

# The Prevalence of Diffuse Idiopathic Skeletal Hyperostosis in Korea

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**ABSTRACT. Objective.** To identify the prevalence of diffuse idiopathic skeletal hyperostosis (DISH) in a large Asian population group.

**Methods.** A total of 3595 subjects (1616 men and 1979 women) over 50 years of age, residing in 2 cities in Korea, were included in this study. The mean age of the study population was  $64.25 \pm 9.06$  years. We reviewed lateral chest radiographs through Picture Archiving and Communication Systems (PACS) and identified DISH according to Resnick's and Julkunen's criteria.

**Results.** One hundred and four (2.9%) of the 3595 subjects were diagnosed with DISH according to classical Resnick criteria. A slight increase in prevalence (4.1%) could be seen using Julkunen's criteria. The prevalence of DISH increased with age, except for the 90-99 year age group. Men were approximately 7 times more likely to have DISH than women using Resnick's criteria.

**Conclusion.** DISH is an age-related skeletal disorder whose overall prevalence is much lower in Koreans than in other Western populations. Interestingly, the prevalence of DISH was 7 times higher in men. We propose that ethnic factors are important elements in the prevalence of DISH. (J Rheumatol 2004;31:2032-5)

*Key Indexing Terms:*

DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS

PREVALENCE

Diffuse idiopathic skeletal hyperostosis (DISH) is a relatively common ossifying diathesis characterized by flowing ligamentous ossification and calcification of the anterolateral part of the vertebral body with relatively well-preserved intervertebral disc space<sup>1</sup>. Thoracic spinal involvement in dish is more common than cervical or lumbar spine<sup>2</sup> involvement; but radiologic manifestations of DISH can be found even in the extraspinal peripheral skeleton<sup>3-6</sup>.

Epidemiologic studies have been carried out to determine the prevalence of DISH in some selected populations or countries, i.e., USA<sup>7,8</sup>, South Africa<sup>9</sup>, Israel<sup>10</sup>, and European countries including Finland<sup>11,12</sup> and Hungary<sup>13</sup>. The overall prevalence according to these studies is quite variable,

ranging from 3.6% to 28%, depending on the diagnostic criteria or study populations. The prevalence of DISH in an Asian population has been studied as part of a mixed population study undertaken in the USA<sup>7</sup>. However, there are no large-scale epidemiological studies based on Asian populations who reside in the Asian region. Because DISH is a relatively common disease in the clinical field, with various clinical symptoms and signs, it is necessary to determine the prevalence of DISH in different ethnic groups. Our study was designed to estimate the prevalence of DISH in a large Asian population group.

## MATERIALS AND METHODS

**Subjects.** Consecutive subjects from 2 different cities in Korea were recruited for this study. The 3595 subjects had visited the hospital as inpatients or outpatients unrelated to musculoskeletal symptoms and signs from March 2003 to July 2003. Patients were over 50 years old at the time of screening; screenings were carried out at 2 university hospitals, the Hanyang University Medical Center (HUMC) and the Catholic University of Daegu Medical Center (DCMC), located in Seoul and Daegu, respectively.

**Screening methods.** Lateral chest radiographs of the 3595 subjects were reviewed. This radiographic review was performed in 2 steps. First, the radiographs were screened by 6 rheumatologists (Kim SK, Choi BR, Jun JB, Choe JY, Kim CG, Chung SH) at the 2 hospitals (HUMC and DCMC). After the screening test, an experienced radiologist (Joo KB) specialized in musculoskeletal radiology confirmed the radiographs to make a definite diagnosis of DISH. We used the Picture Archiving and Communication System (PACS, Piview STAR<sup>TM</sup>), manufactured by INFINIT Technology, Seoul, Korea, to review lateral chest radiographs.

**Diagnostic criteria.** The criterion used for the definite diagnosis of DISH was the presence of 4 or more vertebral bodies with contiguous ligamen-

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tous ossification and calcification, known as Resnick's criteria<sup>1</sup>. A probable diagnosis was made when at least 3 contiguous vertebral bodies were involved (Julkunen's criteria<sup>12</sup>).

**Statistical analysis.** A descriptive analysis was used for evaluating the distribution of DISH in different sex and age groups. Spearman's rank correlation test was performed to estimate the correlation between sex and DISH development according to diagnostic criteria. Odds ratios (OR) and confidence intervals (CI) of the 2 parameters, sex and DISH, were also calculated by chi-square test; p values less than 0.05 were considered significant. All statistical analyses were performed using SPSS software, version 11.0 (SPSS, Chicago, IL).

## RESULTS

**Clinical characteristics.** Lateral chest radiographs of 3595 subjects from 2 cities in Korea (2406 in Seoul, 1189 in Daegu) were involved in this study. The mean age was 64.25 ± 9.06 years; 55% (n = 1979) of the subjects were men and 45% (n = 1616) were women (Table 1). Although there was a significant difference in distribution of sex and age groups between the 2 hospital groups, we considered the 2 groups as a single population group for this prevalence study. The prevalence of DISH was highest at the age group between 60 and 69.

**Prevalence of DISH.** One hundred and four (2.9%) of the 3595 subjects were diagnosed with DISH according to the classical Resnick criteria (Table 2). If we used Julkunen's

Table 1. Distribution of study population according to sex and age groups.

	HUMC	DCMC	Total
Age, mean ± SD	63.63 ± 8.88	65.5 ± 9.30	64.25 ± 9.06
Sex (%)			
Male	1032 (28.7)	584 (16.3)	1616 (45.0)
Female	1374 (38.2)	605 (16.8)	1979 (55.0)
Male to Female	1:1.33	1:1.04	1:1.22
Age group, yrs (%)			
50-59	868 (24.1)	351 (9.8)	1219 (33.9)
60-69	924 (25.7)	453 (12.6)	1377 (38.3)
70-79	482 (13.4)	284 (7.9)	766 (21.3)
80-89	126 (3.5)	93 (2.6)	219 (6.1)
90-99	6 (0.2)	8 (0.2)	14 (0.4)
Total (%)	2406 (66.9)	1189 (33.1)	3595 (100)

HYMC: Hanyang University Medical Center, DCMC: Catholic University of Daegu Medical Center.

Table 2. Prevalence of DISH in Korea by diagnostic criteria.

	Resnick*	Julkunen**
Male (n)		
% within sex	5.4 (88/1616)	7.1 (115/1616)
% of total	2.5 (88/3595)	3.2 (115/3595)
Female (n)		
% within sex	0.8 (16/1979)	1.6 (31/1979)
% of total	0.4 (16/3595)	0.9 (31/3595)
Overall	2.9 (104/3595)	4.1 (146/3595)

\* Four continuous ligamentous ossification and calcification. \*\* Three or more continuous ligamentous ossification and calcification.

criteria that require only 3 involved vertebral bodies for the diagnosis of DISH, the prevalence increased slightly to 4.1%. Table 2 also shows the prevalence of DISH between sex groups according to diagnostic criteria. The prevalence of DISH rose progressively with increasing age from 1.1% to 9.1%, except for the 90-99 year age group (Figure 1). When applying Resnick's criteria, men were 7.1 times more likely to have DISH than women (RR: 7.1, 95% CI 4.13-12.09, p < 0.01) (Figure 2). The relative risk of male to female decreased to 4.8 when using Julkunen's criteria (RR: 4.8, 95% CI 3.22-7.20, p = 0.01).

## DISCUSSION

Various synonyms for DISH have been described in the past few decades. Historically, Meyer and Forester introduced thoracic spinal hyperostosis and calcification as moniliform hyperostosis in 1938<sup>14</sup>. In 1950, Forestier and Rotes Querol differentiated DISH from other spinal diseases and described the novel term senile ankylosing hyperostosis of the spine<sup>15</sup>, after which this spinal abnormality was referred to as Forestier's disease. The term DISH was first introduced by Resnick as a more appropriate description of the disease in 1975<sup>16</sup>. A year later, Resnick and Niwayama

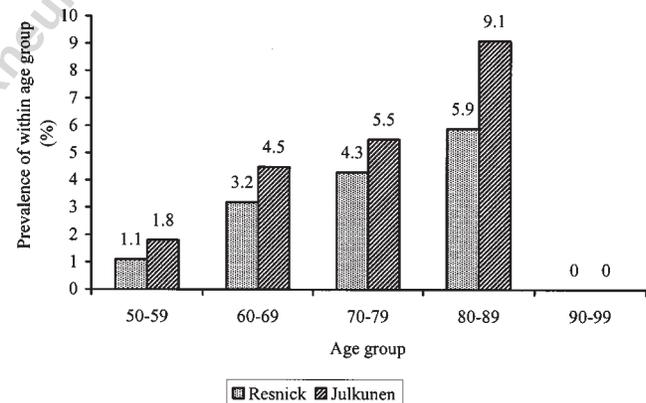


Figure 1. Prevalence of DISH according to age grouping reveals increase with age, except in the 90-99 year age group. The prevalence using Resnick's criteria ranges from 1.1% to 5.9%, whereas using the less strict Julkunen criteria, higher prevalence is seen.

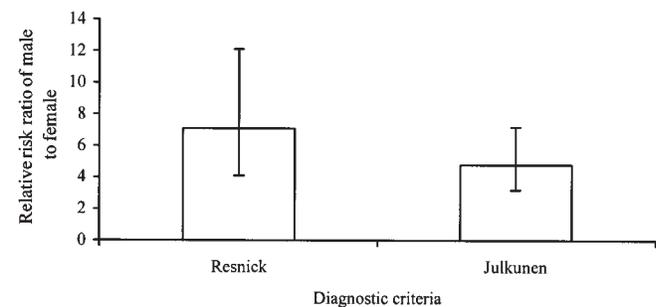


Figure 2. Relative risk ratio between sex and development of DISH. Male to female ratio using Resnick's criteria is higher than with Julkunen's (p < 0.05).

suggested a schematic diagnostic criterion for DISH through an analysis of 215 cadaveric spines and 100 patients with the disease<sup>1</sup>.

This disease entity has mainly been diagnosed by plain chest radiographs. In the initial studies, posteroanterior and lateral chest radiographs were used as screening methods. More recently, some groups utilized computed tomography, cadaveric autopsy<sup>8</sup>, and magnetic resonance imaging<sup>17</sup> for studying the disease. In our study, we used lateral chest radiographs as a method for screening and diagnosing DISH for several reasons. First, radiological findings matched with DISH are most commonly found in the thoracic spine<sup>2</sup>. Second, lateral chest radiographs reveal a relatively high, consistent result in screening DISH and can be reviewed by other radiologists. Mata, *et al*<sup>18</sup> confirmed that chest radiographs are reliable and reasonable as a screening method for DISH. In their study, the sensitivity and specificity of lateral chest radiographs in detecting DISH were 77% and 97%, respectively. Third, the chest radiograph is a readily available and relatively safe method, with low dose radiation.

PACS is a newly developed computerized radiologic method that replaces conventional radiological film. There is no significant difference between conventional films and PACS images in detecting parenchymal and mediastinal chest lesions<sup>19</sup>. However, no data are available as to whether PACS is effective for diagnosing skeletal disorders. We used PACS in our study based on several advantages of this system introduced by Strickland<sup>20</sup>. First, all acquired images are available, at any time, if images are stored. Second, soft tissue and bony structures are well identified by regulating the contrast width and level. Third, we may easily and automatically arrange vast and complex data.

The diagnostic criteria for DISH have not yet been precisely established, and although most clinicians use the so-called Resnick's criteria<sup>1</sup>, several studies have used variable criteria (Table 3). Some authors, including Utsinger<sup>21</sup>, indicated that previous criteria for DISH had high specificity at the expense of sensitivity. In 1985, Utsinger<sup>21</sup> presented his novel and convenient diagnostic criteria that included several categories. Recently, however, some authors have returned to Julkunen's instead of Utsinger's criteria, because the former is a much simpler and easier method. Besides Resnick's criteria, we also used Julkunen's criteria for estimating the prevalence of DISH in our study.

The etiology and pathogenesis of DISH are still unclear. According to several studies, the endocrine, metabolic, and genetic factors are all possible etiologic factors. A number of clinical studies investigated whether correlations between metabolic and endocrine problems and DISH exist. Some authors reported that patients with DISH had a higher serum uric acid level and a higher incidence of diabetes mellitus and obesity<sup>22-25</sup>. Several studies and authors have sought to identify a relationship between DISH and the HLA gene locus<sup>26-28</sup>. There have been debates whether an association of DISH and HLA-A or B locus exists in terms of its pathogenesis. Clinical information and laboratory findings were not evaluated and reviewed in our research, so we could not estimate the association between endocrine, metabolic, and genetic factors and the development of DISH.

In 1985, Utsinger observed that ethnic or racial differences influenced the prevalence of DISH in his review article, based on observations of Pima Indians living on the Gila River reservation in Arizona, USA<sup>21</sup>. Pima Indians have high prevalence of DISH, particularly in men over age 65, who had an incidence of 54%<sup>29</sup>. Recently, Weinfeld, *et*

Table 3. Prevalence studies of DISH.

Study, Year	n	Method of Screening	Age, yrs	Diagnostic Criteria	Prevalence		Country
					Overall, %	Sex, % M:F ratio	
Julkunen <sup>12</sup> , 1975	T: 8993 M: 4225, F: 4768	Chest lateral	> 40	Julkunen <sup>12</sup>	2.6	M: 3.8 F: 2.6	1.5: 1 Finland
Boachie-Adjei <sup>8</sup> , 1987	T: 75 M: 45, F: 30	Autopsy, chest AP & lateral, oblique, CT scan	> 45	Forestier <sup>15</sup>	28	M: 31 F: 23	1.3: 1 USA
Cassim <sup>9</sup> , 1990	T: 1500 M: 1092, F: 408	Chest lateral	> 40	Resnick <sup>1</sup> and Bloom <sup>10</sup>	3.9	M: 3.8 F: 4.2	0.9: 1 South Africa
Weinfeld <sup>7</sup> , 1997	T: 2364 M: 1107, F: 1257	Chest PA & lateral	> 50	Resnick <sup>16</sup>	NM	M: 25 F: 15	1.5: 1 USA
Kiss <sup>13</sup> , 2001	T: 635 M: 307, F: 328	Chest PA & lateral, dorsal, lumbar	> 50	Resnick 3 <sup>1</sup>	3.6	M: 6.1 F: 1.2	5: 1 Hungary
Kim, 2004	T: 3595 M: 1616, F: 1979	Chest lateral (PACS)	> 50	Resnick <sup>1</sup>	2.9	M: 5.4 F: 0.8	7.1: 1 Korea
				Julkunen <sup>12</sup>	4.1	M: 7.1 F: 1.6	4.8:1

T: total, M: male, F: female, Chest PA: chest posterior-anterior, CT scan: computed tomographic scan, NM: not mentioned, PACS: Picture Archiving and Communication Systems.

al suggested that genetic or hereditary differences are more important predisposing factors for DISH<sup>7</sup>. In their prevalence study, patients from ethnic populations were included: 667 white, 144 black, 72 Native-American, 11 Hispanic, and 30 Asian patients. They showed that the Asian, black, and Native-American populations had a remarkably lower prevalence of DISH, although the study population was small. The prevalence of DISH was estimated to be 2.9% to 4.1% according to the diagnostic criteria used in our population study, compared to the generally accepted prevalences of approximately 10% of men and 8% of women over the age of 70 years in Caucasian populations<sup>30</sup>. Our results again confirm the lower prevalence of DISH in the Asian population: Compared with the prevalence of DISH in other studies including subjects over 40 years of age<sup>9,12</sup>, our data including only subjects over 50 showed a lower prevalence. In our study, the prevalence in men was nearly 7 times higher than in women according to Resnick's criteria. Our overall prevalence and relative risk for sex are similar to the results in Hungary<sup>13</sup>.

In summary, the overall prevalence of DISH in Koreans is lower than in Caucasians. The prevalence in Korean women was much lower than in Korean men, although the distribution of sex was similar. We suggest that the prevalence of DISH is possibly influenced by the ethnic factors.

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