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The impact of pregnancy and birth-related risk factors on the incidence of developmental dysplasia of the hip in newborns

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Abstract

Introduction: Developmental dysplasia of the hip (DDH) is a multifactorial condition that, if untreated, can lead to long-term complications such as early-onset osteoarthritis and disability. Risk factors, including breech presentation, family history, female sex, firstborn status, high birth weight, and oligohydramnios, are associated with 50–60% of DDH cases. Screening approaches vary, with selective and universal ultrasound strategies in use. This review examines DDH risk factors related to birth and pregnancy, emphasizing the importance of early diagnosis and timely intervention to improve patient outcomes.

Aim of study: This review explores current knowledge on risk factors for developmental dysplasia of the hip related to birth and pregnancy, highlighting their role in enhancing early diagnosis and timely intervention for affected newborns.

Material and methods:A systematic review of PubMed literature (2019–2024) was conducted using the terms "DDH," "Risk factors," and either "pregnancy" or "birth," with studies manually screened for relevance and credibility,

Results and conclusion: Developmental dysplasia of the hip (DDH) is the most common musculoskeletal disorder in infants, with risk factors including breech presentation, oligohydramnios, primiparity, high birth weight, and uterine scarring. Breech positioning and restricted fetal movements due to low amniotic fluid volume can impair hip joint development. Primiparity and high birth weight may also contribute to DDH by increasing mechanical pressure on the hip. This review analyzes pregnancy-related risk factors for DDH and highlights the importance of early diagnosis through selective screening to improve neonatal outcomes.

Key words: Developmental dysplasia of the hip, DDH, risk factors, pregnancy, birth

1. Introduction

Developmental dysplasia of the hip (DDH) encompasses a broad range of severity, and if not properly managed, it can lead to serious long-term issues. These may include intra-articular damage during the pre-arthritic phase and the early development of osteoarthritis, potentially resulting in significant disability in early adulthood.[1] The term of developmental dysplasia of the hip describes the combined etiology of the disease, with genetic and developmental causes to be responsible for the disorder.[2]

During fetal development, the femoral head takes on a spherical shape, the femur has a short neck, and the greater trochanter begins to form in a primitive state. As the labrum matures,

the femoral head becomes centrally aligned within the acetabulum. The interaction between a correctly aligned femoral head and the joint cartilage is crucial for the continued healthy development of the hip joint after birth.[1,3] By the 11th week of gestation, the hip structure is fully developed. In a healthy hip, the femoral head should be securely positioned within the acetabulum at the time of birth.[3]

Aetiology of developmental dysplasia of the hip is multifactorial, and the presence of risk factors such as breech presentation, positive family history, a female sex, being first child, a high birth weight, and oligohydramnios are associated with this condition. They are corelated with 50–60% of DDH cases in newborns.[4]

Currently, no official international guidelines or standards exist for DDH screening.[5] There are two approaches of DDH ultrasound screening: universal and selective. The selective ultrasound screening strategy includes children with positive clinical examination or risk factors. The universal approach includes performing ultrasound examinations on all newborns.[6]

This review aims to discuss the current knowledge of the risk factors of developmental dysplasia of the hip related with birth or pregnancy. A thorough understanding of risk factors could facilitate into improved diagnosis of affected newborns and the implementation of appropriate treatment at an early stage.

2. Material and methods

A systematic review of scientific articles was conducted using the PubMed database. The terms used for the search included "DDH," "Risk factors," as well as "pregnancy" or "birth." The analysis focused on articles and research papers published from 2019 to 2024. The titles and abstracts were reviewed manually to evaluate their relevance and the source of the article. As this paper is not a meta-analysis, no statistical methods were employed.

3. State of knowledge

Developmental dysplasia of the hip (DDH) is the most common musculoskeletal disorder of the infant age.[2] The occurrence of it in newborns shows significant variation depending on geographical region, being least common among Africans and most prevalent among Native Americans and Caucasians. Globally, the incidence is approximately estimated

at 0.1 to 6.6 cases per 1,000 live births.[7] Diverse theories and risk factors have been proposed as the origin of DDH. Although we do not know the exact etiology of DDH.

3.1 Oligohydroamnios

Amniotic fluid (AF) plays a crucial role in fetal development, making antenatal monitoring of its volume essential. Any alterations in AF volume are carefully observed, as they are regarded as a potential risk factor of adverse perinatal outcomes. The volume of amniotic fluid varies throughout pregnancy, increasing steadily in a linear pattern until around 34 to 36 weeks of gestation. At this stage, the amniotic fluid volume stabilizes at approximately 400 mL and remains consistent until full term. After 40 weeks of gestation, the fluid volume begins to gradually decline, resulting in reduced levels during post-term pregnancies[12,13]. Oligohydramnios is characterized by an amniotic fluid volume that is over 2 standard deviations below the average for a given gestational age. The amniotic fluid index (AFI) is an assessment of AFV. The AFI can be determined after 20 weeks of gestation by dividing the uterus into 4 quadrants through the umbilicus and determining the MVP in each quadrant. The sum of the 4 maximum vertical pockets is equal to the AFI. An AFI less than 5 cm is consistent with oligohydramnios.[12] In the study by Manoukian at al.[13] author suggests that consecutive antenatal scans indicating reduced amniotic fluid should be regarded as an independent risk factor for DDH. They emphasize using repeated findings of reduced AF as the criterion, rather than solely relying on the diagnosis of oligohydramnios, due to potential variations in AF assessment across different hospitals. In the study the overall incidence of combined reduced AF and oligohydramnios in DDH was 16%. In meta-analysis by De Hundt at al.[14] author confirmed that oligohydroamnios was found more frequently in children with developmental dysplasia of the hip, but this correlation was not statistically significant. Oligohydramnios has demonstrated variable association with DDH[13–19]. This variability may stem from the absence of a standardized definition for oligohydramnios and the lack of precise quantification in the literature regarding amniotic fluid volume thresholds for its classification. In the context of DDH screening, the findings of the study by Poacher at al.[15] indicate that oligohydramnios, defined as "the deepest vertical pool or amniotic fluid index below the fifth percentile for amniotic fluid volume," serves as a significant predictor of DDH.

3.2 Breech presentation

Breech presentation refers to the fetus being positioned with its head facing upward in the uterus, causing the buttocks to point toward the birth canal. Breech presentation at delivery is defined as the fetus remaining in this position during the final week before birth. Breech presentation during pregnancy is identified when the fetus is in a breech position at one or more check-ups from 30 weeks of gestation until delivery.[10] At term, this positioning accounts for approximately 5% of births.[20] In the study by Konijnendijk at al. author reported that term infants documented in a breech position during at least one antenatal examination after 30 weeks of gestation demonstrated a 2.01-fold increased risk of developing DDH compared to those without any recorded breech positioning during this period. Infants presenting in a breech position at delivery exhibited nearly a fourfold higher risk. The risk of DDH was further amplified with the duration of breech positioning: 5–8 weeks was associated with a 2.65-fold increase, while 9–13 weeks corresponded to a 3.63-fold increase. Infants identified in a breech position during at least one examination between 37 weeks of gestation and birth had a 3.24-fold higher risk of DDH compared to those who were never in breech, whereas breech positioning confined to 30–36.6 weeks of gestation did not significantly increase the risk of DDH. The findings highlight the critical role of ultrasound screening for breech position and oligohydramnios, especially in the later stages of pregnancy. They also suggest that early intervention to address breech presentation, such as external cephalic version, could lead to lower the risk of hip dysplasia.[21]

The timing of identifying the breech position during examination (weeks of gestation)	Increase in the risk of DDH
>30	2.1
At birth	4
>37	3.24
30-36.6	Not significantly

Table 1. Table summarizing the increase in the risk of DDH depending on the time of detection in the examination of the baby's breech position[10]

Duration of breech position (weeks)	Increase in the risk of DDH
5-8	2.65
9-13	3.63

Table 2. Table summarizing the increase in the risk of DDH depending on the duration of breech position[10]

3.3 Birth weight

In a study by Bache at al.[22] author investigated the relationship between a birth weight exceeding 4000 g and the occurrence of DDH in children. For both genders, infants with a birth weight exceeding 4 kg are more than twice as likely to present with ultrasound abnormalities and require treatment for persistent hip abnormalities. On the other hand, four studies investigated the impact of a birth weight below 2500 g on the occurrence of DDH. These studies confirmed the protective effect of low birth weight (<2500g) on the development of DDH in newborns.[23–26]

3.4 Scarred Uterus

In a study by Ionescu at al. author examined the impact of a scarred uterus on the occurrence of developmental dysplasia of the hip among newborns. Author defined a scarred uterus as cases in which an invasive procedure was performed on the uterus, e.g. a prior cesarean section, curettage, or any other surgical intervention, excluding any previous vaginal deliveries. In the group of children with diagnosed DDH, 30.95% of them were delivered from a scarred uterus.[8]

3.5 Primiparity

Primiparity is one of the significant factors contributing to a baby's risk of developing developmental dysplasia of the hip (DDH).[27,28] In a study by Verbruggen at al.[21] author monitored fetal movements (the kick and muscle forces) using cine-MRI and analyze the resulting stress and strain in the hip joint, examining the hypothesis that changes in biomechanical forces could clarify the connection between specific intra-uterine conditions and the risk of developing DDH. Kick force, stress and strain, were observed to be significantly reduced in instances of breech position, oligohydramnios, and first-time pregnancy. Although a first-time pregnancy is not considered a pathological condition, it is associated with a higher risk of developmental dysplasia of the hip (DDH) compared to subsequent pregnancies.[14,21,29,30]

4. Conclusion

This systematic review aimed to systematise risk factors of DDH related with birth or pregnancy. In our study, we analyzed the impact of factors such as primiparity, oligohydramnios, breech position, uterine scars resulting from previous surgical procedures involving this organ, and neonatal birth weight. Understanding the influence of these factors on the incidence of developmental dysplasia of the hip (DDH) in newborns may facilitate the implementation of appropriate diagnostic measures for the child in the neonatal unit. In countries, such as Denmark[31,32], Spain[33], United Kingdom[34–36] and Italy[37–39], newborn screening for developmental dysplasia of the hip (DDH) is performed only in the presence of risk factors or positive clinical examination.[6] This approach represents a model of selective diagnosis. Ensuring consistency in DDH diagnosis is crucial for providing suitable treatment and minimising variations in standards of care. Future research should focus on examining the impact of implementing appropriate diagnostic measures based on the knowledge of risk factors and their influence on the development of developmental dysplasia of the hip (DDH) in newborns. Additionally, studies should investigate how this affects the initiation of appropriate treatment in children.

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