

Upper airway disease in Jeju Haenyeo: the aging and resilience cohort (JH-ARC) study

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Rhinology 64: 5, 0 - 0, 2026
<https://doi.org/10.4193/Rhin26.196>

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Received for publication:

March 18, 2026

Accepted: May 16, 2026

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Associate Editor:

Ahmad Sedaghat

Dear Editor:

Jeju Haenyeo are traditional female breath-hold divers from Jeju Island, the southernmost and largest island of the Republic of Korea, who harvest marine products without modern diving equipment ⁽¹⁾. During diving, they are repeatedly exposed to cold seawater, breath-holding, and pressure changes ⁽²⁾. The upper airway may be particularly vulnerable, as it is the first anatomical region directly exposed to seawater and pressure-related stimuli. In occupations involving repeated water exposure, increased nasal symptoms and epithelial injury have been reported, supporting the plausibility of upper airway involvement ⁽³⁾. Despite this, upper airway disorders in Jeju Haenyeo have not been systematically investigated.

Using 20 years of real-world data (2004–2023) from the Clinical Data Warehouse of Jeju National University Hospital, we conducted a retrospective cohort study. Haenyeo were identified using a specific insurance code issued upon presentation of a haenyeo identification card — granted exclusively by the national government. To minimize age-related confounding, Haenyeo were matched to non-divers in a 1:3 ratio based on age at first hospital visit. Upper airway diseases were defined as at least one recorded ICD-10 code assigned by otolaryngology specialists (Table S1). The proportion of participants with a recorded diagnosis was compared by anatomical region and disease, and adjusted prevalence ratios (aPRs) with 95% confidence intervals were estimated using Poisson regression with robust variance; to account for potential surveillance bias, analyses were additionally adjusted for healthcare utilization. Region-level analyses

were primary; disease-level and subgroup analyses were exploratory. Age-stratified subgroup and BMI-based sensitivity analyses were performed. Ethical approval was obtained from the Institutional Review Board of this institution (IRB No. 2024-07-009-004); informed consent was waived.

A total of 8,868 Haenyeo and 26,604 age-matched non-diver controls were included, with a mean age of 65.52 ± 10.74 years (Table S2).

Nasal cavity diseases were more frequently recorded in Haenyeo (aPR 1.19, 95% CI 1.06–1.33), largely driven by rhinitis (aPR 1.20, 95% CI 1.05–1.38), particularly allergic rhinitis (aPR 1.30, 95% CI 1.08–1.57), as well as acute sinusitis. Beyond the nasal cavity, pharyngeal diseases (aPR 1.31, 95% CI 1.12–1.54) and laryngeal diseases (aPR 1.28, 95% CI 1.18–1.39) were also more frequently recorded, although these findings should be interpreted as exploratory (Table 1).

For rhinitis, the association was strongest in the youngest age group. Significant interactions by age were observed in chronic laryngitis and laryngopharyngeal reflux (Table S3). These findings were consistent in sensitivity analyses with additional adjustment for body mass index and lifestyle (Tables S4, S5).

The higher rate of recorded upper airway diagnoses in Haenyeo is biologically plausible and consistent with previous studies reporting upper airway disorders in divers, given their repeated exposure to cold seawater and pressure fluctuations, which may

Table 1. Prevalence and adjusted prevalence ratios for upper airway diseases Haenyeo and age-matched non-diver.

Diseases	Haenyeo	Non-diver	Adjusted*			
	n=8,868	n=26,604	p-value	prevalence ratio	p-value	q-value
Nasal cavity	431 (4.86)	983 (3.69)	<0.001	1.19 (1.06 - 1.33)	0.002	-
Rhinitis	309 (3.48)	696 (2.62)	<0.001	1.20 (1.05 - 1.38)	0.006	0.029
Allergic rhinitis	163 (1.84)	333 (1.25)	<0.001	1.30 (1.08 - 1.57)	0.006	0.029
Non-allergic rhinitis	174 (1.96)	437 (1.64)	0.045	1.10 (0.93 - 1.31)	0.269	0.590
Acute sinusitis	69 (0.78)	133 (0.50)	0.003	1.37 (1.02 - 1.84)	0.035	0.129
CRS without NP	124 (1.40)	311 (1.17)	0.089	1.08 (0.87 - 1.33)	0.494	0.640
CRS with NP	38 (0.43)	88 (0.33)	0.180	1.13 (0.77 - 1.67)	0.532	0.650
Mucocele of paranasal sinus	6 (0.07)	25 (0.09)	0.468	0.67 (0.27 - 1.63)	0.376	0.616
Pharynx	222 (2.50)	467 (1.76)	<0.001	1.31 (1.12 - 1.54)	0.001	-
Acute pharyngotonsillitis	148 (1.67)	287 (1.08)	<0.001	1.43 (1.17 - 1.75)	<0.001	0.005
Chronic diseases of tonsils and adenoids	30 (0.34)	93 (0.35)	0.876	0.89 (0.58 - 1.35)	0.577	0.668
Chronic tonsillitis	24 (0.27)	64 (0.24)	0.622	1.01 (0.62 - 1.63)	0.982	0.982
Deep neck infection	13 (0.15)	25 (0.09)	0.190	1.55 (0.78 - 3.09)	0.208	0.507
Larynx	761 (8.58)	1622 (6.10)	<0.001	1.28 (1.18 - 1.39)	<0.001	-
Acute laryngitis and tracheitis	88 (0.99)	214 (0.80)	0.095	1.12 (0.87 - 1.43)	0.392	0.616
Acute obstructive laryngitis [croup] and epiglottitis	4 (0.05)	6 (0.02)	0.280	1.76 (0.50 - 6.27)	0.378	0.616
Other upper respiratory infection	6 (0.07)	20 (0.08)	0.801	0.89 (0.35 - 2.23)	0.803	0.883
Chronic laryngitis	174 (1.96)	359 (1.35)	<0.001	1.33 (1.11 - 1.60)	0.002	0.013
Laryngopharyngeal reflux	603 (6.80)	1249 (4.69)	<0.001	1.32 (1.20 - 1.45)	<0.001	<0.001
Diseases of vocal cords and larynx, NEC	134 (1.51)	306 (1.15)	0.008	1.21 (0.98 - 1.49)	0.071	0.222
vocal cord cyst & nodule	40 (0.45)	85 (0.32)	0.070	1.29 (0.88 - 1.88)	0.192	0.507
vocal cord paralysis	20 (0.23)	45 (0.17)	0.282	1.22 (0.71 - 2.11)	0.465	0.639
vocal cord polyp	16 (0.18)	33 (0.12)	0.317	1.38 (0.74 - 2.58)	0.310	0.616
contract granuloma of vocal cord	19 (0.21)	39 (0.15)	0.172	1.26 (0.71 - 2.25)	0.426	0.626
Laryngeal cyst	25 (0.28)	70 (0.26)	0.767	1.01 (0.64 - 1.59)	0.980	0.982

* Adjusted for cardiometabolic diseases, chronic kidney disease, cancer, and the log-transformed annual non-UAD visit rate

induce chronic mucosal irritation, impair mucociliary clearance, and promote inflammation^(4,5). Associations with acute sinusitis and chronic rhinosinusitis with nasal polyps further support the vulnerability of the sinonasal region to repeated cold water and pressure exposure. Pharyngeal and laryngeal findings, while notable, are presented as secondary observations and may be driven by distinct mechanisms such as infection susceptibility, pressure-related reflux, or cold air exposure^(6,7).

This study has several limitations, including its retrospective single-center design based on electronic medical records, potential selection and information bias, lack of detailed exposure assessment, residual confounding, and limited ability to establish temporal relationships.

Conclusion

Jeju haenyeo showed a higher rate of recorded upper airway diagnoses compared with non-divers, with the strongest and most consistent findings in the nasal cavity, particularly rhinitis and sinusitis. Pharyngeal and laryngeal associations were also observed but require further investigation. These findings support targeted sinonasal health monitoring in this population.

Authorship contribution

Conceptualization: SWC, JC, JDJ. Data curation: MK, JL, MJS JHK. Formal analysis: SWC, EP, SJ, EL, CY, AH, JKR. Funding acquisition: JL, JC, JDJ. Methodology: MK, JL, JC. Project administration: SWC, JC, JDJ. Visualization: MK, JL, JC. Writing - original draft: SWC, MK, JL. Writing - review & editing: JC, JDJ.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Funding

This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grantnumber:RS-2025-25406739).

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This manuscript contains online supplementary material

SUPPLEMENTARY MATERIAL

Table S1. ICD-10 codes for definition of diseases and comorbidity.

Diseases	ICD10
Nasal cavity	J01,J33,J300-J304,J310,J320-J324,J341
Rhinitis	J301-J304,J300,J310
Allergic rhinitis	J301-J304
Non-allergic rhinitis	J300,J310
Acute sinusitis	J01
CRS without NP	J320-J324
CRS with NP	J33
Mucocoele of paranasal sinus	J341
Pharynx	J02,J03,J35,J36,J311,J312,J390
Acute pharyngotonsillitis	J02,J03
Chronic diseases of tonsils and adenoids	J35
Chronic tonsillitis	J350,J358
Deep neck infection	J36,J390
Larynx	J04,J05,J38,J060,J068,J069,J370,K219,J392
Acute laryngitis and tracheitis	J04,J060
Acute obstructive laryngitis [croup] and epiglottitis	J05
Other upper respiratory infection	J069
Chronic laryngitis	J370
Laryngopharyngeal reflux	J392,K219
Diseases of vocal cords and larynx, NEC	J38
Vocal cord cyst & nodule	J382
Vocal cord paralysis	J3800,J3801
Vocal cord polyp	J3810,J3811
Contract granuloma of vocal cord	J383
Laryngeal cyst	J387
Comorbidity	
Cardiometabolic Disease	E11-E14,H280,H360,I10-I13,I15,E78,I20-I25,I50,I60-I62,I69
Chronic Kidney Disease	N18,N19
Cancer	C00-C96

* As no dedicated ICD-10 code exists for laryngopharyngeal reflux, K21.9 was used in accordance with standard otolaryngology practice in Korea.

Table S2. Baseline characteristics of Haenyeo and age-matched non-diver.

Variables	Haenyeo n= 8,868	Non-diver n= 26,604	Standard Mean difference (95% CI)	p-value *
Age at index	65.52 ± 10.74	65.52 ± 10.74	0.00 (-0.02 – 0.02)	>0.999
Comorbidity				
Type 2 diabetes	268 (3.02)	1,095 (4.12)	-0.06 (-0.08 – -0.03)	<0.001
Hypertension	716 (8.07)	2,482 (9.33)	-0.04 (-0.07 – -0.02)	<0.001
Dyslipidemia	219 (2.47)	702 (2.64)	-0.01 (-0.03 – 0.01)	0.386
Cardiovascular disease	341 (3.85)	1,140 (4.29)	-0.02 (-0.05 – 0.002)	0.073
Chronic kidney disease	25 (0.27)	126 (0.47)	-0.03 (-0.06 – -0.01)	0.016
Cancer	468 (5.28)	1,634 (6.14)	-0.04 (-0.06 – -0.01)	0.003
Follow-up duration, years	10.44 ± 6.75	8.48 ± 6.84	0.29 (0.26 – 0.31)	<0.001
Annual non-UAD visit rate, median (Q1-Q3)	3.46 (1.50 – 7.52)	4.34 (1.70 – 11.63)	-0.19 (-0.21 – -0.16)	<0.001

*p-value were calculated independent two-sample test, chi-squared test, and Mann-Whitney U test

Table S3. Prevalence and adjusted prevalence ratios for upper airway diseases by age group among Haenyeo and age-matched non-diver

Diseases	Haenyeo n=8,868	Non-diver n=26,604	Adjusted prevalence ratio*	p-value	q-value
Nasal cavity					
<50	51 (7.20)	93 (4.38)	1.37 (0.98 - 1.92)	0.064	0.408
50-59	134 (7.53)	282 (5.28)	1.25 (1.03 - 1.53)	0.026	0.214
60-69	174 (5.73)	413 (4.53)	1.18 (0.99 - 1.40)	0.069	0.408
70-79	65 (2.53)	175 (2.27)	1.03 (0.77 - 1.37)	0.840	0.984
80+	7 (0.90)	20 (0.86)	1.01 (0.40 - 2.55)	0.991	0.998
Rhinitis					
<50	43 (6.07)	68 (3.20)	1.55 (1.06 - 2.26)	0.023	0.214
50-59	101 (5.68)	217 (4.07)	1.24 (0.98 - 1.55)	0.071	0.408
60-69	123 (4.05)	284 (3.12)	1.20 (0.97 - 1.48)	0.086	0.470
70-79	39 (1.52)	114 (1.48)	0.96 (0.66 - 1.38)	0.815	0.984
80+	3 (0.39)	13 (0.56)	0.81 (0.22 - 2.93)	0.748	0.984
Allergic rhinitis					
<50	25 (3.53)	37 (1.74)	1.62 (0.97 - 2.70)	0.068	0.408
50-59	56 (3.15)	118 (2.21)	1.23 (0.89 - 1.68)	0.208	0.675
60-69	69 (2.27)	120 (1.32)	1.57 (1.17 - 2.12)	0.003	0.047
70-79	12 (0.47)	51 (0.66)	0.69 (0.37 - 1.30)	0.252	0.677
80+	1 (0.13)	7 (0.30)	0.38 (0.05 - 3.11)	0.370	0.812
Non-allergic rhinitis					
<50	23 (3.25)	45 (2.12)	1.30 (0.79 - 2.12)	0.304	0.746
50-59	57 (3.20)	124 (2.32)	1.26 (0.92 - 1.71)	0.145	0.644

	Haenyeo	Non-diver	Adjusted		
Diseases	n=8,868	n=26,604	prevalence ratio*	p-value	q-value
60-69	64 (2.11)	185 (2.03)	0.98 (0.74 - 1.30)	0.891	0.986
70-79	28 (1.09)	76 (0.99)	1.00 (0.65 - 1.55)	0.998	0.998
80+	2 (0.26)	7 (0.30)	1.35 (0.25 - 7.36)	0.726	0.984
Acute sinusitis					
<50	7 (0.99)	15 (0.71)	1.17 (0.48 - 2.87)	0.729	0.984
50-59	22 (1.24)	38 (0.71)	1.54 (0.91 - 2.61)	0.106	0.534
60-69	26 (0.86)	51 (0.56)	1.35 (0.84 - 2.19)	0.217	0.675
70-79	14 (0.54)	24 (0.31)	1.55 (0.78 - 3.06)	0.208	0.675
80+	0 (0)	5 (0.22)	-	-	-
CRS without NP					
<50	12 (1.69)	23 (1.08)	1.25 (0.61 - 2.57)	0.539	0.891
50-59	35 (1.97)	78 (1.46)	1.13 (0.76 - 1.70)	0.540	0.891
60-69	51 (1.68)	143 (1.57)	1.01 (0.73 - 1.39)	0.958	0.987
70-79	22 (0.86)	62 (0.80)	1.01 (0.62 - 1.67)	0.960	0.987
80+	4 (0.52)	5 (0.22)	2.69 (0.54 - 13.28)	0.225	0.677
CRS with NP					
<50	3 (0.42)	11 (0.52)	0.75 (0.21 - 2.72)	0.660	0.984
50-59	9 (0.51)	18 (0.34)	1.16 (0.51 - 2.67)	0.720	0.984
60-69	17 (0.56)	42 (0.46)	1.10 (0.62 - 1.95)	0.755	0.984
70-79	9 (0.35)	17 (0.22)	1.44 (0.64 - 3.23)	0.373	0.812
80+	0 (0)	0 (0)	-	-	-
Mucocoele of paranasal sinus					
<50	2 (0.28)	4 (0.19)	1.65 (0.28 - 9.90)	0.581	0.932
50-59	2 (0.11)	7 (0.13)	0.74 (0.15 - 3.58)	0.711	0.984
60-69	1 (0.03)	10 (0.11)	0.27 (0.03 - 2.13)	0.216	0.675
70-79	1 (0.04)	4 (0.05)	0.69 (0.08 - 6.17)	0.740	0.984
80+	0 (0)	0 (0)	-	-	-
Pharynx					
<50	28 (3.95)	37 (1.74)	2.02 (1.24 - 3.30)	0.005	0.063
50-59	71 (3.99)	138 (2.59)	1.44 (1.09 - 1.92)	0.012	0.126
60-69	84 (2.77)	196 (2.15)	1.18 (0.91 - 1.52)	0.214	0.675
70-79	35 (1.36)	89 (1.15)	1.03 (0.69 - 1.54)	0.886	0.986
80+	4 (0.52)	7 (0.30)	2.15 (0.58 - 7.95)	0.252	0.677
Acute pharyngotonsillitis					
<50	20 (2.82)	17 (0.80)	3.17 (1.65 - 6.07)	0.001	0.009
50-59	48 (2.70)	82 (1.54)	1.62 (1.13 - 2.31)	0.008	0.096
60-69	60 (1.98)	127 (1.39)	1.29 (0.94 - 1.77)	0.109	0.534
70-79	19 (0.74)	57 (0.74)	0.93 (0.55 - 1.58)	0.795	0.984
80+	1 (0.13)	4 (0.17)	0.92 (0.10 - 8.78)	0.940	0.986
Chronic diseases of tonsils and adenoids					
<50	5 (0.71)	12 (0.56)	1.16 (0.40 - 3.34)	0.784	0.984
50-59	15 (0.84)	42 (0.79)	1.04 (0.57 - 1.89)	0.897	0.986
60-69	7 (0.23)	28 (0.31)	0.71 (0.31 - 1.64)	0.424	0.873
70-79	3 (0.12)	9 (0.12)	0.61 (0.13 - 2.81)	0.524	0.891
80+	0 (0)	2 (0.09)	-	-	-

Diseases	Haenyeo n=8,868	Non-diver n=26,604	Adjusted prevalence ratio*	p-value	q-value
Chronic tonsillitis					
<50	5 (0.71)	8 (0.38)	1.80 (0.57 - 5.68)	0.315	0.746
50-59	9 (0.51)	28 (0.51)	0.89 (0.42 - 1.89)	0.762	0.984
60-69	7 (0.23)	21 (0.23)	0.95 (0.40 - 2.24)	0.901	0.986
70-79	3 (0.12)	5 (0.06)	1.08 (0.21 - 5.58)	0.924	0.986
80+	0 (0)	2 (0.09)	-	-	-
Deep neck infection					
<50	3 (0.42)	3 (0.14)	2.45 (0.49 - 12.15)	0.272	0.706
50-59	3 (0.17)	5 (0.09)	1.93 (0.43 - 8.62)	0.390	0.834
60-69	2 (0.07)	11 (0.12)	0.60 (0.13 - 2.78)	0.515	0.891
70-79	4 (0.16)	6 (0.08)	1.80 (0.51 - 6.38)	0.362	0.812
80+	1 (0.13)	0 (0)	-	-	-
Larynx					
<50	117 (16.53)	171 (8.05)	1.82 (1.46 - 2.26)	<0.001	<0.001
50-59	270 (15.18)	512 (9.59)	1.42 (1.24 - 1.63)	<0.001	<0.001
60-69	266 (9.76)	631 (6.93)	1.16 (1.01 - 1.34)	0.034	0.266
70-79	96 (3.74)	283 (3.67)	0.92 (0.73 - 1.17)	0.511	0.891
80+	12 (1.55)	25 (1.08)	1.27 (0.60 - 2.67)	0.535	0.891
Acute laryngitis and tracheitis					
<50	12 (1.69)	21 (0.99)	1.44 (0.71 - 2.94)	0.309	0.746
50-59	32 (1.80)	65 (1.22)	1.34 (0.88 - 2.05)	0.176	0.675
60-69	35 (1.15)	86 (0.94)	1.14 (0.77 - 1.68)	0.526	0.891
70-79	9 (0.35)	39 (0.51)	0.57 (0.27 - 1.22)	0.148	0.644
80+	0 (0)	3 (0.13)	-	-	-
Acute obstructive laryngitis [croup] and epiglottitis					
<50	1 (0.14)	0 (0)	-	-	-
50-59	1 (0.06)	2 (0.04)	1.28 (0.12 - 14.16)	0.838	0.984
60-69	1 (0.03)	2 (0.02)	1.36 (0.12 - 15.03)	0.801	0.984
70-79	1 (0.04)	2 (0.03)	1.37 (0.12 - 15.11)	0.798	0.984
80+	0 (0)	0 (0)	-	-	-
Other upper respiratory infection					
<50	1 (0.14)	2 (0.09)	1.32 (0.12 - 14.55)	0.822	0.984
50-59	3 (0.17)	10 (0.19)	0.93 (0.25 - 3.43)	0.909	0.986
60-69	1 (0.03)	4 (0.04)	0.73 (0.08 - 6.55)	0.780	0.984
70-79	1 (0.04)	4 (0.05)	0.73 (0.08 - 6.51)	0.776	0.984
80+	0 (0)	0 (0)	-	-	-
Chronic laryngitis					
<50	29 (4.10)	28 (1.32)	2.81 (1.67 - 4.74)	<0.001	0.002
50-59	56 (3.15)	105 (1.97)	1.45 (1.05 - 1.99)	0.024	0.214
60-69	60 (1.98)	149 (1.64)	1.12 (0.83 - 1.51)	0.461	0.891
70-79	24 (0.93)	70 (0.91)	0.95 (0.59 - 1.51)	0.816	0.984
80+	5 (0.65)	7 (0.30)	2.21 (0.68 - 7.20)	0.190	0.675
Laryngopharyngeal reflux					
<50	96 (13.56)	131 (6.17)	1.96 (1.53 - 2.52)	<0.001	<0.001
50-59	219 (12.31)	409 (7.66)	1.43 (1.23 - 1.67)	<0.001	<0.001
60-69	208 (6.85)	484 (5.31)	1.18 (1.01 - 1.39)	0.039	0.287

	Haenyeo	Non-diver	Adjusted		
Diseases	n=8,868	n=26,604	prevalence ratio*	p-value	q-value
70-79	70 (2.72)	207 (2.69)	0.93 (0.70 - 1.23)	0.596	0.942
80+	10 (1.29)	18 (0.77)	1.33 (0.58 - 3.09)	0.502	0.891
Diseases of vocal cords and larynx, NEC					
<50	22 (3.11)	46 (2.17)	1.28 (0.77 - 2.13)	0.336	0.779
50-59	50 (2.81)	110 (2.06)	1.25 (0.89 - 1.75)	0.192	0.675
60-69	50 (1.65)	105 (1.15)	1.28 (0.91 - 1.81)	0.161	0.675
70-79	11 (0.43)	41 (0.53)	0.78 (0.39 - 1.58)	0.494	0.891
80+	1 (0.13)	4 (0.17)	0.66 (0.07 - 5.88)	0.709	0.984
vocal cord cyst & nodule					
<50	9 (1.27)	26 (1.22)	0.93 (0.43 - 2.00)	0.852	0.986
50-59	20 (1.12)	33 (0.62)	1.57 (0.90 - 2.73)	0.113	0.534
60-69	11 (0.36)	19 (0.21)	1.57 (0.75 - 3.31)	0.232	0.677
70-79	0 (0)	6 (0.08)	-	-	-
80+	0 (0)	1 (0.04)	-	-	-
vocal cord paralysis					
<50	3 (0.42)	4 (0.19)	2.54 (0.51 - 12.56)	0.255	0.677
50-59	6 (0.34)	8 (0.15)	2.01 (0.70 - 5.79)	0.197	0.675
60-69	8 (0.26)	22 (0.24)	0.96 (0.41 - 2.28)	0.933	0.986
70-79	3 (0.12)	10 (0.13)	0.82 (0.23 - 2.99)	0.768	0.984
80+	0 (0)	1 (0.04)	-	-	-
vocal cord polyp					
<50	4 (0.56)	6 (0.28)	1.67 (0.47 - 5.93)	0.425	0.873
50-59	5 (0.28)	15 (0.28)	1.01 (0.36 - 2.82)	0.991	0.998
60-69	7 (0.23)	11 (0.12)	1.86 (0.66 - 5.23)	0.239	0.677
70-79	0 (0)	1 (0.01)	-	-	-
80+	0 (0)	0 (0)	-	-	-
contract granuloma of vocal cord					
<50	2 (0.28)	4 (0.19)	1.26 (0.23 - 6.90)	0.788	0.984
50-59	4 (0.22)	12 (0.22)	1.06 (0.33 - 3.40)	0.916	0.986
60-69	10 (0.33)	19 (0.21)	1.37 (0.62 - 3.05)	0.440	0.873
70-79	2 (0.08)	3 (0.04)	0.91 (0.09 - 8.71)	0.932	0.986
80+	1 (0.13)	1 (0.04)	2.54 (0.16 - 40.63)	0.510	0.891
Laryngeal cyst					
<50	3 (0.42)	5 (0.24)	1.50 (0.36 - 6.25)	0.579	0.932
50-59	7 (0.39)	30 (0.56)	0.64 (0.28 - 1.46)	0.292	0.740
60-69	10 (0.33)	24 (0.26)	1.15 (0.55 - 2.40)	0.718	0.984
70-79	5 (0.19)	11 (0.14)	1.54 (0.52 - 4.61)	0.438	0.873
80+	0 (0)	0 (0)	-	-	-

*Adjusted for cardiometabolic diseases, chronic kidney disease, cancer, and the log-transformed annual non-UAD visit rate.

Table S4. Characteristics of the sensitivity analysis matched by body mass index.

Variables	Haenyeo n= 894	Non-diver n= 2677	Standard Mean difference (95% CI)	p-value
Age at index	56.68 ± 8.37	56.30 ± 8.05	0.05 (-0.03 - 0.12)	0.223
Body mass index	24.49 ± 3.25	24.54 ± 3.27	0.00 (-0.08 - 0.08)	0.679
Comorbidity				
Type 2 diabetes	23 (2.57)	48 (1.79)	0.05 (-0.02 - 0.13)	0.148
Hypertension	55 (6.15)	161 (6.01)	0.01 (-0.07 - 0.08)	0.881
Dyslipidemia	26 (2.91)	85 (3.18)	-0.02 (-0.09 - 0.06)	0.691
Cardiovascular Disease	22 (2.46)	65 (2.43)	0.002 (-0.07 - 0.08)	0.956
Chronic Kidney Disease	0 (0)	2 (0.07)	-0.04 (-0.11 - 0.04)	>0.999
Cancer	41 (4.59)	159 (5.94)	-0.06 (-0.14 - 0.02)	0.128
Drinking			-0.18 (-0.25 - -0.10)	
Never	757 (84.68)	2081 (77.74)		
Ever	137 (15.32)	596 (22.26)		
Smoking			-0.18 (-0.26 - -0.11)	<0.001
Never	886 (99.11)	2581 (96.41)		
Ever	8 (0.89)	96 (3.59)		
Physical activity (≥1 day / week)			-0.15 (-0.22 - -0.07)	<0.001
None	621 (69.46)	1,674 (62.53)		
Moderate or high	273 (30.54)	1,003 (37.47)		

Table S5. Prevalence and adjusted prevalence ratios of upper airway diseases adjusted for lifestyle factors.

Diseases	Haenyeo n= 894	Non-diver n= 2,677	Adjusted prevalence ratio*	p-value	q-value
Nasal cavity	97 (10.85)	216 (8.07)	1.21 (0.95 - 1.53)	0.129	-
Rhinitis	84 (9.40)	157 (5.86)	1.44 (1.10 - 1.88)	0.007	0.055
Allergic rhinitis	55 (6.15)	76 (2.84)	1.98 (1.40 - 2.81)	0.000	0.003
Non-allergic rhinitis	43 (4.81)	97 (3.62)	1.18 (0.82 - 1.70)	0.364	0.749
Acute sinusitis	12 (1.34)	40 (1.49)	0.80 (0.42 - 1.53)	0.496	0.749
CRS without NP	15 (1.68)	57 (2.13)	0.69 (0.39 - 1.23)	0.211	0.581
CRS with NP	1 (0.11)	13 (0.49)	0.23 (0.03 - 1.77)	0.157	0.532
Mucocele of paranasal sinus	1 (0.11)	5 (0.19)	0.52 (0.06 - 4.44)	0.548	0.753
Pharynx	46 (5.15)	110 (4.11)	1.13 (0.80 - 1.59)	0.505	-
Acute pharyngotonsillitis	32 (3.58)	72 (2.69)	1.18 (0.78 - 1.80)	0.430	0.749
Chronic diseases of tonsils and adenoids	8 (0.89)	26 (0.97)	0.87 (0.39 - 1.93)	0.731	0.797
Chronic tonsillitis	6 (0.67)	19 (0.71)	0.87 (0.34 - 2.18)	0.760	0.797
Deep neck infection	1 (0.11)	5 (0.19)	0.55 (0.06 - 4.78)	0.587	0.759
Larynx	183 (20.47)	375 (14.01)	1.34 (1.12 - 1.60)	0.001	-
Acute laryngitis and tracheitis	19 (2.13)	61 (2.28)	0.84 (0.50 - 1.41)	0.511	0.749
Acute obstructive laryngitis [croup] and epiglottitis	1 (0.11)	1 (0.04)	2.77 (0.17 - 46.48)	0.478	0.749
Other upper respiratory infection	2 (0.22)	8 (0.30)	0.71 (0.15 - 3.36)	0.663	0.773
Chronic laryngitis	37 (4.14)	78 (2.91)	1.32 (0.89 - 1.96)	0.165	0.532
Laryngopharyngeal reflux	153 (17.11)	298 (11.13)	1.41 (1.16 - 1.72)	0.001	0.007
Diseases of vocal cords and larynx, NEC	36 (4.03)	74 (2.76)	1.33 (0.89 - 1.98)	0.169	0.532
vocal cord cyst & nodule	14 (1.57)	29 (1.08)	1.34 (0.70 - 2.55)	0.373	0.749
vocal cord paralysis	4 (0.45)	6 (0.22)	1.65 (0.46 - 5.87)	0.440	0.749
vocal cord polyp	6 (0.67)	6 (0.22)	2.71 (0.87 - 8.45)	0.086	0.473
contract granuloma of vocal cord	4 (0.45)	12 (0.45)	0.88 (0.28 - 2.73)	0.818	0.818
Laryngeal cyst	8 (0.89)	19 (0.71)	1.20 (0.52 - 2.78)	0.667	0.773

*Adjusted for cardiometabolic diseases, chronic kidney disease, cancer, smoking, drinking, physical activity, and the log-transformed annual non-UAD visit rate.