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# Clinical Insights into Developmental Dysplasia of the Hip: Risk Factors and Findings from a Turkish Pediatric Study

## Gelişimsel Kalça Displazisine Klinik Bakış: Risk Faktörleri ve Türk Pediatri Çalışmasından Bulgular

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## ABSTRACT

**Aim**: Limited research exists regarding the connection between developmental dysplasia of the hip (DDH) and risk factors within the Turkish population. This study aimed to explore the potential associations between DDH and various risk factors among Turkish children.

**Material and Method**: The study involved analyzing the medical records of 83 children born in or admitted to Aksaray Training and Research Hospital, with clinical indications of hip dislocation (HD). The study delved into the relationships between DDH and risk factors such as age under 3 years, female gender, twinning, being the first-born child, C-section delivery, breech presentation, prematurity, positive family history, and the presence of associated abnormalities.

**Results**: Within the study group, HD was confirmed in 74 children (89%) as Positive HD, whereas 9 children (11%) were ruled out as Negative HD. Subsequently, 12 children (14.4%) were excluded from the initially positive cases, as their diagnosis was confirmed to be paralytic hip dislocation rather than DDH. Ultimately, DDH was verified in 62 children (74.6%). Statistical analyses using the Chi-square test ($\chi^2$) and odds ratios (OR) revealed notable associations between DDH and positive family history, female gender, age below 3 years, and the presence of associated abnormalities. The corresponding P values and OR were 0.00 (16.5), 0.002 (3.1), 0.005 (2.6), and 0.042 (1.9) respectively.

**Conclusion**: Positive family history, female gender, age under 3 years, and the presence of associated abnormalities were associated with an approximate 16-fold, 3-fold, 2.5-fold, and 2-fold increased risk of DDH respectively.

**Keywords**: Developmental dysplasia of the hip, risk factors, twinning, first-born, C-section, breech, prematurity, positive family history

## ÖZ

**Amaç**: Gelişimsel kalça displazisi (GKD) ile Türk toplumundaki risk faktörleri arasındaki bağlantıya ilişkin sınırlı sayıda araştırma mevcuttur. Bu çalışma, Türk çocukları arasında GKD ile çeşitli risk faktörleri arasındaki potansiyel ilişkileri araştırmayı amaçlamıştır.

**Gereç ve Yöntem**: Çalışma, Aksaray Eğitim ve Araştırma Hastanesi'nde doğan veya hastaneye başvuran, kalça çıkığı (HD) klinik belirtileri olan 83 çocuğun tıbbi kayıtlarının incelenmesini içeriyordu. Çalışmada GKD ile 3 yaş altı, kız cinsiyet, ikiz çocuk sahibi olma, ilk doğan çocuk olma, sezaryen doğum, makat geliş, prematürite, pozitif aile öyküsü ve ilişkili anormalliklerin varlığı gibi risk faktörleri arasındaki ilişkiler araştırıldı.

**Bulgular**: Çalışma grubunda 74 çocukta (%89) HD Pozitif HD olarak doğrulanırken, 9 çocuk (%11) Negatif HD olarak dışlandı. Daha sonra, tanılarının GKD yerine paralitik kalça çıkığı olduğu doğrulanan 12 çocuk (%14,4) başlangıçta pozitif olan vakaların dışında tutuldu. Sonuçta GKD 62 çocukta (%74,6) doğrulandı. Ki-kare testi ($\chi^2$) ve olasılık oranları (OR) kullanılarak yapılan istatistiksel analizler, GKD ile pozitif aile öyküsü, kadın cinsiyet, 3 yaşın altındaki yaş ve ilişkili anormalliklerin varlığı arasında dikkate değer ilişkileri ortaya çıkardı. Karşılık gelen P değerleri ve OR sırasıyla 0,00 (16,5), 0,002 (3,1), 0,005 (2,6) ve 0,042 (1,9) idi.

**Sonuç**: Pozitif aile öyküsü, kadın cinsiyet, 3 yaşın altındaki yaş ve ilişkili anormalliklerin varlığı, GKD riskini sırasıyla yaklaşık 16 kat, 3 kat, 2,5 kat ve 2 kat artırdı.

**Anahtar Kelimeler**: Gelişimsel kalça displazisi, risk faktörleri, ikiz bebek, ilk doğan, sezaryen, makat, prematürite, pozitif aile öyküsü

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## INTRODUCTION

Developmental dysplasia of the hip (DDH) is a prevalent musculoskeletal condition in infancy caused by irregularities in the femoral head or acetabulum and their congruency (1). The persistence of DDH into adolescence and adulthood results in consequences encountered by clinicians, including irregular gait patterns, reduced lower limb strength, increased likelihood of degenerative conditions of the knee and hip joints, postural scoliosis, lower limb deformities, and back discomfort (2). In addition, it has been documented that these consequences are the primary cause of premature hip osteoarthritis requiring total hip arthroplasty (3). Identifying and addressing risk factors in the early stages paves the way for shorter, less intrusive therapies with improved functional outcomes (4). The prevalence of DDH is variable and depends on multiple risk factors including ethnicity, female gender, family history, oligohydramnios (lack of amniotic fluid), breech presentation, fetal position, birth order, maternal estrogen levels, and external environmental exposures (5). A comprehensive analysis including studies from American and European populations estimated the rate of undetected and confirmed DDH to be 1.3 per 1,000; in populations undergoing clinical screening with the Barlow and Ortolani tests, the rate ranged from 1.6 to 28.5, the latter being more common with ultrasonography (US) screening (3). The identification of risk factors contributing to DDH is the result of numerous studies in American, European, African, and Asian countries (5-8). However, studies describing the incidence of DDH and its correlations with various risk factors remain scarce in Turkey (9). Only two retrospective studies have determined the incidence of DDH and investigated its risk factors in the Turkish context(10, 11). Both studies included patients with common DDH risk factors such as family history, female sex, first-born status, positive consanguinity, breech presentation, and mode of delivery. However, these studies only determined the incidence of DDH without statistically testing the association between DDH and these risk factors. Therefore, this research aims to investigate the relationship between DDH and its risk factors among Turkish children in an isolated institution in Aksaray.

## MATERIAL AND METHOD

The study was approved by the local ethics committee and followed the guidelines of the Declaration of Helsinki (Institutional Review Board number: 2018/243). Given the retrospective nature of the study, informed consent was not obtained from patients.

### Study Design and Setting

This was a retrospective study with an analytic descriptive structure conducted in Aksaray, Turkiye, between January 2013 and January 2023.

### Participants and Procedures

At the Aksaray Training and Research Hospital, children were clinically referred if they had potential signs of hip dislocation (HD) based on one or both of the following criteria: a) observable clinical signs and manifestations of hip instability, including noticeable inequality in limb length, uneven skin folds around the thigh and/or buttocks, noticeable clicking and/or perceptible crepitus, irregular hip movement, and gait abnormalities in older children; and b) positive results on Barlow and/or Ortolani assessments. Upon arrival at the hospital, children with clinical suspicion of HD underwent a routine assessment to identify potential risk factor(s). They were then referred for US and/or radiography to confirm the diagnosis of HD. In specific cases, computed tomography (CT) scans were used for further evaluation.

In this study, we included the medical records of adolescents who met the following criteria: 1) of Turkish descent; 2) less than 5 years of age; 3) born between January 2013 and January 2023 or admitted to the medical facility during this period; and 4) with clinical indicators suggestive of HD. Medical records were excluded if the children had chromosomal irregularities, genetic anomalies, paralytic hip dislocation, intrauterine infections, or neonatal sepsis.

According to the hospital registration office, the number of live births among the Turkish population during the period from 1/1/2013 to 30/1/2023 was 34,671. Initially, a total of 737 medical records were screened. From this initial pool, 354 records were excluded due to their relevance to non-Turkish children. In addition, 248 records were disregarded because they did not meet the predetermined inclusion and exclusion criteria. Finally, the total number of eligible medical records that met the established inclusion and exclusion parameters was 135 children. From this point, 52 records were set aside due to incomplete data. This resulted in a final selection of 83 medical records that were included in the study. These records were carefully reviewed twice by two different researchers to ensure the accuracy of the data collected. In addition, an equal number of 83 medical records representing healthy children within the same age range and without DDH were selected to create a control group.

Each individual medical record underwent an exhaustive evaluation process to extract pertinent information, including sex, age, birth order, occurrence of twinning, family history of DDH, mode of delivery (cesarean or vaginal), fetal presentation at birth, degree of maturity, and the presence of any associated anomalies (such as foot deformities, scoliosis, developmental delays, speech impediments, visual impairments, and more). In addition, the records of the study group (those with clinical suspicion of hip dislocation) were carefully reviewed to determine the affected side(s) and the techniques used to confirm

the diagnosis of hip dislocation (clinical assessment, standard radiographs, ultrasonography, and computed tomography). The children were divided into two different age groups for analysis: a) those from birth to less than 3 years (< 3 y), and b) those from 3 to 5 years (> 3 y).

### Statistical analysis

Statistical analyses were performed using SPSS 21.0 software (IBM Inc, Chicago, IL, USA). Given the categorical nature of the data derived from the medical records, descriptive statistics including frequency and percentage distributions were used to elucidate various aspects of the data, including the clinical characteristics of the patients and the diagnostic procedures performed. Pearson's chi-square test ($\chi^2$) was used to identify noteworthy correlations between the diagnosis of DDH and the risk factors studied. The set of risk factors examined included: age less than 3 years, female sex, presence of twins, first-born status, mode of delivery (cesarean section), breech presentation at birth, prematurity, positive family history of DDH, and presence of concomitant anomalies. The criterion for statistical significance was set at $P < 0.05$ (two-tailed). In addition, the odds ratio (OR) was used as a quantitative measure of the associations between the risk factors analyzed and the occurrence of DDH. The calculation of the OR for a given risk factor was performed using the following formula (12):

OR = (Odds of this risk factor in those with DDH)/ (Odds of this risk factor in those without DDH (Health Controls))

Interpretation:

- OR = 1, Risk factor does not affect odds of DDH
- OR > 1, Risk factor associated with higher odds of DDH
- OR < 1, Risk factor associated with lower odds of DDH

## RESULTS

### DDH Diagnosis and Clinical Characteristics

**Figure 1** shows the sequence of diagnostic methods used to verify the presence of HD in the medical records of the 83 children suspected of having HD. Among these children, HD was confirmed in 74 cases (89.1%), constituting the "Positive HD" group, while 9 cases (10.8%) were found to have no HD, constituting the "Negative HD" group. Within the positive HD group, 12 cases (14.4%) were subsequently excluded because they were determined to have paralytic hip dislocation rather than DDH. These excluded cases included 5 cases associated with spina bifida, 3 cases associated with hydrocephalus, 2 cases associated with hypotonia, 1 case associated with microcephalus, and 1 case associated with peroneal neuropathy. Among the remaining cases, DDH was definitively confirmed in 62 children (74.6%). Of note, 5 children (6.1%) had definite exclusion of HD based on clinical examination alone. An additional 7 children (including 5 neonates and 2 infants less than 6 months of age) underwent additional US, resulting in the exclusion of HD in 2 children (2.4%) and confirmation of HD in 5 children (6%). The 70 children over 6 months of age underwent plain radiography, which ruled out HD in 1 child (1.2%) and confirmed it in 66 children (79.5%). In addition, 3 children required further evaluation and underwent CT scans. Of these, HD was excluded in 1 child (1.2%) and confirmed in 2 children (2.4%).

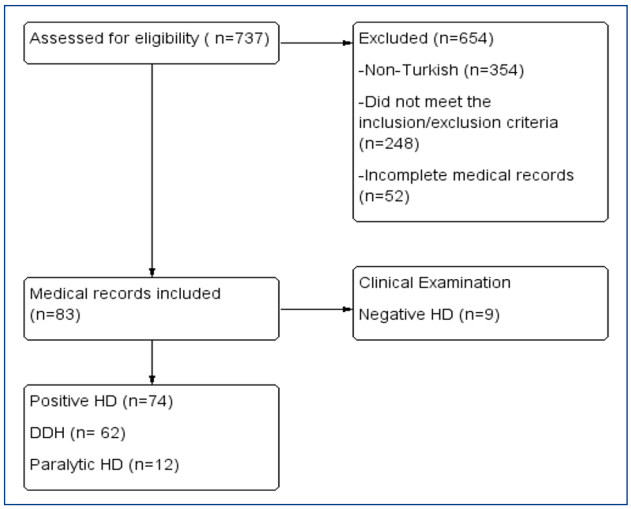


**Figure 1.** Study flow diagram. HD: Hip dislocation; DDH: Developmental dysplasia of the hip; Negative HD: Hip dislocation is not confirmed; Positive HD: Hip dislocation is confirmed

**Table 1** provides an overview of the clinical characteristics of the cohort of 83 children with suspected HD compared with a group of 82 healthy controls. Among the children with confirmed DDH, a significant proportion were female (n = 47, 75.8%) and less than 3 years of age (n = 41, 66.1%). A minority of children with DDH had the following characteristics: first-born status (n = 5, 8%), positive family history of DDH (n = 18, 29.0%), presence of twins (n = 1, 1.6%), cesarean delivery (n = 10, 16.1%), breech presentation at birth (n = 4, 6.5%), preterm delivery (n = 2, 3.2%), and concomitant associated anomalies (n = 8, 12.9%).

Among the children diagnosed with DDH, a significant proportion - 36 cases (58%) - had bilateral involvement, while 26 cases (42%) were unilateral. Regarding the specific side, 15 cases (24.2%) presented with left-sided DDH, while 11 cases (17.7%) presented with right-sided DDH. Within the group of DDH-affected children, 9 cases (14.5%) had associated anomalies, while the majority of 53 cases (85.5%) had no associated anomalies. Of the associated anomalies, renal problems were noted in 4 cases (6.4%), respiratory problems in 3 cases (4.8%), delayed walking in 2 cases (3.2%), foot deformities in 1 case (1.6%), ligamentous laxity in 1 case (1.6%), visual problems in 1 case (1.6%), and chondrodysplasia in 1 case (1.6%). Several of the DDH cases had a combination of these abnormalities.

**Table 1. Clinical characteristics of patients**

| Clinical characteristics | | Study group (suspicion HD) | | | | Control group (healthy) No. (%) |
|---|---|---|---|---|---|---|
| | | Positive HD No. (%) | | Negative HD No. (%) | All suspicion HD No. (%) | |
| | | DDH | PHD | | | |
| Number of children records | | 62 (74.6) | 12 (14.4) | 9 (11) | 83 (100) | 82 (100) |
| Gender | Male | 15 (24.2) | 4 (33.3) | 4 (44.4) | 23 (27.8) | 41 (50) |
| | Female | 47 (75.8) | 8 (66.6) | 5 (55.6) | 60 (72.2) | 41 (50) |
| Age groups | < 3 years | 41 (66.1) | 7 (58.3) | 2 (22.2) | 50 (60.2) | 36 (43.9) |
| | ≥ 3 years | 21 (33.9) | 5 (41.7) | 7 (77.8) | 33 (39.8) | 46 (56.1) |
| Twinning | Single | 61 (98.4) | 11 (91.6) | 9 (100) | 81 (97.5) | 80 (97.5) |
| | Twin | 1 (1.6) | 1 (8.4) | 0 (0) | 2 (2.5) | 2 (2.5) |
| Birth order | 1st born | 5 (8.1) | 2 (16.6) | 1 (11.1) | 8 (9.6) | 14 (17.1) |
| | Others | 57 (91.9) | 10 (83.4) | 8 (88.9) | 75 (90.4) | 68 (82.9) |
| Type of delivery | NVD | 52 (83.9) | 8 (66.6) | 8 (88.9) | 68 (81.9) | 51 (62.1) |
| | CS | 10 (16.1) | 4 (33.3) | 1 (11.1) | 15 (18.1) | 31 (37.9) |
| Presentation | Normal | 58 (93.5) | 11 (91.6) | 9 (100) | 78 (93.9) | 77 (93.9) |
| | Breech | 4 (6.5) | 1 (8.4) | 0 (0) | 5 (6.1) | 5 (6.1) |
| Maturity | Full term | 60 (96.8) | 10 (83.4) | 9 (100) | 79 (95.1) | 73 (89) |
| | Preterm | 2 (3.2) | 2 (16.6) | 0 (0) | 4 (4.9) | 9 (11) |
| Family history | Positive | 18 (29.0) | 2 (16.6) | 1 (11.1) | 21 (25.3) | 2 (2.4) |
| | Negative | 44 (71.0) | 10 (83.4) | 8 (88.9) | 62 (74.7) | 80 (97.6) |
| Associated abnormality | Yes | 8 (12.9) | 11 (91.6) | 5 (55.6) | 24 (28.9) | 6 (7.3) |
| | No | 54 (87.1) | 1 (8.4) | 4 (44.4) | 59 (71.1) | 76 (92.7) |
| DDH affection | Unilateral | 27 (43.5) | 5 (41.6) | - | - | - |
| | Bilateral | 35 (56.5) | 7 (58.4) | - | - | - |
| DDH side | Right only | 11 (17.7) | 0 (0) | - | - | - |
| | Left only | 16 (25.8) | 4 (33.3) | - | - | - |
| | Both | 35 (56.5) | 8 (66.6) | - | - | - |

NVD: Normal vaginal delivery; CS: Cesarean section; HD: Hip dislocation; DDH: Developmental dysplasia of the hip; PHD: Paralytic hip dislocation.

### Associated risk factors

**Table 2** provides a concise overview of the major risk factors that could potentially correlate with an increased likelihood of DDH, along with the strength of these associations as measured by the $\chi^2$ test and OR. The $\chi^2$ test indicated that, among the risk factors examined, a positive family history had a significantly significant association with the presence of DDH (P = 0.00). In the case of a positive family history, a robust association was found, exemplified by an odds ratio of 16.5 (95% CI 3.7-73.9). This means that individuals with a positive family history had an almost 16-fold increased risk of DDH compared to those without a positive family history. In addition, the female gender showed a moderate association (OR = 3.1 (95% CI 1.6-6.5)), indicating that women had approximately a 3-fold increased risk of DDH compared to men. Similarly, children younger than 3 years of age showed a moderate association (OR = 2.6 (95% CI 1.4-5.1)), indicating an approximately 2.5-fold increased risk of DDH compared to children aged 3 to 5 years. In addition, the presence of associated anomalies showed a notable association (OR = 1.9 (95% CI 0.7-5.8)), with a statistically significant p-value of 0.042. This odds ratio suggests that the presence of associated abnormalities was associated with an almost 2-fold increased risk of DDH compared to the absence of such abnormalities.

**Table 2. Measurements of association between DDH and risk factors**

| Risk factors | Chi square ($\chi$ 2) test | Risk estimate | |
|---|---|---|---|
| | p value | OR | (95% CI) |
| Age less than 3 years | 0.005* | 2.6 | (1.4–5.1) |
| Female gender | 0.002 | 3.1 | (1.6–6.5) |
| Twinning | 0.46 | 0.4 | (0.1–4.3) |
| 1 st order children | 0.11 | 0.4 | (0.1–1.3) |
| Cesarean section | 0.002 | 0.3 | (0.1–0.6) |
| Breech presentation | 0.93 | 1.1 | (0.3–4.1) |
| Prematurity | 0.08 | 0.3 | (0.1–1.3) |
| Positive family history | 0.00 | 16.5 | (3.7–73.9) |
| Presence of associated abnormalities | 0.042* | 1.9 | (0.7–5.8) |

*Significant difference (p ≤ 0.05). OR: Odds ratio; CI: Confidence interval.

## DISCUSSION

### DDH diagnosis

The aim of this study was to investigate the association between DDH and risk factors in Turkish children. Conducted at a single institution in Aksaray, 83 children with suspected HD were evaluated, of whom 62 were definitively diagnosed with DDH. Notably, the sample consisted mostly of clinically suspected HD cases, which explains the high DDH prevalence of 74.6%. Approximately 89% were diagnosed by clinical examination and radiography, emphasizing

their primary role. However, these methods may not provide a definitive diagnosis (13). Clinical examinations, particularly the Barlow and Ortolani tests, have a sensitivity of 87% to 99% in experienced practitioners (14). However, their reliability may lead to delayed diagnosis (15, 16). Our study supports this, as 12% required US and CT for diagnosis, and the mean age at diagnosis was 3.8 ± 0.1 years, typically beyond 4 years. This correlates with the findings of Donaldson and Feinstein (17) of delayed diagnosis of DDH due to the evolving shallow acetabulum. Importantly, no cases were missed after US and CT, which are known to have higher sensitivity (18, 19). A recent study (20) concluded that universal ultrasound screening detects DDH even in the absence of risk factors or abnormal clinical examination.

**Clinical characteristics of DDH children**

Among children diagnosed with DDH, most (56.5%) had bilateral involvement. Notably, Loder and Skopelja (21) found bilateral DDH rates ranging from 16.7% in Indo-Malay children to 69% in South American Caucasians. In contrast, Sewell et al (3) reported 20% bilateral cases. Unilateral DDH (n = 27) showed 16 cases (25.8%) on the left and 11 (17.7%) on the right. Ethnicity resulted in a different left-sided prevalence of unilateral DDH, ranging from 44% in Indo-Mediterranean to 81.4% in Australian/New Zealand Caucasians (21). The "left occiput anterior" fetal position, in which the left hip presses against the mother's spine, may explain this (5).

Of the DDH cases, 53 (85.5%) had no concomitant anomalies, while 9 (14.5%) had multiple anomalies. The walking delay was noted in 2 (3.2%), consistent with Bennet and Kamath (22) who found a non-significant delay (13.9 months in DDH; 12.4 in controls). Foot deformity occurred in 1 (1.6%), consistent with Jacobs (23) (1.5%-10% across ethnicities). A Budapest study of 1,767 DDH children found joint laxity in 47 (2.7%), similar to ours (n = 1, 1.6%) (24). Our DDH cohort also had associated anomalies: renal (4 cases, 6.4%), respiratory (3, 4.8%), visual (1, 1.6%), and chondrodysplasia (1, 1.6%). Some had combined anomalies. Few studies detail these sporadic anomalies in DDH children.

**Associated risk factors**

Our results showed that children under 3 years of age had about a 2.6 times higher risk of DDH compared to children over 3 years of age, which was supported by a significant $\chi^2$ test result ($p = 0.005$). Similarly, Loder and Skopelja (21) found a 2.4% prevalence of late DDH (after 20 months) in Norwegian children. Late DDH rates were 1.7% in Oslo and 0.8% in Southern Finland. Female sex and positive family history are known risk factors for DDH (20, 21). Females are affected 3 times more often (75.5% to 86% incidence) than males (25). Our study was consistent with a 75.8% incidence in females, reinforcing their increased susceptibility due to estrogen influence and maternal relaxin hormone (21, 26). A positive family history was found in 29% of DDH cases, higher than reported (12%) (21, 27). Those with a positive family history had a 16-fold increased risk of DDH.

The American Academy of Pediatrics identified breech presentation as a risk for DDH (6.3 times higher than vertex presentation) (21). Storer and Skaggs (5) theorized that persistent hamstring tension in breech infants leads to hip joint instability. Our study found a small association (OR = 1.1) between breech presentation and DDH, possibly due to cesarean delivery (16% of our DDH cases). Neither breech presentation (OR = 1.1) nor cesarean delivery (OR = 0.4) was significantly associated with DDH. A study of 4,782 newborns in Istanbul also found no significant differences in DDH between cesarean delivery (60.2% vs. 63.4%) and breech presentation (12.8% vs. 10.6%) (28).

Children with associated anomalies had an approximately 2-fold increased risk of DDH (OR = 1.9), similar to Shorter et al (29). Surprisingly, being a first child (OR = 0.4) didn't increase the risk of DDH in our study, different from the Istanbul study (20.2% vs. 7.8%) (28). The higher incidence of DDH in firstborns in Istanbul was attributed to the tight abdominal structures of primiparous mothers. In our study, prematurity (OR = 0.3) and twin pregnancies (OR = 0.4) didn't increase the risk of DDH, which is supported by Loder and Skopelja (21) and lower DDH rates in multifetal pregnancies (30). However, Sewell et al (3) reported a higher incidence of DDH in preterm or <5 kg infants, possibly due to restricted uterine movement, especially in oligohydramnios.

Limitations: This retrospective study had several limitations that must be acknowledged. The sample size was relatively small and determined without a comprehensive power analysis. In addition, the study was conducted in a single institution, which may limit the direct generalization of the findings to the broader Turkish population. Thus, the risk factors for DDH identified in our study may not accurately reflect the situation at the national level, which warrants caution in drawing broad conclusions. In addition, our investigation considered numerous risk factors related to DDH, but several other established risk factors weren't examined. Variables such as swaddling practices (full extension and wrapping of the lower extremities), oligohydramnios, possible seasonal trends, maternal and neonatal calcium, vitamin D or vitamin C levels, maternal relaxin concentrations, and connective tissue composition were not included. These unexplored factors may improve our understanding of the complex landscape of DDH risk factors.

## CONCLUSIONS

In conclusion, our study has provided insight into key aspects of DDH assessment and risk factors. Clinical examination and radiography proved to be the primary methods of assessment in our institution. Nevertheless, our findings suggest that US should be considered for screening infants younger than 6 months because of its sensitivity. Regarding potential risk factors for DDH, positive family history, female sex, age less than 3 years, and associated anomalies were associated with approximately 16-fold, 3-fold, 2.5-fold, and 2-fold increased risk of DDH, respectively. However, factors such as breech presentation, twin birth, first birth, prematurity, and cesarean delivery were not associated with DDH in our study. These findings contribute to a broader understanding of DDH, emphasizing early identification and management of high-risk cases. Nevertheless, it's important to acknowledge the limitations of our study, including its small sample size and single-institution nature, which should be taken into account when interpreting these findings.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** The study was approved by Aksaray University Local Ethics Committee and followed the guidelines of the Declaration of Helsinki (Institutional Review Board number: 2018/243).

**Informed Consent:** Because the study was designed retrospectively, no written informed consent form was obtained from patients.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Author Contributions:** All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

## REFERENCES

1. Jackson JC, Runge MM, Nye NS. Common questions about developmental dysplasia of the hip. Am Fam Physician. 2014;90(12):843-50.
2. Thomas SR. A review of long-term outcomes for late presenting developmental hip dysplasia. Bone Joint J. 2015;97-B(6):729-33.
3. Sewell MD, Rosendahl K, Eastwood DM. Developmental dysplasia of the hip. BMJ. 2009;339:b4454.
4. Adibi A, Karami M, Koohi K, Shirahmad M. Prevalence of different hip sonographic types: A cross-sectional study. Adv Biomed Res. 2015;4:23.
5. Storer SK, Skaggs DL. Developmental dysplasia of the hip. Am Fam Physician. 2006;74(8):1310-6.
6. Orak MM, Karaman O, Gursoy T, Cagirmaz T, Oltulu I, Muratli HH. Effect of increase in birth weight in a newborn on hip ultrasonography. J Pediatr Orthop B. 2015;24(6):507-10.
7. Mitchell PD, Redfern RC. The prevalence of dislocation in developmental dysplasia of the hip in Britain over the past thousand years. J Pediatr Orthop. 2007;27(8):890-2.
8. Rhodes AM, Clarke NM. A review of environmental factors implicated in human developmental dysplasia of the hip. J Child Orthop. 2014;8(5):375-9.
9. Koşar P, Ergun E, Yiğit H, Gökharman FD, Kosar U. Developmental dysplasia in male infants: risk factors, instability and ultrasound screening. Hip Int. 2011;21(4):409-14.
10. Bozkurt C, Sarıkaya B, Sipahioğlu S, Altay MA, Çetin BV, Bekin Sarıkaya PZ. Effects of developmental dysplasia of the hip screening program on the treatment strategies: A retrospective study from a tertiary care hospital in the southeast region of Turkey. Acta Orthop Traumatol Turc. 2021;55(5):396-401.
11. Kapicioğlu MIS, Karataş AF, Akkaya M, Korkusuz F, Ömeroğlu H. Six years of experience with the nationwide newborn ultrasonographic hip screening program in Turkey: a considerable change in the type of surgical interventions in developmental dysplasia of the hip. J Pediatr Orthop B. 2023;10.1097/BPB.0000000000001110.
12. Szumilas M. Explaining odds ratios (published correction appears in J Can Acad Child Adolesc Psychiatry. 2015 Winter;24(1):58). J Can Acad Child Adolesc Psychiatry. 2010;19(3):227-9.
13. Gharedaghi M, Mohammadzadeh A, Zandi B. Comparison of clinical and sonographic prevalence of developmental dysplasia of the hip. Acta Med Iran. 2011;49(1):25-27.
14. Baronciani D, Atti G, Andiloro F, et al. Screening for developmental dysplasia of the hip: from theory to practice. Collaborative Group DDH Project. Pediatrics. 1997;99(2):E5.
15. Maxwell SL, Ruiz AL, Lappin KJ, Cosgrove AP. Clinical screening for developmental dysplasia of the hip in Northern Ireland. BMJ. 2002;324(7344):1031-3.
16. Upasani VV, Bomar JD, Parikh G, Hosalkar H. Reliability of plain radiographic parameters for developmental dysplasia of the hip in children. J Child Orthop. 2012;6(3):173-6.
17. Donaldson JS, Feinstein KA. Imaging of developmental dysplasia of the hip. Pediatr Clin North Am. 1997;44(3):591-614.
18. Arti H, Mehdinasab SA, Arti S. Comparing results of clinical versus ultrasonographic examination in developmental dysplasia of hip. J Res Med Sci. 2013;18(12):1051-5.
19. Cooper A, Evans O, Ali F, Flowers M. A novel method for assessing postoperative femoral head reduction in developmental dysplasia of the hip. J Child Orthop. 2014;8(4):319-24.
20. Buonsenso D, Curatola A, Lazzareschi I, et al. Developmental dysplasia of the hip: real world data from a retrospective analysis to evaluate the effectiveness of universal screening. J Ultrasound. 2021;24(4):403-10.
21. Loder RT, Skopelja EN. The epidemiology and demographics of hip dysplasia. International Scholarly Research Notices. 2011;2011.
22. Kamath SU, Bennet GC. Does developmental dysplasia of the hip cause a delay in walking?. J Pediatr Orthop. 2004;24(3):265.
23. JACOBS JE. Metatarsus varus and hip dysplasia. Clin Orthop. 1960;16:203-13.
24. Czeizel A, Tusnády G, Vaczó G, Vizkelety T. The mechanism of genetic predisposition in congenital dislocation of the hip. J Med Genet. 1975;12(2):121-4.
25. Pipa-Muñiz I, de Los Llanos Rodríguez-Rodríguez M, Felgueroso-Juliana MB, Riera-Campillo M, González-Herranz P. Displasia del desarrollo de la cadera en niños con trastorno psicomotor. ¿Factor de riesgo para un mal resultado? (Developmental dysplasia of the hip in children with a psychomotor disorder. A risk factor for a poor outcome?). An Pediatr (Barc). 2016;85(3):142-8.
26. Clinical practice guideline: early detection of developmental dysplasia of the hip. Committee on Quality Improvement, Subcommittee on Developmental Dysplasia of the Hip. American Academy of Pediatrics. Pediatrics. 2000;105(4 Pt 1):896-905.
27. Bjerkreim I, Arseth PH. Congenital dislocation of the hip in Norway. Late diagnosis CDH in the years 1970 to 1974. Acta Paediatr Scand. 1978;67(3):329-32.

28. Güler O, Şeker A, Mutlu S, Çerçi MH, Kömür B, Mahiroğulları M. Results of a universal ultrasonographic hip screening program at a single institution. Acta Orthop Traumatol Turc. 2016;50(1):42-8.
29. Shorter D, Hong T, Osborn DA. Cochrane Review: Screening programmes for developmental dysplasia of the hip in newborn infants. Evid Based Child Health. 2013;8(1):11-54.
30. Li SJ, Ford N, Meister K, Bodurtha J. Increased risk of birth defects among children from multiple births. Birth Defects Res A Clin Mol Teratol. 2003;67(10):879-85.