

Risk factors associated with symptoms of temporomandibular disorders among women with hypermobile Ehlers–Danlos syndrome: Questionnaire-based study in Finland and Sweden

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Abstract

Background: Generalized joint hypermobility as a characteristic feature of Ehlers–Danlos syndromes (EDS) is among the factors contributing to temporomandibular disorders (TMD).

Objective: To evaluate the prevalence of TMD symptoms and their risk factors among women born in Sweden or Finland who were 27- to 78-year-olds with diagnosed hypermobile EDS (hEDS).

Methods: A cohort of women with confirmed hEDS ($n=185$) was constructed from the members of the National EDS Associations in both countries. Based on questionnaire data, frequency of independent variables in terms of socio-demographic, general health and oral health-related factors, comorbid symptoms and psychological distress for self-reported TMD symptoms as the dependent variables, were calculated first. Prevalence ratios (PR) and their 95% confidence interval (95% CI) were estimated for the association between independent and dependent variables.

Results: Nearly all participants reported TMD symptoms (98%) with TMD pain (95%), TMJ clicking (90%) and jaw fatigue (80%) as the most common symptoms and TMJ crepitation (63%) and luxation (44%) as the least common symptoms. Risk factors for TMD among 27- to 50-year-olds participants were Finland as a country of birth, living alone and self-reported worst pain in the body (not the joints). The respective risk factors among the 51- to 78-year-olds were Finland as a country of birth, family history of EDS, tinnitus and regularly taking contraceptives.

Conclusions: Among adult women with confirmed hEDS, socio-demographic and health-related factors and comorbid symptoms were significantly associated with TMD but with differences regarding age group. Therefore, management of TMD requires a multidisciplinary approach among the affected.

KEYWORDS

Ehlers–Danlos syndromes, epidemiology, gender, generalized joint hypermobility, hypermobility spectrum disorder, temporomandibular disorders

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1 | INTRODUCTION

Temporomandibular disorders (TMD) is a collective term to embrace pain and dysfunction in the temporomandibular region.¹ TMD manifests with facial pain, impaired chewing capacity, impaired mandibular movement and temporomandibular joint (TMJ) noises (clicking and crepitation) during movements.² TMD, as the most common cause of nondental oro-facial pain, has a prevalence between 5% and 12% in the general population³ and induces limitations in social function and emotional well-being among the affected.⁴ Higher susceptibility to TMD has been reported among 20- to 64-year-old women,^{5,6} but gradually decreases afterwards.⁶

Generalized joint hypermobility (GJH) is among the factor contributing to TMD.⁷ GJH is an ability to exceed the normal range of motion in multiple joints and has a prevalence of 10%–30% in the general adult population.⁸ Generally, joint hypermobility and its complication are more common among women than men.⁹ GJH is also a characteristic feature of Ehlers–Danlos syndrome (EDS)—a heterogeneous group of inherited connective tissue disorders resulting from mutations either in collagen-encoding genes or in genes encoding collagen-modifying enzymes.¹⁰ Of the current EDS classifications, hypermobile EDS (hEDS) with a prevalence between 1:5000 and 1:20000 is the most common diagnosis.¹⁰ hEDS is clinically diagnosed (with no confirmation genetic test) based on the simultaneous presence of GJH, evidence of specific syndromic features, musculoskeletal manifestations and family history.¹⁰ Those with joint hypermobility and musculoskeletal manifestations that do not fulfil the criteria for hEDS are diagnosed as hypermobility spectrum disorder (HSD).¹¹ HSD and hEDS are considered as one entity because of nearly identical clinical features and consequences.¹⁰

To assess GJH, the Beighton index, among other assessments tools, is most commonly used and has good reproducibility.⁸ The classification of GJH based on this index was modified in 2017 to allow for acquired limitation of joint mobility.¹⁰ Generally, joint laxity decreases with age reflecting the lower cut of point in the Beighton index (4 out of 9) among adults who are over 50 years old compared to those up to 50 years of age (5 out of 9).¹⁰

Individuals with EDS are more prone to TMD¹² with the prevalence of TMD between 40% and 100% among those with EDS.¹³ TMJ hypermobility^{7,12,14} and cervical function of the head and neck¹⁵ have been linked to a higher prevalence of TMD among EDS.

The association between TMD and EDS has been mostly assessed in the mixed EDS subgroups^{16–18} or in the small sample sizes of hEDS.^{16,19,20,21}

The aim of this study was to evaluate the prevalence of self-reported TMD symptoms and their risk factors among adult women born in Sweden or Finland who were up to age 50 and those over age 50 with confirmed hEDS/HSD diagnosis.

2 | MATERIALS AND METHODS

2.1 | Study design

This is a cross-sectional study of the EDS populations in Sweden and Finland. Members of the National EDS Associations in both countries were approached who had a confirmed EDS diagnosis or were under investigation for EDS in the health care system. Data were first collected in Sweden in January to March 2022; then the questionnaire was translated to Finnish and data were collected during November 2022 in Finland.

2.2 | Procedure

The study was performed in accordance with the ethical principles for medical research involving human subjects according to the World Medical Association Declaration of Helsinki. Written information about the purpose of the study was provided in both countries. In Sweden, the questionnaire was sent to the participants via a digital link of the EDS association to the email addresses of the members, and in Finland through the social media platforms of the EDS association, Instagram with 238 followers and Facebook with 1201 followers. In Sweden, the study was approved by the Ethics Committee (Dnr 2021-05840-0) and informed consent was obtained from participants. However, this was not the case in Finland as the participants responded to the questionnaire anonymously.

2.3 | Participants

In total, 279 individuals in Sweden and 73 individuals in Finland responded to the questionnaire. In total, 167 participants were excluded for various reasons. Finally, a cohort of hEDS/HSD of women ($n=185$, age range 24–78 years) were constructed due to overlapping of the clinical features¹⁰ (Figure 1).

2.4 | Questionnaire

A questionnaire consisted of 63 questions dealing with socio-demographic factors, self-perceived general and oral health, EDS types, familial history, comorbid symptoms, psychological factors and symptoms attributed to TMD.

2.4.1 | Dependent variables

Symptoms attributed to TMD were defined in two main aspects—pain and dysfunction. In the questionnaire, five questions were used with ‘yes’ or ‘no’ as possible response options.

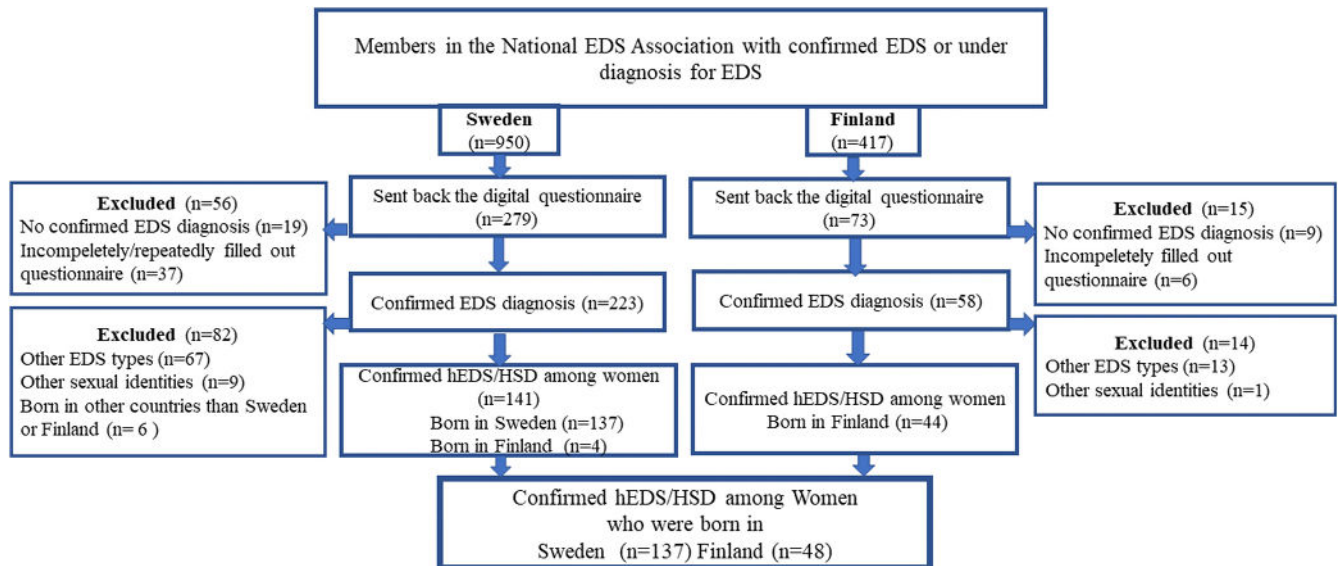


FIGURE 1 Inclusion and exclusion criteria of participants. EDS, Ehlers–Danlos syndrome; hEDS/HSD, hypermobile EDS/hypermobile spectrum disorder.

Jaw pain/fatigue was inquired as follows: 'Do you feel pain, stiffness or fatigue in the jaws when you wake up in the morning?'

Self-reported TMD pain was inquired based on the DC/TMD (diagnostic criteria for TMD) Symptom Questionnaire^{22,23} as follows: 'Have you noticed in the last 30 days that your pain from the jaw, temple or around the ear was affected by any of these activities – chewing hard or tough food, opening your mouth or moving your jaw forward or to the side, biting, squeezing/grinding teeth or chewing gum, or other activities such as talking, kissing or yawning'. In the analysis, TMD pain was defined in the case of at least one positive response.

The two following questions inquired about TMJ clicking and crepitation: 'Do you experience jaw joint noise such as clicking when you open or close your mouth or chew?' and 'Do you experience jaw joint noise like grating when you open or close your mouth or chew?'

TMJ luxation was inquired with the following question: 'Do you experience that the jaw joint goes out when you open your mouth or yawn?'

2.4.2 | Independent variables

Socio-demographic factors

Age was divided into two groups—adults up to age 50 and those over age 50 based on the Beighton index to adjust for generalized joint hypermobility.¹⁰ Country of birth was determined as either Sweden or Finland. Self-reported living condition was categorized as either living with others or alone. Level of education was divided into primary, secondary and university. Employment status was captured by the question of whether the participant currently worked with yes or no as possible answers.

General health-related factors

Family history of EDS was captured by the question of whether the respondent had anyone else in the family with EDS with yes or no as possible answers. The questions regarding self-perceived general health had five response options—very good, good, fair, poor and very poor. The options fair, poor and very poor were further combined to represent poor general health, and the options very good and good were combined to represent good general health. Tobacco usage was divided to never smoked or snuffed versus snuff or smoke either at present or in the past. Respondents were asked if they regularly take contraceptives (not specified), and hormone medications (not specified) with yes or no response options.

Oral health-related factors

Self-perceived oral health was defined like self-perceived general health. Self-reported comfortable occlusion was captured by the question 'Do you feel that your jaw is stable (teeth fit together?)' with yes or no response options. Self-reported bruxism (either clenching or grinding) was captured by two questions: 'Do you usually grind with your teeth?' and 'Do you usually clench with your teeth?' with yes or no response options. An affirmative response to any of the questions was considered as bruxism.

Comorbid symptoms

One question captured the most bothersome pain in the head, neck, arm, upper back, lower back, stomach, feet and in the joints that included the elbow, wrist, hip, knee and ankle. The respondents could choose '0' as 'no bothersome pain', '1' as 'the most bothersome pain' and '2' as 'the next bothersome region' and so on. In the analysis the worst pain defined as '1' versus others. Other comorbid symptoms such as self-reported tinnitus and fatigue were captured by two questions with yes or no response options.

Psychological distress

The Patient Health Questionnaire (PHQ-4) was used as an instrument with four questions to screen for distress as the composite construct of anxiety and depression. First, the total score as the sum of four item scores was calculated. Then, the scores were rated as normal (0–2), mild (3–5), moderate (6–8) and severe (9–12).²⁴

2.5 | Statistical analysis

Data analysis was conducted using STATA version 14. Descriptive information regarding independent variables and dependent variables as TMD symptoms in terms of pain and dysfunction was presented stratified by age; 27- to 50-year-olds and 51- to 78-year-olds. The variance inflation factor (VIF) was used to assess multicollinearity among the independent variables, presenting as a VIF value of less than one. The association between the independent variables and outcomes were also assessed stratified by age with the prevalence ratio (PR) using the 95% confidence interval (95% CI). Then, the adjusted PR was analysed by including the statistically significant variables in the multivariable regression model. The crude and adjusted models are presented in the Appendix S1, and the significant results are presented in the main text.

3 | RESULTS

Table 1 presents higher prevalence of self-reported jaw pain/fatigue among 51- to 78-year-olds compared to 27- to 50-year-olds (81% vs. 78%). TMD pain was reported with higher prevalence among the younger compared to older age group (96% vs. 92%). Neither of the results were statistically significant between age groups.

In general, more than 50% of those who reported pain symptoms were born in Sweden, lived with other and had family history of hEDS/HSD. Nearly 91% reported poor general health, fatigue and bruxism. Among the younger age group, those with secondary education, self-reported poor oral health (51%) and mild PHQ4 scores (26%) reported a higher prevalence of TMD pain symptoms. Among the older age group, university education (nearly 50%), self-reported good oral health (nearly 60%), self-reported worst pain in the body (not the joints) (57%) and those with normal and mild PHQ4 scores reported a higher prevalence for pain symptoms.

In the adjusted analysis among 27- to 50-year-olds ($n=105$), self-reported worst pain in the head, neck, arm, back, stomach or feet (PR: 1.26; 95% CI: 1.02–1.55), and university education (PR: 0.68; 95% CI: 0.54–0.85) remained associated with self-reported jaw pain/fatigue. Living alone (PR: 1.06; 95% CI: 1.00–1.11) remained associated with TMD pain (Table 3).

In the adjusted analysis among 51- to 78-year-olds ($n=77$), regularly taken contraceptives (PR: 1.21; 95% CI: 1.00–1.47) remained associated with self-reported jaw pain/fatigue. University education (PR: 0.86; 95% CI: 0.75–0.98) and regularly taken contraceptives

(PR: 1.13; 95% CI: 1.02–1.26) remained associated with TMD pain (Table 4).

In Table 2, higher prevalence of dysfunction symptoms was reported among the younger age group compared to the older one; TMJ clicking (95% vs. 82%), TMJ crepitation (68% vs. 58%) and TMJ luxation (50% vs. 36%). The result regarding TMJ clicking was statistically significant between the age groups ($p=.003$).

Among the younger age group, more than 50% of those who reported clicking were born in Sweden, while the majority who reported TMJ crepitation and luxation were born in Finland. Secondary education, self-reported poor general health and oral health, tobacco usage, and normal, mild and severe PHQ4 scores were related to the higher prevalence of TMJ clicking, crepitation and luxation. Among the older age group, university education, self-reported good oral health, self-reported worst pain in the body (not the joints) (51%), and normal, mild and moderate PHQ4 scores were related to the higher prevalence for TMJ clicking, crepitation and luxation.

In the adjusted analysis among 27- to 50-year-olds ($n=105$), living alone (PR: 1.06; 95% CI: 1.00–1.13) and regularly taken contraceptives (PR: 0.91; 95% CI: 0.83–0.98) remained associated with TMJ clicking. Finland as a country of birth (PR: 1.70; 95% CI: 1.29–2.26) remained associated with TMJ crepitation. Finland as a country of birth (PR: 1.91; 95% CI: 1.32–2.77) and living alone (PR: 1.43; 95% CI: 1.01–2.04) remained associated with TMJ luxation (Table 3).

In the adjusted analysis among 51- to 78-year-olds ($n=77$), secondary (PR: 0.75; 95% CI: 0.59–0.96) and university education (PR: 0.72; 95% CI: 0.56–0.93) as well as self-reported tinnitus (PR: 1.53; 95% CI: 1.09–2.15) remained associated with TMJ clicking. None of the variables remained significant with TMJ crepitation. Finland as a country of birth (PR: 1.98; 95% CI: 1.42–2.77) and family history of EDS/HSD (PR: 5.03; 95% CI: 1.64–15.44) remained associated with TMJ luxation (Table 4).

4 | DISCUSSION

To the best of our knowledge, this is the first study assessing TMD symptoms and their risk factors among a large sample of hEDS/HSD women. Nearly all the women reported symptoms known to be attributed to TMD. The higher prevalence figures were reported among the 27- to 50-year-old group compared to the 51- to 78-year-old group, apart from jaw pain/fatigue. In the crude and adjusted models, socio-demographic factors, general health-related factors and comorbid symptoms were significantly associated with TMD among both age groups. Psychological distress was significantly associated with TMD pain symptoms only in the crude models among the older age group.

4.1 | TMD among hEDS/HSD

In the total sample, the most common symptoms were TMD pain (95%), TMJ clicking (90%) and jaw pain/fatigue (80%); the least

TABLE 1 Prevalence of self-reported pain symptoms attributed to TMD among women with hEDS/HSD stratified by age, 27- to 50-year-olds ($n=105$) and 51- to 78-year-olds ($n=77$).

Variables	Jaw pain/fatigue $n=147$ (80%)		TMD pain $n=175$ (90%)	
	27- to 50-year-olds $n=82$ (78%) n (%)	51- to 78-year-olds $n=62$ (81%) n (%)	27- to 50-year-olds $n=101$ (96%) n (%)	51- to 78-year-olds $n=71$ (92%) n (%)
Country of birth				
Sweden	49 (59.8)	55 (88.7)	61 (60.4)	64 (90.1)
Finland	33 (40.2)	7 (11.3)	40 (39.6)	7 (9.9)
Living condition				
With other	59 (72.8)	47 (75.8)	71 (71)	54 (76.1)
Alone	22 (27.2)	15 (24.2)	29 (29)	17 (23.9)
Education				
Primary	5 (6.1)	5 (8.1)	5 (4.9)	6 (8.4)
Secondary	47 (57.3)	26 (41.9)	54 (53.5)	31 (43.7)
University	30 (36.6)	31 (50.0)	42 (41.6)	34 (47.9)
Employment status				
Working	49 (60.5)	35 (57.4)	57 (57)	41 (58.6)
Not working	32 (39.5)	26 (42.6)	43 (43)	29 (41.4)
Family history of EDS/HSD				
No	35 (42.7)	22 (35.5)	40 (39.6)	27 (38)
Yes	47 (57.3)	40 (64.5)	61 (60.4)	44 (62)
Self-perceived general health				
Good	6 (7.2)	4 (6.5)	8 (7.9)	6 (8.5)
Poor	76 (92.8)	58 (93.5)	93 (92.1)	65 (91.5)
Tobacco usage (smoking/using snuff)				
No	23 (28.4)	6 (6.5)	26 (25.7)	7 (9.9)
Yes (present / past)	58 (71.6)	58 (93.5)	74 (7)	64 (90.1)
Regularly taken contraceptives				
No	43 (52.4)	39 (62.9)	52 (51.5)	46 (64.8)
Yes	39 (47.6)	23 (37.1)	49 (48.5)	25 (35.2)
Regularly taken hormone medications				
No	68 (82.9)	58 (93.6)	85 (84.2)	66 (93)
Yes	14 (17.1)	4 (6.4)	16 (15.8)	5 (7)
Self-reported joints pain in elbow/wrist/ hip/ knee/ ankle				
Not worst	63 (78.8)	39 (67.2)	75 (75.8)	44 (67.7)
Worst	17 (21.2)	19 (32.8)	16 (24.2)	21 (32.3)
Self-reported pain in head/neck/arm/upper back/lower back/stomach/feet				
Not worst	39 (48.8)	25 (43.1)	53 (53.5)	29 (43.3)
Worst	41 (51.2)	33 (56.9)	46 (46.5)	38 (56.7)
Tinnitus				
No	26 (31.7)	17 (27.4)	35 (34.7)	21 (29.6)
Yes	56 (68.3)	45 (72.6)	66 (65.3)	50 (70.4)
Fatigue				
No	4 (4.9)	1 (1.6)	5 (4.9)	2 (2.8)
Yes	78 (95.1)	61 (98.4)	96 (95.1)	69 (97.2)
Self-reported oral health				
Good	40 (48.8)	37 (59.7)	50 (49.5)	44 (62)
Poor	42 (51.2)	25 (40.3)	51 (50.5)	27 (38)

(Continues)

TABLE 1 (Continued)

Variables	Jaw pain/fatigue <i>n</i> = 147 (80%)		TMD pain <i>n</i> = 175 (90%)	
	27- to 50-year-olds <i>n</i> = 82 (78%) <i>n</i> (%)	51- to 78-year-olds <i>n</i> = 62 (81%) <i>n</i> (%)	27- to 50-year-olds <i>n</i> = 101 (96%) <i>n</i> (%)	51- to 78-year-olds <i>n</i> = 71 (92%) <i>n</i> (%)
Self-reported comfortable jaw				
Yes	48 (58.5)	36 (59.1)	57 (56.4)	40 (57.1)
No	34 (41.5)	25 (40.9)	44 (43.6)	30 (42.9)
Self-reported bruxism (clenching/grinding)				
No	6 (6.2)	3 (4.8)	8 (8)	6 (8.5)
Yes	76 (93.8)	59 (95.2)	92 (92)	65 (91.5)
PHQ4				
Normal (0–2 points)	30 (36.9)	28 (45.1)	38 (37.7)	31 (43.6)
Mild (3–5 points)	21 (25.6)	20 (32.3)	26 (25.7)	24 (33.8)
Moderate (6–8 points)	14 (17.1)	7 (11.3)	17 (16.8)	9 (12.7)
Severe (9–12 points)	17 (20.4)	7 (11.3)	20 (19.8)	7 (9.9)

common symptoms were TMJ crepitation (63%) and TMJ luxation (44%). Based on the current literature, EDS patients experience both TMD pain and dysfunction.^{15,16,19} Among those with GJH, structural alteration of the affected collagen types (I, III and V) in the TMJ²⁵ in terms of ligamentous laxity has been proposed as a possible predisposing risk factor for the development of TMD.^{7,12} Condylar hypermobility may in turn irritate deep posterior temporal nerves resulting in TMJ pain and local damage of the TMJ structures.²⁶ In general, joint laxity decreases with age,⁹ which was also reflected in our findings.

In a study by Jerjes et al among 18 hEDS women aged 23–60 years, 40% reported TMJ dislocation.²¹ Even though the prevalence figure is quite close to our finding in the total sample (44%), a direct comparison of the findings is not rational due to different sample sizes. It was proposed that a symptomatic TMJ luxation (with pain and clicking)²⁷ could be a contributing factor in TMJ osteoarthritis and joint inflammation.²⁸ This may reflect the high prevalence of crepitation among both age groups in our study.

4.2 | Socio-demographic factors

In the adjusted models, Finland as a country of birth was associated with self-reported TMJ crepitation among the younger age group, and with TMJ luxation among both age groups in comparison to Sweden as a country of birth. Moreover, family history had the strongest association with TMJ luxation among the older age group (PR: 5.03; 95% CI: 1.64–15.44). A possible interpretation may be a different ethnicity influencing joint laxity.⁹ Likewise, uniformity of disease mutations at the molecular level due to dramatic isolation was previously proposed in Finland.²⁹ hEDS is inherited in an autosomal dominant manner, meaning that each child of the individual with hEDS has a 50% chance of inheriting disorders.¹⁰ The large

difference between the number of the women who were born in Finland (*n* = 48) and those who were born in Sweden (*n* = 137) may also affect the results.

In our sample, the majority had a high education level and worked. Education level may in part reflect an individual financial situation and a better health status. These levels were relatively high as compared to a previous Swedish study, which showed that more than 50% of EDS subsets were not working.³⁰

Among the younger age group, living alone was significantly associated with self-reported TMD pain, TMJ clicking and luxation. This pattern may be related to a lack of belonging to the best source of support network, that is, 'family', in chronic pain among those who live alone.³¹ Incomprehension regarding social disability with surroundings among EDS was also found to result in anxiety and enhanced somatization,³² which in turn increases chronification of TMD.³³

4.3 | General health-related factors

In our study, the prevalence of regularly taking contraceptives was higher in those reporting pain symptoms compared to those who did not take any contraceptives among the older age group. The role of oestrogen hormone levels and TMD pain among the general population has been suggested previously, with higher prevalence among menopausal women compared to non-menopausal women.³⁴ The fluctuation of sex hormones during menses was also proposed to have an impact on symptomatology and clinical evolution of hEDS.³⁵ More research is needed to establish the role of hormones in TMD among hEDS/HSD.

One of the assessed comorbid symptoms in this study was tinnitus associating specifically with TMJ clicking and luxation in the older age group. In the general population, hearing loss, stress, anxiety and unspecified TMD are among the most common causes for tinnitus.³⁶ The

TABLE 2 Prevalence of self-reported dysfunction symptoms attributed to TMD among women with hEDS/HSD stratified by age, 27- to 50-year-olds ($n=105$) and 51- to 78-year-olds ($n=77$).

Variables	TMJ clicking * $n=166$ (90%)		TMJ crepitation $n=118$ (64%)		TMJ luxation $n=81$ (44%)	
	27- to 50-year-olds $n=100$ (95%) n (%)	51- to 78-year-olds $n=63$ (82%) n (%)	27- to 50-year-olds $n=71$ (68%) n (%)	51- to 78-year-olds $n=45$ (58%) n (%)	27- to 50-year-olds $n=52$ (50%) n (%)	51- to 78-year-olds $n=28$ (36%) n (%)
Country of birth						
Sweden	60 (60)	57 (90.58)	34 (47.9)	39 (86.7)	24 (46.2)	22 (78.6)
Finland	40 (40)	6 (9.5)	37 (52.1)	6 (13.3)	28 (53.8)	6 (21.4)
Living condition						
With other	70 (70.7)	47 (74.6)	49 (70)	34 (75.6)	33 (63.46)	23 (82.1)
Alone	29 (29.3)	16 (25.4)	21 (30)	11 (24.4)	19 (36.54)	5 (17.9)
Education						
Primary	5 (5)	6 (9.5)	5 (7)	4 (8.9)	1 (1.9)	3 (10.7)
Secondary	55 (55)	25 (39.7)	38 (53.6)	19 (42.2)	30 (57.7)	13 (46.4)
University	40 (40)	32 (50.8)	28 (39.4)	22 (48.9)	21 (40.4)	12 (42.9)
Employment status						
Working	56 (56.6)	36 (58.1)	45 (64.3)	23 (52.3)	29 (55.8)	18 (66.7)
Not working	43 (43.4)	26 (41.9)	25 (35.7)	21 (47.7)	23 (44.2)	9 (33.3)
Family history of EDS/HSD						
No	40 (40)	24 (38.1)	27 (38)	17 (37.8)	20 (38.5)	3 (10.7)
Yes	60 (60)	39 (61.9)	44 (62)	28 (62.2)	32 (61.5)	25 (89.3)
Self-perceived general health						
Good	8 (8)	4 (6.4)	7 (9.9)	4 (8.9)	6 (11.5)	4 (14.3)
Poor	92 (92)	59 (93.6)	64 (90.1)	41 (91.1)	46 (88.5)	24 (85.7)
Tobacco usage (smoking/using snuff)						
No	26 (26.3)	7 (11.1)	22 (31.4)	7 (15.6)	16 (30.8)	4 (14.3)
Yes (present / past)	73 (73.7)	56 (88.9)	48 (68.6)	38 (84.4)	36 (69.2)	24 (85.7)
Regularly taken contraceptives						
No	55 (55)	41 (65.1)	38 (53.5)	28 (62.2)	30 (57.7)	16 (57.1)
Yes	45 (45)	22 (34.9)	33 (46.5)	17 (37.8)	22 (42.3)	12 (42.9)
Regularly taken hormone medications						
No	84 (84)	60 (95.2)	61 (85.9)	41 (91.1)	46 (88.5)	26 (92.9)
Yes	16 (16)	3 (4.8)	10 (14.1)	4 (8.9)	6 (11.5)	2 (7.1)
Self-reported joints pain in elbow/wrist/ hip/ knee/ ankle						
Not worst	75 (76.5)	38 (66.7)	52 (75.4)	29 (72.5)	42 (84)	18 (69.2)
Worst	23 (23.5)	19 (33.3)	17 (24.6)	11 (27.5)	8 (16)	8 (30.8)
Self-reported pain in head/neck/arm/upper back/lower back/stomach/feet						
Not worst	34 (34)	29 (49.2)	35 (50.7)	20 (47.6)	24 (48)	12 (46.2)
Worst	46 (46)	30 (50.8)	34 (49.3)	22 (52.4)	26 (52)	14 (53.8)
Tinnitus						
No	34 (34)	14 (22.2)	25 (35.2)	12 (26.7)	19 (36.5)	5 (17.9)
Yes	66 (66)	49 (77.8)	46 (64.8)	33 (73.3)	33 (63.5)	23 (82.1)
Fatigue						
No	4 (4)	1 (1.6)	4 (5.6)	2 (4.4)	2 (3.9)	1 (3.6)
Yes	96 (96)	62 (98.4)	67 (94.4)	43 (95.6)	50 (96.1)	27 (96.4)
Self-perceived oral health						
Good	50 (50)	37 (58.7)	32 (45.1)	26 (57.8)	24 (46.2)	19 (67.9)
Poor	50 (50)	26 (41.3)	39 (54.9)	19 (42.2)	28 (53.8)	9 (32.1)

(Continues)

TABLE 2 (Continued)

Variables	TMJ clicking * n = 166 (90%)		TMJ crepitation n = 118 (64%)		TMJ luxation n = 81 (44%)	
	27- to 50-year-olds n = 100 (95%) n (%)	51- to 78-year-olds n = 63 (82%) n (%)	27- to 50-year-olds n = 71 (68%) n (%)	51- to 78-year-olds n = 45 (58%) n (%)	27- to 50-year-olds n = 52 (50%) n (%)	51- to 78-year-olds n = 28 (36%) n (%)
Self-reported comfortable occlusion						
Yes	57 (57)	34 (54.8)	43 (60.6)	23 (51.1)	31 (59.6)	17 (60.7)
No	43 (43)	28 (45.2)	28 (39.4)	22 (48.9)	21 (40.4)	11 (39.3)
Self-reported bruxism (clenching/grinding)						
No	10 (10.1)	5 (7.9)	7 (9.9)	3 (6.7)	7 (13.7)	1 (3.6)
Yes	89 (89.9)	58 (92.1)	64 (90.1)	42 (93.3)	44 (86.3)	27 (96.4)
PHQ4						
Normal (0–2 points)	38 (38)	30 (47.6)	27 (38)	19 (42.2)	21 (40.4)	11 (39.3)
Mild (3–5 points)	26 (26)	18 (28.6)	18 (25.4)	12 (26.7)	12 (23.1)	9 (32.1)
Moderate (6–8 points)	16 (16)	9 (14.3)	11 (15.5)	9 (20)	6 (11.5)	5 (17.9)
Severe (9–12 points)	20 (20)	6 (9.5)	15 (21.1)	5 (11.1)	13 (25)	3 (10.7)

Note: * Indicates statistically significant results ($p < 0.05$).

Variables	Jaw pain/fatigue	TMD pain	TMJ clicking	TMJ crepitation	TMJ luxation
Country of birth					
Sweden				Ref	Ref
Finland				1.70 (1.29–2.26)	1.91 (1.32–2.77)
Living condition					
With other		Ref	Ref		Ref
Alone		1.06 (1.00–1.11)	1.06 (1.00–1.13)		1.43 (1.01–2.04)
Education					
Primary	Ref				
Secondary					
University	0.68 (0.54–0.85)				
Regularly taken contraceptives					
No			Ref		
Yes			0.91 (0.83–0.98)		
Self-reported pain in head/neck/arm/upper back/lower back/stomach/feet					
Not worst	Ref				
Worst	1.26 (1.02–1.55)				

TABLE 3 Significant adjusted prevalence ratio (PR) and the 95% confidence interval (95% CI) of the associations between socio-demographic and general health-related factors with self-reported symptoms attributed to TMD among women 27- to 50-year-olds ($n = 105$) with confirmed hEDS/HSD.

possible interpretation for tinnitus among the women in our study may be confounded by hearing loss increasing with age³⁷ or anxiety that is preserved in the elderly with EDS.³⁸ However, the mechanism linking TMD and tinnitus among EDS needs to be further elucidated.

In this study, most women with TMD symptoms reported fatigue. Among the hEDS/HSD, chronic fatigue can be due to the various

factors such as poor sleep quality, chronic pain and psychological issues.³⁹ The relationship between sleep disorder and TMD is also well established.⁴⁰

Chronic pain is one of the most common and serious complication of hEDS/HSD and results in both physical and psychological disabilities.⁴¹ Generally, chronic pain among hEDS/HSD can be characterized

TABLE 4 Significant adjusted prevalence ratio (PR), and their 95% confidence interval (95% CI) of the associations between socio-demographic, general health, comorbid and psychological factors with self-reported symptoms attributed to TMD among women 51- to 78-year-olds ($n=77$) with confirmed hEDS/HSD.

Variables	Jaw pain/ fatigue	TMD pain	TMJ clicking	TMJ luxation
Country of birth				
Sweden				Ref
Finland				1.98 (1.42-2.77)
Education				
Primary		Ref	Ref	
Secondary			0.75 (0.59-0.96)	
University		0.86 (0.75-0.98)	0.72 (0.56-0.93)	
Family history of EDS/HSD				
No				Ref
Yes				5.03 (1.64- 15.44)
Regularly taken contraceptives				
No	Ref	Ref		
Yes	1.21 (1.00-1.47)	1.13 (1.02-1.26)		
Tinnitus				
No			Ref	
Yes			1.53 (1.09-2.15)	

as nociceptive due to laxity-based issues,⁴² neuropathic pain⁴³ or nociplastic pain (sensory processing without formal lesion identification).⁴⁴ Among our younger age group, those with worst pain in the body (not the joints) had a prevalence of 1.26 times higher (26% higher) jaw pain/fatigue than those with no worst pain. There is good evidence from other studies that pain elsewhere in the body strongly predicts TMD.⁴⁵ Thus, TMD may be considered as a part of the general pain and not only as local TMD among hEDS/HSD in the management strategies.

4.4 | Psychological distress

More than 50% of the sample who reported TMD symptoms had a higher PHQ-4 score than two points. A higher risk of mood and development disorders has been reported among EDS compared to the general population in Sweden.⁴⁶ Among our older age group, the severe PHQ score was significantly associated with TMD pain symptoms in the crude models. However, this was not the case among the younger age group. A possible interpretation may be related to the lack of knowledge in the EDS field in Sweden⁴⁷ and consequently 'living restricted'.⁴⁸ Thus, the older age probably more often refrained from seeking help due to the stigma and negative beliefs about mental health compared to the younger age group.⁴⁹ However, the knowledge about psychiatric and psychological aspects of health among hEDS/HSD have been increased in a few decades.³⁸ Therefore, the presence of psychological component should be considered in the diagnosis process and management of TMD.

Taken together, TMD among hEDS/HSD is complex and multifactorial, requiring a multidisciplinary approach. Previous studies

have suggested such an approach within management of chronic pain among EDS.^{42,50}

4.5 | Methodological considerations

The present study is the first epidemiological study assessing symptoms attributed to TMD and various risk factors in a large sample of women with confirmed hEDS/HSD stratified by age. The methodology was improved by applying prevalence ratio as a preferred measure of association in the cross-sectional study.⁵¹

The low participation rate in both Sweden (30%) and Finland (18%) might indicate a certain selection bias, and thus affect the generalizability of the findings. Likewise, presence of TMD symptoms may have contributed to participation in this study. The reliability of the data may be questioned as the data were solely based on self-report. Additionally, target population in Finland was approached via social platform. Nevertheless, the impact of these biases on the estimated figures is not possible to assess.

5 | CONCLUSION

There was a high prevalence of TMD symptoms among women with confirmed hEDS/HSD in both countries. Socio-demographic and health-related factors as well as comorbid symptoms were significantly associated with TMD, but with differences regarding age group. Based on our findings, a multidisciplinary approach needs to be considered in the treatment of TMD among the affected.

AUTHOR CONTRIBUTIONS

NY developed the research question and designed the study. NY and KS collected the data. NY managed the analysis and interpretation of results was supported by KS. NY drafted the manuscript and KS, MN and MJT contributed specifically to their field of expertise. All authors critically revised the manuscript and approved the final version.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sets used and/or analysed during the current study are available on reasonable request from the corresponding author.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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