Breech Delivery and Intelligence: A Population-Based Study of 8,738 Breech Infants

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OBJECTIVE: **Long-term intellectual performance in breech-presented infants may be negatively affected by vaginal delivery. We evaluated the effect of presentation at birth and delivery mode on intellectual performance at age 18 years in a nationwide population study.**

METHODS: **We studied 8,738 male infants in breech and 384,832 males in cephalic presentation registered in the Medical Birth Registry of Norway, 1967–1979, and linked to data registered at the National Conscript Service, 1984–1999. Test scores of intelligence testing at conscription were presented as standard nine ("stanine") scores. Mean stanine scores and odds ratios of low score were computed and adjusted for birth order, maternal age, and education.**

RESULTS: **Mean stanine score was slightly higher among breech-presented males than among cephalic-presented males (5.26 versus 5.22, $P = .05$), whereas after adjustment the difference disappeared ($P = .3$). Breech-presented infants had lower mean scores if delivered by cesarean compared with vaginal breech delivery ($P = .03$), and cephalic-presented males scored lower if their mothers had a cesarean delivery instead of a vaginal delivery ($P < .001$). Comparing cesarean and vaginal delivery in breech births, the odds ratio of having a stanine score less than or equal to 3 was 1.12 (95% confidence interval 0.92,1.36), after adjustment for confounding factors.**

CONCLUSION: **Presentation at birth did not affect adult intellectual performance. Cesarean delivery of breech-presented infants did not improve adult intellectual performance when compared with a vaginal delivery. The excess perinatal hazards of breech-presented infants with a vaginal delivery were not reflected in adult intellectual performance. (Obstet Gynecol 2005;105:4–11. © 2005 by The American College of Obstetricians and Gynecologists.)**

LEVEL OF EVIDENCE: II-2

Infants born after breech presentation have increased perinatal mortality and a higher risk of neonatal complications.[1] Poorer outcomes may result either from underlying conditions that cause breech presentation,[2] such as serious birth defects or intrauterine growth restriction,[3] or from damage to the infant during delivery.[1,4] For example, vaginal breech delivery has a higher risk than nonbreech delivery of fetal asphyxia,[3] cord prolapse, aspiration of amniotic fluid, and other complications.[5] It has been suggested that mode of delivery of a breech-presented fetus at term should be a planned cesarean, because vaginal delivery may imply a higher risk of perinatal and neonatal morbidity compared with cesarean delivery.[1,4]

Possible cerebral damage may be avoided if infants presented in breech have a cesarean delivery instead of a vaginal delivery. Mode of delivery may also influence long-term outcomes, such as adult intellectual performance. However, adult cognitive outcomes in follow-up studies of infants delivered in breech presentation are ambiguous.[3,6–9] These studies have included infants from selected populations, often with a low number of participants,[6–9] restricted to term pregnancies,[3,9] and presented without data on potential confounders such as maternal education.[3,6–8]

In Norway, medical data on all births from 16 weeks of gestation have been recorded since 1967 by the Medical Birth Registry of Norway,[10] and data on intellectual performance have been routinely recorded by the National Conscripts Service in all Norwegian males at the age of 18 years. The objective of the present nationwide cohort study was to compare intellectual performance in conscripts born after breech or cephalic presentation by mode of delivery.

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Table 1. Male Live Births in Norway 1967–1979 With Proportions of Cesarean Deliveries, Birth Defects, and Birth Weights, by Presentation at Birth According to Follow-up Status From Birth Through Military Conscription 1984–1999

	n (%)		Cesarean Delivery (%)		Birth Defect (%)		Birth Weight (g)	
Follow-up Status	Breech	Cephalic	Breech	Cephalic	Breech	Cephalic	Breech	Cephalic
Total live births	8,738 (100)	384,832 (100)	14.3	3.5	4.9	2.2	3,233 (758)	3,571 (559)
Dead before age 1 year	517 (5.9)	4,316 (1.1)	8.5	8.9	21.1	16.6	1,942 (945)	2,489 (1,110)
Dead between age 1 year and military draft	81 (0.9)	3,469 (0.9)	8.6	3.2	12.3	5.3	3,140 (762)	3,509 (587)
Emigrated before military draft	86 (1.0)	3,702 (1.0)	22.1	3.9	5.8	2.3	3,194 (658)	3,521 (533)
Disabled, not drafted	209 (2.4)	5,483 (1.4)	13.4	5.0	19.1	10.2	3,022 (838)	3,411 (653)
Untraceable	539 (6.2)	23,815 (6.2)	13.4	3.4	2.8	2.0	3,306 (673)	3,583 (534)
Drafted*	7,306 (83.6)	344,046 (89.4)	14.8	3.4	3.4	1.8	3,325 (661)	3,587 (535)
Study cohort	6,597 (75.5)	311,164 (80.9)	14.6	3.4	3.5	1.9	3,328 (658)	3,591 (533)

Birth weights are expressed as mean (standard deviation).

* Drafted with missing intelligence test or maternal education data: n = 709 for breech presentation and n = 32,882 for cephalic presentation.

MATERIALS AND METHODS

From 1967 to 1979, 393,570 singleton liveborn infant boys were registered in the Medical Birth Registry. By the national identification number, data on delivery were linked with data on intellectual performance recorded by the National Conscripts Service 1984–1999. In addition, we included linked information from Statistics Norway and the National Health Insurance Office (Table 1). All Norwegian men are required to register with the draft board at 18 years of age for physical and mental examinations. Only those who are permanently disabled before this age are exempted from attending.

Births were divided into those delivered in breech presentation (8,738; 2.2%) and those in cephalic presentation (384,832; 97.8%). Conscripts with data on intelligence testing and on maternal educational level, as obtained from the linkage to Statistics Norway, comprised the study cohort of 6,597 breech-presented and 311,164 cephalic-presented births.

General intellectual performance was measured by a 53-minute validated group intelligence test, which was developed in 1953 for the Norwegian draft board and revised in 1962. The test includes time-limited subtests covering 3 categories of items: verbal analogues, number series, and geometrical figures. Each subtest is organized by increasing difficulty. The test questionnaire comprised a total of 120 questions. All conscripts received standard instructions before taking the time-limited tests. The test is highly correlated with the Wechsler Adult Intelligence Scale ($r = .73$).[11] The results are presented as standard nine ("stanine") scores, i.e. single-digit standard scores (with values from 1 to 9) based on a normal distribution, in which the mean is 5.0 and the standard deviation is 1.96. A low score was defined as less than or equal to 3, corresponding to the 10th percentile of the stanine distribution.

Presentation at birth was either breech or cephalic, and mode of delivery was either vaginal or cesarean. If not otherwise stated, mode of delivery was categorized as vaginal. Breech vaginal deliveries (5,633 births) were subdivided into assisted breech, forceps to after-coming head, and breech extraction. Cephalic vaginal deliveries (300,621 births) were categorized as uncomplicated, forceps delivery, vacuum extraction, or shoulder dystocia. Data on birth weight (in grams), gestational age (in weeks), birth defects, maternal age (years), year of birth, birth order (including stillbirths), marital status, presentation, and mode of delivery were obtained from the Medical Birth Registry. Data on birth weight were missing for 657 births (0.2% of the total birth cohort), and data on gestational age were missing for 13,544 births (3.4%). Birth weight was divided into 8 categories (< 1,500 g, 1,500–4,499 g in 500-g categories, and ≥ 4,500 g). Gestational age was estimated from the reported last menstrual period and analyzed as completed weeks of gestation. Preterm birth was defined as gestational age less than 37 weeks. Small for gestational age was defined as birth weight below the 10th percentile for gestational age according to a recent Norwegian standard.[12] One or more birth defects were recorded in 8,718 infants (2.2% of the total birth cohort), coded by the International Classification of Diseases, Eighth Revision, with minor modifications.[13] Maternal age and year of birth were complete, birth order was missing for 471 births, and marital status was missing for 547 mothers. Maternal age was categorized into 5 groups (≤ 19 years, 20–24 years, 25–29 years, 30–34 years, and ≥ 35 years); year of birth into 3 periods (1967–70, 1970–74, and 1975–79); birth order into either 1 and 2 or more, or 1, 2,

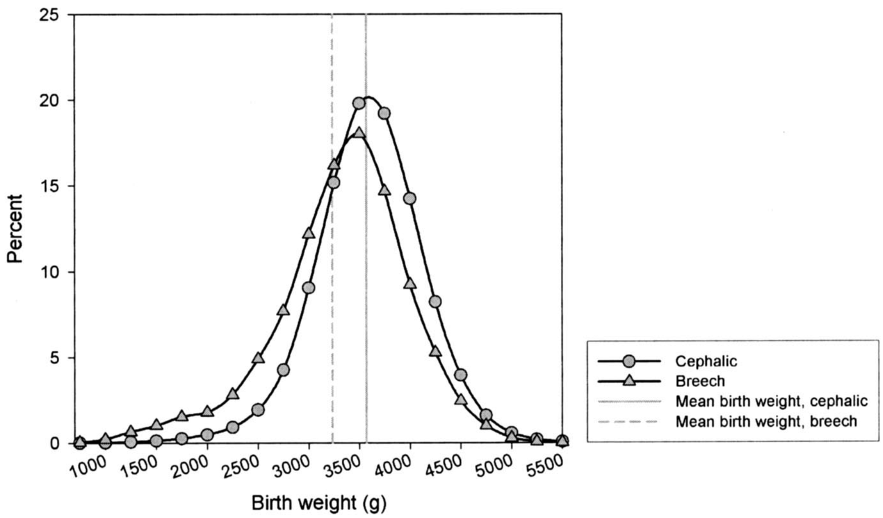

Fig. 1. Distribution of birth weight in breech and cephalic births in Norway, 1967–1979.

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3, 4, and 5 or more; and marital status as married or unmarried. Data on highest attained maternal educational level (completed years) were obtained from Statistics Norway, and were missing for 20,966 mothers (5.3%). Maternal educational level was classified into low (≤ 10 years), medium (11–14 years), or high (≥ 14 years).

Mean stanine score and differences between mean stanine scores were computed by analysis of variance (crude analyses) and general linear models (adjusted analyses). For dichotomous outcomes, crude odds ratios were calculated, and logistic regression analysis was used to evaluate and adjust for potential confounding. In these models, all independent variables were treated as categorical. Odds ratios are reported with 95% confidence intervals. All tests were two sided, and $P < .05$ was chosen as level of statistical significance. SPSS 11.0 (SPSS Inc, Chicago, IL) was used for statistical analyses.

The study was approved by the Regional Committee for Medical Research Ethics, by the Norwegian Board of Health, and by the Norwegian Data Inspectorate.

RESULTS

Breech-presented infants had an excess infant mortality of 4.8%, and long-term follow-up showed that these infants had an excess disability rate of 1% when compared with cephalic-presented infants (Table 1). Childhood and adolescent mortality were the same in both groups. Cesarean delivery was approximately 4 times (14.3% versus 3.5%) more common in breech births than in cephalic births. Birth defects were more than twice as frequent (4.9% versus 2.2%, $P < .001$). Among breech births, 14.9% were preterm, compared with 4.8% of cephalic births ($P < .001$). Among breech births, 20.3% were born small for gestational age, compared with 11.8% of cephalic births ($P < .001$).

Among conscripts in the study cohort, mean birth weight was 3,328 g for breech and 3,591 g for cephalic births, i.e. 263-g difference (Fig. 1). In the study cohort, breech infants delivered by cesarean were on average 129 g heavier than vaginally delivered breeches (mean birth weight 3,438 g versus 3,309 g), whereas among cephalic births mean birth weight was 127 g lower for cesarean deliveries than for vaginal deliveries(3,468 g versus 3,595 g).

Table 2 shows mean intelligence test scores at conscription by presentation, stratified by potential confounding factors. Within each category, maternal age and educational level was positively associated with intellectual performance, whereas there was a negative association with birth order and being unmarried.

In breech presentation, stanine score was slightly higher (5.26 versus 5.22, $P = .05$) than for those in cephalic presentation (Table 3). However, after adjustment for birth order, maternal age, and maternal educational level, the difference was attenuated ($P = .3$). Further adjustment for year of birth did not change this result. Because mean birth weight among breech-presented infants was lower than among cephalic-presented infants, we considered the birth weight distributions of both groups (Fig. 1). There was a shift of distribution toward lower weights among the breech-presented infants compared with the cephalic-presented infants, and in the left tail of the breech distribution a residual of preterm births was recognized. When such weight distributions are shifted, adjusting for birth weight in a regression model would introduce an artifact ("the low birth weight paradox").[14] We therefore assessed intellectual

Table 2. Mean Intelligence Test (Stanine) Scores of Male Conscripts in Norway (1984–1999) Born in Breech or Cephalic Presentation, by Birth Characteristics

Birth Characteristics	Breech		Cephalic		
	Mean Stanine Score (SD)*	n	Mean Stanine Score (SD)*	n	P (χ^2 Test)†
Year of birth					
1967–1970	5.20 (1.89)	2,071	5.13 (1.83)	105,834	
1971–1974	5.34 (1.85)	2,118	5.25 (1.85)	97,827	
1975–1979	5.24 (1.77)‡	2,408	5.26 (1.76)§	107,503	< .001
Maternal age (y)					
< 20	4.69 (1.76)	551	4.77 (1.73)	22,913	
20–24	5.15 (1.78)	2,416	5.09 (1.79)	110,479	
25–29	5.47 (1.84)	2,118	5.36 (1.82)	104,240	
30–34	5.37 (1.88)	975	5.37 (1.83)	49,480	
> 34	5.31 (1.89)§	537	5.29 (1.85)§	24,052	< .001
Birth order					
1	5.42 (1.81)	3,538	5.42 (1.81)	127,514	
2	5.21 (1.81)	1,786	5.17 (1.78)	104,917	
3	4.99 (1.85)	785	5.01 (1.81)	49,566	
4	4.73 (1.89)	290	4.89 (1.83)	18,562	
5+	4.66 (1.85)§	198	4.67 (1.86)§	10,605	< .001
Marital status					
Unmarried	4.86 (1.81)	661	4.82 (1.78)	26,701	
Married	5.30 (1.83)§	5,936	5.25 (1.82)§	284,463	< .001
Maternal educational level					
Low	4.42 (1.74)	1,643	4.47 (1.73)	81,238	
Medium	5.39 (1.76)	4,263	5.34 (1.75)	198,898	
High	6.46 (1.66)§	691	6.36 (1.66)§	31,028	.06

SD, standard deviation.
* Analysis of variance (overall test of mean stanine score by categories of the listed maternal and birth characteristics).
† χ^2 test (in a $2 \times \chi -$ table, testing whether presentation at birth distributes differently by each of the listed maternal and birth characteristics).
‡ $P = .04$.
§ $P < .001$.

performance at conscription for both types of presentation of term births within categories of birth weight (Fig. 2). By restricting the analyses to term births, the low-birth-weight infants mainly represented growth-restricted infants. Mean stanine score increased by birth weight for both types of presentation. For birth weights below 2,500 g, there was no difference between breech and cephalic births ($P = .7$), but for infants between 2,500 and 3,999 g, breech infants performed better than cephalic infants (unadjusted mean stanine score 5.33 versus 5.21, $P = .001$). This difference between breech and cephalic births disappeared when adjusting for birth order, maternal age, and educational level ($P = .2$).

As mentioned previously, cesarean delivery rate was much higher in breech presentation. Cesarean delivery rate was positively associated with maternal age and maternal educational level, whereas there was a negative association with birth order ($P < .001$ for all).

In crude analyses, conscripts presented in breech and delivered by cesarean did not perform better than vaginally delivered breeches (mean stanine score 5.32 versus 5.25, $P = .3$) (Table 3). To evaluate potential confounding, we adjusted for birth order, maternal age, and maternal educational level. In adjusted analyses, intellectual performance among the breech-presented men who were delivered by cesarean was slightly lower compared with vaginal breech delivery (a difference of −0.13, $P = .03$). Birth weight was not included in the regression models because of the differences in distributions between cesarean and vaginal deliveries. When comparing cesarean and vaginal delivery for cephalic-presented conscripts, the unadjusted difference was 0.04 (5.25 versus 5.21, $P = .02$). However, in adjusted analyses, the score was slightly lower among cephalic-presented men who were delivered by cesarean compared with vaginal delivery (a difference of −0.11, $P < .001$).

Intellectual performance after a breech vaginal birth varied according to the method of vaginal breech delivery ($P = .002$) (Table 3). However, in adjusted analyses, the intellectual performance was similar when comparing delivery by either forceps to the after-coming head or breech extraction, to the assisted breech delivery ($P = .06$ and 0.2, respectively). Cephalic-presented men had no differences in intellectual performance when comparing either forceps delivery or delivery complicated by shoulder dystocia, with uncomplicated delivery ($P = .08$

Table 3. Mean Intelligence Test (Stanine) Scores of Male Conscripts in Norway (1984–1999) by Presentation at Birth and Mode of Delivery (1967–1979)

Presentation/Mode of Delivery	n	Stanine Score [Mean (SD)]	Mean Difference* Unadjusted (SE)	P	Mean Difference* Adjusted (SE)†	P
Breech	6,597	5.26 (1.84)	0.04 (0.02)	.05	−0.02 (0.02)	.3
Cephalic	311,164	5.22 (1.82)	0 (Reference)		0 (Reference)	
Total	317,761					
Breech						
Cesarean	964	5.32 (1.80)	0.07 (0.06)	.3	−0.13 (0.06)	.03
Vaginal	5,633	5.25 (1.84)	0 (Reference)		0 (Reference)	
Total	6,597					
Cephalic						
Cesarean	10,543	5.25 (1.80)	0.04 (0.02)	.02	−0.11 (0.02)	< .001
Vaginal	300,621	5.21 (1.82)	0 (Reference)		0 (Reference)	
Total	311,164					
Vaginal breech						
Forceps to aftercoming head	457	5.47 (1.81)	0.21 (0.09)	.02	0.16 (0.09)	.06
Breech extraction	374	5.10 (1.76)	−0.17 (0.10)	.1	−0.13 (0.09)	.2
Unspecified breech	612	5.07 (1.84)	−0.19 (0.08)	.02	−0.06 (0.08)	.4
Assisted breech	4,190	5.26 (1.85)	0 (Reference)		0 (Reference)	
Total	5,633					
Vaginal cephalic						
Forceps	6,093	5.55 (1.83)	0.35 (0.02)	< .001	0.04 (0.02)	.08
Vacuum extraction	8,168	5.50 (1.81)	0.30 (0.02)	< .001	0.04 (0.02)	.03
Shoulder dystocia	1,100	5.15 (1.81)	−0.05 (0.06)	.4	−0.06 (0.05)	.3
Uncomplicated	285,260	5.20 (1.82)	0 (Reference)		0 (Reference)	
Total	300,621					

SD, standard deviation; SE, standard error.

* Mean difference = mean stanine score − reference stanine score.

† Adjusted analyses: All of the following factors are included in the model: maternal age (y): < 20, 20–24, 25–29, 30–34, ≥35; maternal education (y): < 11, 11–14, > 14; birth order: 1, 2+. Reference groups: maternal age, 25–29 y; maternal education, > 14 y; birth order, 2+.

and .3 in adjusted analyses), whereas conscripts delivered by vacuum extraction performed better than those delivered uncomplicated ($P = .03$) (Table 3). However, the 3 groups of complicated cephalic vaginal births had mean birth weights above mean for uncomplicated births; for example, mean birth weight for shoulder dystocia was 4,361 ± 501 g. Thus, based on birth weight alone, a higher intelligence score would be expected among the complicated as compared to uncomplicated cephalic births. If the analyses within cephalic vaginal births in Table 3 were restricted to birth weights greater than or equal to 3000 g, there were no significant effects for the 3 groups of complicated compared with uncomplicated births ($P > .10$ for all).

The odds ratio of having a stanine score less than or equal to 3 among conscripts presented in breech was 0.96 (95% confidence interval 0.90,1.02) compared with conscripts in cephalic presentation (Table 4). The lack of an association with birth presentation persisted after adjustment for birth order, maternal age, and education (1.02; 0.96,1.09). Among breech births, the adjusted odds ratio of having low stanine score in cesarean delivery compared with vaginal breech delivery was 1.12 (0.92, 1.36). For cephalic births, the risk of having a similarly low score was 1.10 (1.04, 1.16) when comparing cesarean with vaginal delivery.

DISCUSSION

Because of the possible hazards to the newborn of vaginal breech delivery, we hypothesized that adult intellectual performance after such a birth would be reduced. This hypothesis was not confirmed. No difference in intellectual performance between male conscripts delivered in breech compared with cephalic presentation was observed. Follow up of the breech births revealed that cesarean delivery did not improve adult intellectual performance when compared with vaginal delivery. Our results are interesting and clinically significant because a lower intelligence test score was not found among vaginally delivered breech infants.

We are aware of a possible selection bias among breech-presented infants, because a higher proportion of breech-presented infants never appeared before the draft board (16.4%), compared with cephalic-presented infants (10.6%), owing to excess mortality and disability

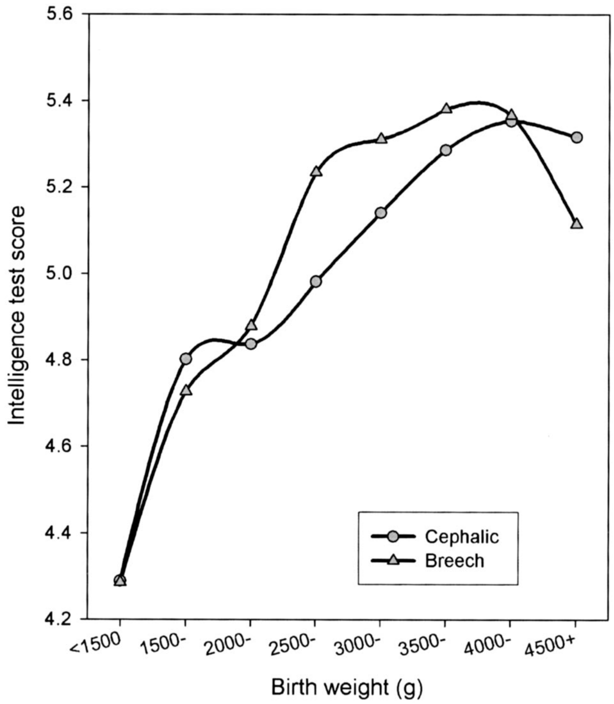

Fig. 2. Mean intelligence test (stanine) score at conscription (1984–1999), by birth weight among males born at term (gestational age ≥ 37 weeks), in breech or cephalic presentation in Norway (1967–1979).

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among breech births. Nonappearance before the draft board possibly could have been associated with lower intellectual performance, leading to an overestimate of the mean scores among conscripts presented in breech. Breech infants, who either died or became disabled, weighed on average 547 g and 389 g less at birth than cephalic-presented infants. Interestingly, a lower birth weight was also observed among the breech infants making it to the draft board, the breech weighing 263 g less than the cephalic. Although some of the breech infants, being very preterm or small for gestational age, were lost for conscription, the majority had data on intelligence testing with equal scores as the cephalic infants, despite the lower birth weight of the breech infants, even when restricting to term births. Thus, selection bias is unlikely to explain the finding that intelligence score was independent of presentation at birth.

If any misclassification was present, we might assume that some breech or cesarean deliveries have been classified as cephalic or vaginal deliveries, respectively, and, if our hypothesis were correct, thereby reducing the intelligence test score in uncomplicated deliveries. However, presentation and mode of delivery have always been considered critical variables in the medical registration of births, and misclassification is considered to be infrequent.

Two previous studies failed to observe any effect of breech presentation[9] or delivery method among breech infants on intellectual performance.[7,9] In a recent Finnish study, the need for specific additional teaching at school among infants delivered vaginally or by cesarean in breech or cephalic presentation was similar.[3] However, in a Danish study, young men delivered in breech presentation had lower cognitive outcome, independent of delivery mode, and the authors concluded that unidentified factors cause both breech delivery and a deficient cognitive outcome.[6]

In a study by Roemer et al,[8] children born in noncephalic deliveries (including both vaginal breech deliveries and elective cesarean deliveries irrespective of presentation) had significantly better intelligence test scores

Table 4. Odds Ratio and 95% Confidence Interval of Intelligence Test (Stanine) Score Less Than or Equal to 3 Among Male Conscripts (1984–1999) by Presentation at Birth and Mode of Delivery (1967–1979)

	Stanine Score				
Presentation/Mode of Delivery	1–9 (n)	≤ 3 (n)	≤ 3 (%)	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)
Breech	6,597	1,098	16.6	0.96 (0.90–1.02)	1.02 (0.96–1.09)
Cephalic	311,164	53,555	17.2	1.00 (Reference)	1.00 (Reference)
Total	317,761	54,653	17.2		
Breech					
Cesarean	964	150	15.6	0.91 (0.76–1.10)	1.12 (0.92–1.36)
Vaginal	5,633	948	16.8	1.00 (Reference)	1.00 (Reference)
Total	6,597				
Cephalic					
Cesarean	10,543	1,744	16.5	0.95 (0.90–1.00)	1.10 (1.04–1.16)
Vaginal	300,621	51,811	17.2	1.00 (Reference)	1.00 (Reference)
Total	311,164				

OR, odds ratio; CI, confidence interval.

* All of the following factors were included in the model: maternal age (y): < 20, 20–24, 25–29, 30–34, ≥ 35; maternal education (y): <11, 11–14, > 14; birth order: 1, 2+. Reference groups: maternal age, 25–29 y; maternal education, > 14 y; birth order, 2+.

compared with vaginal cephalic deliveries. In our study, cesarean delivery in cephalic births was associated with a reduced intelligence test score when compared with vaginal delivery, consistent with the fact that infants delivered by cesarean in cephalic presentation are a more heterogeneous group comprising more pathological conditions than infants delivered vaginally. Furthermore, Roemer et al described an association between instrumental vaginal delivery in cephalic presentation and higher intelligence test scores.[8] Our initial results confirm these findings. However, in adjusted analyses, the slight effects initially observed for forceps and vacuum deliveries disappeared.

The low cesarean delivery rates in our study compared with modern rates, indicate that the vaginal breech deliveries were not highly selected, as is the case in modern obstetrics. Traditionally, Norwegian obstetricians have preferred vaginal delivery for breech births. Our results show that this "vaginal attitude" did not impair adult intelligence among breech infants. Data from this historical cohort are relevant because the cesarean delivery rates in developing countries are still low. Risks of neonatal complications, rather than adult intelligence, are crucial in the choice of delivery mode. Our results are a supplement to previous studies,[1,4,5] but must be interpreted carefully in the discussion about how to deliver a fetus in breech presentation.

Birth order, maternal age, and maternal educational were strong predictors of offsprings' adult intellectual performance, and were also associated with the presentation of birth and mode of delivery. The higher scores observed in crude analyses for breech versus cephalic infants, and for cesarean versus vaginal delivery among breech infants, were due to confounding by birth order, maternal age, and maternal education. Maternal smoking is negatively associated with educational level, but maternal smoking has only minor influences on mode of delivery.[5] Unfortunately, data on smoking or on whether a cesarean delivery was elective or emergency were unavailable.

Infants born in breech have considerably reduced birth weights and are more often preterm. However, the different birth weight distributions complicate the comparison between breech and cephalic births. We had the opportunity to evaluate intellectual performance by birth weight stratified by presentation at birth, an approach that has not been published previously. Inclusion of absolute birth weight in the regression model, or standardizing on birth weight, would have exaggerated the effect on intellectual performance of breech compared with cephalic presentation. If the analyses of presentation at birth in Table 3 were adjusted for absolute birth weight and gestational age, the adjusted mean difference would have changed from -0.02 to $+0.11$ in favor of breech births ($P < .005$). Standardizing breech births in 100-g categories of birth weight using the birth weight distribution of cephalic infants, the intellectual performance for breech infants would have changed from 5.24 (observed) to 5.30 (estimated). Thus, small size is "more normal" and less "dangerous" for breech infants than for cephalic infants. This is a general phenomenon observed in perinatal health.[14]

The higher proportion of small for gestational age infants within breech presentation could imply a higher proportion of males with low intelligence test score, or a general reduction for the breech group. However, the increased risk of being small for gestational age among breech infants did not seem to imply a higher risk of low intellectual performance for this group when compared with the cephalic group. Thus, the etiology of small for gestational age may be different for breech-presented and cephalic-presented infants.

In conclusion, there was no effect of presentation at birth on adult intellectual performance. For male infants in breech presentation, cesarean delivery did not improve adult intellectual performance when compared with vaginal delivery. The excess perinatal risk for infants vaginally delivered in breech presentation was not reflected in adult intellectual performance.

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