minimum; Max.: Maximum

Table II. The means of pelvic diameter measurements according to age.

Measurements	Decade 1 (18-19 years) (n=7) Mean±SD	Decade 2 (20-29 years) (n=57) Mean±SD	Decade 3 (30-39 years) (n=57) Mean±SD	Decade 4 (40-45 years) (n=44) Mean±SD	P value
APDI	127.86±8.55	123.58±10.71	120.04+10.74	116.91+8.65	0.003
APDO	110.14±7.69	114.30±9.00	118.75±9.42	118.70±8.15	0.005
SL	108.29±8.18	105.28±10.41	106.63±9.21	104.34±11.20	0.614
SD	19.14±5.21	17.35±4.85	17.19±5.28	18.57±4.40	0.413
Diameter conjugata obstetrica	128.00±8.78	123.89±10.39	120.05±10.67	116.82±8.69	0.001
Diameter conjugata vera	129.14±7.45	125.81±11.18	122.42±11.62	119.09±9.82	0.009
Conjugata diagonalis	136.29±7.30	135.30±10.83	132.30±11.39	129.55±10.39	0.052
Conjugata transversa	120.29±8.77	124.30±7.95	128.33±7.08	127.30±9.69	0.012
Diameter bispinous	105.29±6.83	106.14±9.10	109.68±8.62	107.57±10.47	0.198
Diameter tubercularis	102.43±4.72	102.11±15.57	101.84±8.26	99.61±8.87	0.697
Brim Index	106.81±9.44	99.95±9.09	93.77±9.26	92.31±9.98	<0.001

APDI: Anteroposterior diameter of the pelvic inlet; APDO: anteroposterior diameter of the pelvic outlet; SL:Sacrum length; SD:Sacrum diameter; SD:Standard deviation; Min.: Minimum; Max.: Maximum; N: Subject numbers; P value: Significance level

Table III. The quantitative descriptive data for measured parameters and Brim indices.

Measurements	Gynecoid type (n=84) Mean+SD	Android type (n=16) Mean+SD	Antropoid type (n=41) Mean+SD	Platypelloid type (n=24) Mean+SD	P value
APDI (mm)	118.87±7.19	130.25±6.48	128.78±8.17	107.33±8.67	<0.001
APDO (mm)	115.55±9.50	116.31±8.55	118.27±8.52	119.25±9.09	0.224
SL (mm)	103.54±10.59	111.00±8.38	109.66±9.39	102.46±7.10	0.001
SD (mm)	17.82±4.86	21.50±3.74	15.71±4.09	18.13±5.54	0.001
Diameter conjugata obstetrica (mm)	119.02±6.87	130.25±6.48	128.90±8.29	107.25±8.54	<0.001
Diameter conjugata vera (mm)	121.24±8.13	132.88±6.21	131.10±8.41	108.67±9.58	<0.001
Conjugata diagonalis (mm)	131.10±7.73	141.94±6.91	140.80±8.31	118.79±10.11	<0.001
Conjugata transversa (mm)	128.06±6.72	119.75±5.77	121.27±8.52	133.25±7.54	<0.001
Diameter bispinous (mm)	108.81±8.71	103.31±6.17	103.66±9.45	113.71±8.88	<0.001
Diameter tubercularis (mm)	102.90±8.87	104.00±24.99	96.29±7.81	102.88±7.45	0.010
Brim Index	93.02±4.41	108.84±4.29	106.44.±4.78	80.47±4.05	<0.001

APDI: Anteroposterior diameter of the pelvic inlet; APDO: anteroposterior diameter of the pelvic outlet; SL:Sacrum length; SD:Sacrum diameter; SD:Standard deviation; Min.: Minimum; Max.: Maximum; N: Subject numbers; P value: Significance level

Also, the values of obstetric conjugation were also used to diagnose possible presence of pelvic ring gross narrowing: the first degree of narrowing (conjugata vera from 11 to 9) was found in 18 pelvises and 12 pelvises with the pathological degree of narrowing belonged to the platypelloid type followed by android type pelvis with 6 pelvices. In this paper, there are females who did not deliver naturally (47.85 %). 24.85 % of them are of android type pelvic ring followed by anthropoid type, platypelloid type and least (7 subjects) gynecoid type. These can be interpreted as the android type pelvis which is not appropriate for natural labor; a good assessment of birth canal can reduce the labor risks. Also, only 7 females who delivered by cesarean have gynecoid type pelvic type. Even if a female who has gynecoid type pelvis and the capacity to give birth normally, some reasons can be effective in the decision for cesarean delivery; fear of delivery, and personal preference, etc. A striking finding of our study was that APDI and SL were significantly lower in subjects having pathological narrowing according to conjugata obstetrica values ($p<0.05$). However, SD and APDO were lower in subjects having pathological narrowing according to conjugata obstetrica values, but there was no significant difference between two groups (Table IV).

Table IV. The values of APDI, SL, SD and APDO in subjects having or no having pathological narrowing according to conjugata obstetrica values.

Measurements	Subjects having pathological narrowing according to conjugata obstetrica values (n=18 subjects)	Subjects having no pathological narrowing according to conjugata obstetrica values (n=147)
APDI	102.33±5.61 (90.00-111.00)	123.01±8.53 (102.00-146.00)
P value	<0.001	
Sacrum length	98.67±7.49 (81.00-112.00)	106.48±10.09 (77.00-130.00)
P value	0.002	
Sacrum depth	17.06±6.36 (5.00-28.00)	17.78±4.72 (8.00-30.00)
P value	0.558	
APDO	116.72±11.26 (96.00-136.00)	116.85±8.92 (91.00-139)
P value	0.956	

APDI: Anteroposterior diameter of the pelvic inlet; APDO: anteroposterior diameter of the pelvic outlet; SD:Standard deviation; Min.: Minimum; Max.: Maximum; N: Subject numbers; P value: Significance level.

Table V. Correlation of pelvic diameters and measurements.

Measurements	Decade	APDI	APDO	Sacrum length	Sacrum depth	Diameter conjugata obstetrica	Diameter conjugata vera	Conjugata diagonalis	Conjugata transversa	Diameter bispinous	Diameter tuberculariss
APDI	r=-.287 p>0.05	-	0.138 0.077	0.433 <0.001	-0.006 >0.05	-0.303 <0.001	0.952 <0.001	0.932 <0.001	0.065 >0.05	0.138 >0.05	0.038 >0.05
APDO	0.245 0.002	0.138 0.077	-	0.080 >0.05	-0.241 0.002	0.136 >0.05	0.117 >0.05	0.133 >0.05	0.135 >0.05	0.143 >0.05	-0.019 >0.05
Sacrum length	-0.051 >0.05	0.433 <0.001	0.080 >0.05	-	-0.288 <0.001	0.433 <0.001	0.515 <0.001	0.544 <0.001	0.075 >0.05	0.042 >0.05	-0.045 >0.05
Sacrum depth	0.054 >0.05	0.006 >0.05	0.241 0.002	-0.288 <0.001	-	0.001 >0.05	-0.054 >0.05	-0.032 >0.05	0.132 >0.05	0.139 >0.05	0.101 >0.05
Diameter conjugata obstetrica	-0.303 <0.001	0.991 <0.001	0.136 >0.05	0.433 <0.001	0.001 >0.05	-	0.948 <0.001	0.927 <0.001	0.069 >0.05	0.151 =0.05	0.041 >0.05
Diameter conjugata vera	-0.282 0.001	0.952 <0.001	0.117 >0.05	0.515 <0.001	-0.054 >0.05	0.948 <0.001	-	0.965 <0.001	0.049 >0.05	0.136 >0.05	-0.018 >0.05
Conjugata diagonalis	-0.214 0.006	0.931 <0.001	0.133 >0.05	0.544 <0.001	-0.032 >0.05	0.927 <0.001	0.965 <0.001	-	0.058 >0.05	0.107 >0.05	-0.046 >0.05
Conjugata transversa	0.202 0.009	0.065 >0.05	0.135 >0.05	0.075 >0.05	0.132 >0.05	0.089 >0.05	0.049 >0.05	0.058 >0.05	-	0.859 <0.001	0.357 <0.001
Diameter bispinous	0.088 >0.05	0.138 >0.05	0.143 >0.05	0.042 >0.05	0.139 >0.05	0.151 =0.05	0.136 >0.05	0.107 >0.05	0.859 <0.001	-	0.859 <0.001
Diameter tuberculariss	-0.083 >0.05	0.038 >0.05	-0.019 >0.05	-0.045 >0.05	0.101 >0.05	0.041 >0.05	-0.018 >0.05	-0.046 >0.05	0.357 <0.001	0.382 <0.001	-
Brim Index	-0.371 <0.001	0.760 <0.001	0.028 >0.05	0.299 <0.001	-0.071 >0.05	0.764 <0.001	0.734 <0.001	0.710 <0.001	-0.587 <0.001	-0.427 <0.001	-0.194 0.013

APDI: Anteroposterior diameter of the pelvic inlet; APDO: anteroposterior diameter of the pelvic outlet; SD:Standard deviation; Min.: Minimum; Max.: Maximum; N: Subject numbers; P value: Significance level; r: correlation level

DISCUSSION

The pelvis is an anatomically complex and functionally informative bone. It contributes to both human locomotion and obstetrics. Due to pelvis' important role in obstetrics, it is one of the most sexually dimorphic bony elements (DeSilva & Rosenberg, 2017). Bony pelvis has essential functions, namely force or weight transferring, protection, and muscle attachment. The outer surface of the pelvis stabilizes many extremely strong muscles, such as the gluteal and thigh muscles (Bazira, 2021). The pelvis plays important functions in childbirth, while newborn must pass through the birth canal (DeSilva & Rosenberg, 2017). The female pelvic form has managed to attract the attention of researchers for many years. The relationship of the female pelvis with the birth event is one of the main reasons for this interest. Moreover, the fact that pelvic bone structure and development varies depending on nutritional, geographical and environmental conditions as well as racial characteristics has increased the interest in this region (Çiftçioglu *et al*., 2022).

Several radiological methods of pelvis including ultrasonography, computed tomography, magnetic resonans imaging have been used commonly to determine the pelvic type for pelvimetry (Lenhard *et al*., 2009; Daghighi *et al*., 2013; Arıncı & Elhan, 2014; Korhonen *et al*., 2014; Vázquez-Barragán *et al*., 2016; Bazira, 2021, Ciftçioglu *et al.*, 2022; Vucinic *et al*., 2022). Both MR and CT pelvimeters usually are used due to cephalopelvic disproportion presence during labor (Çiftçioglu *et al*., 2022). CT can be considered the most accurate and reliable measurement for high-quality pelvimetry. Worldwide, approximately 18.5 million cesarean sections are performed annually, of which one half are unnecessary. Correct obstetric intervention is important in reducing maternal and perinatal deaths (Vázquez-Barragán *et al*., 2016). Especially maternal pelvis affects the soft tissue damage degree that may occur during delivery, and the choice of delivery mode. In addition, factors such as a wide inlet, a large interspinous diameter, and a large suprapubic arch are known to be associated with a normal vaginal delivery (Nichols & Randall, 1996; Kim *et al*., 2011; Çiftçioglu *et al*., 2022). The decision regarding normal labor requires the knowledge of normal diameter of the pelvis. Also, the apertura pelvis superior is the biggest obstacle the foetus encounters during labor because it is restricted by bones and is difficult to expand (Çiftçioglu *et al*., 2022). Knowledge of five measurements is essential for healthy delivery: Diameter transversa and diameter conjugata obstetrica for apertura pelvicis superior, and diameter transversa, diameter interspinales, and diameter sagitalis posterior for aperture pelvicis inferior. Additionally, when newborn's baby head is normal size, if the diameter conjugata obstetrica (apertura superior pelvis) is lower than 10 cm; diameter interspinalis (apertura pelvis inferior) is lower than 9.5 cm; and diameter transversa (apertura pelvis inferior) is lower than 8 cm, pelvis is no convenient to normal delivery (Gökmen, 2003; Kotarinos, 2016; Yücel, 2018). An obstetrical conjugate which is clinically significant is more than 10 cm. The relationship between pelvic structure and obstetric damage is absolutely necessary in the obstetrics and gynecology. Reduction in pelvic cavity and excessive fetal size are reasons of feto-pelvic disproportion. The pelvic diameters' contraction can create dystocia during labor because of decrease in its capacity (Kim *et al*., 2011). Additionally, when assessing the birth canal, the knowledge about the pelvic type and narrowing degree of is vital to reduce the risk of injury or death to the female or fetus during delivery. The pathological narrowing may be a indicator of the non-gynecoid pelvic types (Arıncı & Elhan 2014; Perlman *et al*., 2019; Dzupa *et al*., 2021).

The information of pelvic size including diameters or shape, features of the pelvis is of great importance for surgeons, radiologists and obstetricians. In this study we measured pelvic diameters, sacrum length and sacrum dept. Also, pelvic shape were determined according to both pelvic classification (gynecoid type, android type, anthropoid type, and platypellodi type) and Brim index formula which is calculated with the ratio between the shortest parameter in the sagittal plane and the widest parameter in the transverse plane of the pelvic inlet multiplied by 100; conjugata vera/ diameter transversa maxima*100 (Bull, 1949; Vucinic *et al*., 2022). In a study consisting of 54 healthy Serbians, gynecoid pelvic type was found in 28 subjects (51.85 %), followed by platypelloid type with 11 subjects (20.37 %), anthropoid type with 8 subjects (14.81 %); and android type with 7 subjects (12.96 %) (Vucinic *et al*., 2022). In Caldwell & Moloy (1938) a study with Columbia population, Gynecoid type pelvis is the most seen pelvic type (41.4 %), followed by android type pelvis (32.5 %), anthropoid type pelvis (23.5 %) and the least seen type platypelloid type pelvis (2.6 %) (Caldwell & Moloy, 1938). The corresponding value was found in 34.8 % of cases as gynecoid type; 20.4 % anthropoid type; 17.1 % android type, and 27.7 % platypelloid type pelvis (Chen *et al*., 1982). In a study conducted with Turkish population, the gynecoid type pelvis was seen by 64.1 %, platypelloid type by 16.5 %; anthropoid by 11.3 %, and android type by 8.1 % (Çiftçiog˘lu *et al*., 2022). In our population, 50.91 % of participants has gynecoid type pelvis, followed by 24.85 % antropoid type, 14.55 % platypelloid, and 9.70 % android type pelvis. When we evaluate the data of different several populations, it is seen that the most common type is the gynecoid type pelvis, although there is a difference in the prevalence of pelvis types. It can be said that the factors mentioned above have an effect on the differences seen in these rates.

According to classical anatomy sources, in the anthropoid type pelvis, the diameter of the conjugata vera is long, weak and oval aperture is seen. In these types, the sacrum is long and the pelvic cavity is deep. In the android type pelvis, the diameter bispinous is small (Gökmen, 2003; Arıncı & Elhan, 2014; Paulsen *et al*., 2018; Yücel, 2018). In this paper, diameter bispinous value was found least in anthropoid type than the other shapes, sacrum length was longer than gynecoid and platypelloid types.

In a study, APDI is both an important part of the birth canal where fetus engages and for the evaluation of obstetric prognosis. The upper part of bith canal is the narrowest section and clinically used in evaluation of obstetrical prognosis. This regionis also the narrowest part that the fetus has to pass through and is more strategic location. This area will determine whether to have a vaginal delivery (Aubry *et al*., 2018). We researched a relation between pathological narrowing and sacrum length, sacrum depth, anteroposterior diameter of pelvic inlet and anteroposterior diameter of pelvic outlet. In this respect, we would like to state that this study is the first of its kind. We obtained a striking finding of our study. The APDI and SL were significantly lower in subjects having pathological narrowing according to conjugata obstetrica values ($p<0.05$). However, SD and APDO were lower in subjects having pathological narrowing according to conjugata obstetrica values, however no significant difference was found between two groups.

Knowledge about the diameter bispinous before labor, is important because this distance plays a role as a passage for the width of the fetal head. Also, the other important measure is anteroposterior diameter of pelvic inlet to determine the pelvis type according to shape. As mentioned above, in assessment the probability of the fetus passing through the birth canal, to interpret the pelvic type and narrowing degree to reduce the risk of injury or death to the fetus and the mother (Wischnik *et al*., 1993; Vucˇinic´ *et al*., 2022). In a study performed with 54 healthy Serbian subjects, the conjugata vera, diameter transversa maxima, the posterior sagital diameter, conjugata anatomica, diameter bispinosus and Brim index were reported as 12.40 cm, 13.67cm, 5.64 cm, 12.96 cm, 11.25 cm, and 90.49 %, respectively (Vucinic *et al*., 2022). Diameter transversa maxima values were between 12.2cm and 13.3cm in Germany (Wischnik *et al*., 1993; Çiftçioglu *et al*., 2022), 13.1 cm and 13.5 cm in American subjects (Kelly *et al*., 1975; Varner *et al*., 1980), 12.4 cm in England (Russell & Richards, 1971), 12.2 cm in Chinese, and 12.66 cm in Turkish population, respectively. The diameter mediana values were between 10.8 cm and 12.00 cm in Germany population, 11.0cm and 12.2 cm in Americans, 11.4 cm in English subjects, 11.07 cm in Nigerians, and 11.34 cm in Turkish healthy subjects, respectively. The conjugata vera were declared between 9.8 cm and 11.9 cm in germany subjects, 11.9cm in Chinese subjects, and 10.77cm in Turkish subjects, respectively (Çiftçioglu *et al*., 2022). As a result of the analysis of all these data, it is seen that geographical and racial factors are effective and valid in shaping the pelvic structure. In Koreans, the values of some diameters such as true conjugata (12.5 cm), obstetrical conjugata (11.97 cm), diagonal conjugata (13.35cm), interspinosus diameter (9.77 cm), and transverse diameter (12.48 cm) were evaluated, respectively (Kim *et al*., 2011). In this paper, conjugata vera (11.90cm), conjugata obstetrica (12.12 cm), conjugata diagonalis (13.11cm), conjugata transversa (12.81 cm), diameter interspinosus (10.88 cm), diameter intertubercularis (10.29 cm), and Bindex (93.02 %) were obtained, respectively. In this paper, there are females who delivered no naturally (47.85 %). 24.85 % of them are of android type pelvic ring followed by anthropoid type, platypelloid type and least (7 subjects) gynecoid type. These can be interpretted as the android type pelvis is not appropriate for natural labor and a good assessment of birth canal can reduce the labor risks. Also, only 7 females who delivered with cesarean have gynecoid type pelvic type. A cesarean delivery decision may be made to a female who has a gynecoid pelvis and is able to deliver normally, for reasons such as fear of childbirth, the person's own decision, or another health problems that may develop. In conclusion, cesarean section was performed in approximately 47.85 % one-half of the women, confirming the assumption of an increasing trend toward performing cesarean section. Although, the gynecoid pelvic type is considered ideal for labor, or the pelvic type are appropriate for natural labor, this sometimes may no affect the labor type, naturally or by cesarean section. A striking finding of our study was that APDI and SL were significantly lower in subjects having pathological narrowing according to conjugata obstetrica values.

POLAT, S.; ISIK, E. I.; VURALLI, D.; ÖKSÜZLER, M.; ÖKSÜZLER, F. Y.; ÖZSAHIN, E. & GÖKER, P. Evaluación de la asociación entre los diámetros pélvicos y tipos de pelvis en imágenes de tomografías computarizadas en mujeres turcas sanas. *Int. J. Morphol., 41(6)*:1781-1788, 2023.

RESUMEN: La pelvis contribuye tanto a la locomoción humana como a la obstetricia. El parto vaginal normal se asocia con una entrada espaciosa y un diámetro interespinoso grande. Este artículo tuvo como objetivo medir diámetros cruciales del anillo pélvico y determinar tanto la prevalencia de los tipos pélvicos como los tipos de parto, incluido el parto vaginal normal o la cesárea en mujeres turcas sanas. Además, se buscó evaluar la presencia de relación entre los tipos de pelvis y los diámetros de la pelvis. La forma laboral de los sujetos se obtuvo de los registros hospitalarios. Este estudio retrospectivo se llevó a cabo en 165 mujeres sanas con edades comprendidas entre 18 y 45 años. Se midieron el

diámetro anteroposterior de la entrada pélvica (APDPI), el diámetro anteroposterior de la salida pélvica, la longitud del sacro (SL), la profundidad del sacro, la conjugada vera, el conjugado obstétrico, el conjugado diagonal, el diámetro transverso, el diámetro biespinoso y el diámetro intertuberoso. A partir de estas mediciones se calculó el índice del ala y se decidió tipo ginecoide, antropoide y platipoide. Además, el tipo androide se calculó en función de la relación entre el diámetro sagital posterior de la entrada y la conjugada obstétrica. El 50,91 % de los participantes tenía pelvis de tipo ginecoide, seguida del 24,85 % de pelvis de tipo antropoide, el 14,55 % de tipo platipeloide y el 9,70 % de tipo androide. Hubo una diferencia significativa en las mediciones de APDPI, SL, SD, Conjugada vera, Conjugada obstétrica, Conjugada diagonal, Conjugata transversa, diámetro biespinoso, diámetro intertubercular e índice de ala según los tipos de pelvis. El primer grado de estrechamiento (conjugada vera del 11 al 9) se encontró en 18 pelvis y 12 pelvis, siendo el grado patológico de estrechamiento del tipo platipeloide seguido de pelvis tipo androide con 6 pelvis. La pelvis tipo androide no es apropiada para el parto natural y una buena evaluación del canal del parto puede reducir los riesgos. Además, solo 7 mujeres que dieron a luz por cesárea tenían un tipo pélvico de tipo ginecoides. El APDPI y SL fueron significativamente más bajos en mujeres que tenían estrechamiento patológico según los valores obstétricos conjugados.

PALABRAS CLAVE: Diámetro de pelvis; Forma pélvica; Obstétrica conjugada; Trabajo casero o natural; Índice del ala.

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Corresponding author:
Dr. Sema Polat
Cukurova University
Faculty of Medicine
Department of Anatomy
Adana
TURKEY

E-mail: sezaoz@hotmail.com