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**ORIGINAL ARTICLE**

# Interrelationship Between Newborn Developmental Dysplasia of the Hip and Fetal Malpresentations and Malposition in Labor: A cross sectional study

***Hataw Taha Mohammed [1*], Shahla Kareem Alalaf [2], Las Jamal Khorsheed Hwaizi [3]***

***Author's Information***
1. *Maternity Teaching Hospital, Erbil city, Kurdistan region, Iraq*
2. *Professor at Hawler Medical University, College of Medicine,Department of Obstetric and Gynecology,Erbil city,Kurdistan region,Iraq.*
3. *Erbil teaching hospital, Kurdistan Higher Counsel of Medical Specialities, professor of Orthopedic Surgery, Consultant Orthopedic surgeon, First Consultant in DDH, Erbil city, Kurdistan region, Iraq.*

***Corresponding author:**
**Shahla Kareem Alalaf**
*Shahla_alaf@yahoo.com*

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***Abstract***

***Background:*** *Developmental Dysplasia of the Hip (DDH) is one of the most common congenital musculoskeletal problems in newborns. Its incidence varies in different populations and multiple risk factors have been reported*
***Objectives:****To determine the prevalence of developmental dysplasia of the hip (DDH) in newborns who had malposition and malpresentation at the time of delivery and to identify the presence of any other risk factors.*
***Methods:*** *A cross-sectional study was conducted on 507 Kurdish women who had fetal malpresentation and malposition during labor at the Maternity Teaching Hospital, Erbil city, Kurdistan Region. Ultrasound of the newborn's pelvis was conducted within 14 days of delivery and the Graf ultrasound method was used to screen for DDH.*
***Results:*** *The prevalence of DDH was 6.5 %. No significant associations were detected between the prevalence of DDH and the gestational age, parity, family history of DDH, mode of delivery, and amniotic fluid volume or any categories of mal-presentation.*
***Conclusions:*** *The rate of DDH is considerably high among a sample of Kurdish ethnicity neonates. There are no relative risk factors for its development.*

***Keywords:*** *Developmental Dysplasia of the Hip, DDH, Malposition, Malpresentations, Breech presentation*

## 1. INTRODUCTION

Developmental Dysplasia of the Hip (DDH) is one of the most common congenital musculoskeletal problems in newborns (1). It encompasses abnormalities in the anatomy of the articular and periarticular area, hip instability, capsular laxity, and abnormal growth of the acetabulum (2). The incidence of DDH varies from 1 to 7 % across several different populations (3,4), and these differences in the incidence rate could be related to the differing inclusion criteria applied in the various studies, the age of the newborns at the time of assessment, and additional genetic factors, such as racial differences (5). Early identification of affected infants is important for optimal outcomes, as the treatment results become worse with a delayed diagnosis after the neonatal period (6). Multiple risk factors have been reported in relation to DDH like family history, breech presentation, first born child, oligohydramnios, female gender, multiple pregnancy, ethnicity, torticollis, and foot deformities (6-9). Although these risk factors increase the possibility of developing dysplasia of the hip, not every child with developmental dysplasia has them. Accordingly, screening programs for DDH have been recommended for many years and various programs were established including pure clinical examination, selective ultrasonographic screening of newborns with risk factors for DDH, or global neonatal ultrasonographic screening (10). The recommendations for early screening of DDH state that newborns must undergo a clinical examination of their hips by a pediatrician or neonatologist after birth. Many newborns did not have any of the reported risk factors for DDH but still had the condition, which leads us to question if they may have had other risk factors that have not yet been examined and reported on. We proposed that malposition and malpresentation of the fetuses before delivery could be a risk factor for DDH, which would mean that the obstetrician may play a role in the early diagnosis of DDH. Accordingly, this study was conducted to determine the prevalence of DDH, based on a sonographic diagnosis, for neonates with malpresentation and malposition before delivery and the presence of any other risk factors for DDH in this group of newborns, in a busy tertiary obstetric hospital, serving patients of the Kurdish ethnic group.

## 2. METHODOLOGY

Ethical consideration: The Ethics and Scientific Committee of the Kurdistan Board of Medical Specialties approved this study on November 2, 2020 (License Number 830). Written informed consent was obtained, at the time of the first interview, from each woman who agreed to participate in the study. All participants were assured that their information would be kept confidential and would be used for research purposes only. All interviews were carried out in accordance with the ethical standards of the institutional research committee and with the Declaration of Helsinki.

**Study design:**

A cross sectional study was conducted at our institution on 507 women who were diagnosed with malpresentation and malposition at the time of delivery from June 1, 2020 to July 30, 2021. All newborns of these women had pelvic ultrasonography to screen for DDH.

**Setting of the study:**

The study was conducted at the Maternity Teaching Hospital, Erbil city, Kurdistan Region, Iraq. The Maternity Teaching Hospital is the main public hospital in the city and regarded as a tertiary obstetrics and gynecology center. It is where most deliveries occur and is accessible to women of different socio-demographic backgrounds. However, deliveries also occur in homes and a number of private hospitals (11).

**Inclusion and exclusion criteria:**

The inclusion criteria included: patients who were aged 18 years or older, any parity, gestational age greater than or equal to 34 weeks, malpresentation or malposition of the fetus at the time of delivery, vaginally or cesarean deliveries, and those who agreed to participate in the study. Multiple pregnancy, multiple congenital malformations, stillbirth and refusal to participate were regarded as exclusion criteria.

**Sample size:**

The sample size was calculated by using a formula from Epi InfoTM software, Version 7 (Centers for Disease Control and Prevention, Atlanta, GA, USA), with the following parameters: a 95% confidence level; a population size of 7500 people; an estimated frequency of 10 % (determined from a pilot study conducted for this purpose) and an acceptable margin of error of 2.5%.

The total number of participants who met the inclusion criteria was 515. Unfortanuately, eight newborns died before completing the first 2 weeks of life and missed to follow-up so that their mothers were excluded from the study. The final number of women who were enrolled in the study was 507.

**Data collection and study tool**:

Potential participants (i.e., women who were admitted to our hospital in order to give birth either naturally or surgically by caesarean section) were invited to participate in the study and were interviewed. The participants completed a questionnaire to determine their demographic data, which included the women's age; her obstetrical history including polyhydramnios (defined as the deepest vertical pocket (DVP) > 8 cm or amniotic fluid index (AFI) ≥ 25 cm), oligohydramnios (defined as DVP < 2 cm or AFI < 5 cm) (12), parity categorized as primigravid (first pregnancy), multiparous (parity of 1—4), and grand multiparous (parity of 5 and more); and gestational age in weeks. New-borns were classified as preterm, if they were born before completing 37 weeks' gestation or term if they were born after a gestational age of 37 weeks (13). A family history of DDH was recorded.

**Fetal malpresentation and malposition:**

Fetal malpresentation was defined as when a fetal part other than the head was engaged in the maternal pelvis. Fetal malposition in labor included: those positions in which the occiput was in either the posterior or transverse position (14); breech presentation, in which the fetus was in the longitudinal lie with the buttocks or lower extremity entering the pelvis first (15); transverse lie of the fetus, where the long axis of the fetus was approximately perpendicular to the long axis of the mother (16); brow presentation, when the leading presenting part was the forehead; and face presentation, when the fetal presenting part was the face (17). During delivery, information regarding the method of delivery (vaginal, elective cesarean section, or emergency cesarean section) was documented. After the baby was born, the data regarding the newborns' sex and weight were recorded. All newborns were screened for the presence of DDH by the second author who is a senior orthopedic expert in pelvic hip ultrasonography. The Graf ultrasound method (18) was used to screen for DDH in these newborns. Scanning and measurement techniques: During the first 14 days after delivery, in a specially arranged environment for conducting pelvic ultrasounds on newborns,

the newborns were screened for DDH using ultrasonography. A 7.5 MHz linear array probe ultrasound machine (Shantou Institute of Ultrasonic Instruments Co., Ltd., Guangdong, China) was used. The infant was placed on their side and his/her mother held their shoulder. The examiner held both legs straight. The probe was positioned on the greater trochanter and it was moved forwards and backwards until the perfect view was obtained. When the plane and lower end of the ilium and the labrum of the acetabulum were clearly visible, lines were drawn and the angles were measured. For the measurement of the alpha and beta angles, three anatomic landmarks including the iliac line, triradiate cartilage, and labrum were used (19). The newborn remained in a lateral decubitus position and coronal images were taken with subsequent measurement of the alpha and beta angles (20). The Graf alpha angle was defined as ‘‘the angle formed between the acetabular roof and the vertical cortex of the ilium in the coronal plane’’ (19). An alpha angle greater than 60° was considered normal and less than that was considered abnormal (i.e., DDH). The Graf beta angle was measured by ‘‘a line drawn through the vertical ilium and the cartilaginous acetabular labrum’’ (19). A Beta angle less than 55° was considered normal and above that was considered abnormal. According to this method all newborns were divided into one of two groups regarding the diagnosis of DDH:

1. A newborn with an alpha angle greater than 60° and a beta angle less than 55° were categorized as normal (i.e., no DDH present).
2. A newborn with an alpha angle less than 60° and a beta angle greater than 55° were regarded as having DDH.

**Statistical analysis:**

Data were analyzed using the Statistical Package for Social Sciences, version 25. Appropriate sttistical tests were applied accordingly; the Chi-square test used to compare nominal variables, as an alternative, Fisher’s exact test used when chi-square was unapplicable. (when more than 20% of the cells in a table had an expected value of < 5). Level of signifciance (p value) of ≤ 0.05 was considered as statistically significant.

## 3. RESULTS

The mean age of participated women ± standard deviation (SD) was 27.7 ± 6.4 (range 18 to 46) years. Preterm pregnancies reported in 19.1 % of women, (**Table 1**). The prevalence of DDH was 6.5 %. No significant association was detected between the prevalence of DDH and mother's age, gestational age, parity, family history of DDH, mode of delivery and amniotic fluid volume. However, it is worth noting that the prevalence of DDH was 33.3 % among those with a family history of DDH compared to a prevalence of 6.2 % among those with no family history. This difference was close to the level of significance (**Table 2**). No significant association was found between the prevalence of DDH and the categories either malpresentation or malposition, but it is evident that none of the newborns with face and brow presentations had DDH as shown in (**Table 3**) . No significant association was detected between the prevalence of DDH and the weight and sex of the new born (**Table 4**).

Table 1. Basic characteristics of the study sample .

| Variable | | No. | (%) |
|---|---|---|---|
| Age (years) | < 20 | 32 | (6.3) |
| | 20-24 | 156 | (30.8) |
| | 25-29 | 121 | (23.9) |
| | 30-34 | 106 | (20.9) |
| | 35-39 | 69 | (13.6) |
| | ≥ 40 | 23 | (4.5) |
| Gestational age (weeks) | Preterm < 37 | 97 | (19.1) |
| | Full term 37-42 | 410 | (80.9) |
| Parity | Nulliparous | 173 | (34.1) |
| | Multiparous | 304 | (60.0) |
| | Grand multiparous | 30 | (5.9) |
| Total | | 507 | 100.0 |

Table 2. Prevalence of developmental dysplasia of the hip as stratified by the mothers' characteristics.

| Variable | | N | Normal | | DDH | | P.Value |
|---|---|---|---|---|---|---|---|
| | | | No. | % | No. | % | |
| Age (years) | < 20 | 32 | 32 | 100.0 | 0 | 0.0 | 0.636* |
| | 20-24 | 156 | 146 | 93.6 | 10 | 6.4 | |
| | 25-29 | 121 | 110 | 90.9 | 11 | 9.1 | |
| | 30-34 | 106 | 99 | 93.4 | 7 | 6.6 | |
| | 35-39 | 69 | 65 | 94.2 | 4 | 5.8 | |
| | ≥ 40 | 23 | 22 | 95.7 | 1 | 4.3 | |
| Gestational age (weeks) | Preterm < 37 | 97 | 92 | 94.8 | 5 | 5.2 | 0.548** |
| | Full term 37-42 | 410 | 382 | 93.2 | 28 | 6.8 | |
| Parity | Nulliparous | 173 | 163 | 94.2 | 10 | 5.8 | 0.634** |
| | Multiparous | 304 | 282 | 92.8 | 22 | 7.2 | |
| | Grand multiparous | 30 | 29 | 96.7 | 1 | 3.3 | |
| Family history of DDH | Yes | 6 | 4 | 66.7 | 2 | 33.3 | 0.052* |
| | No | 501 | 470 | 93.8 | 31 | 6.2 | |
| Mode of delivery | Vaginal | 116 | 107 | 92.2 | 9 | 7.8 | 0.534** |
| | Cesarean section | 391 | 367 | 93.9 | 24 | 6.1 | |
| Amniotic fluid volume | Normal | 455 | 428 | 94.1 | 27 | 5.9 | 0.120* |
| | Oligohydramnios | 39 | 35 | 89.7 | 4 | 10.3 | |
| | Polyhydramnios | 13 | 11 | 84.6 | 2 | 15.4 | |
| **Total** | | 507 | 474 | 93.5 | 33 | 6.5 | |

DDH: Developmental dysplasia of hip.
* Compared by Fisher's exact test
** Compared by Chi square test.

Table 3. Prevalence rate of developmental dysplasia of the hip stratified by fetal malpresentation and malposition.

| Variable | N | Normal | | DDH | | P-Value |
|---|---|---|---|---|---|---|
| | | No. | % | No. | % | |
| **Types of malpresentation** | | | | | | |
| Breech | 260 | 240 | 92.3 | 20 | 7.7 | 0.568* |
| Transverse lie | 27 | 23 | 85.2 | 4 | 14.8 | |
| Face | 10 | 10 | 100 | 0 | 0 | |
| Brow | 4 | 4 | 100 | 0 | 0 | |
| **Total** | 301 | 277 | 85.2 | 24 | 14.8 | |
| **Types of malposition** | | | | | | |
| Persistent occipito-posterior | 186 | 178 | 95.7 | 8 | 4.3 | 1.00** |
| Persistent occipito-transverse | 20 | 19 | 95 | 1 | 5 | |
| **Total** | 206 | 197 | 95.6 | 9 | 4.4 | |

DDH: Developmental dysplasia of hip.
* Compared by Fisher's exact test
** Compared by Chi square test.

Table 4. Prevalence rate of developmental dysplasia of the hip by newborn weight and sex.

| Variable | | N | Normal | | DDH | | P-Value |
|---|---|---|---|---|---|---|---|
| | | | No. | % | No. | % | |
| Newborn weight (Kg) | < 2.5 | 72 | 68 | 94.4 | 4 | 5.6 | 0.872* |
| | 2.5-3.9 | 376 | 350 | 93.1 | 26 | 6.9 | |
| | ≥ 4 | 59 | 56 | 94.9 | 3 | 5.1 | |
| Newborn sex | Male | 253 | 240 | 94.9 | 13 | 5.1 | 0.212** |
| | Female | 254 | 234 | 92.1 | 20 | 7.9 | |
| **Total** | | 507 | 474 | 93.5 | 33 | 6.5 | |

DDH: Developmental dysplasia of hip.
* Compared by Fisher's exact test
** Compared by Chi square test.

## 4. DISCUSSION

One of the common and significant health problems facing children is DDH [21, 22]. Uncorrected DDH is associated with long-term morbidity such as gait abnormalities, chronic pain and degenerative arthritis (23). The prevalence of DDH in the current study was 6.5 % among 557 women with malposition and mal presentation of their fetuses in labor. This result is in line with a study that was performed on infants in the first month of life as a screening method for diagnosis of DDH, who reported that the incidence of DDH in Sulaimani city, Iraq, was approximately 6.5 % out of 1521 newborns (24). However, the incidence of DDH is generally reported to be 1:100 (25), which is lower than our findings. While a meta-analysis showed the incidence of DDH for children without associated risk factors to be 11.5/1,000 live births (26), the authors claimed that differences in the rate might be attributable to the onset of the evaluation for DDH, the variety of diagnostic methods used to diagnose DDH, and differing geographical locations (25,26). We also believe that geographical and ethnic variability may have a role in determining the rate of DDH.

Multiple perinatal risk factors were used to predict the newborn's risk for DDH for the purpose of selective ultrasound screening or rapid orthopedic referral (27). The clinical features which were thought to indicate a high risk for DDH are: female sex, family history of DDH, breech delivery, first born baby, high birth weight, and abnormal examination of the hip (27, 28). On the contrary, the current study findings exhibited no statistically significant association between the prevalence of DDH and clinical variables such as the mother's age, gestational age, parity, mode of delivery, amount of amniotic fluid, malpresentations and malpositions of the fetus, and birth weight. Although the examination of the newborn with risk factors for DDH is important, most DDH occurs in infants who do not have the known risk factors for this condition (29, 30). A study conducted by Talbot et al., on a cohort of 64 670 live births, assessed the incidence of late presenting DDH (which was defined as presentation after three months of life) and used ultrasound and plain radiography to confirm the diagnosis of DDH to show that 72 % of the late presenting cases had no risk factors (31). In general, the assessment for risk factors is a poor predictor of DDH (32). There are no

screening programs for the evaluation of DDH at our hospital; the new borns are usually examined clinically for the presence of a click by the junior house officers and referred to more a senior pediatrician if the clinical findings are positive. We assumed that most developing countries will have similar regulations. Although there is universal neonatal clinical screening and selective ultrasound screening, late cases of irreducible hip dislocation still occur (31). We recommend that the obstetricians following women during labor should ask for screening all newborns for DDH in our locality using clinical and sonographic method , for those with and without risk factors. Additionally, we recommend the implementation of a national screening program for DDH to be arranged, with the training and education of house officers and junior pediatricians who are involved in the physical examination of neonates and infants.

## 5. CONCLUSIONS

This study showed a high prevalence of DDH in newborn infants in our hospital and there were no significant differences found for the risk factors of DDH. There is a need for improved awareness and early detection of DDH for all newborns at the institution where they are born.

**Ethical Approval:**

All ethical issues were approved by the authors. Data collection and patients enrollment were in accordance with Declaration of Helsinki of World Medical Association , 2013 for the ethical principles of researches involving human. Signed informed consent was obtained from each participant and data were kept confidentially.

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