



## Research

# Developmental Hip Dysplasia Screening in Child Health Follow-up and Risk Factors Assessment Review

## Çocuk Sağlığı Takibinde Gelişimsel Kalça Displazisi Taraması ve Risk Faktörleri Değerlendirmesi

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### ABSTRACT

**Objective:** Developmental dysplasia of the hip (DDH) is the most common skeletal dysplasia. For early diagnosis, screening is recommended. The aim of our study was to determine the incidence of DDH and type IIa hips among infants, evaluate the risk factors for DDH, and review the studies on the same topic that were conducted in Türkiye.

**Methods:** For this retrospective descriptive study, the records of all infants who were followed up between December 2014 and May 2015 by a "Child Health Follow-up Outpatient Clinic" were investigated for DDH. A total of 300 infants constituted the study group. Risk factors for DDH, including gender, being first born, birth weight and height, maternal age, mode of delivery, multiple births, skeletal deformity, oligohydramnios, breech presentation, swaddling, positive family history, and examination findings related to DDH were extracted from the files. Missing information was gathered by phone from parents.

**Results:** The incidence of DDH was 0.3%. The rate of immature hip was 16.7%. Immature hip and positive family history, swaddling, and left hip involvement had a statistically significant relationship. In the follow-up, only one case developed hip dysplasia, and 98% of cases with immature hips returned to normal at the end of the third month.

**Conclusion:** Immature hips may resolve without requiring intervention. Infants who are swaddled and have a positive family history of DDH should be carefully monitored. Left side involvement of immature hips is an important risk factor for DDH.

**Keywords:** Developmental dysplasia of the hip, screening, risk factors

### ÖZ

**Amaç:** Gelişimsel kalça displazisi (GKD) en sık görülen iskelet displazisi olarak bilinmektedir. Erken teşhis için tarama yapılması önerilir. Çalışmamızın amacı bebeklerde GKD ve tip IIa kalça görülme sıklığını belirlemek, GKD için risk faktörlerini değerlendirmek ve aynı konuda Türkiye'de yapılmış çalışmalarını gözden geçirmektir.

**Gereç ve Yöntem:** Bu retrospektif tanımlayıcı çalışma için, Aralık 2014-Mayıs 2015 tarihlerinde "Çocuk Sağlığı İzlem Polikliniği" tarafından izlenen tüm bebeklerin kayıtları GKD açısından incelendi. Toplam 300 bebek çalışma grubunu oluşturdu. GKD için risk faktörleri olan cinsiyet, ilk doğum, doğum kilosu ve boyu, anne yaşı, doğum şekli, çoğul doğum, iskelet deformitesi, oligohidramnios, makat geliş, kundaklama, pozitif aile öyküsü ve GKD ile ilgili muayene bulguları dosyalardan elde edildi. Eksik bilgiler velilerden telefonla toplanmıştır.

**Bulgular:** GKD insidansı %0,3 olarak saptandı. İmmatür (olgunlaşmamış) kalça oranı %16,7 idi. İmmatür kalça ve pozitif aile öyküsü, kundaklama ve sol kalça tutulumu arasında istatistiksel olarak anlamlı bir ilişki vardı. Takipte sadece bir olguda kalça displazisi gelişti ve olgunlaşmamış kalça olgularının %98'i üçüncü ayın sonunda normale döndü.

**Sonuç:** Bebeklerde immatür kalça müdahale gerektirmeden düzelebilir. Kundaklanmış ve ailesinde GKD öyküsü olan bebekler dikkatle izlenmelidir. Ayrıca immatür kalçanın sol taraf tutulumu GKD için önemli bir risk faktörü oluşturmaktadır.

**Anahtar Kelimeler:** Gelişimsel kalça displazisi, tarama, risk faktörleri

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## INTRODUCTION

Developmental dysplasia of the hip (DDH) encompasses a range of hip abnormalities in which the femoral head and acetabulum fail to develop and articulate anatomically (1). DDH is asymptomatic during infancy and early childhood; thus, screening by periodic physical examination after birth and the use of radiographic imaging, especially ultrasound, is crucial in early detection (2). To reduce the exposure of babies to radiation, hip ultrasound is the method for the identification of hip dysplasia just before the ossification of the femoral head (3). A risk-based screening program for DDH was started in Türkiye in 2013 as a pilot study and then became a nationwide practice in 2014. All neonates with a family history of DDH up to second-degree relatives, first-born girl of the family oligohydramnios multiple pregnancy, breech presentation, foot deformities, congenital muscular torticollis, plagiocephaly, scoliosis, pelvic obliquity, and adduction contracture of the hip are referred for ultrasound scanning (4).

Still, there is no consensus on the exact timing of and indications for ultrasonography (USG) among expert groups (5). In the literature, ultrasound screening for DDH is recommended after the fourth week of life (day 22 and beyond) (6). Imaging advancements have created uncertainty, particularly in the first few months of life, regarding whether minor degrees of anatomic and physiologic variability are clinically significant or even abnormal (2). Hips with a slightly shallow acetabulum and rounded bony rim before 3 months of age are classified as Graf type IIa and considered developmentally immature (7). Some mild cases of DDH (and the immature hip) may resolve without intervention (1). Therefore, a different definition was made by Peled et al. (8), who defined "true DDH as a hip that underwent a subsequent treatment".

The aim of this study was to determine the incidence of DDH and type IIa hips among infants. In addition, we aim to evaluate the risk factors for DDH and review the results of studies on this topic, which were conducted in Türkiye.

## METHODS

The study was conducted by retrospectively examining the medical records of infants admitted to the Child Health Follow-up Outpatient Clinic of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine during the neonatal period between December 2014 and May 2015.

### Selection and Identification of Cases

Infants whose hip ultrasound scans were performed by İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of

Medicine, Department of Radiology between 4 and 6 weeks of life and those who regularly came to routine controls for at least nine months were eligible to join the study. Infants with neural tube defect anomalies, genetic syndromes, neuromuscular diseases, and preterm infants were excluded. At each child's health follow-up visit, parental counseling for child care is provided. Back positioning of the infant during sleep, spending some time on the tummy, and putting on comfortable clothes for the infant is advised. It is also suggested that the diaper be placed waist high (above the spina iliaca) by leaving at least two fingers distance between the diaper and the baby's abdomen in a comfortable way. Swaddling is not recommended. In this study, all infants were investigated by physical examination for DDH. Limitations of hip abduction and positive Galeazzi sign (an obvious short leg) were sought as clinical findings. Ortolani and Barlow tests were performed on infants up to three months of age at every visit. Sonographic examinations and classifications were performed along with the Graf technique (3). Graf classification type IIb and higher hips were considered dysplastic hips in our study to calculate the prevalence of DDH.

The following DDH risk factors were extracted from the files: gender, birth weight and height, being first born, maternal age, breech presentation, mode of delivery, multiple birth, oligohydramnios, swaddling, skeletal deformity, positive family history, and examination findings related to DDH. Missing information such as swaddling of babies was collected from parents by phone calls.

### Statistical Analysis

IBM® SPSS® Statistics for Windows version 21.0. (IBM Corp., Armonk, N.Y., USA) was used for statistical analysis. For descriptive analyses, categorical data were expressed as percentage and (n), continuous data were expressed as mean and standard deviation if they showed normal distribution, and median (minimum-maximum) if they did not show normal distribution. Normal distribution was determined by the coefficient of variation, histogram, and normality tests. In the comparison of the numerical data of the two independent groups, Student's t-test was used if normal distribution conditions were met. Parameters with non-normal distribution were assessed using the Mann-Whitney U test. The chi-square test and Fisher's Exact test were employed in the analysis of categorical variables. Findings were assessed with 95% confidence interval (CI), with  $p < 0.05$  level of significance. We also conducted binary logistic regression analyses to evaluate the independent risk factors for type IIa hips. The univariate and multivariate (Backward:LR) methods were used for logistic regression analysis.

The study was initiated following the approval of the Clinical Research Ethics Committee of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine, dated 03.05.2016 and decision numbered A-16.

## RESULTS

Three hundred infants were included in the study. The study included 125 girls (41.7%) and 175 boys (58.3%). The mean birth weight was 3137.03±557.23 gr, and the mean birth height was 49.69±2.68 cm. The mean age of mothers was 30.77±5.76 years. The risk factors that were sought for the study and the results are given in Table 1. Four infants had pes equinovarus deformity (1.3%). No pathological findings related to DDH were detected in the physical examinations of the infants.

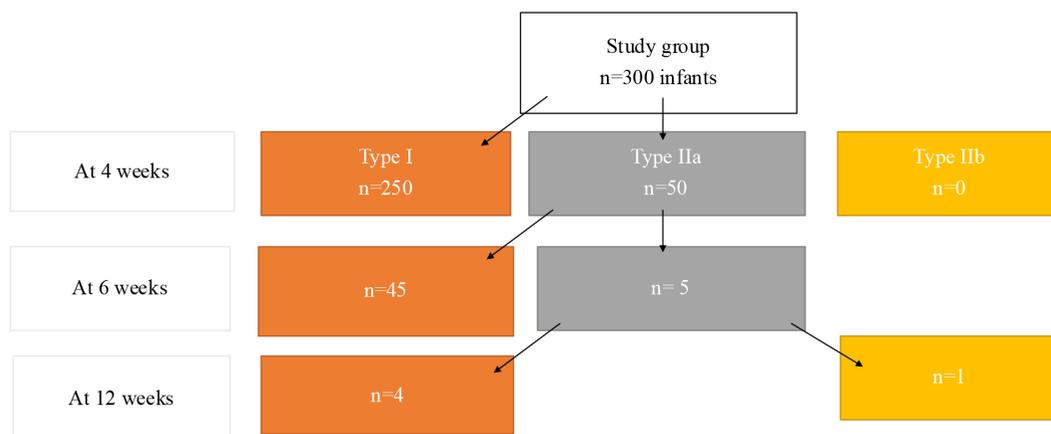
The hip USG performed at the fourth week after birth of 300 infants identified 250 hips as type I hips (normal) and 50 hips as type IIa (immature) hips. Control hip USGs were performed at the sixth week after birth, and 45 of the immature hips revealed normal hip USG results, while five of them (1.6%) were classified as type IIa (Figure 1). Orthopedic follow-ups were planned, and at the end of the third month, only one baby’s hip progressed to type IIb, whereas the other four babies’ hip developments were evaluated as normal. The recovery rate of type IIa hips was 98%. One baby, who progressed to type IIb, was followed up by the orthopedic clinic, and a Pavlik bandage was applied. The incidence of DDH was 0.3% in the study, and the rate of immature hip was 16.7%. The distribution of immature hips and side involvement are given in Table 2. A significant difference was found between type IIa hip and left hip involvement (p=0.040). At the age of nine months, hip examinations of all babies were evaluated as normal in the study group.

A comparison of risk factors and hip types is given in Table 3. There was no relationship between immature hip

**Table 1.** Distribution of risk factors in the study group

Risk factors	Number of infants (%)
<b>Gender</b>	
Girl	125 (41.7)
Boy	175 (58.3)
<b>First born child of the family</b>	
Yes	131 (43.7)
No	169 (56.3)
<b>Multiple pregnancy</b>	
Yes	27 (9)
No	273 (91)
<b>Breech position</b>	
Yes	2 (0.7)
No	298 (99.3)
<b>Mode of delivery</b>	
Cesarean section	230 (76.7)
Vaginal	70 (23.3)
<b>Skeletal deformity</b>	
Yes	4 (1.3)
No	296 (98.7)
<b>Family history of DDH</b>	
Yes	17 (5.7)
No	283 (94.3)
<b>History of swaddling</b>	
Yes	28 (9.3)
No	272 (90.7)
<b>History of oligohydroamnios in pregnancy</b>	
Yes	15 (5)
No	285 (95)

DDH: Developmental dysplasia of the hip



**Figure 1.** Initial and follow-up hip ultrasonography results of the group according to Graf classification

**Table 2.** The distribution of immature hips and side involvement

	Type IIa hips	Type I hips	p-value
Right hip	22 (7.3)	278 (92.7)	0.040
Left hip	37 (12.3)	263 (87.7)	

and gender, birth weight, birth height, first birth, mode of delivery, older maternal age (25 and older), multiple births, skeletal deformity oligohydramnios, or breech presentation ( $p>0.05$ ). When we reviewed babies born at 4000 g and above, 12 (4.8%) babies with normal hips and 5 (10%) babies with immature hips were detected. There was no significant relationship between high birth weight and maturity of hips ( $p>0.05$ ).

Immature hips were detected in 13.6% of infants who swaddled. There was a significant difference between swaddling and immature hips ( $p<0.001$ ). In the study group, 52.9% of infants had a positive family history. There was a significant difference between positive family history and immature hips ( $p<0.001$ ).

In the study, 50 babies (100 hips) were classified as immature hips (type IIa) at 4-week-old USG screenings. Nine of them (18%) had bilateral hip involvement, whereas 13 (26%) had right hip involvement and 28 had left hip involvement (56%). In the univariate logistic regression analysis, gender, first born child of the family, multiple pregnancy, breech position, mode of delivery, and skeletal deformity were not associated with type IIa hips. History of swaddling and family history were found to be related to type IIa hips. In the multivariate logistic regression analysis, a history of swaddling [Exp (B): 3.978, 95% CI: 1.648-9.601,  $p=0.002$ ] and family history of DDH [Exp (B): 4.078, 95% CI: 1.362-12.211,  $p=0.012$ ] were found to be risk factors for type IIa hips (Table 4).

**Table 4.** Risk factors related to type IIa hips

	Univariate regression			Multivariate regression (Backward:LR)		
	Exp (B)	95% CI	p-value	Exp (B)	95% CI	p-value
Gender (ref: girl)	1.086	0.585-2.017	0.793	-	-	-
First born child of the family	1.120	0.609-2.061	0.716	-	-	-
Multiple pregnancy	1.487	0.568-3.895	0.419	-	-	-
Breech position	5.082	0.313-82.625	0.253	-	-	-
Mode of delivery (ref: vaginal delivery)	1.095	0.528-2.273	0.807	-	-	-
Skeletal deformity	1.680	0.171-16.491	0.656	-	-	-
History of swaddling	5.505	2.425-12.493	<0.001	3.978	1.648-9.601	0.002
Family history of DDH	6.640	2.423-18.20	<0.001	4.078	1.362-12.211	0.012

CI: Confidence interval, DDH: Developmental dysplasia of the hip

**Table 3.** Comparison of risk factors and hip types

Risk factors	Type I hips n (%) (n=250)	Type IIa hips n (%) (n=50)	p-values
<b>Gender</b>			
Girl	105 (42)	20 (40)	0.793
Boy	145 (58)	30 (60)	
<b>First born child of the family</b>			
Yes	108 (43.2)	23 (46)	0.716
No	142 (56.8)	27 (54)	
<b>Multiple pregnancy</b>			
Yes	21 (8.4)	6 (12)	0.417
No	229 (91.6)	44 (88)	
<b>Breech position</b>			
Yes	1 (0.4)	1 (2)	0.306
No	249 (99.6)	49 (98)	
<b>Mode of delivery</b>			
Cesarean section	191 (76.4)	39 (78)	0.807
Vaginal	59 (23.6)	11 (22)	
<b>Skeletal deformity</b>			
Yes	3 (1.2)	1 (2)	0.520
No	247 (98.8)	49 (98)	
<b>Family history of DDH</b>			
Yes	8 (3.2)	9 (18)	<0.001
No	242 (96.8)	41 (82)	
<b>History of swaddling</b>			
Yes	15 (6)	13 (26)	<0.001
No	235 (94)	37 (74)	
<b>History of oligohydroamnios in pregnancy</b>			
Yes	13 (5.2)	2 (4)	1
No	237 (94.8)	48 (96)	

DDH: Developmental dysplasia of the hip

**Table 5.** Summary of studies from Türkiye related to DDH investigation

Reference	Year	Number of patients	Incidence of DDH	Age group	Family history of DDH	Breech	Sex	First born	Swaddling	Other evaluated DDH risk factors
Ömeroğlu et al. (11)	1999	150	11.0%	Av. 3.9 mo	Yes	Yes	NA	NA	NA	Limitation of abduction, pili asymmetry were found to be significant in DDH cases.
Akman et al. (12)	2007	403	3.4%	Av. 6.4 mo (4 w.-10 mo)	No	No	No	No	No	Olygohidroamnios was associated with DDH. In correlation analysis, there was a correlation between female gender and swaddling.
Dogruel et al. (13)	2008	3541	4.71%	4-6 w.	Yes	Yes	Yes/female	No	Yes	Caesarean section, skeletal anomaly, olygohidromamnios, low birth weight and prematurity did not yield as significant risk factors.
Tosun et al. (14)	2010	310	21.0%	0-9 mo.	No	No	No	Yes	No	The presence of pes calcaneovalgus, birth weight over 4 kg, limitation of abduction was found to be significant in DDH cases.
Guner et al. (15)	2012	265	11.7 %	4 w.	Yes	No	Yes /female	NA	Yes	Consanguineous marriage is a significant factor.
Güler et al. (16)	2016	4782	9.9%	1 mo.	No	No	Yes/female	Yes	No	Vaginal birth, torticollis and foot deformities were not significant.
Saglam et al. (17)	2017	1025	0.29%	1.7±1.3 mo.	NA	NA	Yes/female	No	NA	....
Kural et al. (18)	2019	9758	0.2%	NA	No	Yes	Yes/female	No	NA	Multiple pregnancy, torticollis, limitation of abduction, Ortolani and Barlow maneuvers were significant.
Ömeroğlu et al. (19)	2019	952	NA	33-45 days	Yes	Yes	NA	No	Yes	Family history, swaddling and oligohidromamnios were found to be the three significant risk factors correlated with a higher rate of unstable/decentred hip(s) (Graf types D/III/IV) in patients with DDH.
Demir et al. (20)	2020	4551	3.71%	80.3±20.3 days	Yes	No	No	No	No	Prematurity, oligohidromamnios.

Av: Average, mo: Month/months, w: Week/weeks, NA: Not applicable, DDH: Developmental dysplasia of the hip

## DISCUSSION

The risk-based screening experience of DDH is presented in this study. After the widespread use of hip USG, the detection rate of immature hips has increased, and close follow-up is required. The rate of immature hip was 16.7% in our study, whereas positive family history and swaddling were detected as risk factors. In addition, left hip involvement was identified to be related to the immature hip.

In the literature, the rates of immature hips in newborn populations vary between 2.3% and 45% (9). Although the spontaneous normalization rate in type IIa hips is reported to be high, dysplasia may persist or worsen in 5-10% of cases (7). In our study, only one patient proceeded to type IIb hip. Therefore, we calculated the true DDH rate as 0.3%. In Türkiye, there were many studies related to the incidence of DDH. The incidence rate varies between 0.2% and 21%; thus, it may depend on the screening method and definition of DDH and population (Table 5).

The definition of family history in DDH varies across screening programs. In the United Kingdom, hip problems of first-degree family members (this includes baby's parents or siblings, who have had a hip problem that started as a baby or young child that needed treatment) is defined as a family risk factor (10). In the screening program conducted in Türkiye, DDH cases up to second-degree relatives are defined as family history risk factors (4). In our study, we used this definition, and a family history of DDH was found to be a risk factor for immature hips. In Table 5, the studies from Türkiye carried out on different dates related to the investigation of DDH risk factors are given (11-20). Considering the family history used in the studies, there is a need for meta-analysis studies on whether family history is a risk factor in Türkiye or not.

Traditional swaddling involves wrapping the newborn from shoulder to hip or all the way to the foot for a certain period with the hips in extension and adduction and knees in extension (19). In the child health follow-up, swaddling was not recommended in the study group. Contrary to this recommendation, swaddling was detected in 9.3% of infants and was defined as a risk factor for immature hips. A prospective study that investigated the effect of swaddling on the development of DDH found that infants who were swaddled had 2.65 times greater odds of developing DDH (15). Also, swaddling was associated with a higher rate of unstable/decentred hip(s) in patients with DDH (19).

DDH can be unilateral or bilateral. In our study, type IIa was observed in the left hip in 37 of the cases, and it was statistically significant. In many studies, the occurrence of

DDH was significantly higher on the left side than on the right side of the body (21). In the literature, this phenomenon was explained due to an adducted position of the left leg of the fetus against the mother's sacrum in the uterus (22). Çekiç et al. (23), conducted a study with 1186 newborns. Only 10 newborns with type IIa hips did not improve to type Ia and worsened to other types. Eighty percent of these cases were seen in left hip involvement (23). We emphasize that left-sided involvement of immature hips is an important risk factor for DDH.

Our study had some limitations. Missing information, such as history of swaddling, was gathered by phone and was based on parents' recall. This may cause recall bias. Preterm infants were not included.

## CONCLUSION

In the DDH screening program, it is important to determine the rate of immature hips and the true rates of DDH. The immature hips may resolve without requiring intervention, but infants who are swaddled and have a positive family history of DDH should be carefully monitored. Left side involvement of the immature hip may need additional attention for DDH.

## ETHICS

**Ethics Committee Approval:** The study was initiated following the approval of the Clinical Research Ethics Committee of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine, dated 03.05.2016 and decision numbered A-16.

**Informed Consent:** Retrospective study.

## Authorship Contributions

Surgical and Medical Practices: F.A., E.G., B.K., İ.A., Concept: F.A., E.G., U.S., İ.A., Design: F.A., E.G., U.S., İ.A., Data Collection or Processing: F.A., U.S., Analysis or Interpretation: F.A., E.G., B.K., U.S., İ.A., Literature Search: F.A., B.K., Writing: F.A., E.G., B.K., U.S., İ.A.

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