The Prevalence of Diffuse Idiopathic Skeletal Hyperostosis in an Outpatient Population in the Netherlands

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ABSTRACT. ***Objective.*** In diffuse idiopathic skeletal hyperostosis (DISH), spinal ankylosis may occur due to longitudinal ligament ossification. DISH can lead to back pain, impaired mobility, and displaced fractures after minor trauma. Its etiology is unknown, but is associated with obesity and type 2 diabetes mellitus. We investigated the prevalence of DISH in an outpatient population in the Netherlands.

Methods. Chest radiographs of 501 patients (age > 50 yrs) referred to our institution by general practitioners for non-spine-related conditions were reviewed. DISH was established according to defined criteria; 3-level involvement was defined as pre-stage DISH. Logistic regression analysis was used to investigate the influence of age and sex on the prevalence of DISH.

Results. The overall prevalence of DISH was 17.0% (95% CI 13.7–20.3). A significant increase with age was observed (odds ratio 1.03, 95% CI 1.01–1.05; p = 0.006). The odds ratio of male sex was 1.85 (95% CI 1.20–2.86; p = 0.006). The individual predicted probability of developing DISH was 32.1% in 80-year-old men and 16.9% in women of the same age. Pre-stage DISH was found in 4.6% of the individuals and was more frequent in women.

Conclusion. The prevalence of DISH in this outpatient cohort was 17.0%, which is high compared to recent reports. Age and sex were significantly related to the presence of DISH, suggesting that men and older individuals have a higher probability of developing DISH. (First Release June 1 2008; J Rheumatol 2008;35:1635–8)

Key Indexing Terms:
DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS PREVALENCE SPINE AGE

Diffuse idiopathic skeletal hyperostosis (DISH) is a common musculoskeletal disorder in which ligaments and entheses slowly become ossified, eventually leading to decreased mobility of the affected region[1]. DISH is observed mostly in the elderly and demonstrates a male predominance[2]. Its etiology is unknown, but it is associated with obesity and type 2 diabetes mellitus[3,4]. DISH has received little attention in clinical literature compared to other ankylosing disorders such as ankylosing spondylitis (AS), probably since its symptoms are usually mild, consisting of minor back pain and/or a slight loss of function[5,6]. More serious complications of DISH, however, have also been described, such as myelopathy and spinal canal stenosis[7-9]. Similar to patients with AS, patients with DISH may experience complete spinal ankylosis. Fusion of multiple spinal segments subsequently leads to stiff and long lever arms on which forces can act, potentially leading to displaced and unstable fractures, even after minimal trauma[10-12]. Since patients with DISH may have a history of back pain and interpretation of their radiographs can be difficult due to pathological osseous changes, they have an increased risk of delayed fracture diagnosis[13].

Prevalences of DISH range from 2.9% in a Korean population[14] to 25% in Caucasian men in the USA[15]. Since the reports from Julkunen, *et al* in 1975[16] and 1981[17], the most recent Western European data have been published by Pappone, *et al*[18], reporting a prevalence of 15.1% in a cohort of Italian women. Acknowledging that DISH may be associated with type 2 diabetes, obesity, and advanced age, all typical traits of modern affluent societies, its prevalence can be expected to increase during the coming decades[19,20].

We assessed the current prevalence of DISH in an outpatient population of individuals over 50 years of age in the Netherlands and calculated individual predicted probability of developing DISH.

MATERIALS AND METHODS

Radiographs of all patients over 50 years of age visiting the outpatient clinic of the Department of Internal Medicine for a first consultation from October 2004 until October 2006 were selected from the radiological database of our institution by means of a coding system. All patients were referred to the outpatient clinic by general practitioners for various medical

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conditions. From this group consisting of 1065 patients, the posteroanterior (PA) and lateral chest radiographs of the first 501 consecutive patients (in alphabetical order) were reviewed by 2 authors (LAW and HMEQvU). When consensus on the diagnosis could not be reached, a third investigator (JJV) was consulted. The original radiological reports were retrieved for formal assessment of thoracic pathology.

All chest radiographs were acquired with computed radiography equipment (Optimus ZP33; Philips Medical Systems, Eindhoven, the Netherlands), using a standardized technique (125 kV with 2 lateral fields; 200 cm film-focus distance). The images were examined with a Picture Archiving and Communication System (PACS) viewer (Philips) with a 1536 × 2048-pixel monitor able to display 256 shades of grey (3MP2FH; Barco, Kortrijk, Belgium). Tools regularly used in PACS were threshold, zoom, and invert.

DISH was established when the radiological criteria of Resnick and Niwayama were fulfilled on the PA or lateral view or both[21]. Ossification of the anterior longitudinal ligament over 3 contiguous vertebral bodies (i.e., 2 discs bridged) was considered to be the likely precursor of fully developed DISH and defined as "pre-stage DISH"; this was recorded separately to provide insight into the natural course and progression of DISH. Individuals with inconclusive radiographs, regardless of cause, were scored as non-DISH subjects.

SPSS (version 12.0.2) was used for statistical evaluations. Logistic regression analysis was performed to investigate the influence of age and sex on the prevalence of DISH. To differentiate correctly in this analysis, individuals diagnosed with pre-stage DISH were regarded as non-DISH subjects. Finally, the individual predicted probability of developing DISH was calculated. In this analysis, which was directly retrieved from the logistic regression model, the individual predicted lifetime risk of developing DISH, according to age and sex, was calculated.

RESULTS

The mean age of all study subjects was 66.6 ± 10.7 years (range 50–91 yrs); 45.7% of subjects were male. The mean age of individuals with defined DISH was 69.6 ± 10.0 years, versus 66.0 ± 10.8 years for subjects not displaying DISH. The overall prevalence of DISH in this cohort was 17.0% (95% CI 13.7–20.3). Prevalence increased with advancing age, to 23.4% (95% CI 16.6–30.4) in patients 70–79 years of age (Table 1). DISH was established in 22.7% (95% CI 17.3–28.1) of the men and in 12.1% (95% CI 8.3–16.0) of women of the entire group (Table 2). Pre-stage DISH was found in 4.6% (95% CI 2.8–6.4) of subjects and was more frequent in women. The male/female ratio of those with DISH was 1.6:1, in pre-stage DISH it was 0.6:1. The overall male/female ratio in this cohort was 0.8:1.

Logistic regression analysis showed that both male sex and age were significantly related to the presence of DISH. The odds ratio for sex was 1.85 (95% CI 1.20–2.86; p = 0.006). For increasing age the odds ratio was 1.03 (95% CI 1.01–1.05; p = 0.006), demonstrating men and older individuals would have a higher probability of developing DISH. The relationship between age, sex, and the probability of developing DISH is depicted in Figure 1. Men 60 years of age, for instance, have an individual predicted probability of developing DISH of 18.8%; by the age of 80 this risk is increased to 32.1%. Women have 9.1% chance of having DISH when they are 60 years old; by the age of 80 years this risk has almost doubled, to 16.9%.

The diagnosis DISH was not described in any of the radiological reports. In 97.6% of the affected subjects the diagnosis of DISH could be established on the PA radiograph, versus 40.0% on the lateral view. In 2 cases DISH was detectable on the lateral view only. In 36 patients (7.2%), radiological assessment of DISH was inconclusive because of superimposition of intrathoracic structures and/or poor radiographic quality.

DISCUSSION

In this study of 501 subjects over 50 years of age visiting the outpatient internal medicine clinic for various unrelated conditions, we found the overall prevalence of DISH to be 17.0%, which is high compared to the available literature. The most recent data concerning the prevalence of DISH in a Western European society are from Pappone, *et al*[18], who

Table 1. Prevalence of DISH stratified in 10–year age groups: number of patients (percentage; 95% confidence interval).

Status	Age Group			
	50–59	60–69	70–79	80+
No DISH	139 (84.8; 79.3–90.3)	97 (77.0; 69.6–84.3)	108 (74.5; 67.4–81.6)	49 (74.2; 63.7–84.8)
Pre-stage DISH	7 (4.3; 1.2–7.4)	8 (6.3; 2.1–10.6)	3 (2.1; –0.25–4.4)	5 (7.6; 1.2–14.0)
DISH	18 (11.0; 6.2–15.8)	21 (16.7; 10.2–23.2)	34 (23.4; 16.6–30.4)	12 (18.2; 8.9–27.5)
Total	164 (100.0)	126 (100.0)	145 (100.0)	66 (100.0)

Table 2. Prevalence of DISH by sex: number of patients (percentage; 95% confidence interval).

Status	Women	Men	Total
No DISH	225 (82.7; 78.2–87.2)	168 (73.4; 67.6–79.1)	393 (78.4; 74.8–82.0)
Pre-stage DISH	14 (5.2; 2.5–7.8)	9 (3.9; 1.4–6.5)	23 (4.6; 2.8–6.4)
DISH	33 (12.1; 8.3–16.0)	52 (22.7; 17.3–28.1)	85 (17.0; 13.7–20.3)
Total	272 (100.0)	229 (100.0)	501 (100.0)

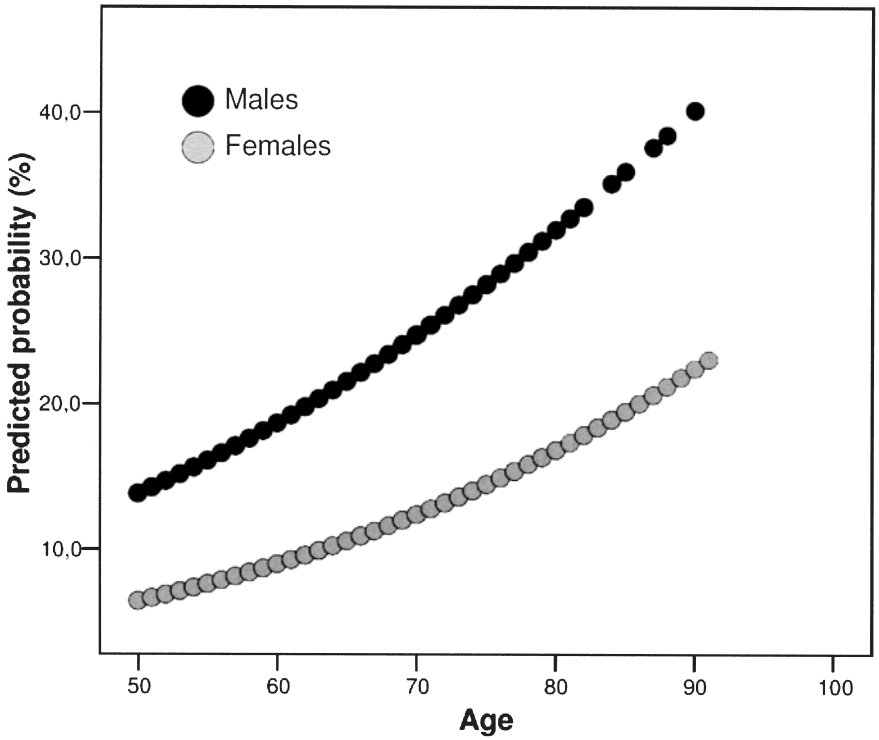

Figure 1. Individual predicted probability of developing DISH, according to age and sex.

reported a prevalence of DISH of 15.1% in a cohort consisting of 93 Italian women over 40 years of age. Their results are comparable to the findings for our cohort of women.

Julkunen, *et al* performed a large population based study in the early 1980s, in a cohort of 9000 individuals over 40 years of age, which was representative for the general population of Finland[16,17]. They found hyperostosis in 3.8% of men and 2.6% of women. Unfortunately, they did not use the formal Resnick and Niwayama criteria in their survey, and their methodology differs considerably from ours, making the results less comparable and difficult to interpret.

Kiss, *et al* reported a high prevalence in their epidemiological survey in Budapest, Hungary, in 2002[22]. Using the modified Resnick 2 criterion (2-level bridging over 3 adjacent vertebral bodies) they found DISH to be present in 27.3% of the men and 12.8% of women[16]. In our study, 2-level bridging was defined as pre-stage DISH, because it was considered to be the precursor of actual DISH; this was present in 4.6% of our subjects. Three-level bridging over 4 contiguous vertebrae, meaning DISH as originally defined by Resnick and Niwayama, was present in 6.1% of men and in 1.2% of women in the cohort described by Kiss and coworkers. The difference in prevalence of DISH between their report and our study could result from the fact that their oldest patient group was 70–79 years, while we included patients over 80 years as well. Further, modern lifestyle-related diseases such as obesity and type 2 diabetes mellitus, both associated with the development of DISH, have appeared in Western European countries like The Netherlands decades earlier than in most East European countries, arguably explaining another important factor for this difference in prevalence[19].

Weinfeld, *et al* studied more than 2300 hospitalized and outpatient individuals from 2 different hospitals in Minneapolis, MN, USA, in 1997 using the formal Resnick-Niwayama criteria, and found a prevalence of 25% in men and 15% in women[15]. The prevalence results in our outpatient population are comparable to theirs, suggesting exposure to similar risk factors for developing DISH in North America and Western Europe.

Interestingly, we found a higher prevalence of pre-stage DISH in women than in men (male/female ratio of 0.6:1). Although there were no women with pre-stage DISH in the group aged 70–79 years, the trend indicates that the prevalence of pre-stage DISH also increases with age. It seems likely that in men, DISH develops at a younger age, demonstrates a higher prevalence at any given age compared to women, and progresses faster than in women as well. In women, ligament ossification probably starts later in life and does not always progress into fully developed DISH.

A posteroanterior (PA) chest radiograph may be a reliable screening tool to diagnose DISH. In our study, DISH could be established on the PA chest radiograph in 97.6% of the subjects. DISH was detectable on the lateral view in 40.0%. Thus, we suggest that a standard PA chest view is an easily obtainable screening tool to diagnose DISH in a clinical setting. Acquiring both PA and lateral views, however, could further increase the sensitivity of this instrument[23]. In

cases where radiographic interpretation is difficult due to projection of thoracic structures or poor quality of the radiograph, a lateral thoracic radiograph could add extra diagnostic information.

The focus on specific cardiac/pulmonary/abdominal pathology in this series of chest radiographs could explain the absence of the diagnosis of DISH in the original radiological reports. It is likely that the attention of the examining radiologist was on the intrathoracic structures, rather than on skeletal pathologies, when pursuing the clinical questions. However, low level of awareness for DISH cannot be ruled out.

The etiology of DISH remains unknown, but associations with metabolic disorders such as type 2 diabetes mellitus and obesity have been suggested[3,4]. Since these conditions seem to have become endemic in Western societies due to lifestyle, DISH could become a more frequent and therefore more important disease in the coming decades.

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