Relative Risk and Incidence for Developmental Dysplasia of the Hip

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Objective To determine the incidence and associated risk factors of developmental dysplasia of the hip (DDH) in a modern population without universal screening.

Study design Children with DDH were identified from the Manitoba Centre for Health Policy's Data Repository by the use of *International Classification of Diseases* diagnosis codes as well as physician billing tariffs for surgical procedures for DDH for all children born between 1995 and 2012. To identify the outpatient-treated patients, ultrasound scans and radiographic imaging for DDH were reviewed for 2004-2012. Overall incidence was calculated on the basis of birth rate for the province per year. Relative risks of sex, first born, breech position, clubfoot deformity, multiple gestations, as well as regional health areas were analyzed with χ^2 tests.

Results We identified 1716 cases of DDH of 258 499 newborns. The incidence of DDH was calculated at 6.6/1000 newborns. Late-presenting DDH was detected in 2.2/1000 newborns. Female first-born children, clubfoot deformity, and breech position were associated significantly with an increased risk. Children with DDH born in rural areas of the Northern and Central part of Manitoba presented at a later age than those who are born in the urban areas ($P < .0001$)

Conclusion This study shows the need for improved early detection and awareness at well-baby clinics of risk factors and regional differences for DDH. *(J Pediatr 2017;181:202-7).*

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Developmental dysplasia of the hip (DDH) is a spectrum of pathology in children that includes mild dysplasia of the acetabulum, subluxation, and complete dislocation of the hip joint. If left untreated, the dysplastic hip can further deteriorate with subluxation, muscle contractures, gait disturbances, and osteoarthritis.

Ideally, the child is treated with a Pavlik harness before the age of 6 months. This outpatient treatment is minimally invasive, with excellent outcomes and a very low rate of complications.[1] If the diagnosis is made at an older age and the child approaches walking, however, interventions such as open hip reposition, femoral osteotomies, and pelvis osteotomies will be necessary. Therefore, late-diagnosed DDH will increase the risk for residual dysplasia or avascular necrosis of the femoral head as a complication of the treatment. It is estimated that 1 in 6 children treated for DDH will develop osteoarthritis by 45-50 years of age.[2]

Because there is no true cause for DDH—the anatomy of the hip joint develops normally in utero and DDH is therefore not a congenital deformity but rather a developmental disease—multiple risk factors have been identified, such as breech position, female sex, first-born status, positive family history, foot deformity, multiple gestation, and oligohydramnios.[3,4] The incidence rate for DDH ranges from 1/1000 to 20/1000, depending on the literature and the region.[5-7] The incidence of late-diagnosed DDH is less and is estimated to be around 1/5000.[1,5,8]

In Canada, there is no universal screening program for DDH as there is in Europe and Australia.[1,5,9,10] The detection of clinical abnormalities, such as limited abduction, with hip instability testing (Ortolani and Barlow) will depend on the experience of the nurse or doctor in well-baby clinics. It is known that there is a wide variety of clinical recognition often leading to late-diagnosed DDH, even after walking age, when the child starts limping because of leg-length discrepancy.

Manitoba reflects the culturally diverse population of Canada, with children from all backgrounds, including large indigenous, French Canadian, and Hutterite communities. There is a total population of almost 1.2 million people: 16.7% is of Aboriginal identity, 15.7% are immigrants, and 13.1% is a visible minority (nonwhite, non-Aboriginal) population.[11]

There are anecdotal citations of clinical observations dating back to 1950 that describe a high rate of DDH. The purpose of this study was to establish the incidence of early and late diagnosed DDH in Manitoba and to identify the risk factors associated with DDH within this population.

DDH	Developmental dysplasia of the hip
ICD	*International Classification of Diseases*
RR	Relative risk
RHA	Regional Health Authorities

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Methods

After approval from our ethics board, we conducted a retrospective cohort review. All children aged 0-17 years diagnosed with DDH between 1995 and 2012 were identified with the *International Classification of Diseases* (ICD) diagnosis codes for DDH (ICD-9-Clinical Modification codes 754.3 and 755.63 and ICD-10-Canada code Q65) as well as physician billing tariffs for surgical procedures for DDH (ie, dislocation reduction and spica casting) from the Manitoba Centre for Health Policy's Population Health Research Data Repository.

To identify conservatively treated patients, we used the radiology records—both ultrasound scans and pelvis radiographs—because all children were seen and treated at Health Sciences Centre Children's hospital (Winnipeg) between 2004 and 2012. Because there can be an important inter-rater variability in ultrasound scans and to avoid overdiagnosing, we used a 55° or less of bony roof angle (alpha angle) as described by Graf to diagnose DDH.[12] The pelvis radiographs were examined for interrupted Shenton line, dysplastic acetabular index, and (sub)luxation of the hip.

To examine risk factors for DDH and regional differences, a birth cohort of children born between 1995 and 2012 were followed from birth to death, migration out of province, or December 31, 2012, whichever came first. Demographic information for patients, such as place of birth, sex, age at diagnosis/treatment, first born, multiple gestation, and breech birth position (at birth-registered presentation code), were identified with the Manitoba Centre for Health Policy's Data Repository. ICD-9-Clinical Modification and ICD-10-Canada diagnosis codes for clubfoot also were identified from the Repository and linked to the DDH population. Children diagnosed with cerebral palsy, spina bifida, or arthrogryposis multiplex congenita were excluded from the birth cohort.

Canada has a public healthcare system that is governed by each province. Manitoba consists of 5 Regional Health Authorities (RHAs; previously 11 [2013]). For crude rates, cases of DDH were assigned the RHA in which they resided as of diagnosis date. For the relative risk (RR) calculations, children in the birth cohort were assigned their RHA by use of their postal code at date of birth.

Statistical Analyses

Crude rates of DDH and 95% CIs were calculated per 1000 newborns, overall, per year, and per RHA. For the birth cohort, the RR of DDH and 95% CIs were calculated to assess for differences in risk factors such sex, multiple gestation, and clubfoot. Statistical significance of RRs was tested with the χ^2 test. An ANOVA regression model was run to measure regional differences in the average age at presentation. Differences in least squares means and 95% CIs were calculated to compare the mean age at diagnosis for each region with the provincial average.

Results

We identified 1716 cases of DDH for a total of 258 499 newborns between 1995 and 2012. For the birth cohort, we identified a subset of 1469 cases; the remaining cases were children diagnosed in 1995-2012 but born before 1995 or born out of province. A total of 64.9% of cases of DDH were female compared with 35% male for the birth cohort. Of the female patients with DDH, 46.8% were first born. Breech position was present in 19.3% of the patients with DDH. Only 1.9% were twins or triplets. Breech position in multiple gestations was only present in less than 1%. Of the 1469 cases of DDH, 42 patients also were diagnosed with clubfoot.

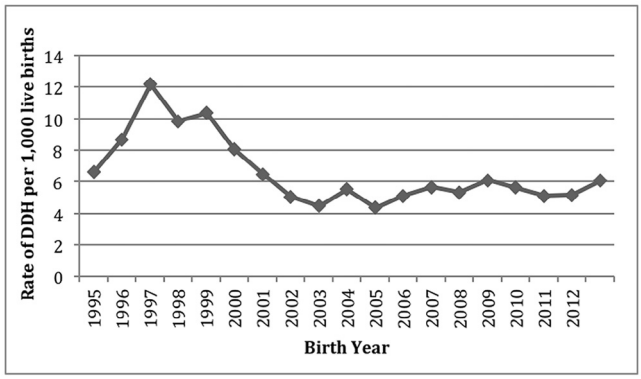

Figure 1. Incidence of DDH per 1000 newborns in 1995-2012.

The incidence of DDH was 6.6/1000 newborns. In 66% of these newborns, the diagnosis was made within the first 6 months of age. Of the 1716 patients, only 42 patients were diagnosed between the age of 3 and 6 months. Therefore, we defined 6 months as late-diagnosed DDH, because treatment with a Pavlik harness can still be effective in this younger age group. The remainder received treatment after 6 months, including 16% after walking age. The radiology dataset added another 8.6% cases of DDH for 2004-2012 but did not change the incidence significantly (**Figure 1**).

The patient-related RRs of DDH were significant for female sex and first-born female child. Breech presentation also was a significant risk factor both in singletons and multiple gestations. In contrast, breech position compared with other birth presentations in multiple gestations showed a significant reduced risk for DDH. The presence of a clubfoot also was associated with a greater risk of DDH. Macrosomia was associated with a reduced risk of DDH. Multiple gestations (none breech) were not found to be a greater risk of DDH (**Table I**).

Although there are elevated rates of DDH in Interlake-Eastern and the north of the province, regional-related RRs of

Table I. RRs for DDH

Risk factor	RR (95% CI)	*P* value
Female vs male	1.33 (1.28-1.38)	<.0001
First born	1.15 (1.09-1.22)	<.0001
First-born female vs male	1.37 (1.30-1.45)	<.0001
First-born female vs other female	1.18 (1.11-1.27)	<.0001
Multiple birth	0.73 (0.50-1.06)	.0925
Breech birth	5.03 (4.51-5.60)	<.0001
Clubfoot	10.34 (7.60-14.05)	<.0001
Macrosomia	0.88 (0.77-1.00)	.0441