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Diffuse idiopathic skeletal hyperostosis (DISH) and its relation to back pain among older men: The MrOS Study

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Abstract

Objectives—To estimate the prevalence of diffuse idiopathic skeletal hyperostosis (DISH) in a cross sectional study of elderly men age 65-100 years, and to examine back and neck pain as possible correlates of DISH.

Methods—DISH was defined using Resnick's criteria and scored according to Mata on lateral spine radiographs of 298 randomly selected participants from the MrOS Study. Standardized self-reported questionnaires were used to assess the frequency and severity of back and neck pain, and the relation of these to DISH status was estimated with Chi-square tests, as well as prevalence ratios (PR) and 95% confidence intervals using log-binomial regression models.

Results—DISH was observed in 126 older men (42%), increased with age (30%, 39%, 48%, and 56% for ages 65-69, 70-74, 75-79, and ≥80 respectively), and was positively associated with body mass index (BMI)($p=0.04$) and blood pressure ($p=0.02$). Significantly less back pain in the past 12 months was reported among men with DISH as compared to men without (59% vs. 71%, $p=0.03$) which remained after adjustment for age, BMI and blood pressure (PR=0.73, 95% CI=0.57-0.95). Back pain severity ($p=0.07$) and frequency ($P=0.06$) were also less frequent among men with DISH compared to men without; while reported neck pain was similar between groups ($P=0.39$).

Conclusions—Among community dwelling elderly men, DISH prevalence is high, increases with age, and is positively associated with BMI and blood pressure. Frequency of self reported

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back over the past 12 months was lower in older men with DISH as compared to those without DISH.

Introduction

Diffuse idiopathic skeletal hyperostosis (DISH) is an age-related disorder characterized by ossification and calcification of soft tissues like entheses and joint capsules. Evidence of the ossification can be found throughout the body, but is best visualized in the spine.¹ DISH involving the spine is identified radiographically by flowing ligamentous ossification and calcification of the anterolateral aspect of the vertebral body with relatively well preserved disc space.² Resnick and Niwayama specifically defined DISH as the radiographic finding of (1) calcification or ossification along the anterolateral aspects of at least four contiguous vertebral levels (across 3 disc spaces) with (2) relative preservation of disc height in the involved vertebral segments without degenerative disc disease.³ In 1998, Mata et al. developed a scoring system for DISH so that the presence of DISH could be reproducibly assessed.⁴ This system scores individuals that fulfill the Resnick criteria by numerically classifying each vertebral level based on the amount of ossification and whether partial or complete bridging of the disc space is present.

DISH is observed mainly in the elderly with increasing prevalence according to age.⁵⁻⁶ Men are much more frequently affected by DISH than women, with US prevalence estimates of 25% in men and 15% in women age 50 and older; estimates increase with age, up to 35% for men and up to 26% for women among those 80 years and older.⁷ The etiology of DISH is unknown, although metabolic disturbance is hypothesized to be a factor.⁸⁻¹²

Although DISH affects the spine, few studies have evaluated the association of DISH and back pain.¹¹⁻¹³⁻¹⁴ Two of three studies reported increased back pain frequency at the study visit in those with and without DISH,¹¹⁻¹³ and the other study reported no association between DISH and back pain in the past 6 months.¹⁴ One study that compared visual analog back pain scores at the study visit among DISH cases and non-cases,¹³ may have been flawed because history of back pain was an exclusion criterion for recruitment of control patients but not DISH patients. All three studies were limited by small sample sizes and were drawn from clinic populations which may be more symptomatic than community dwelling individuals. Furthermore, none of these studies reported sex-specific associations between DISH and pain. Current data indicate that DISH is more prevalent in men, which suggests that gender influences pathology.⁶⁻¹⁵⁻¹⁷ Given the sex differences in prevalence estimates, it may be important to study the relation of DISH and back pain separately among men and women. Study cohorts of older community dwelling individuals, who have not been pre-selected for disease or pain status, may provide a less biased estimate of the magnitude of the association between DISH and back pain.

The objective of this study was to estimate the prevalence of radiographic DISH in the thoracic and lumbar spine among elderly men, and to determine its association with a history of back pain in the past 12 months, as well as back pain severity and frequency. We also explored the relation of DISH in the thoracic and lumbar spine with neck pain. We used a cross sectional design and data collected from community dwelling men age 65-100 years participating in the Osteoporotic Fractures in Men (MrOS) study.

Methods

Parent Cohort

The MrOS Study enrolled 5,995 men from March 2000 through April 2002 as described elsewhere.¹⁸⁻¹⁹ Briefly, recruitment occurred at six US academic medical centers in

Birmingham AL, Minneapolis MN, Palo Alto CA, Pittsburgh PA, Portland OR, and San Diego CA. Men aged 65 years and older who were able to walk unassisted and had at least one natural hip for femoral bone density measurement were eligible for the study. The MrOS study was approved by the Institutional Review Boards at all participating institutions. All participants in the cohort provided informed consent. At enrollment, men completed a self-administered questionnaire and attended a clinic visit at their local site which included the ascertainment of thoracic and lumbar radiographs.

Spine radiographs were obtained at all enrollment sites using the same standardized protocol. Participants were placed on their left side in the lateral position with legs flexed and both arms at right angles to the body. The long axis of the spine was set parallel to the table and the mid-axillary (coronal) plane of the body was aligned to the table midline. Images were obtained from T2 to S1. All films were sent to the MrOS San Francisco Coordinating Center for central quality review, digitization and archiving. This protocol was designed primarily for the ascertainment of vertebral fracture in the cohort.

Selection of the Study Sample

To establish initial data on spinal conditions other than vertebral fracture, 300 MrOS participants were randomly sampled at baseline using a computer generated random number. Available radiographs were transferred to the authors for the assessment of DISH. Two of the films were unreadable, resulting in a study sample of 298 men.

Assessment of DISH

Ossification of each disc space level from T2 to S1 was assessed, and then graded according to the Mata scoring system.⁴ We did not include T1 in our assessment because it tended to be difficult to visualize on most films. Each vertebral level was scored as: (0) no ossification, (1) ossification without bridging, (2) ossification with incomplete bridging, and (3) ossification with complete bridging of the disc space. DISH was defined according to the Resnick criteria and required the presence of flowing ossification or calcification along the anterolateral aspect of at least 4 contiguous vertebral levels (3 disc spaces), with relative preservation of disc height.³ These three contiguous disc spaces had to have a Mata grade of 2 or 3 to be considered suitable for fulfilling the Resnick criteria.

Inter- and intra-rater reproducibility was assessed by having two raters (PD, JY) independently evaluate DISH on 35 randomly chosen images. Inter-rater and intra-rater agreement regarding presence or absence of DISH were both excellent with Kappa values of 0.88 and 0.89, respectively. Intraclass correlation coefficients for agreement on the number of levels affected were also high, being 0.97 for inter-rater reproducibility and 0.98 for intra-rater reproducibility.

Because several men had ossification with at least some bridging, but not at 3 contiguous levels, we created an ossification severity variable to count the number of vertebral levels with ossification scored as Mata grade 2 or 3. We then cross classified our severity variable with DISH status to yield 4 severity levels: No DISH with 0-2 levels affected, No DISH with 3-6 levels affected, DISH with 3-6 levels affected, and DISH with >6 levels affected.

We also evaluated the lowest vertebral level of the spine affected by DISH (lowest point of three contiguous vertebral levels). If all three lowest contiguous vertebral levels with ossification were entirely in the thoracic spine, then we classified this as 'thoracic' DISH; if the lowest 3 levels spanned the thoracic and the lumbar spine regions, then we classified this as 'thoracolumbar' DISH; and, finally, if the 3 lowest contiguous vertebral levels of DISH were entirely in the lumbar spine, then we classified this as 'lumbar' DISH.

Ascertainment of back pain and neck pain

History of back pain in the past 12 months was assessed at enrollment with questions derived from the North American Spine Society questionnaires for back and neck pain.²⁰ Men who reported any back pain were further queried about the severity of pain (mild, moderate, or severe) and the frequency of being bothered by back pain (never, rarely, some of the time, most of the time, or all of the time). Men who reported no back pain in the past 12 months were classified as having 'none' for severity of back pain. Responses for 'severe back pain' and 'always being bothered by back pain' were infrequent, so these categories were combined with the adjacent category ('moderate back pain' and 'most of the time' respectively) for analysis. All participants were queried as to whether back pain limited their usual activities.

Similar questions were asked about any neck pain in the past 12 months and the frequency of neck pain (once, 2-3 times, or ≥ 3 times in past 12 months). The answers 'once' and '2-3 times' were combined for analyses, and those reporting no neck pain were classified as a frequency of 'never.' The following question was also asked about changes in neck pain with head positioning: "Does neck pain feel better, worse, or the same when you extend your head to look upward?"

Other Measures

Comprehensive information was obtained with objective measurements and self reported questionnaires at the MrOS enrollment. Items used in this study included demographics; self-reported history of high blood pressure, diabetes, arthritis, or gout; anthropometric and systolic blood pressure measurements; and lifestyle characteristics. History of cigarette smoking was classified for analysis as never or ever. The Physical Activity Scale for the Elderly (PASE) was obtained, which provided a total physical activity score calculated from sub-scores for leisure, occupational and household activities.²¹ Height (cm) was measured using a Harpenden stadiometer. Participants were weighed (kg) on a balance beam or digital scale while wearing light indoor clothing and no shoes. Body mass index (BMI) (kg/m^2) was calculated from height and weight measures. In addition, men were queried about their weight and height at age 25, and this data was used to calculate a BMI for the men at age 25. The BMI measures were categorized as normal (18-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese (≥ 30 kg/m^2).²² The 12-item short form survey instrument (SF-12) was also used as an estimate of physical and mental health.²³

Statistical Methods

The proportion of men with DISH and 95% confidence intervals (CI) were calculated in the study sample overall and according to 5-year age groups. In descriptive analyses, distributions of baseline characteristics among men with and without DISH were estimated using chi-square tests for categorical variables or t-tests for continuous variables. The Cochran-Armitage test was used to test for trend of DISH prevalence according to age.

The association of prevalent DISH with back and neck pain frequencies was estimated with prevalence ratios (PR) and 95% CI using log binomial regression models.²⁴ All baseline characteristics that differed according to DISH status (age, body mass index (BMI), systolic blood pressure) were assessed as possible confounders, using the criteria of a $\geq 10\%$ change in the point estimate as the criterion for confounding.²⁵ Both unadjusted and multivariate adjusted PRs are presented. All statistical analyses were conducted using SAS software (SAS Institute, Cary NC, USA).

Results

Characteristics

Distributions of characteristics in the study sample and in the entire cohort were similar. For example, mean (sd) age was 74(6) years in both the study sample and the parent cohort, mean height was 174(7) cm in both, and the study sample mean for BMI was 28(4), where as the cohort mean BMI was 27(4) (data not shown). The study sample participants were mainly Caucasian (90%), approximately 60% reported a history of smoking, and most reported their health as either excellent or good (85%). Diabetes was common, with 12% reporting a diabetes diagnosis.

Distribution of DISH

DISH was observed in 126 of the 298 men evaluated (42%). The prevalence of DISH increased linearly with age (p for trend = 0.001) (Fig. 1). Compared to men without DISH, men with DISH were on average older, had higher current BMI and BMI at age 25, and higher systolic blood pressure (Table 1). Men with and without DISH did not vary from one another with respect to race, current or past weight, physical activity score, quality of life scores, smoking, or by self-reported diabetes, stroke, gout, or history of hypertension. To evaluate the inconsistency between current measured systolic blood pressure and history of hypertension according to DISH status, we restricted the analysis to men not using any prescription blood pressure medication. Differences in systolic blood pressure between the two groups remained. Among men with DISH, systolic blood pressure (mmHg) was 141 (22) on average and among those without DISH it was 132 (19), $p=0.003$. In contrast, if restricting to men taking anti-hypertensive medications, those with DISH had a similar measured systolic blood pressure (142(21) mmHg), to those without DISH (141(20) mmHg) ($p=0.65$).

We next examined the vertebral levels affected by ossification (Table 2). Among the 172 men who did not meet the criteria for DISH, 59 men (34%) had no ossification. Of the remaining 113 men, 65% had ossification of at least one vertebra, with 78 men (45%) having 1-2 levels affected and 35 men (20%) having 3 to 6 non-contiguous levels affected. Among the 126 with DISH, we observed that 52 men (41%) had 3-6 vertebral levels affected, and 74 men (59%) had greater than 6 levels affected. When we further evaluated the lowest level of the spine affected by DISH (lowest three contiguous affected disc spaces), we observed that 48 (38%) had only thoracic involvement, 62 (49%) had thoracolumbar involvement, and 16 (13%) had involvement entirely in the lumbar vertebrae. We noted that those with lumbar vertebral involvement tended to have the greatest number of vertebral levels affected by ossification.

Back pain within the past 12 months was reported by 66% of men and history of neck pain was reported by 37%. Men with DISH less often reported back pain in the past 12 months than those without DISH (59% vs. 71%, $p=0.03$). Similarly, men with DISH were slightly less likely to report severe back pain (37% vs. 42%, $p=0.07$) or being severely bothered by back pain (13% vs. 20%, $p=0.06$) than those without DISH. When asked to report the locations of reported back pain (cervical, thoracic, thoracolumbar, and/or lumbar), those with and without DISH reported similar back pain locations. (Data not shown) Neck pain did not differ between those with and without DISH in the thoracic through lumbar spinal regions. However, men with DISH were more likely to report that neck pain was worse when looking up as compared to those without DISH. Statistics are presented in table 3 including prevalence estimates, which were not materially changed by the three correlates: age, BMI, and systolic blood pressure.

As the DISH was observed at lower levels of the spine, a corresponding increase in the prevalence of self reported back pain over the past 12 months was observed (Figure 2). However, the 95% confidence intervals for prevalence of back pain overlapped, indicating that the prevalence estimates did not differ statistically from one another. Likewise, further analysis evaluating the possible association between the location of back pain (neck, upper back, mid-back, and/or low back pain) and the lowest observed level of DISH, demonstrated no significant differences between these groups. (Figure 3)

We performed a few additional sensitivity analyses to evaluate the effects of vertebral ossification on the preceding analyses. First, similar to results shown in Figure 1, we observed that the number of vertebral levels with ossification (regardless of DISH status) increases with age ($p < 0.0001$). Next, restricting to those with any ossification, men who fulfilled the criteria for DISH remained less likely to report back pain in the past 12 months (59%) compared to men with non-DISH ossification (non-contiguous levels) (73%) ($p = 0.03$). Finally, we excluded those with DISH, and observed that those with non-DISH ossification have a similar frequency of reported back pain in the past 12 months as those with no ossification (73% vs. 68% respectively, $p = 0.51$). These results indicate that the inverse association we observed between DISH and back pain prevalence was not affected by including men with non-DISH ossification in the referent group.

Discussion

In this cohort of community dwelling older men not preselected for back pain or medical reasons, DISH was present in 42%, with a nearly linear association between DISH prevalence and age. Measured systolic blood pressure, current BMI and BMI at age 25 were also positively associated with DISH. Older men with DISH were also observed to be less likely to report a history of back pain in the past year than men without DISH.

Positive associations of DISH with age and BMI,^{6-7, 15, 17, 26} and blood pressure¹⁰⁻¹¹ have been reported in the DISH literature. Our results are consistent with these findings. Our analysis of DISH and measured blood pressure stratified by antihypertensive use indicates that the relation between blood pressure and DISH may only be in men with untreated (or under treated) hypertension.

Our results counter previous reports of a positive association between DISH and back pain.^{11, 13} One group, who compared 56 outpatients with DISH to 43 outpatients with spondylolysis and 31 healthy controls, reported a significantly higher frequency of back pain and stiffness among the DISH patients.¹³ Another study reported more pain in the lumbar and thoracic spine in 18 DISH patients as compared to 20 age matched controls with osteoarthritis.¹¹ In contrast, a third study demonstrated no difference in back pain between DISH cases and controls. They evaluated chest radiographs from men and women admitted to a hospital in Finland for reasons other than back pain. The 106 DISH cases, as compared to 178 patients without DISH, reported similar frequency of back pain in the past 6 months in the cervical (28% vs. 21%), thoracic (9% vs. 7%), and lumbar spine (33% vs. 41%).¹⁴ All three of the studies cited above are limited by selection bias, where patient recruitment from a hospital or clinic may increase the likelihood of including DISH patients who are symptomatic with back pain.

We explored the relation of DISH to neck pain because of the possibility that reduction of motion in one segment of the spine could theoretically contribute to pain in another segment. We observed no association between thoracic and/or lumbar DISH and neck pain, suggesting that our hypothesis does not hold. However, since no cervical spine radiographs

were obtained in MrOS, we could not directly evaluate the relation of cervical DISH and neck pain.

Our report adds to knowledge about the distribution of ossification in the spine. Although Resnick's definition of DISH requires contiguous ossification over four vertebral levels (three disc spaces), we observed that ossification frequently occurs at other non-contiguous vertebral levels as well. The median number of vertebral levels affected by ossification increased as DISH diagnosis was observed lower in the spine (i.e. lowest observed area with three contiguous disc spaces affected). To our knowledge, no other studies have addressed the overall number of vertebral levels affected by ossification. It is possible that men with lumbar DISH have greater DISH progression than men with thoracic DISH. Although our data suggest the possibility that the back pain frequency may increase among men with progression of DISH into the lumbar spine, the 95% confidence intervals for back pain prevalence overlapped, indicating that there is no statistical difference between these groups.

Our study has several strengths. The MrOS cohort includes community dwelling older men residing in multiple geographic areas of the US, who were not preselected for DISH or back/neck pain. DISH was assessed with high reliability in our study sample. Thus, it is unlikely that random misclassification of DISH status affected the estimates. The findings of this study are also more broadly applicable to older men in the United States than the previous DISH studies, since DISH was evaluated in community dwelling individuals from six locations around the US.

One limitation to this study is the lack of generalizability to men younger than 65 years and to women. However, older men have been reported to have the highest prevalence of DISH^{6-7, 15, 17, 26}, and this study therefore targets the group most affected by DISH. Only 10% of this population was non-Caucasian, which limits conclusions about associations in other racial or ethnic groups. We were also unable to assess stiffness in the spine. Men with DISH may experience stiffness without pain. Additionally, our cross-sectional study was unable to evaluate progression of DISH and whether DISH tends to commence in the thoracic vertebrae and then form in the lumbar vertebrae secondarily. And finally, due to the lack of cervical radiographs, we could not directly assess the association between cervical DISH and neck pain. Future research designed specifically to evaluate consequences of DISH and DISH progression in a large community dwelling cohort could address these limitations.

Rothschild²⁸ and Hutton²⁹ have both suggested that DISH may be a protective mechanism in the spine secondary to other spinal conditions, and that DISH should not quickly be considered an explanation for back pain. In this study, the presence of DISH was associated with a lower prevalence of any back pain in the past 12 months, and thus, lends support to the idea that DISH may actually increase stability in the spine resulting from "natural" fusion, leading to less back pain. This may occur once the osteophyte completely bridges the motion segment. The sensitivity analyses we conducted also lend some support to this hypothesis. The frequency of back pain in the past 12 months was comparable among men with non-DISH ossification and with no ossification at all. Moreover, when we restricted analyses to only those with ossification, men with DISH remained significantly less likely to report back pain compared to those with non-DISH ossification. These results suggest that, if ossification does reduce the likelihood of back pain, it does so at the point where the ossification completely bridges the motion segment.

In conclusion, DISH was observed in 42% of older men. Concordant with other reports, DISH was positively associated with BMI and systolic blood pressure. However, in contrast to previous studies evaluating DISH in patient populations, community dwelling older men

from the United States with DISH reported less frequent and less severe back pain than their counterparts without DISH. It is plausible that this association may be due to increased stabilization of the spine through “natural” fusion of the vertebrae.

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Figure 1.
Prevalence of DISH according to age among men age 65-100 years: the MrOS study.

Figure 2.
Presence of back pain in the past 12 months according to lowest region of the spine affected by DISH: the MrOS Study.

Figure 3.

Location of back pain reported among men ages ≥ 65 years according to lowest region of the spine with DISH: the MrOS Study. Note: columns can add to $>100\%$ due to report of back pain in multiple locations.

Table 1

Baseline characteristics according to DISH in men 65 and older: The MrOS Study

Number (% of sample)	DISH		P-value *
	No 172 (58%)	Yes 126 (42%)	
Characteristic	Mean(sd)	Mean(sd)	P-value *
Age (years)	73.3 (3.2)	75.7 (5.9)	<0.0001
Height (cm)	174.9 (7.3)	173.6 (6.5)	0.11
Weight (kg)	83.3 (13.7)	84.5 (12.2)	0.46
Weight at age 25 (kg)	72.20 (10.4)	73.82 (10.6)	0.19
BMI (kg/m ²)	27.1 (3.5)	28.0 (3.6)	0.04
BMI at age 25 (kg/m ²)	22.6 (2.7)	23.4 (2.8)	0.01
Systolic Blood Pressure (mmHg)	139 (20)	144 (21)	0.02
PASE **	151.9 (69.6)	143.7 (60.2)	0.29
SF-12			
Physical	48.3 (10.0)	47.5 (10.7)	0.53
Mental	56.3 (5.7)	55.9 (6.9)	0.53
Characteristic	Number (%)	Number (%)	P-value †
Age (years)			
65-69	58 (34%)	25 (20%)	0.01
70-74	46 (27%)	29 (23%)	
75-79	41 (24%)	38 (30%)	
≥80	27 (16%)	34 (27%)	
Body Mass Index (kg/m ²)			
<25	51 (30%)	24 (19%)	0.11
25-29	85 (49%)	72 (57%)	
≥30	36 (21%)	30 (24%)	
Race			
Caucasian	154 (90%)	114 (90%)	0.79
Other	18 (10%)	12 (10%)	
Smoking			
Never	79 (46%)	47 (37%)	0.14
Ever	93 (54%)	79 (63%)	
Diabetes			
No	154 (90%)	107 (85%)	0.23
Yes	18 (10%)	19 (15%)	
Hypertension			
No	91 (53%)	61 (48%)	0.44
Yes	81 (47%)	65 (52%)	
Gout			
No	160 (93%)	114 (90%)	0.42

	DISH	
	No	Yes
Number (% of sample)	172 (58%)	126 (42%)
Yes	12 (7%)	12 (10%)

* P-values from t-tests

† chi-square tests

** Physical Activity Score for the Elderly²¹

Table 2

Vertebral levels with DISH-like ossification according to lowest level of defined DISH in elderly men

	No DISH (n=172)	Lowest level of contiguous vertebral involvement defined as DISH		
		Thoracic (n=48)	Thoraco- lumbar (n=62)	Lumbar (n=16)
# of Vertebral Levels with Ossification*	Numbers of Men			
0	59			
1	43			
2	35			
3	20	6	2	
4	10	10	3	1
5	4	9	4	1
6	1	6	10	0
7		4	10	1
8		5	7	0
9		5	7	1
10		2	11	1
11		1	4	0
12			2	1
13			2	4
14				3
15				1
16				2
Median (IQ range)**	1 (0-2)	4 (3-5)	8 (6-10)	13 (9.5-14)

* Number of non-contiguous vertebral levels with ossification consistent with DISH of level 2 or 3 as defined by Mata4

** Median number of vertebral levels affected by ossification. IQ range = interquartile range

Table 3

Back pain according to DISH status: The MrOS Study

Characteristic	DISH		Unadjusted PR	Multivariate* Adj PR (95% CI)
	No N=172	Yes N=126		
Number (%)	Number (%)			
Any Back Pain				
No	50 (29%)	52 (41%)	Ref	Ref
Yes	122 (71%)	74 (59%)	0.74	0.73 (0.57-0.95)
Back Pain Severity				
None	50 (29%)	52 (41%)	Ref	Ref
Mild	50 (29%)	27 (21%)	0.69	0.70 (0.49-1.00)
Moderate/Severe	72 (42%)	47 (37%)	0.77	0.75 (0.56-1.01)
Frequency of Being Bothered by Back Pain				
No Back Pain	50 (29%)	52 (41%)	Ref	Ref
Rarely	34 (20%)	16 (13%)	0.63	0.65 (0.42-1.03)
Some of Time	54 (31%)	42 (33%)	0.86	0.84 (0.62-1.13)
Most/ All of Time	34 (20%)	16 (13%)	0.63	0.61 (0.40-0.92)
Neck Pain				
No	105 (61%)	83 (66%)	Ref	Ref
Yes	67 (39%)	43 (34%)	0.89	0.87 (0.66-1.16)
Frequency of Neck Pain				
Never	105 (61%)	83 (66%)	Ref	Ref
1-3 Times	19 (11%)	11(9%)	0.83	0.88 (0.53-1.46)
> 3 Times	48 (28%)	32 (25%)	0.91	0.87 (0.64-1.19)
When you look up, is neck pain...?*				
Same/Better	54 (81%)	29 (67%)	Ref	Ref
Worse	13 (19%)	14 (33%)	1.48	1.47 (0.90-2.40)

* Adjusted prevalence ratio (PR) for age categories: 65-69, 70-74, 75-79, ≥80 years; BMI categories: normal (<25), overweight (25-29) and obese (≥30) kg/m²; and systolic blood pressure < or ≥140mmHg

** Question asked only to those reporting neck pain (N=67 without DISH and N=43 with DISH)