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Full length Research Article

Prevalence of Acetabular Dysplasia and its Associated Factors: Major Determinants of Hip Function.

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Summary: The hip joint bears a considerable proportion of the human weight, and the ability to efficiently perform its plethora of functions depends on the status of the acetabulum. Morphological alteration of the acetabulum results in acetabular dysplasia which adversely affects the hip joint. The objectives of this study were to determine acetabular morphology, factors that are associated with acetabular dysplasia which compromise hip joint functions and the prevalence of acetabular dysplasia in apparently healthy adults in Calabar. This prospective cross-sectional study was carried out in the Radiology department of the University of Calabar teaching hospital, Calabar, Nigeria over a 5-months period and involved 100 apparently healthy subjects. Pelvic radiographs were conducted for all the subjects and afterwards center edge angle of Wiberg and acetabular angle of Sharp evaluations were done on all the images on a direct digital radiography viewer. Chi square, T-test and Pearson's correlation were used to analyze the data. Mean center edge angle of Wiberg and acetabular angle of Sharp were 27.41 ± 0.730 (SEM) and 39.00±0.860 (SEM) respectively. Center edge angle of Wiberg and acetabular angle of Sharp were significantly associated with age (P=0.000 & P=0.000), marital status (P=0.002 & P=0.000) and employment status (P=0.001 & P=0.002). BMI was only significantly associated with center edge angle of Wiberg (P=0.004). Abnormal center edge angle of Wiberg and acetabular angle of Sharp were mostly seen in individuals below 40 years (64% & 88%, respectively), married (65% & 63%, respectively) and employed (75% & 53%, respectively). Most of the individuals with BMI above 25 had abnormal center edge angle of Wiberg (62%). Mean BMI in males was significantly greater than that of females (P=0.000). Acetabular dysplasia was noted in 4 males and the prevalence of acetabular dysplasia was 4%. It is concluded that the center edge angle of Wiberg and the acetabular angle of Sharp in our population are similar to the values in some European and Asian populations, and the prevalence of acetabular dysplasia is low in this locality. Being a male that is married, employed, overweight and below 40 years are significantly associated with the occurrence of acetabular dysplasia and by implication, are determinants of hip joint function.

Keywords*: Center edge angle, Acetabular angle, Acetabulum, Acetabular dysplasia, Hip joint function, Radiograph*

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INTRODUCTION

The hip joint is a ball and socket joint that is formed by the acetabulum and the femoral head (Hassa *et al.*, 2023). It plays a substantial role in the weight-bearing mechanics of the human body (Vuralli *et al.*, 2022). Since the center of gravity of a human being is located around the hip joint, it aids in the maintenance of trunk balance and generally improves postural stability (Jeremic *et al.*, 2011). For an efficient performance of the array of hip joint functions, which include flexion, extension, adduction, abduction, circumduction, external rotation and internal rotation (Böker *et al.*, 2020; Vuralli *et al.*, 2022), the acetabular morphology (depth and width) and its orientation has to be within normal limits (Hassa *et al.*, 2023).

Over the past 20 years there has been an evolving body of evidence that lucidly illuminates the sequence of events which results as a consequence of the development of acetabular dysplasia that culminates to an early failure of hip joint function (Welton *et al.*, 2023). In the onset of acetabular dysplasia, the roof becomes progressively shallow and vertically oriented. The effect of this mal-orientation is a reduction in the surface area for weight-bearing between the acetabulum and the femoral head making the joint's force per unit area to significantly increase during walking and other activities. The fibrocartilaginous acetabular labrum then undergoes hypertrophy, to compensate for deficient bony acetabular coverage, and gradually partial or full-thickness tears occur which is accompanied by an accelerated degeneration of the hyaline articular cartilage that ultimately leads to pains, osteoarthritis and impaired hip joint function (Pun, 2016; Khaliq *et al*., 2022; Hong *et al*., 2023). This impairment limits the hip joint's range of motion and causes an obvious marked limp when walking (Pun, 2016).

Acetabular dysplasia exists when one of the two criteria are met; The first criterion is when the center edge angle of Wiberg is equal to or below 250 and the second criterion is when the acetabular angle of Sharp is equal to or above 420 (Umer *et al*., 2009; Jeremic *et al*., 2011; Mannava *et al*., 2017; Hofmann *et al*., 2017; Soydan *et al*., 2021). High values of center edge angle of Wiberg reflects a deep acetabulum while low values are indicative of both a shallow acetabulum and a significant reduction in the anterior, superior and lateral coverage of the femoral head (Tuğrul *et al*., 2020; Hassa *et al*., 2023).

It has been proven over the years that racial and geographical variations have profound influence on the anthropometric parameters of the bones, therefore it is essential to learn and understand the average dimension of the acetabulum as a part of the hip joint in this locality. Furthermore, the findings of this study will potentially provide a scientific basis for a better understanding of the pathogenesis of some sociodemographic and socioeconomic situations that initiate or contribute to the emergence of common diseases of the hip joint. The ortho-pediatricians and prosthetists will benefit immensely from the findings of this study since it will potentially enhance accurate fabrication of prostheses (Jeremic *et al*., 2011; Busato *et al*., 2021; Hassa *et al*., 2023). Moreover, awareness of the average dimensions of the hip joint bones in both sexes will be of prodigious assistance to forensic experts (Jeremic *et al*., 2011).

In most climes, the standard image evaluation of the acetabulum, in clinical practice, is ideally the antero-posterior view of plain pelvic radiographs (Böker *et al*., 2020; Nishimura *et al*., 2023). The parameters employed in the radiographic evaluation for acetabular dysplasia are center edge angle of Wiberg and acetabular angle of Sharp (Cevik and Cicek, 2020). There is no literature in this region of the country on acetabular morphology in adults and the factors that predispose the acetabulum to undergo dysplastic transformation.

We aimed to assess acetabular morphology, determine factors that are associated with acetabular dysplasia which compromise hip joint functions and the prevalence of acetabular dysplasia in apparently healthy adults in Calabar, Nigeria.

MATERIALS AND METHODS

Study design: This prospective cross sectional single center study was conducted in the Radiology department of the University of Calabar Teaching Hospital, Calabar, Nigeria. The duration of the study was from January 2023 to May 2023. The study population was obtained from the patients who were referred to the Radiology department from other departments within the confines of the University of Calabar Teaching Hospital, Calabar and from other health facilities within the city and beyond, to perform pelvic radiographs. In strict compliance with the Helsinki declaration, approval was obtained from the health research ethics committee of the University of Calabar teaching hospital before the study commenced. The protocol number assigned to this study by the ethical committee was UCTH/HREC/33/557. Convenience sampling method was employed for the study.

Exclusion criteria: Radiographs that were not obtained in the accurate plane, radiographs that demonstrated pathologies, history of pelvic trauma/fracture, pelvic radiographs that are not symmetrical, history of pelvic surgery, family history of developmental dysplasia of the hip, known hip disease, low back pain, groin pain, thigh pain, those wearing pelvic implants or prothesis, pregnant women, < 18 years of age, breast feeding mothers, individuals with sickle cell disease, metabolic disorder such as hyperuricemia.

Sample size: The study involved 100 subjects who met the enrollment criteria and voluntarily filled the consent form and questionnaire out of 338 patients. Most of the cases were excluded on the basis of fracture/history of trauma, avascular necrosis of the femoral head, hip joint asymmetry during measurements, hip joint osteoarthritis, osteomyelitis, congenital anomalies, fibrous dysplasia, osteoporosis and pelvic lesions suspected to be tumors or metastases.
The information obtained from the subjects which included age, gender, center edge angle of Wiberg, acetabular angle of Sharp, socio-demographics were recorded as data for this study.

Operational definition

Acetabular dysplasia: In the context of this study, acetabular dysplasia is said to exist when the acetabulum of an evaluated hip joint has both a center edge angle of Wiberg equal to or less than 250 and acetabular angle of Sharp equal to or above 420. The prevalence of acetabular dysplasia will be determined thus,

$$\textit{Prevalence of Acetabular dysplasia} = \frac{\textit{Number of subjects with both abnormal center edge angle and abnormal acetabular angle}}{\textit{Total number of subjects}} \times 100$$

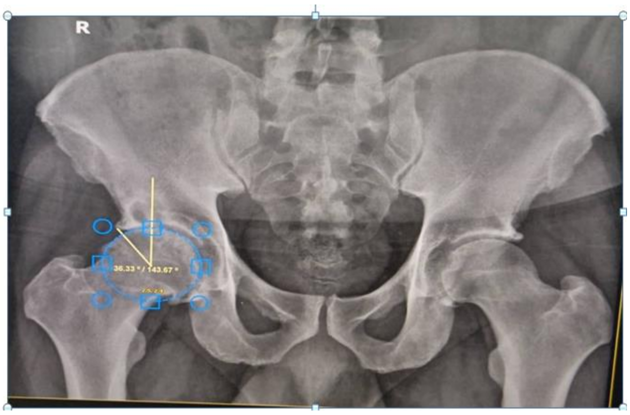

Figure 1
A pelvic radiograph that displays the lines utilized to measure the center edge angle of Wiberg

Center edge angle of Wiberg evaluation: A circle is drawn round the edges of the femoral head. A horizontal line is drawn from the center of the circle to emerge from the medial outer margin of the circle and another line, which is at right angles to the first line, is drawn vertical upwards from the center of the circle. A third line is drawn from the center of the circle to the lateral margin of the acetabulum. The angle formed at the center of the circle between the second and third lines is regarded as the center edge angle of Wiberg (Figure 1) (Tuğrul *et al*., 2020).

Acetabular angle of Sharp evaluation:
A horizontal line is drawn to traverse the pelvic tear drop on one side and extend to the pelvic tear drop on the other side to ensure symmetry. Then a second line is drawn from the pelvic tear drop on one side to the lateral margin of the acetabulum. The angle between these two lines at the pelvic tear drop is regarded as the acetabular angle of Sharp (Figure 2) (Baharuddin *et al*., 2011).

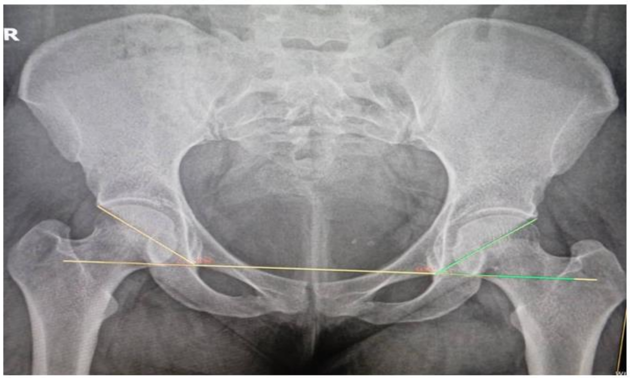

Figure 2:
A pelvic radiograph that displays the lines utilized to measure the acetabular angle of Sharp

Protocol: BRIVO XR575, a digital x-ray machine manufactured in 2021 by General Electric in CHINA and installed in the Radiology department in 2022, was utilized for this study. An antero-posterior pelvic radiograph was obtained with the subjects lying in a supine position. Gonad shields were utilized. The subjects' legs were extended and internally rotated by 200 with a distance of 100 cm between the image detector and the x-ray tube. The vertical x-ray beam was made to get to the image detector at a point that is 5 cm above the pubic symphysis (Baharuddin *et al*., 2011; Jeremic *et al*., 2011). For a pelvic radiograph to be deemed appropriate for the study, there should be symmetry of both obturator foramina and iliac crest, and the femoral necks must appear in true AP views (Ege *et al*., 2016). The center edge angle of Wiberg and the acetabular angle of Sharp were measured on the direct digital radiography viewer.
Two Radiography interns performed all the measurements and a vastly experienced Radiologist, who was blinded to the study, randomly selected 50 images to confirm the reliability of the prior evaluation and rule out inter-observer bias. The center edge angle of Wiberg and the acetabular angle of Sharp were obtained from the right and left hip joints and the mean values for each parameter were recorded.

Statistical analysis: The statistical packages for social sciences version 23 (SPSS Inc., Chicago, Il, USA) was employed to analyze the data obtained. The values were reported as means ± standard error of mean (SEM). Appropriate tables and scatterplot were the means of displaying results where applicable. Chi square analysis and T-test were done to assess the relationship of all the variables with abnormal center edge angle of Wiberg and acetabular angle of Sharp, respectively and to measure the differences in the values of these variables. P value < 0.05 was considered statistically significant.

RESULTS

The study group was made up of 54 males and 46 females. Majority of the male and female subjects had acetabulum with normal center edge angle of Wiberg (n=34 & n=28, respectively) and acetabular angle of Sharp (n=24 & n=34, respectively). Age (P=0.000 & P=0.000), marital status (P=0.002 & P=0.000) and employment status (P=0.001 & P=0.002) were significantly associated with center edge angle of Wiberg and acetabular angle of Sharp, respectively but gender was not (P=0.441 & P=0.879). No subject above 40 years had abnormal center edge angle of Wiberg value and only eight (8) had abnormal acetabular angle of Sharp.

Table 1
Distribution and association of sociodemographic characteristics with center edge angle of Wiberg and acetabular angle of Sharp (n=100)

		CEA (Degrees)		**P value**	**SHARP (Degrees)**		**P value**
		≤ 25 (n/%)	**> 25 (n/%)**		**≥ 42 (n/%)**	**< 42 (n/%)**	
Gender	**Males**	20 (37)	34 (63)	0.441	18 (39)	28 (61)	0.879
	Females	22 (48)	24 (52)		20 (37)	34 (63)	
Age (Years)	**< 40**	42 (64)	24 (36)	0.000*	30 (88)	4 (12)	0.000*
	> 40	0 (0)	34 (100)		8 (12)	58 (88)	
Educational status	**Educated**	18 (39)	28 (61)	0.704	16 (35)	30 (65)	0.665
	Uneducated	24 (44)	30 (56)		22 (41)	32 (59)	
Marital status	**Married**	30 (65)	16 (35)	0.002*	34 (63)	20 (37)	0.000*
	Unmarried	12 (22)	42 (78)		4 (9)	42 (91)	
Employment status	**Employed**	24 (75)	8 (25)	0.001*	36 (53)	32 (47)	0.002*
	Unemployed	18 (27)	50 (73)		2 (6)	30 (94)	
BMI (kg/m^2)	**> 25**	32 (62)	20 (38)	0.004*	22 (42)	30 (58)	0.514
	< 25	10 (21)	38 (79)		16 (33)	32 (67)	

(*) – P value less than 0.05 is significant; BMI – Body mass index; CEA – Center edge angle of Wiberg; SHARP – Acetabular angle of Sharp

Most of the subjects with abnormal center edge angle of Wiberg and abnormal acetabular angle of Sharp were below 40 years (n=42 & n=30), married (n=30 & n=34) and employed (n=24 & n=36), respectively. The subjects' BMI was significantly associated with center edge angle of Wiberg (P=0.004) but was not associated with acetabular angle of Sharp (P=0.514) and most of them with BMI > 25kg/m2 had acetabulum with abnormal center edge angle of Wiberg (n=32). Educational status was also not significantly associated with the center edge angle of Wiberg (P=0.704) and acetabular angle of Sharp (P=0.665), and most of the subjects within this variable had acetabulum with normal center edge angle of Wiberg (n=58) and acetabular angle of Sharp (n=62) (Table 1). Only four male subjects had both abnormal center edge angle of Wiberg and abnormal acetabular angle of Sharp. Therefore,

$$\text{Prevalence of acetabular dysplasia} = \frac{4}{100} \times 100 = 4\%$$

The mean center edge angle of Wiberg and acetabular angle of Sharp in the study were 27.41±0.730 (SEM) and 39.00 ± 0.860 (SEM) with a range of 20.120 to 35.440 and 30.320 to 51.350, respectively. The age of the subjects was from 18 to 60 years and the mean age was 33.58±1.71 years (SEM). The mean value of the BMI was 29.59±1.41 kg/M2 which shows that the subjects in this study were generally overweight (Table 2).

Table 2:
The mean values of the general descriptive statistics of the subjects

	n	Mean ± SEM	Min	Max
AGE (Years)	100	33.58 ± 1.71	18.00	60.00
BMI (Kg/m^2)	100	29.89 ± 1.41	16.60	38.30
CEA (Degrees)	100	27.41 ± 0.73	20.12	35.44
SHARP (Degrees)	100	39.00±0.86	30.32	51.35

BMI – Body mass index; CEA – Center edge angle of Wiberg; SHARP – Acetabular angle of Sharp

The mean BMI in males, 34.03±1.72 Kg/M2 (SEM), was shown to be significantly more than that in females, 29.15±1.35 Kg/M2 (SEM), (P=0.000), even though the least BMI was recorded in a male, 16.60 Kg/M2. In this study, the mean center edge angle of Wiberg for males was 26.57±0.740 (SEM) with a range of 20.310 to 33.330 and for females was 28.39±1.320 (SEM) with a range of 20.120 to 35.440. The mean values of the acetabular angle of Sharp in males was 39.18±1.230 (SEM) with a range of 30.330 to 51.350 and for females it was 38.80±1.210 (SEM) with a range of 30.320 to 48.330. The differences in the mean values of the center edge angle of Wiberg and the acetabular angle of Sharp for both genders were insignificant (Table 3). The scatter plot showed that the two variables, center edge angle of Wiberg and acetabular angle of Sharp, had a linear negative relationship. The gradient of the scatter plot was 0.462 depicting that both variables had a moderate strength of association. The Pearson's correlation between center edge angle of Wiberg and acetabular angle of Sharp was significant (r=-0.344, P=0.000) (Figure 3).

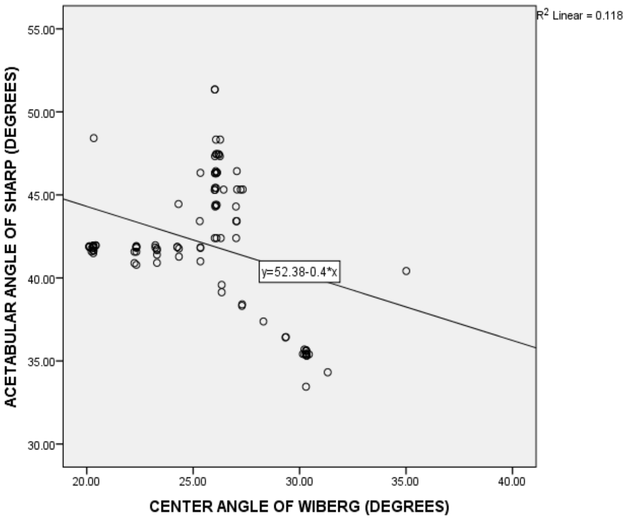

Figure 3
A scatter plot showing the relationship of the center edge of Wiberg and the acetabular angle of Sharp

DISCUSSION

The mean center edge angle of Wiberg in this study was observed to be 27.41±0.730 which was in consonant with previous report of researches conducted by Hassa *et al.*, (2023) in Turkey (29.89±2.950) and Nishimura *et al.*, (2023) in Japan (27.9±4.800). Incongruent to our findings are an array of reports with higher values in diverse climes and these include the studies of Vuralli *et al*., (2022) in Turkey (32.78±2.0500), Jeremic *et al*., (2011), whose study included Serbian subjects that had been treated for fractures before (33.50±6.500), Umer *et al*., (2009) in Pakistan (35.50±6.600), Khaliq *et al*., (2022) also in Pakistan (33.190), Hofman *et al*., (2017) in Germany (35.81±9.560), Han *et al*., (1998) who focused on Koreans above 20 years (32.50±6.400), Baharudeen *et al*., (2011) in Malaysia (31.69±5.480), Werner *et al*., (2012) in USA (33.600) and Jacobsen and Sonne-Holm (2005) in Denmark (34.600).

Table 3
The differences in the mean values of the general descriptive statistics of the subjects based on gender

	MALES			FEMALES				
	Mean ± SEM	**Min**	**Max**	**Mean ± SEM**	**Min**	**Max**	**T-test**	**P value**
AGE (Years)	34.70±2.34	19.00	60.00	32.26±2.55	18.00	58.00	-0.707	0.483
BMI (Kg/m^2)	34.03±1.72	16.60	38.30	29.15±1.35	20.50	36.70	5.96	0.000*
CEA (Degrees)	26.57±0.74	20.31	33.33	28.39±1.32	20.12	35.44	1.251	0.217
SHARP (Degrees)	39.18±1.23	30.33	51.35	38.80±1.21	30.32	48.33	-0.222	0.825

(*) – P value less than 0.05 is significant; BMI – Body mass index; CEA – Center edge angle of Wiberg; SHARP – Acetabular angle of Sharp

Acetabular angle of Sharp has been widely credited with the capacity to compensate for the replete shortcomings of the center edge angle of Wiberg and as a result its evaluation is considered more reliable for the diagnosis of acetabular dysplasia (Jeremic *et al*., 2011; Baharudeen *et al*., 2011), however, Soydan *et al*., (2021) reiterating the relevance of center edge angle of Wiberg, succinctly stated that it has a significant correlation with the development of osteoarthritis. It was observed in this study that the mean acetabular angle of Sharp was 39.00±0.860. Similar value was noted in the studies done by Hassa *et al*., (2023) in Turkey (37.8±2.330), Jeremic *et al*., (2011) in Serbia (38.00±3.800), Vuralli *et al*., (2022) in Turkey (39.22±2.600), Umer *et al*., (2009) in Pakistan (37.80±4.370) and Han *et al*., (1998) in Koreans (37.00±3.700). In contrast, higher values of the acetabular angle of Sharp have also been reported such as those of Nishimura *et al*., (2023) in Japan (44.40±3.100) and Baharudeen *et al*., (2011) in Malaysians (42.35±3.260). Generally, the outcome of the comparisons of the acetabular parameters obtained in this study lucidly shows that our results displayed substantial similarity with studies done on populations in Turkey, Japan, Serbia, Pakistan and Korea.

Gender wise, we found out that the mean center edge angle of Wiberg was lower in males (26.57± 0.740) than females (28.39± 1.320) but this difference was not significant (P=0.217). In consonance with our results Vuralli *et al*., (2022) in Turkey observed in their study that the mean value of the center edge angle of Wiberg was marginally higher in females than males (33.68±1.860 vs 32.0±1.890) and this difference was significant (P<0.001). Busato *et al*., (2021) also in agreement noted that the mean center edge angle of Wiberg was significantly higher in Brazilian females (35.50±9.500 vs 32.60±7.100; P=0.013). In a dissimilar trend, several literatures reported that males had a higher center edge angle of Wiberg. The compendium included the reports of Jeremic *et al*., (2011) in Serbia (33.60±5.800 vs 33.30±6.900), Hong *et al*., (2023) in Korea (37.41±6.500 vs 31.67±5.400; P <0.001), Nishimura *et al*., (2023) in Japan (29.80±4.600 vs 27.50±5.000; P<0.001), Umer *et al*., (2009) in Pakistan (36.28±6.440 vs 34.57±6.780; P=0.004), Busato *et al*., (2021) in Brazil (35.50±9.500 vs 32.60±7.100; P=0.013) and El-Heis *et al*., (2018) in Jordan (38.00±5.810 vs 38.00±5.790; P=NS).

On the other hand, the acetabular angle of Sharp was observed to be higher in males in our study (39.18±1.230 vs 38.80±1.210) and the difference was also not significant (P=0.825). In accordance with our finding, Vuralli *et al*., (2022) in Turkey, shared similar opinion as they demonstrated that the mean acetabular angle of Sharp was significantly greater in males (39.89±2.350 vs 38.45±2.660; P<0.001), Hutabarat *et al*., (2018) in Indonesia, also observed that the mean acetabular angle of Sharp was higher in males than females (59.76±7.740 vs 58.08±6.350). In a deviation from our finding, females were shown to possess a higher acetabular angle of Sharp compared to males as stated by the reports of Jeremic *et al*., (2011) in Serbia (38.50±3.900 vs 37.50±3.600), Nishimura *et al*., (2023) in Japan (44.30±3.100 vs 43.3±3.100; P<0.001), Lavy *et al*., (2003) in Malawi (38.60±4.900 vs 36.90±4.000; P<0.005) and Ege *et al*., (2016) in Turkey, (38.50±2.100 vs 37.90±2.500; P=0.0001). It can be inferred that the acetabular morphology of the male population in the region of this study was more susceptible to develop acetabular dysplastic changes than the hips of the female population.

The prevalence of acetabular dysplasia was found to be 4% in this study which was in divergence with other literatures. Slightly higher prevalence rates of acetabular dysplasia were observed in the researches conducted by Soydan *et al*., (2021) in Turkey (8.63%) and Busato *et al*., (2021) in Brazil (6%). At the other spectrum of findings, lower prevalence predominated in the reports of Jeremic *et al*., (2011) in Serbia (2.9%) and El-Heis *et al*., (2018) in Jordan (2.2%). It can be inferred that the prevalence of acetabular dysplasia in this study was lower than the prevalence in Turkey and Brazil but higher than what was reported in Serbia and Jordan. In this study the prevalence of acetabular dysplasia was 4% in males and 0% in females. A contradictory postulation with respect to the gender inclination observed in this study was highlighted by Soydan *et al*., (2021) in Turkey and Jeremic *et al*., (2011) in Serbia, who reported a prevalence of 7.26% in males and 10.30% in females, and 2.20% in males and 3.60% in females, respectively. However, Hassa *et al*., (2023) discovered in their research that the prevalence of acetabular dysplasia was similar in both gender (males - 1.9% vs females - 1.4%; P=1.000). Our findings suggests that 4% of the population within the age group of this study are afflicted with acetabular dysplasia and are currently at risk of having functional impairment of the affected hip joint.

This study buttressed the validity of employing either the technique of center edge angle of Wiberg evaluation or acetabular angle of Sharp evaluation in the determination of acetabular dysplasia by demonstrating the existence of a significant relationship between both methods (r=0.722; P=0.000). Umer *et al*., (2009) in Pakistan, aligned with our study as they concisely reported that the center edge angle of Wiberg correlates significantly with the acetabular angle of Sharp (r=0.393, P<0.001). Still in accordance with the findings of this study, Soydan *et al*., (2021) in Turkey noted that there was a moderate correlation between center edge angle of Wiberg and acetabular angle of Sharp (r=0.650). On this premise both methods can be regarded as complementary in the diagnosis of acetabular dysplasia. In variance, Jeremic *et al*., (2011) in Serbia, reported that there was no significant relationship between the acetabular angle of Sharp and the center edge angle of Wiberg (P>0.05).

In this study, it was observed that age was significantly associated with center edge angle of Wiberg and acetabular angle of Sharp (P=0.000, respectively) and furthermore, abnormal values following acetabular morphological evaluation were predominantly exhibited by individuals below 40 years. In the same vein, Tugrul *et al*., (2020) whose study was done on healthy children between 5 and 14 years in Turkey, found out that center edge angle of Wiberg significantly correlated with age (r=0.511, P=0.000). In addition, Hofmann *et al*., (2017) in Germany, lucidly observed that age had a significant correlation with center edge angle of Wiberg (r=0.31; P<0.001) and acetabular angle of Sharp (r=-0.38; P<0.001). Nishimura *et al*., (2023) in Japan, observed that there was a significant correlation between age and the acetabular angle of Sharp (r=-0.006; P=0.040) and the center edge angle of Wiberg (r=0.007; P=0.030). Similarly, Umer *et al*., (2009) in Pakistan, observed that abnormal values of the acetabular angle of Sharp was significantly associated with young age groups (r=-0.825; P=0.022). Nishimura *et al*., (2023) in Japan, opined that the acetabular angle of Sharp in young age group was demonstrated to have larger angles in their study which was in keeping with the development of acetabular dysplasia. Further corroborating our findings, Adanir and Zorer, (2018) in Turkey, explicitly opined that as the center edge angle of Wiberg reduces to abnormal values, which is in keeping with the onset of acetabular dysplasia, the age at which osteoarthritis occurs proportionately reduces. In complete disagreement, Jeremic *et al*., (2011) in Sebia, found out that there was no significant association between age and the development of acetabular dysplasia.

Amazingly, we observed that marital status was significantly associated with center edge of Wiberg (P=0.002) and acetabular angle of Sharp (P=0.000) and most of the married subjects in this study had abnormal values. As a way of unravelling this relationship, Polenick *et al*., (2015) found out that the severity of osteoarthritis, which might have been a result of acetabular dysplasia, generally increases when there is a corresponding reduction in spouse life satisfaction over a 6 months period (P=0.020). However, when spousal closeness persists, an increase in spouse life satisfaction leads to a reduction in the severity of osteoarthritis (P=0.049). This suggests that family disharmony has a place in the modulation of the severity of osteoarthritis and consequently determines the capacity of the hip joint to function properly. Moreover, Jorgensen *et al*., (2011) realized that being married, marginally heightened the risk of hip osteoarthritis in the Danish population than being unmarried.

In this study it was realized that employment status was significantly associated with center edge angle of Wiberg (P=0.001) and acetabular angle of Sharp (P=0.002). A preponderant number of the subjects who were employed exhibited abnormal values of center edge angle of Wiberg and acetabular angle of Sharp. Illuminating the possible underlying basis for this association, Coggon *et al*., (1998) in England, found out that males whose jobs entailed lifting loads weighing 10 kg or more on a regular basis for a long duration had a higher incidence of hip osteoarthritis, likely as a sequela of acetabular dysplasia, and its severity was directly proportional to the weight of the loads and length of exposure to such jobs. There was however, no such association noted in women. Work posture was also demonstrated to have a significant place in the occurrence of hip osteoarthritis, as affirmed by Pratama *et al*., (2023) in Indonesia, (P=0.002).

Croft *et al*., (1992) in UK, also observed that the odds of acquiring hip osteoarthritis likely through acetabular dysplasia, substantially increased in males whose jobs involved standing for more than 2 hours in a day over a period of about 40 years (OR 2.7; CI 95%: 1.0 – 7.3). Furthermore, Coggon *et al*., (1998) inferred that the risk of acquiring hip osteoarthritis was increased in women whose jobs entailed walking a distance of 3.2 km per working day. In addition, long period exposure to frequent climbing of stairways during working hours was shown to greatly increase the risk of hip osteoarthritis in both males and females. Jorgensen *et al*., (2011) in Denmark and Ali *et al*., (2021) in Pakistan, concisely stated that males and females with low-income jobs were frequently exposed to conditions that lead to the development of osteoarthritis (P=0.001) (Adanir and Zorer, 2018). Teichtal *et al*., (2015) in Melbourne, Australia, observed that exposure to heavy lifting in individuals aged between 18 and 30 years was significantly associated with the risk of bone marrow lesions around the femoro-acetabular region (OR 3.9; CI 95%: 1.6 – 9.8; P < 0.010) and the risk of cartilage defects at the supero-lateral aspects of the femoral head (OR 1.6; CI 95%: 1.0 – 2.5; P = 0.04). These combined outcomes of exposure to heavy lifting induces a remodeling of the acetabular morphology in young age group to promote the onset of hip osteoarthritis. Acetabular dysplasia has been proven without any modicum of doubt to have a significant role in the manifestation of hip osteoarthritis (Soydan *et al*., 2021).

In this study we noticed that body mass index (BMI) was significantly associated with center edge angle of Wiberg (P=0.000) with the BMI of the male subjects significantly greater than their female counterparts (P=0.000). Most of the subjects in this study with abnormal center edge angle of Wiberg were overweight. Aligning with our findings, Adanir and Zorer, (2018) in Turkey attributed the extremely high rate of acetabular dysplasia, to the high BMI of the female participants in their study. In fact, they recorded an immense number of females with a center edge angle of Wiberg below 200 and the female to male ratio observed in this category was 4.1:1. However, in this study the male population rather had a higher BMI. In tangent to this finding, Nishimura *et al*., (2023) in Japan, found out that BMI had no correlation with center edge angle of Wiberg (P=0.22) and acetabular angle of Sharp (P=0.21). Cevik and Cicek (2020) in Turkey, also opined that the BMI of an individual has no bearing on the acetabular morphology.

Evaluation of the acetabular morphology in this study was conducted in one health facility, which was a limitation, and as such may not be regarded as a true representation of the population of this locality. Multi-center study for the evaluation of center edge angle of Wiberg and acetabular angle of Sharp with BMI matched subjects, and with a larger population is highly recommended. This study only included subjects devoid of hip joint abnormality. However, it would have been more enlightening to investigate the center edge angle of Wiberg and acetabular angle of Sharp in subjects with primary osteoarthritis. Even though the 2D image evaluation suffices for the diagnosis of acetabular dysplasia, a 3D image for acetabular volume-surface evaluation will provide more crucial and wholesome information on the status of the acetabulum.

In conclusion, the center edge angle of Wiberg and the acetabular angle of Sharp in our population are similar to the values in some European and Asian populations. Being married, employed, overweight and below 40 years are significantly associated with acetabular dysplasia and by implication are determinants of hip joint function. The prevalence of acetabular dysplasia is low (4%) in this locality and overweight males are highly susceptible to develop acetabular dysplasia.

Long term employment in a low-income job that involves physically carrying heavy items while maintaining abnormal postures, standing for hours, frequent use of stairways and walking long distances to achieve the objectives of one’s employers all contribute to alter the morphology of the acetabulum and promote the events that ultimately impair hip functions. In addition, persistent marital disharmony resulting from the spouses living apart or growing apart while living together is a factor, with a psycho-somatic basis, that regulates the severity of osteoarthritis, which further deteriorates a deformed acetabulum, and also adversely affects the functions of the hip joint as a consequence.

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REFERENCES

Adanir, O., and Zorer, G. (2018). Comparison of four parameters to assess acetabular dysplasia and acetabular dysplasia rates in primary hip osteoarthritis patients: A study in Turkish population. *Journal of orthopaedic surgery* (Hong Kong). 26(2), 2309499018768032. https://doi.org/10.1177/2309499018768032

Ali, A. A., Bhutto, N., Chandio, S., Waqas, S., Khoso, A. R., *et al*. (2021) Association of different Demographic characteristics with Hip Osteoarthritis patients attending the different Hospitals across the Karachi and Quetta. *Open J Orthop Rheumatol*. 6(1), 062-066. DOI: 10.17352/ojor.000040

Baharuddin, M. Y., Zulkifly, A. H., Kadir, M. R. A., *et al*. (2011). Morphometric study of the acetabular in Malay population normal hips and its clinical applications. *J Med Sci*. 11(5), 213-219. DOI:10.3923/jms.2011.213.219.

Böker, S. M., Adams, L. C., Fahlenkamp, U. L., *et al*. (2020). Value of susceptibility-weighted imaging for the assessment of angle measurements reflecting hip morphology. *Scientific reports.* 10(1), 20899. https://doi.org/10.1038/s41598-020-77671-1

Busato, T. S., Milan, T. V., Matioski Filho, G. R., *et al*. (2021). Anthropometric Tomographic Study of the Hip in a Brazilian Regional Population. *Revista brasileira de ortopedia*. 57(2), 230–240. https://doi.org/10.1055/s-0041-1731658

Cevik, H., and Cicek, E. D. (2020). Measurement Changes Used for femoroacetabular impingement diagnosis in hip pain. *EJMI*. 4(2), 228-234.

Coggon, D., Kellingray, S., Inskip, H., *et al*. (1998). Osteoarthritis of the hip and occupational lifting. *American journal of epidemiology.* 147(6), 523–528. https://doi.org/10.1093/oxfordjournals.aje.a009483

Croft, P., Cooper, C., Wickham, C., *et al*. (1992). Osteoarthritis of the hip and occupational activity. *Scandinavian journal of work, environment & health.* 18(1), 59–63. https://doi.org/10.5271/sjweh.1608

Ege, T., Köse, Ö., Demiralp, B., *et al*. (2016). Eriskin kalça displazisinin değerlendirilmesinde normal radyolojik ölçüm değerleri; Anadolu toplumunda 1732 sağlikli kalçanin değerlendirilmesi. *Gulhane Medical Journal.* 58(3), 245-249. https://dx.doi.org/10.5455/Gülhane.172969

El-Heis, M., Gharaibeh, M., Al-Omari, M., *et al*. (2018). The centre edge angle of Wiberg of acetabulum in adult Jordanian population. MOJ Orthop Rheumatol. 10(2), 168-170. DOI: 10.15406/mojor.2018.10.00407

Han, C., Yoo, J., Lee, W., *et al*. (1998). Radiographic parameters of acetabulum for dysplasia in Korean adults. *Yonsei Med J*. 39(5), 404-408.

Hassa, E., Kosehan, D., Ulu Ozturk, F., *et al*. (2023). The determination of acetabular parameters in a Turkish population sample: CT-based retrospective analysis of side and gender differences. Medicine. 102(43), e35706. https://doi.org/10.1097/MD.0000000000035706

Hofmann, U. K., Ipach, I., Rondak, I. C., *et al*. (2017). Influence of age on parameters for femoroacetabular impingement and hip dysplasia in x-rays. Acta ortopedica brasileira. 25(5), 197–201. https://doi.org/10.1590/1413-785220172505173951

Hong, K. B., Lee, W. S., Kang, K., *et al*. (2023). Evaluation of lateral and anterior center-edge angles according to sex and anterior pelvic plane tilt angle: a three-dimensional quantitative analysis. *Journal of orthopaedic surgery and research*. 18(1), 280. https://doi.org/10.1186/s13018-023-03763-z

Hutabarat, A., Saleh, R., Sakti, M., *et al*. (2018). Morphology study of the acetabulum values of Indonesian Deutero Malay Sub-race population in south Sulawesi. *Journal of Medical Sciences*. 18: 69-75.

Jacobsen, S., and Sonne-Holm, S. (2005). Hip dysplasia: a significant risk factor for the development of hip osteoarthritis. A cross-sectional survey. *Rheumatology.* (Oxford, England) 44(2), 211–218. https://doi.org/10.1093/rheumtology/keh436

Jeremic, D., Jovanovic, B., Zivanovic-Macuzic, I., *et al*. (2011). Sex dimorphism of postural parameters of the human acetabulum. *Arch. Biol. Sci. Belgrade*. 63(1), 137-143. DOI:10.2298/ABS1101137J

Jørgensen, K. T., Pedersen, B. V., Nielsen, N. M., *et al*. (2011). Socio-demographic factors, reproductive history and risk of osteoarthritis in a cohort of 4.6 million Danish women and men. *Osteoarthritis and cartilage.* 19(10), 1176–1182. https://doi.org/10.1016/j.joca.2011.07.009

Khaliq, S., Qamar, A., Khokhar, S. K., *et al*. (2022). Morphometric study of acetabular depth and coverage and their clinical importance. *Pakistan journal of medical sciences*. 38(8), 2227–2233. https://doi.org/10.12669/pjms.38.8.5915

Lavy, C. B., Msamati, B. C., and Igbigbi, P. S. (2003). Racial and gender variations in adult hip morphology. *International orthopaedics*. 27(6), 331–333. https://doi.org/10.1007/s00264-003-0507-0

Mannava, S., Geeslin, A. G., Frangiamore, S. J., *et al*. (2017). Comprehensive clinical evaluation of femoroacetabular impingement: Part 2, plain radiography. *Arthroscopy techniques.* 6(5), e2003–e2009. https://doi.org/10.1016/j.eats.2017.06.011

Nishimura, T., Watanabe, H., Taki, N. *et al*. (2023). Standard radiographic values for the acetabulum in Japanese adolescents: a cross-sectional study. *BMC Musculoskelet Disord*. 24, 257. https://doi.org/10.1186/s12891-023-06368-z

Polenick, C. A., Martire, L. M., Hemphill, R. C., *et al*. (2015). Effects of change in arthritis severity on spouse well-being: The moderating role of relationship closeness. Journal of family psychology: JFP: *journal of the Division of Family Psychology of the American Psychological Association* (Division 43). 29(3), 331–338. https://doi.org/10.1037/fam0000093

Pratama, R. Y., Indreswari, L., and Sutejo, I. R. (2023). The occupational risk factors associated with hip osteoarthritis in agricultural communities in Jember. *Jurnal Ilmiah Kedokteran Wijaya Kusuma*. 12(2), 151-157.

Pun S. (2016). Hip dysplasia in the young adult caused by residual childhood and adolescent-onset dysplasia. Current reviews in musculoskeletal medicine. 9(4), 427–434. https://doi.org/10.1007/s12178-016-9369-0

Soydan, Z., Ceylan, H. H., Kasabaligil, A., *et al*. (2021). Correlation between borderline acetabular dysplasia and hip osteoarthritis: A retrospective cross-sectional radiographic study. *J Orthop trauma surg rel res*. 16(5), 1-5.

Teichtahl, A. J., Smith, S., Wang, Y., *et al*. (2015). Occupational risk factors for hip osteoarthritis are associated with early hip structural abnormalities: a 3.0 T magnetic resonance imaging study of community-based adults. *Arthritis research & therapy*. 17(1), 19. https://doi.org/10.1186/s13075-015-0535-3

Tuğrul, A. İ., Yılmaz, G., Aydın, B. K., *et al*. (2020). Center-edge angle values in healthy children between 5 and 14 years old in Turkey. *Acta orthopaedica et traumatologica turcica*. 54(1), 15–19. https://doi.org/10.5152/j.aott.2020.01.451

Umer, M., Sepah, Y. J., Asif, S., *et al*. (2009). Acetabular morphometry and prevalence of hip dysplasia in the South Asian population. *Orthopedic reviews*. 1(1), e10. https://doi.org/10.4081/or.2009.e10

Vuralli, D., Polat, S., Oksuzler, M., *et al*. (2022). The importance of acetabular morphometry in determining hip dysplasia. *Int. J. Morphol*. 40(6), 1641-1647.

Welton, K. L., Kraeutler, M. J., Garabekyan, T., *et al*. (2023). Radiographic parameters of adult hip dysplasia. *Orthopaedic journal of sports medicine.* 11(2), 23259671231152868. https://doi.org/10.1177/23259671231152868

Werner, C. M., Ramseier, L. E., Ruckstuhl, T., *et al*. (2012). Normal values of Wiberg's lateral center-edge angle and Lequesne's acetabular index-a coxometric update. *Skeletal radiology*. 41(10), 1273–1278. https://doi.org/10.1007/s00256-012-1420-7.