

## ORIGINAL ARTICLE

# ACETABULAR DYSPLASIA IN THE SAMI POPULATION: A POPULATION STUDY AMONG SAMI IN NORTH NORWAY

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Received 24 September 2007; Accepted 13 December 2007

## ABSTRACT

**Objectives.** The overall aim of this study was to evaluate the acetabular coverage of the femoral head as measured by the centre-edge (CE) angle of Wiberg and to evaluate any association between low back pain and hip dysplasia in a Sami-dominated area (the municipalities of Karasjok and Kautokeino) in north Norway.

**Study design.** A cross-sectional population-based study, which included questionnaires and a radiographic examination of the hips.

**Methods.** A total of 1,723 individuals were invited to participate in a general health survey. Of these, 78.2% attended the screening and filled out a questionnaire that included questions about ethnicity and symptoms of back problems; 836 participants returned the questionnaire. Back problems were reported by 210 participants, the rest had no complaints. All 210 participants with back problems and a random sample of 206 with no back pain were invited for a radiographic examination, 75% and 76%, respectively, showed up for the examination.

**Results.** The centre-edge (CE) angle of Wiberg was found to be 28 (+/-7) and 27 (+/-7) degrees for the left and right hip, respectively. Our results showed that 17% of the Sami had definite dysplasia, 21% had light dysplasia and 62% had normal hip joints. Thus, 38% of the Sami had more or less dysplastic hips. The oldest participants had a significantly smaller CE-angle than the younger ones. However, no associations were found between acetabular dysplasia and back complaints.

**Conclusions.** A high prevalence of hip dysplasia was found in this Sami-dominant area. No significant association could be found between low back pain and dysplasia.

(*Int J Circumpolar Health* 2008; 67(1):147-153)

**Keywords:** population-based study, ethnicity, Sami, indigenous, hip joint, dysplasia, CE-angle

## INTRODUCTION

The Sami are the indigenous inhabitants of the northernmost parts of the Scandinavian countries and Russia. The majority of Sami live in Norway.

The Sami's skeletal-muscle system has been subject to many descriptions and speculations since Linnè described it in his travel diaries from Swedish Lapland in 1732 (Carl von Linne, *Laplandsresan*, 1739). Linnè noted that the Sami walked as if they suffered from dislocated hips. He was also very engaged by the fact that they showed great stamina and were very agile and athletic.

Developmental dysplasia of the hip (DDH) has previously been reported to occur more frequently among the Sami population as compared with the general western European population (1,2). DDH refers to a continuum of abnormalities in the immature hip that can range from subtle dysplasia to dislocation. The pathophysiology and natural history of the range of morphological and clinical disorders that constitute developmental dysplasia of the hip are poorly understood. It is probably polygenetically inherited, as numerous studies have shown hereditary links in up to 25% of cases (2). However, specific heredity factors have never been established (3). Developmental dysplasia varies among ethnic populations and has an uneven geographical distribution (4,5). A high prevalence occurs in north Italy, southern Germany, the Czech Republic and Japan, while the disease is very rare in China and among African-Americans in the U.S. (2,6–10).

There have been disagreements about the etiology of the high prevalence of DDH among the Sami. On one side, we find spokespeople who support the hereditary theory, but on the other side there are those who believe in a mechanical aetiology. The Lapp (Sami) cradle theory as the reason for the high prevalence of DDH among the Sami has existed since Wessel's publication in 1918 (1). Before the First World War, it was common for Sami children to spend their first year of life in a cradle. While lying in a Sami cradle, the hips are forced into a maximal negative position with full adduction and extension and internal rotation. This position could be a possible reason for a predisposed dislocation, if not the main reason for the development of this disease.

The concept of acetabular coverage refers to the radiographic relationship of the superolateral roof of the acetabulum to the femoral head, as quantified by the centre-edge (CE) angle of Wiberg (11). Normally the CD-angle is above 24 degrees, while a CD-angle below 20 degrees is considered acetabular dysplasia. It is generally accepted that hip dysplasia is a major cause of secondary osteoarthritis (OA) (2,12–14). Furthermore, hip problems have been assumed to influence the joints in the knee or cause low back pain. On the basis of these considerations, a cross-sectional population-based study of 2 Sami municipalities, Karasjok and Kautokeino, was undertaken. The aim of the study was to investigate the acetabular coverage of the femoral head as evaluated by the CE-angle. The other objective of the study was to investigate a possible correlation between acetabular dysplasia and back problems.

## MATERIAL AND METHODS

### Geographic and population characteristics

The Sami are the native people of northern Scandinavia. In Norway, there are approximately 50–70,000 Sami inhabitants. Genetically, the Sami are to some extent mixed with other Scandinavian populations, but genetic distinctions can still be traced. The Sami are an ethnic minority in Norway, but in the municipalities of Karasjok and Kautokeino, which belong to the county of Finnmark, they constitute the majority of the population (>80%).

In the municipalities of Karasjok and Kautokeino, 1,723 individuals were invited to participate in a general health survey in 1987, and 1,347 persons (78.2%) attended the screening. A questionnaire to be filled in at home and returned by mail was distributed to those who attended the screening. It included questions concerning ethnicity (when 2 or more of the grandparents were Sami, clients were defined as Sami) and symptoms of back problems (back pain longer than 4 weeks during the last year). Out of the 1,347 participants, 1,130 (84%) declared that they were Sami, of whom 424 men and 412 women (74%) returned the questionnaire (Table I). Back problems were reported by 210 participants (25%), while 626 had no back complaints. All 210 participants with back problems were invited to a radio-

graphic examination, of whom 158 (75%) turned up. Furthermore, a random sample of 206 participants among those with no back complaints were invited to participate as a control group, of whom 157 (76%) showed up for the examination (Table I).

A customary standing anteroposterior radiograph was taken with the feet pointing straight forward. The same radiology technicians recorded all the pictures. The Wiberg CE-angle was defined as the angle formed by a line from the centre of the femoral head to the lateral margin of the acetabular roof, and a line perpendicular to that joining the centres of the two femoral heads as described by Wiberg (11).

The films were read by an orthopaedic specialist who was unaware of the clinical status of the subjects. The minimum CE-angle from the left or right side of each subject was used in the statistical calculations. According to Wiberg (11), we defined CE-angles greater than 24 degrees as normal, angles between 20 and 24 degrees as subnormal or light dysplastic, while angles below 20 degrees were defined as pathologic.

### Statistics

The statistical analysis was performed in SPSS v12. Chi-square tests were used as appropriate and p values less than 0.05 were considered to be statistically significant. Pearson's correlation

**Table I.** Sami invited to participate in the population study.

Age groups(yrs)	Sami attending the screening			Sami respondents			Sami examined with X-ray		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
20–39	146	146	272	112	100	212	25	35	60
40–49	209	205	414	157	145	302	48	58	106
50–64	207	122	429	155	167	322	77	72	149
Total	562	573	1135	424	412	836	150	165	315

analysis was performed between right and left CE-angles. Normal distribution was tested by Q-Q plots.

A linear regression analysis was performed to examine for possible differences in CE-angles between the back pain group and the control group. The smallest CE-angle of the left and right side was defined as a dependent variable, against the independent variables of age, gender and back pain.

**Ethics**

The study was approved by the Regional Ethical Committee for Medical Research in

North Norway. The national Datainspectorate (Datatilsynet) gave us permission to establish personal records. This work was supported by Medisinsk forskning I Finnmark, at the University of Tromsø.

**RESULTS**

The figures of mean CE-angles in different age groups are given in Table 2. The average CE-angle was 27.6 (SD+/-7) degrees. A small non-significant difference between the left and right mean CE-angles was noted in

**Table II.** Mean CE-angle in Sami males and females.

Gender		CE-angle right degree	CE-angle left degree
Female	Mean±SD	26,24±7,65	28,12±7,37
Male	Mean±SD	27,66±6,63	28,49±6,16
Total	Mean±SD	26,91±7,20	28,30±6,80

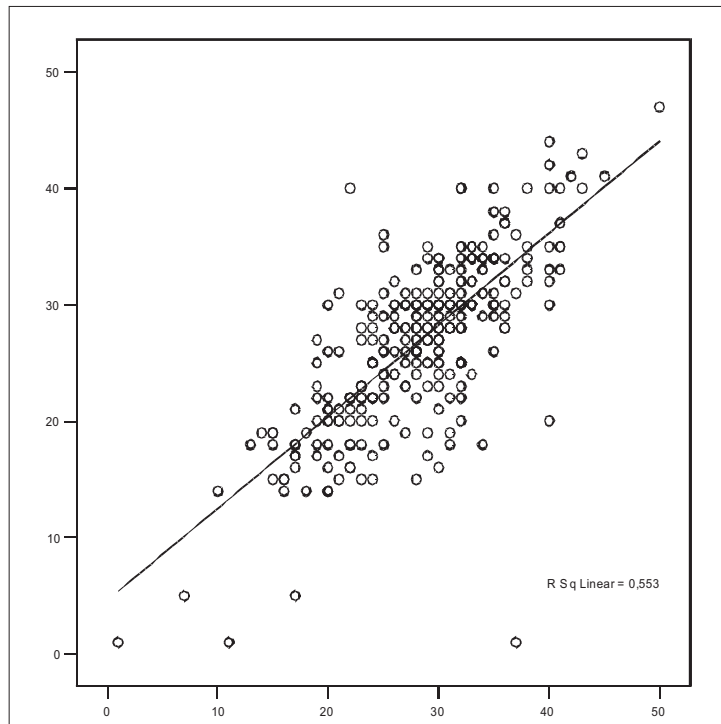


Figure I. Pearson correlation between Wiberg angles of right and left hip (p<0.001).

both genders. There was a high correlation between the CE-angle from the right and left side (Figure 1).

A linear regression analysis was performed to test for a possible difference in the CE-angle between the individuals with back complaints and those without. However, we did not find any significant association between back pain and gender on the CE-angle. The smallest mean CE-angles of the left and right side hip with 95% confidence intervals from the back-pain group and the non-back-pain group are presented in Table III.

There was a significant linear trend ( $p < 0.007$ ) towards a lower minimum CE-angle with increasing age, which persisted after adjustment for gender and back pain. If back pain was removed from the model, gender then yielded a P value of 0.089 (Table IV).

Table IV shows the prevalence of acetabular dysplasia with different degrees: 17% of the Sami had definite dysplasia, 21% had light dysplasia and 62% had normal hip joints. Thus, 38% of the Sami more or less had dysplastic hips, with it being more predominant among the women.

**Table III.** Smallest mean CE-angle of the left and right side hip in those with and without back pain and their 95% CI.

Age group (yrs)	Back-pain group		Non-back-pain group	
	n	CE-angle degree (95% CI)	n	CE-angle degree (95% CI)
20–39	23	26,5 (24,4–28,7)	37	27,7 (25,4–30)
40–49	43	25,2 (23–27,4)	63	27,3 (25,6–29,1)
>50	92	25,2 (23,8–26,6)	57	24,4 (22,5–26,3)
Mean	158	25,4 (24,3–26,4)	157	26,4 (25,2–27,5)

**Table IV.** A linear regression model was constructed with the smallest CE-angle as the dependent variable and age, gender and back pain as the independent variables ( $CE = \text{Constant} + \beta_1 \cdot \text{age} + \beta_2 \cdot \text{gender} + \beta_3 \cdot \text{back pain}$ ). If back pain was removed from the model, gender yielded a p value of 0.089.

Model summary	Mean square (df):	f	r <sup>2</sup>	p
ANOVA	Model: 176 (3) Error: 47 (311)	3.74	0.035	0.012
Coefficients	$\beta$ (95% CI)	t		p
Gender (f vs. m)	-1.35 (-2.89 0.18)	-1.74		0.083
Age	-0.12 (-0.21 -0.03)	-2.69		0.007
Back pain (y vs. n)	-0.68 (-2.23 0.87)	-0.86		0.388

**Table V.** Prevalence of dysplasia in Sami males and females.

	n	Raw data prevalence		Weighted prevalence	
		Definite (%)*	Light (%)**	Definite (%)	Light (%)
Men	150	14	17	12	14.5
Women	165	21	24	22	22
All	315	17	21	17	19

\*CE-angle <20 degrees.

\*\*CE-angle 20–24 degrees.

## DISCUSSION

Femoral head coverage is the most significant factor in the normal development of the hip. Of the many radiographic indices reported, the CE-angle of Wiberg (11) is one of the most applicable indicators of lateral coverage of the femoral head in the coronal plane. Radiographic indices of the pelvis may be influenced by tilting. However, according to Anda et al. (15), pelvic incline while standing and supine pelvic radiographs vary insignificantly. Wiberg (11) described the normal range of the CE-angle by measuring radiographs of 100 asymptomatic volunteers aged 20-35 years. He concluded that CE-angles greater than 25 degrees were normal, angles between 24 and 20 degrees were borderline, while angles below 20 degrees were pathological. These ranges have been confirmed in other investigations, and the average CE-angle has been found to be 37(+/-10) degrees (16,17). In the present study, we found that the figures in the Sami population were far below these ranges. In a recent study from Copenhagen (12), 5% of the population had definite dysplasia compared with 17% of the Sami population, giving a highly significant difference ( $p < 0.0005$ ).

It is well known that the risk of abnormal development of the hip in the Sami population is greater than among Norwegians (2). Our study may support the assumption that there are genetic variations in the anatomy of the hip joint. In the Sami population, the

small CE-angle reflects a rather dysplastic acetabulum and poor coverage of the femoral head as compared with what has been described in other populations. This situation could destabilise the hip.

On the other hand, undiagnosed/untreated congenital dysplasias of the hip in the first years of life tend to result in acetabular dysplasia acetabular in adult life. It is well accepted that the inadequate health care system of the Sami population may account for such consequences. Also, we found that the oldest participants had significantly smaller CE-angles than the younger ones. These observations could be interpreted in view of the improper health care provided to the Sami some generations ago for early diagnostics and treatment of DDH.

High frequency of back pain has previously been described in the Sami population (18). This phenomenon is shown to be age-related. An aim of our study was to investigate a possible correlation between acetabular dysplasia and hip instability and back complaints. However, no such associations were detected. The CE-angles, as indices of acetabular dysplasia and hip instability, were equal in the participants with and without back complaints.

In conclusion, the previously described high prevalence of hip dysplasia in the Sami population could be confirmed in the present population study. However, no significant association between low back pain and dysplasia could be detected.

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