



## Original Article

# Epidemiology of developmental dysplasia of the hip at a tertiary hospital in Oman

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## ABSTRACT

**Objectives:** Developmental dysplasia of the hip (DDH) is common in Oman in clinical practice, but the incidence in Oman is still unknown. This study aimed to evaluate the incidence and characteristic features of DDH in the Omani population managed at Khoula Hospital (KH).

**Methods:** This is a retrospective study conducted at KH, targeting all Omani pediatric patients who have been officially diagnosed with DDH between the periods from January 2009 to December 2019. The data were collected from the medical record system at the hospital and phone interviews with the patient's family to fill out the missed information.

**Results:** The study included 795 DDH-diagnosed patients, out of which 652 (82.0%) were female and 143 (18.0%) were male, giving a ratio of 4.5:1. Bilateral DDH was diagnosed in 300 (37.7%) patients, left-sided DDH in 307 (38.6%), and right DDH in 188 (23.6%) patients. At least half of the DDH cases were 6 months old or younger at the first presentation to the hospital and 16.6% were diagnosed after the age of 18 months. Remarkably, at least one risk factor was present for 581 (73.1%) patients. The remaining patients had no risk factors for DDH at all. The prevalence of the first child in the family was 33.0% and oligohydramnios 10.9%. The estimated DDH incidence in this study is 1.05/1000 live births/year.

**Conclusion:** Based on the national live births annual records from Oman National Center for Statistics and Information, this study estimated the DDH incidence to be 1.05/1000 live births. These findings cannot be generalized nationally as they are from a single center. We recommend conducting a multicenter prospective study to identify DDH incidence in Oman accurately. National guidelines and screening programs must be developed and executed for early detection and management.

**Keywords:** Developmental dysplasia of the hip, Epidemiology, Oman, Khoula hospital, Screening

## INTRODUCTION

Developmental dysplasia of the hip (DDH) is a disorder of abnormal hip development resulting in a spectrum of hip anomalies ranging from dysplasia and subluxation to complete dislocation.<sup>[1,2]</sup> Many risk factors have been reported to be associated with the development of DDH. Major risk factors associated with DDH include firstborn babies, intrauterine breech position, female gender, oligohydramnios, and positive family history.<sup>[3,4]</sup> Clinical presentation

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and management depend on the age of detection. Delayed detection and treatment of DDH may increase the probability of progression to a more advanced disease leading to more long-term complications requiring complex operations or even untreatable conditions.<sup>[3]</sup>

In general, the incidence of hip dislocation and hip subluxation is found to be approximately one out of 1000 live births/year and one in 100 live births/year, respectively.<sup>[4,5]</sup> Locally, no published studies have been conducted to explore the incidence, risk factors, and geographic distribution of DDH cases in Oman managed at a tertiary hospital. Therefore, the primary purpose of this study was to identify the incidence of DDH in the Omani population managed at our center over 11 years.

## MATERIALS AND METHODS

This retrospective and cross-sectional study was conducted on all patients who presented to the pediatric orthopedic outpatient clinic at Khoula Hospital (KH) between January 1, 2009, and December 31, 2019. KH is a governmental tertiary center in the Sultanate of Oman with a Pediatric orthopedic surgery service, where all newborns suspected to have DDH and those diagnosed with DDH are referred to the center for further investigations, management and follow-up, while very few cases are managed in other hospitals around Oman. The inclusion and exclusion criteria for selecting patients are presented in [Table 1]. A total sample number of 1385 cases with a provisional diagnosis of DDH from January 1, 2009, to December 31, 2019 were retrieved from the Information Technology (IT) department at KH using different international classification of disease (ICD) codes in the system, such as congenital dislocation of the hip, clicking hip, clicking sound, and congenital subluxation of the hip. Then, the sample size of patients was filtered to 814 cases based on the inclusion and exclusion criteria.

The patients' demographic data and the well-known risk factors associated with DDH [Table 2] were gathered from the medical record system at KH and collected in an Excel data sheet. A direct phone call questionnaire to the families of 463 patients was conducted to fill out the required

information, which was not documented in the system. The final total number included in the study was 795 patients. Nineteen patients were excluded because neither the information in the system nor the families were reachable.

All the collected data were transferred into the Statistical Package for the Social Sciences (SPSS version 26 for cleaning, coding, and descriptive statistics). Descriptive statistics were used to describe and summarize the data. Continued variables were summarized using the mean and standard deviation. Categorical variables were summarized using frequency and percentage.

## RESULTS

The study included 795 DDH-diagnosed patients, 652 (82.0%) of them were female and 143 (18.0%) were male with a ratio of 4.5:1. Based on the annual birth records at a national and regional level from the Oman National Center for Statistics and Information (NCSI), the estimated range of incidence for the study period is 0.91–1.30/1000 live births/annum. The average incidence is 1.05/1000 live births/annum [Figure 1].

[Table 3] summarizes the incidence per region in Oman between the period of 2010 and 2018. The local demographic database was initiated in 2010, while most of the 2019 newborns were not yet diagnosed with DDH on analyzing our data. Therefore, the 2009 and 2019 data were excluded from the study.

The age at the first visit to KH was also included in the study, which showed different ages at presentation. Remarkably, at least 50% of the DDH cases were ≤6 months old, and 16.6% were diagnosed after the age of 18 months. Furthermore, the median age of the patients at the first visit to a hospital with positive sibling history of DDH was included in the study. Out of 103 cases that have positive sibling history of DDH, at least 50% of the cases with sibling history were ≤9 months old.

Two hundred ninety-three patients (36.7%) were born in the Muscat region and distributed between different hospitals such as KH (15.0%), Royal Hospital (12.0%), Sultan Qaboos

**Table 1: The inclusion and exclusion criteria for selection of patients.**

Inclusion	Exclusion
1. All Omani patient	1. DDH cases diagnosed outside the study period
2. Both males and females	2. Expatriate patient
3. Officially diagnosed with DDH based on the following findings: <ul style="list-style-type: none"> <li>• Frank hip dislocation on radiograph</li> <li>• Abnormal acetabular index</li> <li>• IHDI type II, III or IV</li> <li>• Graf classification type IIb, III, and IV on ultrasound images</li> </ul>	3. Graf classification I and IIA in ultrasound
	4. Patient with DDH and associated with neuromuscular disorders, arthrogyposis, and teratological condition or syndromes

DDH: Developmental dysplasia of the hip, IHDI: international hip dysplasia institute

**Table 2: The prevalence of characteristics features and risk factors among the study population.**

Variable	Category	Prevalence n, (%)
Gender	Female	652 (82.0)
	Male	143 (18.0)
Age of patient at first visit to KH	0–6 months	428 (53.8)
	7–12 months	80 (10.1)
	13–18 months	155 (19.5)
	>18 months	132 (16.6)
Method of delivery	SVD	604 (76.0)
	LSCS	191 (24.0)
Intrauterine position (Breech)	Yes	170 (21.4)
	No	625 (78.6)
Consanguinity	Yes	372 (46.8)
	No	422 (53.1)
Family history	Yes	182 (22.9)
	No	613 (77.1)
Oligohydramnios	Yes	87 (10.9)
	No	706 (88.8)
Other sibling	Yes	103 (13.0)
	No	692 (87.0)
First child in the family born with DDH	Yes	263 (33.1)
	No	532 (66.9)
At least one risk factor present with DDH cases	Yes	581 (73.1)
	No	214 (26.9)

DDH: Developmental dysplasia of the hip, KH: Khoula hospital, SVD: Spontaneous vaginal delivery, LSCS: Low-segment cesarean section

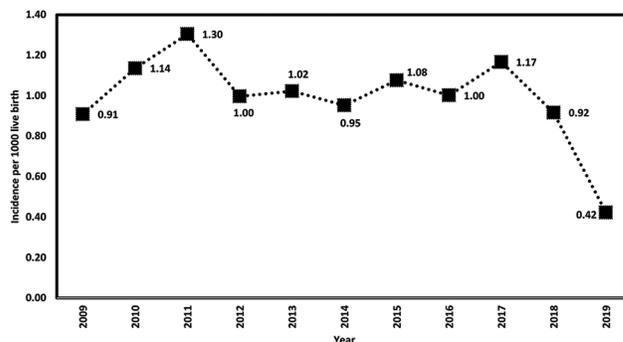
**Table 3: The incidence of DDH per region in Oman between the period of 2010 and 2018.**

Region	DDH	Total live births	Incidence per 1000 live birth
South Batinah	126	81588	1.54
Muscat	186	123093	1.51
Wusta	8	6096	1.31
North Sharqiyah	57	50513	1.13
Musandam	7	6761	1.04
South Sharqiyah	54	57109	0.95
North Batinah	117	139946	0.84
Dhahirah	33	39965	0.83
Dhofar	36	49728	0.72
Dakhiliyah	64	99755	0.64
Buraimi	8	16126	0.50

DDH: Developmental dysplasia of the hip

University Hospital (5.0%), Armed Forces Hospital (1.5%), Royal Oman Police Hospital (1.1%), and Private Hospitals (2.1%). On the other hand, Al Rustaq Hospital showed the highest number of cases born with DDH outside the Muscat region, with 123 cases (19.0% of the total cases).

Left DDH was diagnosed in 307 (38.6%) patients, right DDH in 188 (23.6%), and 300 (37.7%) patients with bilateral DDH. The study also showed that 604 (76.0%) of the cases were



**Figure 1:** The incidence of developmental dysplasia of the hip/1000 live birth/year.

born by spontaneous vaginal delivery (SVD) and 191 (24.0%) by low-segment cesarean section (LSCS). The risk factors prevalence among the population was investigated [Table 2]. Remarkably, at least one risk factor was present for 581 (73.1%) patients. The remaining patients had no risk factors for DDH at all.

## DISCUSSION

DDH is the most common hip pathology in children. Estimation of its incidence helps the national authority in demand identification, resource allocation, and mobilization. The absence of a proper mass screening program renders this task difficult due to frequent late presentations. The incidence rate is calculated on regional and national bases after getting the annual natality rate from the NCSI. The DDH incidence in the population of this study was 1.05 (0.91–1.30)/1000 live births/year, which is comparable with the international figures. The calculated incidence for Muscat governate is 1.51/1000 live births/year. The DDH incidence range is generally between 1 and 350/1000 live births and depends on many factors, including firstborn babies, intrauterine breech position, female gender, oligohydramnios, and positive family history.<sup>[3,4,6]</sup> In many systemic reviews, the incidence of DDH in American and European populations is 1.3/1.000.<sup>[7]</sup> In the Gulf region, the incidence in Saudi Arabia and UAE were reported as 3.8 and 3.17 cases/1000 live births, respectively.<sup>[8,9]</sup> However, we believe that we cannot generalize the findings to the Omani population because very few cases are treated in other hospitals and some of them are managed outside Oman. Still, it will give a kick-start to the process and a rough estimate of the incidence in the country. The only way to determine the exact incidence is to run a prospective mass screening program.

In this study, the child’s age at diagnosis was calculated when the patient first presented to KH. However, a good number of cases were referred from other regional hospitals with either a suspicion or diagnosis of DDH before presenting to KH for

further management. It was difficult to trace the date of first diagnosis in these children. This may have contributed to the increased age at presentation.

Studies showed that known major risk factors contributing to DDH with different ratios and percentages, including female gender, intrauterine breech position, firstborn baby, oligohydramnios, and positive family history.<sup>[3,4]</sup> Worldwide, the female gender has a higher risk and is more commonly involved in DDH but with different ratios and percentages.<sup>[10-12]</sup> In our study, the prevalence of DDH was more predominant among females, with female-to-male ratio of 4.5:1. In comparison, studies conducted in Saudi Arabia showed a female-to-male ratio of 6:1, while the ratio was 3–6:1 in US and Europe.<sup>[1,6]</sup>

Unexpectedly, the prevalence of DDH among children born in breech position in Oman was on the lower side, compared to the meta-analysis studies in the literature, which showed that breech presentation is a major risk factor statistically contributing to DDH due to intrauterine fetal position.<sup>[10,13]</sup> The previous studies did not show any significant statistical difference between the different delivery modes and the risk of DDH.<sup>[14]</sup> However, the prevalence of DDH cases was 76% of cases born by SVD and 24% by LSCS. A large study conducted in the South Australian population showed a similar reduction in the risk for babies with a breech presentation delivered by cesarean section.<sup>[14]</sup>

It has been reported that 12–33% of affected patients with DDH have a positive family history.<sup>[15,16]</sup> Our study showed that 22.9% had a family history of DDH. Interestingly, 46.9% of parents were consanguineous. We think that this may be due to first-degree marriages that are common in Oman, but this needs to be explored more for better correlation, as well as to consider other tests to see if there is a correlation between the two. The risk of DDH for children with affected one sibling, one parent, or a parent with a sibling has been reported as 6%, 12%, and 36%, respectively.<sup>[17]</sup> Our study has shown that 13% of patients had siblings diagnosed with DDH.

Furthermore, multiple studies have found that firstborn children and oligohydramnios are associated factors with DDH. In firstborn children, this is explained by the mother's unstretched, tight uterine and intra-abdominal muscles, while in oligohydramnios, the exact cause is not yet known, but the tight intrauterine space can be a reason.<sup>[18,19]</sup> In this study, the prevalence of the first child in the family was 33.0% and oligohydramnios 10.9%.

It is documented in the literature that DDH is more commonly found in the left hip. This may be attributed to the fact that the left occiput anterior position is the most common intrauterine position, making the left hip continuously adducted with pressure from the mother's lower spine.<sup>[18,19]</sup> In our study, patients diagnosed with left DDH were also found to be the highest percentage (38.6%), followed by bilateral DDH (37.7%) and right DDH (23.6%).

## Limitations

The study is retrospective in nature, which created multiple limitations. First, there is a possibility of missing some cases and not including them in the study due to search codes that are not matching the initial ICD diagnosis code entered by doctors in the medical record system. In addition, the possibility of recall bias in obtaining the missed important information through the phone, such as risk factors, oligohydramnios, family history, and breech presentation. Finally, calculated the date of diagnosis from the first presentation to KH even when they were referred with the diagnosis from other centers.

## CONCLUSION

The study included 795 DDH-diagnosed patients, of which 82.0% were female and 18.0% were male, giving a ratio of 4.5:1. Bilateral DDH was diagnosed in 37.7% of patients with left-sided DDH in 38.6%, and right DDH in 23.6% patients. At least half of the DDH cases were 6 months old or younger at the first presentation to the hospital and 16.6% were diagnosed after the age of 18 months. Remarkably, at least one risk factor was present for 73.1% of patients. The remaining patients had no risk factors for DDH at all. The prevalence of the first child in the family was 33.0% and oligohydramnios 10.9%. The estimated incidence of DDH in this study is 1.05/1000 live births/year. However, these findings cannot be generalized nationally as they are from a single center.

## RECOMMENDATIONS

This research was conducted to study the epidemiology of DDH in Oman and to form a foundation for potential bigger studies in the future. We recommend conducting a multicenter prospective study to estimate DDH incidence in Oman accurately. In addition, national guidelines and screening programs must be developed and executed for early diagnosis, documentation, and management.

## Acknowledgment

This study was presented during the Oman Medical Specialty Board annual research forum in December 2021. Hence, the abstract was published in Oman Medical Journal (OMJ) as a supplemental abstract only. OMJ automatically publishes all residents' research projects presented during the annual research forum in Oman Medical Specialty Board.

- Oman Medical Specialty Board Research Forum 2021/2022: Abstracts
- Epidemiology of Developmental Dysplasia of the Hip at a Tertiary Hospital in Oman
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## AUTHORS' CONTRIBUTIONS

AMS: Principal investigator, conception and study designs, statistical analysis and interpretation, manuscript preparation. AMN: Supervisor, conception and study designs, manuscript preparation and approval. TAM: Co-principal investigator, conception and study designs, data collection, manuscript preparation. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

## USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that there was no use of Artificial Intelligence (AI)-Assisted Technology for assisting in the writing or editing of the manuscript and no images were manipulated using the AI.

## ETHICAL APPROVAL

The research project was approved by the Research Committee at Oman Medical Specialty Board, while the ethical approval was obtained from the Medical Research and Ethics Committee at KH on 03/11/2020 with the proposal ID number MoH/CSR/20/23498.

## DECLARATION OF PATIENT CONSENT

Retrospective study and data was collected from the system.

## FINANCIAL SUPPORT AND SPONSORSHIP

The study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

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