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ORIGINAL RESEARCH

Food and Beverage Habits Among Individuals with Primary Hyperhidrosis: A Case-Control Survey in Sweden

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Aim: Excessive sweat production in primary hyperhidrosis (PH) can lead to water and mineral loss, yet data on patients' dietary habits are limited.

Purpose: To explore associations between food and beverage consumption and severe PH.

Patients and Methods: Participants with primary palmar and axillary hyperhidrosis (n=171) and without hyperhidrosis (n=165) completed a validated questionnaire on food and beverage habits at two hospitals in northern Sweden. Frequency and quantity of specific foods and beverages were compared between groups.

Results: A total of 336 individuals participated in this study (men, n=109; women, n=218; unspecified sex, n=9). Individuals with PH were younger (18–29 years, n=104 vs n=66; p<0.001) and more frequently female compared to controls (n=75 vs 58; p<0.001). Total caffeine consumption was higher in PH (median score: 186.6 vs.151.0; p<0.001), and 57% of individuals with PH consumed energy drinks weekly compared with 39.5% of controls (p<0.001). Spicy foods, fatty foods, fast foods, and sweets were reported to trigger sweating. Women with PH more often reported difficulties replenishing water loss, and increased thirst was the most reported symptom in both men and women.

Conclusion: PH was associated with higher caffeine intake, distinct beverage consumption patterns, and self-reported fluid loss symptoms. These findings indicate potential associations between diet and PH and may inform patient education and future research, although causality cannot be inferred from this study.

Keywords: hyperhidrosis, questionnaire survey, food habits, beverage habits

Introduction

Excessive sweat production that is not physiologically necessary is termed hyperhidrosis. While there is no clear definition of hyperhidrosis, it is classified either as primary or secondary, often associated with a medical condition.[1] In primary hyperhidrosis (PH), sweating is focal or multifocal, and patients complain of excessive sweating at rest.[2] PH has been described to affect men and women in equal proportions, and a hereditary cause is often described for the disease.[3–5] The prevalence of PH has been estimated to be 5.5% in the adult Swedish population,[6] 2.8–4.8% in the USA[5,7] and 2.79–5.75% in Japan.[4]

In clinical practice, PH is diagnosed according to the patient's medical history,[2] while the Hyperhidrosis Disease Severity Scale (HDSS) assesses the severity of sweating.[8] HDSS consists of one question with four answers. Each answer corresponds to one point, yielding 1–4 points on the HDSS scale. A total of 1–2 points is interpreted as mild sweating, while 3–4 points indicate moderate to severe sweating problems.[9] Quantitative measurements of sweat production are rarely performed in clinical practice due to their time-consuming nature and the lack of a standardised

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method. There is often a delay in obtaining a diagnosis of PH, which can cause great suffering with negative psychosocial consequences for those affected.[10] Excessive sweating in PH causes stigma, and those affected tend to avoid social activities or abstain from certain educations or professions.[11,12]

Although sweat production may be localised to a few anatomical sites in PH, the sweat volume can be considerable and, in severe cases, comparable to that produced during strenuous physical exercise. It has been described that in exercise, the body loses water via sweat, from 0.5 L/h up to 3 L/h among athletes.[13,14] In severe hyperhidrosis, there is indication that sweat production could exceed 3L sweat/h.[15] During sweat production, the body also loses minerals such as sodium, chloride, potassium, magnesium, calcium, and heat.[16] These losses must be replenished for optimal function of the body. In healthcare, it is common for patients with PH to seek advice on dietary choices that may impact sweat production, potentially exacerbating or reducing it. Although healthcare professionals are limited in their response due to deficient data, anecdotally, patients with PH report that food and drinks containing sugar, fat, salt, spices, caffeine, and alcohol exacerbate sweat production.[17] Dietary factors such as starchy and spicy food could influence thermoregulation, specifically via the activity of the sympathetic nervous system.[18,19] However, the relationship between habitual dietary patterns and sweat production in individuals with hyperhidrosis remains largely unexplored and to the best of our knowledge, there are no studies providing data regarding the eating and drinking habits of patients with hyperhidrosis. Improving this understanding could provide insight into modifiable lifestyle factors that affect disease severity and patient quality of life. Thus, the aim of this study was to examine food and beverage consumption habits in individuals with hyperhidrosis compared with those without the disorder.

Materials and Methods

Design

A cross-sectional exploratory questionnaire survey.

Participants

Participants consisted of patients visiting the Department of Dermatology and Venereology at Umeå University Hospital, County of Västerbotten, and Östersunds Hospital, County of Jämtland and Härjedalen, between January 2022 and December 2023. Patients with gustatory or non-axillary/non-palmar hyperhidrosis are generally not treated in state-subsidised specialised healthcare in Sweden due to cost-benefit considerations and national guidelines on hyperhidrosis management in Dermatology and Venereology. The patients had already been diagnosed with PH in primary care and were referred for botulinum toxin treatment if they had an HDSS score of 3 or 4, indicating severe hyperhidrosis. None of the participants used anticholinergic medications prior to their visit, since it would have affected the assessment of their sweating. Inclusion criteria were reading and understanding Swedish and being ≥18 years of age. Exclusion criteria were botulinum toxin treatment within the past 12 months, pregnancy or lactation. Participants without hyperhidrosis consisted of healthy medical students or other dermatological patients without a diagnosis of hyperhidrosis. No randomisation was applied, as non-probability (consecutive) sampling was used, and all eligible patients within the study period were considered for participation.

Questionnaire

Food and Beverage Habits Questionnaire

The original questionnaire examined background characteristics, including HDSS (6 items), diet (13 items), and fluid intake (4 items). The diet section consisted of topics investigating eating habits, food associated with hyperhidrosis, and salt consumption, as well as a table investigating the consumption frequency and quantity of foods. The beverage intake section investigated topics such as fluid loss and its potential symptoms, the effect of caffeine, consumption frequencies, and the drinking quantity of broad types of beverages (Supplementary Questionnaire S1).

Translation and Validation

The original questionnaire and its items were compiled and constructed by Prof. Dunford at the University of Warwick, United Kingdom, due to her expertise in the field of physiology. The English version of the questionnaire was translated

into Swedish and back to English by a professional translator. The translated questionnaire was further revised for relevance and content by a group of researchers experienced in questionnaire surveys at the Department of Dermatology and Venereology, Umeå University, Sweden. Additional items, such as height, weight, and further investigation into the consumption of beverages and food, were added, making the questionnaire more relevant for Scandinavian conditions. Although no original items were removed, cordial was added to the beverages section, and cheese curls, popcorn, frozen ready meals, French fries, and energy bars were included in the food section. In the next step, the revised questionnaire was tested among ten physicians and nurses at the Department of Dermatology and Venereology, Umeå University Hospital, for its relevance and content. A further revision was made to increase the accuracy of some of the items. Finally, the questionnaire was tested among 20 hyperhidrosis patients and 20 patients without hyperhidrosis, rating each item between 1 (very low) and 5 (very high) points for its content, language, and relevance. In addition, if the patients rated an item with 1 or 5, they were instructed to provide a more detailed response. Items scoring a mean value of ≤3.0 points by more than 70% of the patients were meant to be excluded. This method was based on Bloom's cutoff scores to assess the Likert scale responses.[20] Since all questionnaire items scored above this threshold, no exclusion was made.

Data Collection

Participants were included on the day of their visit to the Clinic by nurses who were not involved in their care after giving informed consent. Filling out the questionnaire took approximately 10–15 minutes. Among individuals without hyperhidrosis, n=87/120 (72.5%) responded. All invited medical students (n=78) and individuals with PH (n=171) completed the questionnaires. Completed questionnaires were returned by dropping them into a box situated in the waiting rooms at the clinics. The response rate was 99.8% to all items in the questionnaire.

Ethics

The procedures used in this study adhere to the tenets of the Declaration of Helsinki. Informed and written consent were collected from all the participants. All questionnaires and responses were coded. The statistical work was performed by a blinded, non-clinician to minimise potential biases. The Swedish Ethical Review Authority approved this study; Dnr 2021-05404-01.

Statistics

As there were no data available regarding the investigated topic, a sample size calculation was not performed. However, including a minimum of 150 individuals with hyperhidrosis and 150 individuals without hyperhidrosis was regarded as a reasonable sample size, considering non-response, the number of patients seeking help at our clinics annually and for statistical measurements of the difference between the two groups.[21]

In the statistical analysis, the X^2-test was used for categorical data unless otherwise stated. Persons not declaring their sex or defining themselves as "other" than men or women (n=9) were excluded from comparisons between sexes due to their small sample size. Missing data across the questionnaire and for all items were in total 44, evenly distributed among 19272 response options. Student´s *t*-test was used for the comparison of means in normally distributed variables.[22] The Mann–Whitney *U*-test was used for the comparison of medians for data that was not normally distributed.[23] Spearman's rank test was used in correlation analysis. A two-sided significance level of 0.05 was adopted for all tests.

Participants' responses regarding the frequency and the quantity of food and beverages consumed were adjusted with weighting factors to address imbalances and response impact. A scoring system was constructed to calculate the total consumption score for each item by multiplying response factors in frequency and quantity.[24] Data was analysed with SPSS version 29.0 (IBM Corp., Armonk, NY, USA).

Results

A total of 336 people participated in the study. In the PH group, n=127 (75%) were women and n=43 (25%) men, compared with n=91 (58%) women and n=66 (42%) men in the non-PH group (p<0.001). Most PH patients were under 30 years (n=82, 64.6%), with n=37 (29.1%) aged 30–49 and n=8 (6.3%) aged ≥50. The non-PH group had a broader distribution: n=26 (39.4%) aged 18–29, n=22 (33.3%) aged 30–49, n=8 (12.1%) aged 50–64, and n=10 (15.2%) aged ≥65 (p<0.001).

In men with PH, 32/43 (74.4%) reported an HDSS score of 3–4 points, while 11/43 (25.6%) scored 1–2 points. In women with PH, 93/127 (73.3%) reported an HDSS score of 3–4 points, while 34/127 (26.8%) scored 1–2 points. There was no significant difference in severity between sexes (p=0.519). Women reported having received a PH diagnosis at a lower age (11–17 vs 18–29: p<0.001). There was no significant difference in proportion between men and women having hyperhidrosis in feet (n=9/43, 20.9% vs n=23/126, 18.3%; p=0.83), palms (n=18/43, 41.9% vs n=58/126, 46.0%; p=0.59), axilla (n=31/43, 72.1% vs n=82/126, 65.1%; p=0.55), face (n=2/43, 4.7% vs n=4/126, 3.2%; p=0.89) and groins (n=2/43, 4.7% vs n=6/126, 4.8%; p=0.96). The severity of PH, as assessed by the HDSS, did not differ significantly between sexes (3.09±0.84 vs 3.01±0.75; p=0.61) (Table 1). However, the severity of PH was correlated with increasing amounts of sweating sites (r=0.15, p<0.05).

Increased feeling of thirst was the most common symptom reported by n=13/43 (31.9%) of men and n=49/127 (38.6%) of women with hyperhidrosis (p=0.39), followed by dry lips and mucosal dryness (n=13/43, 31.9% men vs n=43/127, 33.9% women; p=0.38) and noticing darker urine (n=10/43, 23.3% men vs n=30/127, 24.2% women; p=0.83). Other self-reported symptoms due to hyperhidrosis were headache, dry skin, cold hands, cramps in legs/feet in the evening/night, fungal infections, psychological negative burdens, social anxiety, and aesthetic problems. While men more often reported having no difficulties replenishing the water loss caused by hyperhidrosis (n=30/43, 69.8% vs n=54/126, 42.9%; p=0.002), women reported being too busy (n=3/43, 7.0% vs n=30/126, 23.8%; p=0.04), having to drink several times a day (n=2/43, 4.7% vs n=26/126, 20.6%; p=0.046) and being forced to visit the bathroom more often (n=1/43, 2.3% vs n=25/126, 19.8%; p=0.006) as issues hindering them from replenishing water loss. The only difference found for salt consumption was that individuals without PH more often used salt when cooking food (p<0.001).

Food and Beverage Consumption in Hyperhidrosis

Spicy foods (n=57/171, 33.3%), fatty foods (n=16/171, 9.4%), sweets (n=13/171, 7.6%) and fast food (n=9/171, 5.2%) were reported to increase sweat production, while n=133/171 (77.8%) of individuals with PH stated that caffeine did not affect sweating. Beverage consumption was higher in individuals with PH (median: 36.5, IQR: 27.3–49.3) compared to

Table 1 Characteristics of the Participants

	PH (n=170)		**No PH (n=157)**		**p (PH vs no PH)**
	Men	**Women**	**Men**	**Women**	
Participants*, n (%)	43 (25)	127 (75)	66 (42)	91 (58)	<0.001[a]
Age, yrs., n (%)					
18–29	22 (51.2)	82 (64.6)	26 (39.4)	40 (44.0)	<0.001[b]
30–49	18 (41.9)	37 (29.1)	22 (33.3)	32 (35.2)	
50–64	3 (7.0)	8 (6.3)	8 (12.1)	15 (16.5)	
>65	0	0	10 (15.2)	4 (4.4)	
BMI, mean (SD)	26.3 (4.1)	23.7 (4.0)	25.1 (4.5)	23.9 (3.5)	0.84[c]
Localisation, n (%)					
Axilla	31 (72.1)	81 (64.3)			0.350[a]
Palms	18 (41.9)	59 (46.8)			0.572
Feet	9 (20.9)	23 (18.3)			0.699
Groins	2 (4.7)	6 (4.7)			1
Face	2 (4.7)	4 (3.2)			0.651
Other**	3 (7.0)	8 (6.3)			0.885
Multifocal***	10 (23.3)	35 (27.6)			0.952

Notes: *Individuals not declaring their sex (n=9) are not described (1 with PH and eight without PH) in this table **Other localisations described as back, buttocks, below the breasts and genitals. ***Multifocal is defined as hyperhidrosis on more than one localisation of the body. [a]Calculated using X^2 test, [b]Calculated using Mann–Whitney *U*-test, [c]Calculated using Student's *t*-test.

Abbreviations: n, number; PH, primary hyperhidrosis; yrs., years; SD, ± standard deviation; BMI, Body Mass Index; HDSS, Hyperhidrosis Disease Severity Scale.

Table 2 Significant Food and Beverage Consumption Differences Between the Two Groups

Food and Beverage Items	PH (n=171)	Without PH (n=165)	Z Test Statistics	p[a]
	Mean Rank*	Mean Rank*		
Light soda	181.9	154.6	2.64	0.008
Cola Light	182.6	153.9	2.85	0.004
Coffee	149.1	188.6	−3.76	<0.001
Energy drinks	186.6	149.7	3.78	<0.001
Cheese	149.5	188.2	−3.68	<0.001
Soup	156.6	180.1	−2.42	0.016
Sausages	155.1	182.4	−2.67	0.008
Caffeine-containing drinks**	186.6	151.0	3.10	<0.001

Notes: [a]Calculated using the Mann–Whitney *U*-test. *Mean rank is given as scores constructed by multiplying factors for frequency (never or less than once a week = x 0.5; once a week = x 1; 2–3 times a week = x 2.5; 4–6 times a week = x 5; once a day = x 7; 2 times a day = x14 and > three times a day = x 21) and for quantity (< 1 unit = x 0.5; 1 unit = x 1; 1.5 units = x 1,5; 2 units = x 2 and > two units = x 3) ie varying between 0.25–63. **Caffeine-containing drinks, including tea, coffee, cola, cola light and energy drinks.

Abbreviations: n, number; PH, primary hyperhidrosis.

those without hyperhidrosis (median: 35.5, IQR: 27.5–46.8), but the difference was not statistically significant (p=0.22). The differences in reported food and beverage consumption are described in Table 2.

A total of n=97/171 (57.0%) of individuals with PH consumed energy drinks during the week, while the corresponding proportion in those without PH was n=62/157 (39.5%; p<0.001). Consumption of energy drinks was positively correlated with increased light soda (r=0.31; p<0.001) and Cola light (r=0.32; p<0.001) consumption and negatively correlated with age (r=–0.32; p<0.001) and lower coffee consumption (r=–0.20; p=0.008).

Discussion

This study is among the first to consider the impact of diet on sweating and fluid intake in individuals diagnosed with PH. Unsurprisingly, individuals with PH reported spicy food as the most common trigger for sweat production. In secondary hyperhidrosis, gustatory sweating, sometimes caused by autonomic sudomotor dysfunction, can be triggered on the face or neck when consuming spicy or hot foods and beverages.[25] Hence, it is unknown whether individuals with PH are more or less likely to suffer from the same mechanism or whether a combination of several mechanisms affects the sweat production. The role of fatty food, fast food or sweets, which were also reported to exacerbate hyperhidrosis, is unclear. Temporary increased cortisol, insulin and other hormones, increasing metabolism and body temperature, could be potential mediators in this process.[26,27] While some patients have reported anecdotally that certain foods, such as those rich in calcium, may reduce sweating, there is no scientific evidence to support the idea that any specific diet can alleviate sweating from PH. Although our study did identify differences in the consumption of some items such as cheese, soup, and sausages, these findings are more likely to reflect general dietary habits rather than a direct effect on sweating.

In beverage consumption, the total caffeine consumption, including energy drinks, was significantly higher among individuals with PH. In 2018, the Swedish Food Agency reported from a cross-sectional survey that 12.6% of high school students in Sweden had consumed energy drinks in the past couple of days.[28] In 2013, the European Food Safety Authority reported that energy drink consumption was reported by 30% of individuals between 18–65 years, while 68% of those between 10–18 years were frequent consumers.[29] Considering these reports and our findings indicating that energy drink consumption is more common in young individuals, while coffee consumption is more common with increasing age, it was more accurate to compare the total caffeine consumption of the participants. Interestingly, individuals with PH had a significantly higher consumption of caffeine-containing beverages. Caffeine has been

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described to increase sweat production via activation of the sudomotor function.[30,31] Although univariate analyses revealed higher caffeine and energy drink consumption among individuals with PH, these differences could describe age-related or lifestyle factors, such as the higher proportion of younger participants in the control group (medical students). Similarly, observed differences in hydration and dietary patterns could be influenced by sex or age rather than hyperhidrosis. As such, residual confounding cannot be excluded, and future studies with larger samples or multivariable analyses are warranted to clarify these associations.

Sweating also varies significantly based on environmental conditions and personal traits. Individuals with PH can produce several litres of sweat daily, comparable to athletes training in hot environments.[32] Although we did not observe a significant difference in water and salt intake between the groups, our findings suggest that hydration may be challenging for some patients with PH, particularly women. Since observations were based on self-reported data, and physiological measurements were not performed, clinicians may consider discussing hydration strategies and caffeine intake with patients suffering from severe hyperhidrosis, particularly in social situations, often reported to exacerbate sweating.

While comorbidities were not systematically evaluated in this study, prior research indicates that individuals with PH seldom exhibit significant somatic comorbidities but are more likely to present with psychiatric conditions or other dermatological disorders.[6,33] Due to this knowledge, and the fact that one diagnostic criterion for PH is sweating without an apparent cause,[2] the absence of formal comorbidity data is unlikely to have significantly impacted our findings. Moreover, even if comorbidities had been recorded for all participants, the cross-sectional and questionnaire-based design of this study would not have enabled a meaningful assessment of each condition's influence on dietary habits or sweating patterns.

Gender differences were notable, with women reporting greater challenges in replenishing water loss, consistent with previous research showing that women with severe hyperhidrosis report a greater negative impact on their daily lives than men.[34,35] To our knowledge, difficulties in replenishing water intake for women with PH have not been described in previous publications and could partially explain why most patients seeking medical care are often women.

Alcohol consumption can potentially influence sweating and hydration, but it was not included in our questionnaire. Previous research in a separate cohort of patients with PH, utilising the Alcohol Use Disorders Identification Test, found no evidence of alcohol misuse.[33] Hence, based on our clinical experience and the lack of evidence for increased alcohol consumption in PH, this study focused on dietary habits and non-alcoholic beverages.

Finally, a large proportion of men (approx. 30%) and women (approx. 40%) with hyperhidrosis reported feeling thirst, and regardless of gender, having dry lips, mucosal dryness and darker urine. While data regarding the volume of urine, as it is a predictor for potentially developing kidney stones,[36] could not be obtained from our participants, our findings suggest a need for guidelines to emphasis the importance of recognising early signs of dehydration in hyperhidrosis and recommending adequate fluid intake for patients.

Strengths and Limitations

A strength of this study was the large sample of participants diagnosed with hyperhidrosis and a non-PH cohort, which can be difficult to obtain. However, we share the same limitation regarding most questionnaires in cross-sectional studies, being unable to determine causality. Factors such as recall bias, response bias, seasonal variations, occupational activity or unspecified sources for water intake could have influenced the participants' responses. Food frequency questionnaires do not always capture full nutritional information, as many food items are omitted.[37] It is also important to consider that the absence of standardised dietary recommendations for patients with PH complicates the interpretation of our findings, as there are no established benchmarks for comparison.

Another key strength was the cross-cultural translation of the questionnaire, ensuring its applicability in a Nordic context. However, further validation is warranted to fully assess the psychometric properties of the Swedish version, as formal reliability metrics, construct validity, and factor analyses were not performed. Also, due to the non-randomised design of this study, caution is warranted when generalising the findings to the broader population. However, the use of consecutive sampling and a well-defined cohort strengthens the internal validity of our findings.

The control group included medical students representing a younger age subgroup, which could have resulted in a demographic difference compared with the PH cohort. However, most patients with PH seeking medical care are usually below the age of 30 years, which creates a challenge in recruiting age-matched controls in a dermatological setting. These differences in age and potential lifestyle factors may influence dietary habits and should be considered when interpreting the findings of this study. Furthermore, no objective measurements regarding body fluids, such as electrolyte levels or urine output, were obtained from the participants, which limits the ability to draw physiological conclusions about hydration status or mineral loss. However, since hyperhidrosis is a clinical diagnosis and additional tests are neither required by national guidelines nor routine in healthcare, it would have been difficult to justify further tests and examinations outside of standard practice.

Conclusion

Individuals with PH reported increased consumption of caffeine-containing beverages, such as coffee and energy drinks, and identified spicy foods as common triggers for sweating. Women with PH experienced greater challenges in maintaining hydration, and a substantial proportion of participants reported thirst and related symptoms. While additional research is needed to clarify causal relationships, our results provide preliminary insights that could inform future research on lifestyle factors in hyperhidrosis management.

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Disclosure

The authors report no conflicts of interest in this work.

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