The impact of intra-uterine factors on neonatal hip instability

An analysis of 1,059,479 children in Norway

Thore Hinderaker[1], Anne K Daltveit[2], Lorentz M Irgens[2], Alf Udén[1,3] and Olav Reikerås[1,4]

The records of the Medical Birth Registry of Norway from 1970 through 1988 contain information on maternal health, course of delivery and health of 1,059,479 newborns. The overall prevalence at birth of neonatal hip instability (NHI) was 0.9 percent: 0.6 percent in boys and 1.4 percent in girls. In breech presentation, the rate was 4.4 percent. In vaginally delivered children, the rate was only marginally higher compared to those delivered by cesarean section. In children with a birthweight less than 2,500 g, the rate was 0.3 percent. In vertex presentation, the duration of pregnancy had no influence in boys whilst, in breech presentation, the prevalence increased up to the 39th week of gestation. In girls, the NHI rate increased with the duration of gestation, particularly in breech presentation. In first-born children, these patterns were even more obvious. The data are consistent with a hypothesis that intra-uterine mechanical factors, in combination with hormonal factors, are of importance rather than the actual trauma of vaginal delivery.

[1]Department of Orthopedics, Tromsø University Hospital; [2]Medical Birth Registry of Norway, Bergen; [3]Department of Orthopedics, Malmö General Hospital, University of Lund, Sweden; and [4]The National Centre for Orthopedics, Sophies Minde, Oslo, Norway. Correspondence: Dr. Olav Reikerås, The National Centre for Orthopedics, N-0570 Oslo, Norway Tel +47–22 954300. Fax –22 378541
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Since the 1960s, Dunn (1976) has pointed out the importance of intra-uterine mechanical factors in the etiology of congenital dislocation of the hip. However, there are many contradictory results concerning the relative importance of these factors. The National Medical Birth Registry of Norway, with data on more than 1 million children, gave an opportunity to study such factors with great statistical accuracy. The aim of this study was to analyze the interaction between birth order, sex, intra-uterine position and gestational age in the occurrence of neonatal hip instability (NHI). Furthermore, we wanted to study the impact on the hip joints of vaginal delivery in breech presentation.

Material and methods

The Medical Birth Registry of Norway was established in 1967. Each record contains information on maternal health, the course of delivery and the health of the newborn. The present study was based on all births in Norway 1970–1988, altogether 1,059,479 infants, comprising 1,046,336 live births. From the total number of births, the following were excluded from the analyses: births of unknown gestational age (4 percent) and birthweight (0.1 percent), multiple births (2.0 percent), births with congenital malformations (3.0 percent) and oligohydramnion (0.1 percent) as well as stillbirths (1.2 percent), altogether 9.4 percent of all births, leaving 959,412 births selected for further analyses (Table 2).

Data on birthweight, sex, birth order, gestational age, mode of presentation (vertex, breech) and delivery (vaginal, cesarean section) were analyzed. In the registry, two terms for NHI were used: congenital dislocation of the hip and positive sign of Ortolani. Since there is no strict difference between the two terms in this context, they were used as one entity (NHI). In the analysis of interaction of sex, presentation, birth order and gestational age, only singletons with a birthweight exceeding 2,499 g were included.

Statistics

The Student's *t*-test was used for comparing differences between means and the chi-square test for comparing proportions. Multiple logistic regression analysis was performed on variables categorized as

Table 1. Categorization of variables used in multiple logistic regression analysis of NHI in Norway 1970–1988

Variable	Categorization
Birth order (BO)	1,2+
Sex (SX)	Male, female
Gestational age (GA)	–37, 38–39, 40–41, 42+
Presentation (PR)	Vertex, breech
Delivery (DL)	Vaginal, cesarean

shown in Table 1, using the statistical package BMDP (Dixon et al. 1990), with odds ratios as measures of effect. Univariate analysis showed no increase of NHI with birthweight for infants weighing more than 2,499 grams. Consequently, birthweight was not included as a covariate in the analysis.

Results

Among all 1,046,336 live births, 9,955 cases of NHI were reported with a prevalence at birth of 1.0 percent. Among the selected 959,412 births, 106 cases were reported among 41,547 infants weighing less than 2,500 g (0.26 percent) against 9,377 cases among the remaining 917,865 (1.02 percent) ($P < 0.001$) (Table 2). In the latter group in breech presentation, the prevalence was 4.54 percent (719/15,824) when born vaginally and 4.25 percent (341/8,025) when delivered by cesaran section ($P < 0.001$) while, in vertex presentation, the prevalence was 0.93 percent (8,317/894,016).

The model obtained in the multiple logistic regression analysis was:

logit NHI rate = BO + SX + GA + PR
+ GA*SX + GA*PR
+ BO*SX + BO*PR
+ SX*PR

implying the following significant associations: NHI was more frequent in birth order 1, in females, at high gestational ages and in breech presentation (Figure 1).

The 5-first order interactions observed implied an increased association with gestational age in females (GA*SX) and in breech presentation (GA*PR), a higher NHI rate in birth order 1 among females (BO*SX) and in breech presentation (BO*PR) and a higher rate among females in breech presentation (SX*PR). No second-order interactions were observed. Furthermore, term delivery (DL) was not included in the final model, implying no significant protective effect of cesarean section. Since no interaction was observed between birth order (BO) and gestational age (GA), odds ratios with 95 percent confidence intervals adjusted for birth order were calculated (Table 3), quantifying the associations already accounted for.

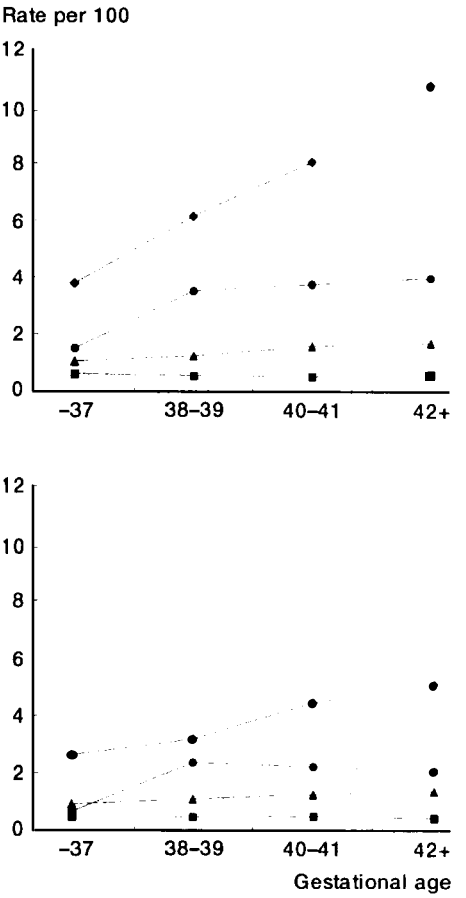

Figure 1. Prevalence at birth of NHI in birth order 1 (top) and birth order 2 (bottom) by gestational age, sex and presentation among all births in Norway 1970–1988, selected according to specified criteria (see text). ◆ breech female, ● breech male, ▲ vertex female, and ■ vertex male.

Discussion

The data in this study are derived from the national compulsory medical notification of births. Each form is filled in by the midwife and physicians attending the birth and examining the newborn. Generally, in Norway all newborns are evaluated with Ortolani's test within the first or second day. While many of the physicians are trained pediatricians, more inexperi-

Table 2. Prevalence at birth (percent) of NHI by birthweight, mode of presentation and mode of delivery among all births in Norway 1970–1988, selected according to specified critera[a] (The National Birth Registry of Norway)

	Total	Birthweight		Vertex		Breech	
		< 2500	≥ 2500	Vaginal	C. section	Vaginal	C.section
Cases	9,483	106	9,377	7,834	483	719	341
Population	959,412	41,547	917,865	846,388	47,628	15,824	8,025
Rate per 100	1.03	0.26	1.02	0.93	1.01	4.54	4.25

[a]Known gestational age and birthweight, singleton, without congenital malformation and oligohydramnion, and liveborn.

Table 3. Estimated odds ratio, with 95 percent confidence intervals, for NHI prevalence rates at birth in Norway 1970–1988, by sex, presentation and gestational age adjusted for birth order

		Gestational age			
Sex	Presentation	–37	38–39	40–41	42+
Female	Vertex	1.00	1.15 (1.01–1.32)	1.41 (1.21–1.64)	1.55 (1.35–1.78)
	Breech	1.00	1.93 (1.43–2.60)	2.53 (1.87–3.42)	3.19 (2.33–4.38)
Male	Vertex	1.00	1.07 (0.88–1.23)	1.06 (0.90–1.25)	1.07 (0.90–1.29)
	Breech	1.00	1.73 (1.26–2.37)	1.90 (1.39–2.59)	2.21 (1.58–3.09)

enced physicians may also take part in these routines from time to time. Thus, the study was based on cases of NHI that were ascertained through procedures that were not strictly standardized. However, the overall prevalence of 1.0 percent at birth was rather close to those reported in more controlled studies from Norway and Sweden in which provocation, according to Barlow or Palmen, was used (Sanfridson et al. 1991, Hinderaker et al. 1992). Provided there was no registration bias related to the variables used in the analyses, this inexactness in the diagnosis will not interfere with the analysis of our data. The proportion among all cases of boys (29 percent) was of the same magnitude as in other series (Fredensborg and Nilsson 1976, Cyvin 1977, Palmén 1984, Hinderaker et al. 1992), and supports the assumption of an unbiased registration.

The slightly higher rate of NHI in infants with breech presentation born vaginally, as compared with those delivered by cesarean section, indicated that the mechanical influence of vaginal delivery was of limited importance to NHI. In the reports by Luterkort et al. (1986) and Clausen and Thygesen-Nielsen (1988), there was no statistical difference. However, there were rather few observations, and higher rate of NHI was not significant in those born vaginally. The very low rate in children with a birthweight < 2,500 g and positive association with duration of pregnancy support the concept of intra-uterine mechanical factors, as proposed by Dunn (1976). The effect of these mechanical factors is most obvious in children in breech presentation. Whether this mainly occurs in children with maximally flexed hips and extended knees (frank breech), as suggested by Luterkort et al. (1986), cannot be clarified in this study.

The higher incidence in firstborns was probably due to a narrower intra-uterine cavity. This effect of birth order was most obvious in breech presentation and in girls. The importance of limited space in the causation of NHI is obvious from the very low rate in children with a low birthweight.

The unexpected finding that the rate did not increase much after the 39th week in boys in breech presentation was significant. The same trend was observed both in firstborns and in those with higher birth orders. Why boys are less influenced by duration of pregnancy than girls is not obvious. The higher overall rate in girls can only to a very small extent be explained by the increased frequency of breech presentation in girls. Most likely, there is a difference in the connective tissue. Perhaps an increased maturation of receptors for estrogen in female fibroblasts can contribute to the increasing rate in girls of greater gestational age. Thus, an interaction may exist between several factors in the causation of NHI.

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