

Primary Focal Hyperhidrosis: Disease Characteristics and Functional Impairment

Henning Hamm^a Markus K. Naumann^b Jonathan W. Kowalski^c
Sandra Kütt^a Chris Kozma^d Chris Teale^e

^aDepartment of Dermatology, University of Würzburg, Würzburg, and ^bDepartment of Neurology, Klinikum Augsburg, Augsburg, Germany; ^cGlobal Health Outcomes Research, Allergan, Irvine, Calif., and ^dDepartment of Pharmacy, University of South Carolina, West Columbia, S.C., USA; ^eFormerly European Health Economics Unit, Allergan, High Wycombe, UK

Key Words

Hyperhidrosis · Hyperhidrosis Impact Questionnaire · Dermatology Life Quality Index · Health-related quality of life

Abstract

Background: There are few published data on the clinical characteristics of hyperhidrosis. **Objective:** To describe the functional impairment caused by primary focal hyperhidrosis. **Methods:** Patients with hyperhidrosis (n = 345) were enrolled at the Department of Dermatology, University of Würzburg. Controls (n = 154) were a convenience sample of subjects without hyperhidrosis. Hyperhidrosis characteristics, health-related quality of life and functional impairment were assessed. **Results:** Patients with axillary hyperhidrosis reported a later age at onset and a higher prevalence of a family history of hyperhidrosis than patients with palmar hyperhidrosis. Sixty-three percent of patients reported occupational impairment related to hyperhidrosis. Hyperhidrosis patients reported emotional and physical impairment, with a greater proportion of the axillary group reporting impairment. More than 50% of patients reported moderate

to extreme impairment in personal relationships and in social situations. **Conclusion:** Primary focal hyperhidrosis is a serious medical condition, affecting work productivity, daily activities, emotional well-being and personal relationships.

Copyright © 2006 S. Karger AG, Basel

Primary focal hyperhidrosis (PFH) is a disorder of bilateral, relatively symmetric sweating beyond physiological needs. It is typically localized to the axillae, palms, soles or face [1]. The pathophysiology of PFH is not well understood, and it is hypothesized to result from hyperstimulation of eccrine, and possibly apoeccrine, sweat glands by an autonomic pathway [1, 2].

PFH can result in substantial occupational, physical and emotional impairment, as well as considerable difficulties in personal relationships and social situations [3–5]¹. Recent epidemiological research indicates that the

¹ Kowalski J, Glaser D, Lowe N, Ravelo A: Quality-of-life and economic impact of primary axillary hyperhidrosis: results from a North American clinical study population (poster). 6th Annu Eur Congr Int Soc Qual Life Res, Prague, November 2003.

prevalence of hyperhidrosis in the USA may be as great as 2.8% and that 0.5% of the population suffer from severe axillary sweating (i.e. sweating that is either barely tolerable or intolerable and frequently or always interferes with daily activities) [6]. Two thirds of persons with hyperhidrosis have never discussed their excessive sweating with a healthcare professional [6].

Measuring the functional limitations and health-related quality of life (HRQOL) of patients with PFH is important for clinicians and researchers in determining the need for treatment, assessing the effectiveness of treatment, informing patients about the expectations of treatment, and in some cases providing information to third-party payers about the necessity and value of medical treatment. In addition, evidence-based guidelines for diagnosing and treating PFH include interference with daily activities as a criterion for diagnosis and to aid in determining the necessity for medical treatment [1]. Moreover, since gravimetric measurements of sweat production can vary over time and differ among patients [3], and because there is no clearly established threshold for severity with gravimetric methods [7], measurements of functional impairment and HRQOL may more accurately reflect the severity of the disorder than isolated measurements of sweat production.

Previous research has reported the marked negative effects of PFH on daily activities and HRQOL [3–5, 8–11]¹. However, none of these studies assessed functional impairment and HRQOL relative to those in a control group without hyperhidrosis or in terms of comparison by focal location (e.g. axillary and palmar). In addition, there are few published data on the clinical characteristics of PFH (e.g. age at onset, family history) or use of resources (e.g. physician visits). Thus, the purpose of this research is to assess and quantify key characteristics, use of resources and the extent of functional impairment in daily activities and HRQOL in a large cohort of patients with PFH and to assess differences in these measures by chief focal area of sweating (i.e. axillary vs. palmar) as well as relative to those in a convenience sample of nonhyperhidrosis control subjects.

Methods

Study Population

Patients with primary hyperhidrosis seeking care at the Dermatology Clinic of the University of Würzburg between March 1999 and February 2000 were invited to participate in the research. In addition, a comparative sample of nonhyperhidrosis control subjects of approximately the same age and body mass index were re-

cruited from hospital staff and students. Participants completed the battery of 3 questionnaires at a single time and were not compensated.

Patient-Reported Measures

Hyperhidrosis Impact Questionnaire

Hyperhidrosis characteristics, use of medical resources and functional limitations in daily activities due to hyperhidrosis were assessed by using the 41-item module of the Hyperhidrosis Impact Questionnaire (HHIQ[®])². The content of the HHIQ is based on a thorough literature review and on qualitative interviews with physicians and patients. The questionnaire includes a comprehensive set of items on hyperhidrosis-specific clinical factors (e.g. age at onset, focal location of sweating, family history, symmetry of sweating), use of medical resources (physician office visits, past treatments and their effectiveness), employment and productivity, various daily activities and psychological and emotional well-being. Nonhyperhidrosis controls completed an identical version of the HHIQ as hyperhidrosis patients except that the word 'hyperhidrosis' was replaced by 'sweating'. Each item on the HHIQ is individually scored. The validity and reliability of this scale, as well as its utility in measuring the burden of the disease and the effect of treatment in patients with hyperhidrosis, have been reported previously [6, 10, 12]^{2,3}.

Dermatology Life Quality Index

Dermatology-specific HRQOL was assessed by using the Dermatology Life Quality Index (DLQI), a reliable and validated 10-item questionnaire that is widely used to measure the effects of dermatological disease on HRQOL [13]. The total scores range from 0 to 30, with higher scores indicating greater impairment. Six domain scores are also calculated: symptoms and feelings, daily activities, leisure, work and school, personal relationships and treatment.

12-Item Short-Form Health Survey

General health status was assessed by using the 12-item Short-Form Health Survey (SF-12[®]). A valid and reliable instrument, the SF-12 produces 2 scores: the Physical Component Summary score and the Mental Component Summary score [14]. The scores range from 0 to 100, with higher scores indicating better functioning. The scores were normalized by using US population norms so that a score of 50 is the mean score in the USA, regardless of disease status.

Literature Search

To benchmark the effects of hyperhidrosis on HRQOL, Pubmed was searched for studies that used the DLQI or were involved in its development. The search terms included combinations of 'DLQI', 'hyperhidrosis' and 'quality of life'. Most of the articles selected came from the search with 'DLQI' as the search term. Dermatological conditions were ranked by mean DLQI total scores.

² Teale C, Roberts G: Development, validity, and reliability of the Hyperhidrosis Impact Questionnaire (HHIQ) (abstract). *Qual Life Res* 2002;11:702.

³ Glaser DA, Lowe NJ, Eadie N, et al: 52-week prospective randomized double-blind placebo-controlled safety and efficacy study of 2 dosages of botulinum toxin type A treatment for primary axillary hyperhidrosis (poster P.05.158). *Annu Meet Am Acad Neurol*, San Francisco, April/May 2004.

Table 1. Demographic characteristics of the study population

Characteristic	Controls (n = 154)	Hyperhidrosis		
		all (n = 345)	axillary (n = 165)	palmar (n = 116)
Sex, %				
Male	43	47	42	42
Female	57	53	58	58
Age, years	32 (7)	33 (13)	32 (12)	30 (9)
Height, cm	174 (10)	173 (13)	172 (9)	172 (18)
Weight, kg	69 (13)	71 (14)	70 (14)	68 (12)

For age, height and weight, results are expressed as means, with SD in parentheses.

When more than 1 study reported mean DLQI total scores for the same disease, the highest score was used for ranking and a range was created.

Statistical Analysis

Data on individual HHIQ items were assessed as has been previously published, in terms of the proportion of patients reporting impairment for the given response (e.g. proportion reporting at least moderately, quite a bit or extremely limited versus not limited or only somewhat limited), depending on the item's response options [6, 10]². Proportions were calculated by using as the denominator the number of subjects who responded to the question. Differences between the groups (control, all hyperhidrosis, axillary hyperhidrosis and palmar hyperhidrosis) were analyzed by using global statistical tests followed by post hoc comparisons. Specifically, differences in the proportion of patients with a particular HHIQ response were analyzed by using the χ^2 (global) followed by the χ^2 or Fisher exact tests for pairwise comparisons. Differences in categorical data were analyzed by using the Kruskal-Wallis test (global) followed by the Mann-Whitney U test for paired comparisons. ANOVA (global) followed by the Scheffé test was used to test differences in means (DLQI and SF-12). When global tests did not detect any significant differences between groups, no pairwise comparisons were made. A p value of 0.05 was considered statistically significant.

Results

Demographics

Three hundred forty-five patients with PFH and 154 control subjects without hyperhidrosis completed the 3 questionnaires. Of the patients with hyperhidrosis, 165 cited the axillae (axillary group) and 116 cited the palms (palmar group) as their chief, but not necessarily exclusive, site of involvement. The remaining 64 patients cited other focal locations as their chief area of complaint or could not determine a key focal site of involvement. There were no statistically significant differences between

groups (control, all hyperhidrosis, axillary hyperhidrosis and palmar hyperhidrosis) in demographic characteristics such as sex, age, height and weight (table 1). All study subjects were of German ethnicity.

Presentation and Key Characteristics of Hyperhidrosis

The key characteristics of hyperhidrosis and its main focal subtypes are shown in table 2. Significantly more patients with hyperhidrosis (37%) reported that family members had hyperhidrosis than did control subjects (9%, $p < 0.001$), and significantly more patients with axillary hyperhidrosis reported having affected family members (40%) than did those with palmar hyperhidrosis (28%, $p < 0.05$). The majority of patients with hyperhidrosis reported that their sweating was symmetric. However, a sizable minority of patients with axillary hyperhidrosis (21%) reported predominant sweating on one side of the body, whereas only 6% of patients with palmar hyperhidrosis reported such a pattern ($p < 0.001$). A clearly different pattern in age at onset was seen with axillary and palmar hyperhidrosis. The onset of palmar hyperhidrosis was almost exclusively (95%) before the age of 18 years. In contrast, the onset of axillary hyperhidrosis was nearly always at 12 years or older. Forty-nine percent of the patients with axillary hyperhidrosis reported its onset at between the ages of 12 and 17 years and 44% at the age of 18 or older.

Use of Medical Resources

Eighty-five percent of patients with hyperhidrosis reported that they had visited a physician in the past year because of their hyperhidrosis. The frequency of visits to healthcare providers was generally similar between patients with axillary and palmar hyperhidrosis.

Table 2. Presentation and key characteristics of hyperhidrosis

Characteristic	Controls (n = 154)	Hyperhidrosis		
		all (n = 345)	axillary (n = 165)	palmar (n = 116)
Presence of affected family members ¹ , %	9	37	40	28
Sweating symmetric ¹ , %	100	87	79	94
Age at onset ² , %				
<12 years	–	27	7	58
12–17 years	–	42	49	36
>17 years	–	32	44	5

The sum of the proportions may not equal 100 due to rounding.

¹ Statistically significant differences between controls and axillary, controls and palmar, and axillary and palmar.

² Statistically significant difference between axillary and palmar.

Patients with hyperhidrosis had also tried various treatments for their condition, including antiperspirants (88%), herbal medicines (62%), iontophoresis (33%), prescription medications (21%), botulinum toxin treatment (7%) and surgical sympathectomy of the sweat glands (2%). The majority of patients, regardless of focal location, rated most of the treatments they had used as poor or not effective, with 2 exceptions. Botulinum toxin treatment was rated by the majority of patients (overall 72%, axillary 86%, palmar 67%) as good or very good; the 1 patient with palmar hyperhidrosis who had tried surgery found it to be good or very good, and 3 (60%) of the 5 patients with axillary hyperhidrosis found it to be average, good or very good.

Impairment Associated with Hyperhidrosis

Occupational Impairment

Many patients with hyperhidrosis reported that their sweating negatively affected their career choices and work habits, with 42% claiming that their sweating had prevented them from following a particular career path.

Patients also indicated that their hyperhidrosis had a strong negative effect on their current work performance (fig. 1). Sixty-three percent of patients with hyperhidrosis (axillary 65%, palmar 62%), but only 1% of control subjects, reported feeling moderately to extremely limited at work, and 44% (axillary 46%, palmar 38%) reported that their sweating resulted in moderate to extreme impairment of their effectiveness at work. In contrast, none of the control subjects reported that sweating affected their work effectiveness. Patients also reported that because of their hyperhidrosis it was moderately to extremely true

that they accomplished less at work (31% overall, 33% axillary, 24% palmar), that they made changes in the way they work (43% overall, 41% axillary, 41% palmar) and that they worked less carefully and accurately than they should (25% overall, 27% axillary, 24% palmar). None of the control subjects reported these limitations at a moderate or greater level. There were no significant differences on any measure of occupational impairment between the axillary and palmar groups.

Time and Effort Spent Treating Hyperhidrosis

Patients with hyperhidrosis reported spending considerable time and effort treating their hyperhidrosis symptoms (fig. 2a). Fifty-one percent reported changing their clothes at least twice a day, 20% reported showering or bathing at least twice a day, and 33% reported spending 15 min or more a day treating their symptoms. Patients with axillary hyperhidrosis spent significantly more time and effort managing their symptoms than patients with palmar hyperhidrosis (fig. 2b). Patients with axillary hyperhidrosis were significantly more likely than those with palmar hyperhidrosis to change their clothes at least twice a day (70 vs. 31%, $p < 0.001$), to shower or bathe at least twice a day (27 vs. 10%, $p < 0.001$) and to spend at least 15 min a day treating their symptoms (38 vs. 22%, $p < 0.01$).

Emotional Impairment

Patients with hyperhidrosis reported a significant emotional impairment (fig. 3a). The majority of patients reported feeling unhappy or depressed (63%) and less confident than they would like (74%). The corresponding

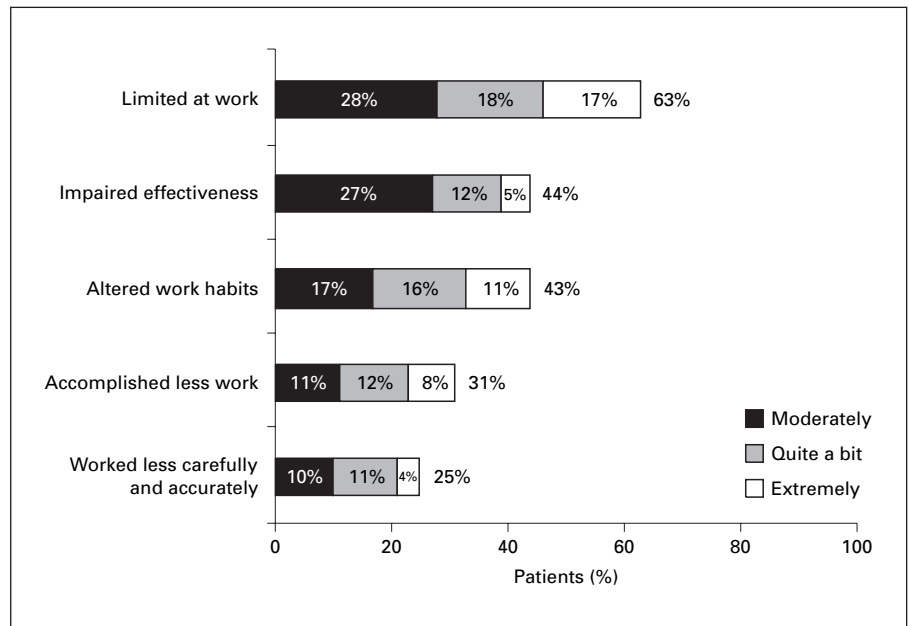


Fig. 1. Occupational impairment due to hyperhidrosis. Subjects were asked a series of questions regarding the effects of sweating symptoms on their ability to function at work. Responses of ‘moderately’ or greater are shown for patients with hyperhidrosis. No more than 1% of the control subjects responded to any of the items with ‘moderately’ or greater. Limited at work: ‘How limited do you feel you *currently* are at work due to your hyperhidrosis (n = 320)?’ Response options: extremely limited, quite a bit limited, moderately limited, somewhat limited, not limited. Impaired effectiveness: ‘Over the past 3 months, on the days that you continued working, how much do you think your hyperhidrosis symptoms influenced your effectiveness at work (n = 215)?’ Response options:

extremely, quite a bit, moderately, a little, not at all. Altered work habits: ‘During the past 3 months, I did my work but with some changes because of my hyperhidrosis (n = 322).’ Accomplished less work: ‘During the past 3 months, I feel I accomplished less work than I should because of my hyperhidrosis (n = 313).’ Worked less carefully and accurately: ‘During the past 3 months, I feel I have worked less carefully and accurately than I should because of my hyperhidrosis (n = 313).’ Response options: extremely true, quite a bit true, moderately true, a little true, not at all true. Note: total proportion may not equal the sum of response categories due to rounding.

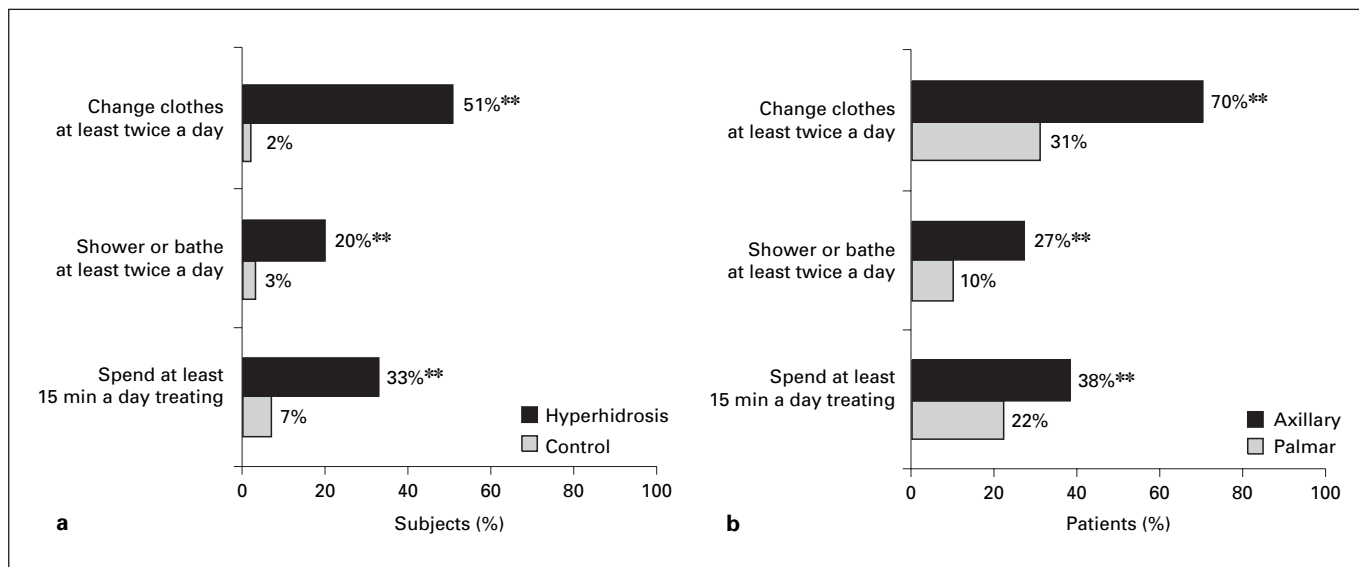
values in the control subjects were 0 and 3%. Nearly three quarters of hyperhidrosis patients (74%) reported that they felt moderately (26%) or significantly (47%) emotionally damaged or injured; no control subjects reported this. Patients with axillary hyperhidrosis were significantly more likely than those with palmar hyperhidrosis to report feeling unhappy or depressed (71 vs. 54%, $p < 0.01$; fig. 3b).

Impairment in Personal Relationships and Social Situations

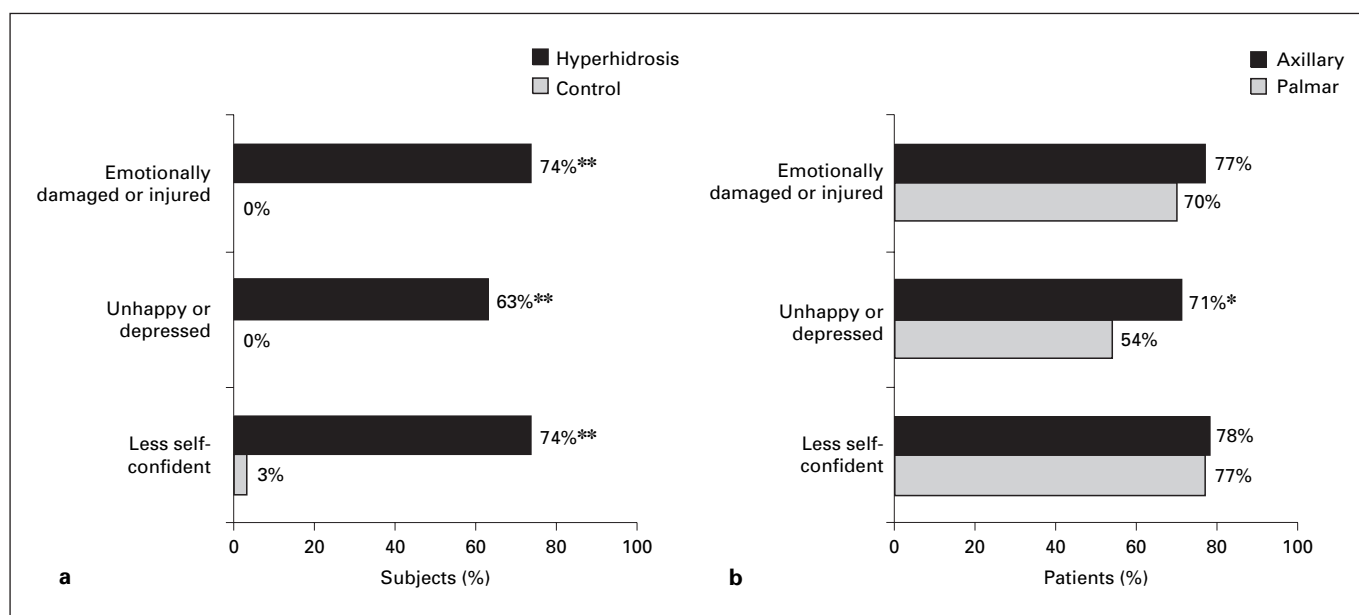
Compared to control subjects in which no more than 3% responded with ‘moderately’ or greater on any of these items, large proportions of patients with hyperhidrosis reported feeling moderately, quite a bit or extremely limited in personal relationships and in social situations ($p < 0.001$; fig. 4). Large proportions of patients reported

feeling moderately to extremely limited in developing personal relationships (59 vs. 2% of controls), in participating in family events or spending time with friends (54 vs. 1%) and in sexual activities (34 vs. 0%) because of their sweating. More than 50% of all patients reported feeling moderate to extreme limitations in social situations such as meeting people for the first time (71 vs. 2% of controls), being in public places (56 vs. 1%) and shaking hands (58 vs. 3%). Patients with axillary and palmar hyperhidrosis were similarly limited in social situations, with 2 exceptions. Patients with palmar hyperhidrosis were significantly more limited in shaking hands than those with axillary hyperhidrosis (97 vs. 33%, $p < 0.001$) and the latter were more limited in being in public places than the former (65 vs. 45%, $p < 0.001$).

Patients with hyperhidrosis reported significantly greater changes in their leisure activities than did control



2



3

Fig. 2. Physical impairment due to hyperhidrosis in patients with hyperhidrosis and control subjects (a) and in patients with axillary hyperhidrosis and patients with palmar hyperhidrosis (b). * $p < 0.01$, ** $p < 0.001$. Subjects were asked a series of questions regarding the effect of their sweating symptoms on time and effort required daily for personal hygiene. 'How frequently must you change your shirt or other clothes due to the effects of your hyperhidrosis (control = 147, hyperhidrosis = 339, axillary = 165, palmar = 111)?' Response options: I can wear my clothes for several days, daily, twice per day, 3 times or more per day. 'How frequently do you shower or take a bath (control = 149, hyperhidrosis = 342, axillary = 165, palmar = 115)?' Response options: less than daily, daily, twice a day, 3 times or more per day. 'How long per day on average do you spend treating your hyperhidrosis (control = 134, hyperhidrosis = 309, axillary = 156, palmar = 102)?' Response options: <15 min, 15–30 min, 30–60 min, >60 min).

Fig. 3. Emotional impairment due to hyperhidrosis in patients with hyperhidrosis and control subjects (a) and in patients with axillary hyperhidrosis and patients with palmar hyperhidrosis (b). * $p < 0.01$, ** $p < 0.001$. Proportions of subjects reporting moderate or significant emotional damage and reporting feeling unhappy or depressed and less confident than they would like because of their hyperhidrosis are shown. 'Do you feel emotionally damaged/injured by your hyperhidrosis (control = 149, hyperhidrosis = 340, axillary = 163, palmar = 115)?' Response options: not affected emotionally, affected to a small extent emotionally, moderately affected emotionally, significantly affected emotionally. 'My hyperhidrosis has caused me to feel less confident than I would like (control = 146, hyperhidrosis = 337, axillary = 161, palmar = 113)/feel unhappy or depressed (control = 146, hyperhidrosis = 337, axillary = 161, palmar = 113).' Response options: yes, no.

Fig. 4. Impairments in personal relationships and in social situations due to hyperhidrosis. Subjects were asked a series of questions regarding the effect of their sweating symptoms on functioning in personal relationships and in social situations. ‘How limited do you *currently* are in each of these activities/situations due to your hyperhidrosis? In developing personal relationships (n = 322)/on family occasions or with friends (n = 331)/in sexual activities (n = 316)/when meeting or being introduced to people for the first time (n = 330)/being in public places (n = 327)/when shaking hands (n = 325).’ Response options: extremely limited, quite a bit limited, moderately limited, somewhat limited, not limited. Note: total proportion may not equal the sum of response categories due to rounding.

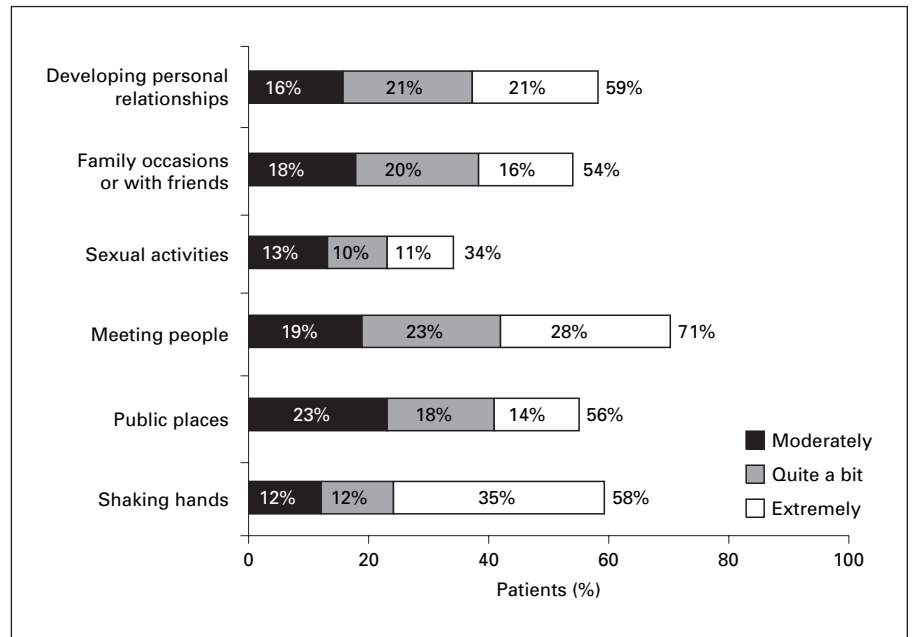
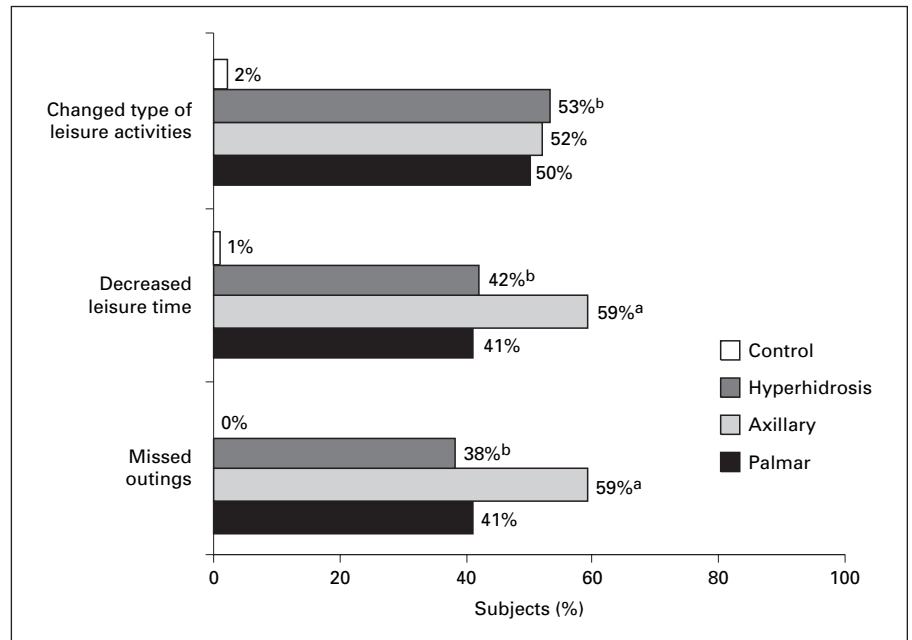


Fig. 5. Alterations in leisure activities due to hyperhidrosis in all patients with hyperhidrosis, control subjects, patients with axillary hyperhidrosis and patients with palmar hyperhidrosis. ^a p < 0.05, axillary versus palmar groups; ^b p < 0.001, all hyperhidrosis versus control. ‘My hyperhidrosis has caused me to change the types of leisure activities I pursue (control = 146, hyperhidrosis = 337, axillary = 161, palmar = 113), miss outings or events with friends or family (control = 146, hyperhidrosis = 337, axillary = 161, palmar = 113), decrease the amount of time I spend pursuing leisure activities (control = 146, hyperhidrosis = 337, axillary = 161, palmar = 113).’ Response instructions: Please check all that apply.



subjects (p < 0.001; fig. 5). Because of their sweating, 53% of patients changed the types of leisure activities in which they participated, 42% decreased their leisure time and 38% missed outings with family and friends. The corresponding values in the control subjects were 2, 1 and 0%. Axillary hyperhidrosis had a greater effect on leisure activities than palmar hyperhidrosis, with significantly more patients with axillary hyperhidrosis than those with

palmar hyperhidrosis decreasing their leisure time (59 vs. 41%, p < 0.05) and missing activities with family and friends (59 vs. 41%, p < 0.05).

Health-Related Quality of Life

Hyperhidrosis patients reported significantly greater impairment in dermatology-specific HRQOL than control subjects (table 3). The mean DLQI total scores in

Table 3. DLQI scores

DLQI domain	DLQI score, mean (SD)			
	controls (n = 134)	hyperhidrosis		
		all (n = 319)	axillary (n = 152)	palmar (n = 109)
Total score (range 0–30) ¹	0.7 (2.0)	9.2 (5.8)	10.0 (5.6)	8.8 (5.9)
Symptoms and feelings (range 0–6) ¹	0.4 (0.9)	2.1 (1.3)	2.2 (1.3)	2.1 (1.2)
Daily activities (range 0–6) ^{1,2}	0.1 (0.5)	2.6 (1.8)	3.2 (1.5)	2.1 (1.8)
Leisure (range 0–6) ¹	0.0 (0.3)	1.8 (1.7)	1.9 (1.7)	1.6 (1.7)
Work and school (range 0–3) ¹	0.1 (0.4)	1.0 (0.9)	1.0 (0.9)	1.0 (0.8)
Personal relationships (range 0–6) ¹	0.0 (0.3)	1.5 (1.6)	1.5 (1.6)	1.7 (1.6)
Treatment (range 0–3) ^{1,2}	0.0 (0.3)	0.2 (0.6)	0.2 (0.4)	0.4 (0.7)

¹ Statistically significant differences between controls and all hyperhidrosis.

² Statistically significant difference between axillary and palmar.

Table 4. Pretreatment DLQI total scores in dermatological diseases and conditions with DLQI scores of 8 or higher

Disease	DLQI score
Palmar hyperhidrosis [3, 4, 11]	18–9.1
Axillary hyperhidrosis [3, 4, 11]	17–11.6
Dermatitis/eczema (inpatient) [18]	16.2
Focal hyperhidrosis (general) [3, 9]	15.5–10.1
Psoriasis (inpatient) [18]	13.9
Forehead hyperhidrosis [11]	12.5
Atopic eczema/dermatitis [13, 21–24, 27]	12.5–5.8
Psoriasis (outpatient) [19–24]	11–4.5
Contact dermatitis [21]	10.8
Pruritus [13, 20]	10.5–10
Urticaria [20, 21, 29]	9.5–3.9
Acne [13, 20, 21, 23, 26]	9.3–4.3
Birthmarks [20]	9
Nodular prurigo [21]	8.7
Dermatitis/eczema (outpatient) [13, 19, 20, 23, 30]	8.7–4.1
Scabies [20]	8.6

hyperhidrosis patients were 9.2 (all patients), 10.0 (axillary patients) and 8.8 (palmar patients). The control group had a mean DLQI total score of 0.7 (each group vs. control, $p < 0.001$). The mean scores in all DLQI domains were significantly greater in the hyperhidrosis group than the control group ($p < 0.001$). The mean treatment score was significantly higher in the palmar group than the control group (0.38 vs. 0.04, $p < 0.001$). There were 2 significant differences in DLQI domain scores between axil-

lary and palmar patients. The mean daily activities score was higher (poorer HRQOL) in the axillary group than the palmar group (3.2 vs. 2.1, $p < 0.001$), and the mean treatment score was higher in the palmar group than the axillary group (0.4 vs. 0.2, $p < 0.01$).

The results on the SF-12 confirmed that patients with PFH had a poorer general health status than control subjects. Hyperhidrosis patients had lower mean scores (indicating poorer health status) than did control subjects on both the Mental Component Summary score (44.4 vs. 50.8, $p < 0.001$) and the Physical Component Summary score (52.9 vs. 54.9, $p < 0.01$).

An analysis of the literature further supports the observation that hyperhidrosis results in significant HRQOL impairments (table 4). We found 40 publications that either referenced or used the DLQI to assess disease status, half of which reported usable mean DLQI scores in 44 different dermatological diseases or disease subsets. When relevant, the dermatological diseases were differentiated by focal location or by disease severity if such differences were reported in the publication (e.g. palmar hyperhidrosis vs. axillary hyperhidrosis; inpatient psoriasis vs. outpatient psoriasis). The mean DLQI total scores in a single patient population were reported in 68% (30/44) of these diseases. The remaining conditions, including psoriasis, dermatitis and eczema, and acne, had 2 or more patient populations from which a range of mean pretreatment DLQI total scores could be summarized. Dermatological conditions with a published DLQI score of 8 or higher are presented in table 4. Hyperhidrosis was associated with higher DLQI scores than other dermatological diseases,

indicating poorer HRQOL. Furthermore, the effect of hyperhidrosis was at least as great as that of dermatitis and eczema (inpatient, atopic and contact dermatitis) and psoriasis (inpatient and outpatient). Notably, in the literature search, the DLQI scores were highest in patients with palmar and axillary hyperhidrosis, and there was no difference in overall effect between these focal locations.

Discussion

This research provides important information and confirms the findings in previous research on the characteristics, functional impairment and HRQOL of patients with PFH. Previous research did not include comparisons with a nonhyperhidrosis control group or detailed analyses by main focal location of primary hyperhidrosis in a large sample of patients. The concurrent administration of a hyperhidrosis-specific, a disease-specific and a general HRQOL measure provides a comprehensive analysis of the functional and HRQOL impairment associated with this condition.

Consistent with previous reports [1, 14, 15], PFH had an early age at onset and sweating was generally symmetric. In addition, the data also suggest a genetic basis for PFH. Previous work proposed a genetic basis for palmar hyperhidrosis, estimating that the allele for palmar hyperhidrosis is present in 5% of the population and that 1 or 2 copies of this allele would result in disease 25% of the time [16]. However, as there is no consistent pattern of transmission, it is much more likely that more than 1 gene is involved in PFH and that an individually varying genetic predisposition exists that is determined by an unknown number of susceptibility and severity genes. This also seems to be true for many other frequent dermatological conditions, such as atopic dermatitis, psoriasis, androgenetic alopecia and alopecia areata. The assumption of complex inheritance is also consistent with the grossly varying intensity of sweat production between affected persons. Few of the control subjects in our study reported having family members who had excessive sweating, further supporting the hypothesis of an inherited trait.

The results of the HHIQ provide a comprehensive view of the impairment associated with hyperhidrosis, with patients showing marked impairments in many aspects of life. Substantial numbers of patients reported changing their career path or being limited in work productivity because of their disorder. Patients also spent much time and energy in tasks related to personal hy-

giene. This was particularly evident in those with axillary hyperhidrosis. Emotional impairment was strikingly strong in patients with PFH, the majority of whom reported feeling emotionally damaged or injured and feeling unhappy or depressed. Perhaps related to this, patients with hyperhidrosis appeared to have difficulty in intimate relationships. Many reported feeling limited with family and friends, in developing new relationships and in sexual activity. Their answers to questions about social functioning suggest that hyperhidrosis is an isolating condition, with large proportions of patients reporting feeling limited in interactions with other people and many reporting having limited or altered their leisure activities and having missed social outings because of their condition. Consistent with these data, a recent report by Weber et al. [17] indicates that patients with PFH severe enough for indication of treatment with botulinum toxin A scored above the upper range of normal on a standard measure of social phobia. This social phobia appears to be a reaction to hyperhidrosis symptoms because, after treatment, social phobia scores returned to the normal range in this group of patients.

Consistent with the impairment reported on the HHIQ, patients reported marked decrements in HRQOL associated with hyperhidrosis. The mean DLQI total score in patients in this study (9.2) was of the same magnitude as those reported in other skin conditions that are assumed to impose a physical or psychological burden, such as inpatient or outpatient psoriasis (13.9–4.5) [18–24], Hailey-Hailey disease (6.1) [25], rosacea (7.8) [20], acne (9.3–4.3) [13, 20, 21, 23, 26], pruritus (10.5–10) [13, 20], contact dermatitis (10.8) [21] and atopic dermatitis (12.5–5.8) [13, 21–24, 27]. On the basis of a comparative literature analysis, the HRQOL impairment associated with hyperhidrosis can exceed that of the severest dermatological diseases as measured by the DLQI. Our data fall within the range of DLQI scores (18–9.1) reported in patients with hyperhidrosis in related studies [3, 4, 11]. Moreover, the current study extends these observations, because it was conducted in a large cohort of patients with hyperhidrosis and had a control group.

The results on the SF-12, a general measure of HRQOL, were consistent with those on the DLQI. Patients with axillary and palmar hyperhidrosis both had significantly lower scores on the Mental and Physical Component Summary scores of the SF-12 than did control subjects.

This study is the first comprehensive comparison of disease characteristics and disease-associated impairment between the palmar and axillary subtypes of hyperhidrosis. We found many similarities between the sub-

types, but there were some key differences. The onset of palmar hyperhidrosis occurs earlier, in childhood, than that of axillary hyperhidrosis, which occurs in adolescence or later. These findings suggest that the onset of axillary hyperhidrosis may be related to physiological, possibly hormonal, changes that are associated with puberty. In addition, a significantly greater proportion of patients with axillary hyperhidrosis reported having first-degree relatives with hyperhidrosis, suggesting a stronger genetic predisposition for axillary hyperhidrosis than palmar. Clarifying the genetic basis for hyperhidrosis, however, will require detailed genetic studies.

According to this study, axillary hyperhidrosis also appears to be associated with a greater degree of impairment than palmar hyperhidrosis. Significantly greater proportions of patients with axillary hyperhidrosis reported feeling unhappy or depressed. They also reported greater social impairment, with larger proportions of them reporting having missed social outings, being limited in public places and having decreased their leisure time. Patients with axillary hyperhidrosis also spent more time on personal hygiene related to managing their disorder. This finding may be explained by the fact that axillary hyperhidrosis is more visible to other people and is more difficult to hide or eliminate than palmar hyperhidrosis. Nevertheless, both palmar and axillary hyperhidrosis can each result in a substantially diminished HRQOL and impairment across a range of daily activities.

This study is limited in that patients were self-referred and may therefore represent a population with severer disease. In addition, many of these patients were disappointed by the information and treatment that had been offered by other healthcare professionals. These data then likely describe characteristics of patients with severe untreated hyperhidrosis. Consistent with this notion, a recent household survey of persons with severe axillary hyperhidrosis (i.e. sweating is barely tolerable or intolerable and frequently or always interferes with daily activities) reported somewhat lower levels of impairment [6]. For example, in that study 34% of respondents reported moderate to extreme limitations at work, 65% reported being moderately or significantly emotionally affected by their condition, and 35% reported moderate to extreme limitations in spending time with family and friends. The corresponding values in our study are 63, 74 and 54%. Nevertheless, the current study provides comprehensive information on the population of patients with axillary hyperhidrosis seeking treatment. In addition, it is important to note that skin maceration or secondary infection due to hyperhidrosis, which has been suggested in the lit-

erature [28], was not reported by any of the subjects in this study who could be characterized as having severe PFH. This observation suggests that hyperhidrosis-induced skin maceration and secondary infections are rare occurrences and should not be used as criteria in determining access to treatment.

An additional limitation of this study is that patients indicated the focal area that was most bothersome, but this area was not necessarily the only area of sweating. A secondary location could also have been contributing to their reported impairment. Further research is needed to determine the relative impairment in persons with single focal locations of sweating and those with multiple locations.

In conclusion, our study provides the most comprehensive picture to date of the characteristics of PFH, including age at onset, hereditary aspects, physiological features and impairment associated with the disorder. This study is also the first to analyze disease characteristics and impairment by focal location and relative to a nonhyperhidrosis control group. The data presented here confirm that PFH is not merely a cosmetic inconvenience but a serious, often disabling, medical condition that has profound effects on work productivity, routine daily activities, emotional well-being and personal relationships.

Acknowledgments

We thank Ilka Kinkelin, MD, for her help in wording some of the questions on the HHIQ and Holly Strausbaugh, PhD, for writing support.

References

- 1 Hornberger J, Grimes K, Naumann M, Glaser DA, Lowe MJ, Naver H, Ahn S, Stolman LP, Multi-Specialty Working Group on the Recognition, Diagnosis, and Treatment of Primary Focal Hyperhidrosis: Recognition, diagnosis, and treatment of primary focal hyperhidrosis. *J Am Acad Dermatol* 2004;51:274–286.
- 2 Lonsdale-Eccles A, Leonard N, Lawrence C: Axillary hyperhidrosis: eccrine or apocrine? *Clin Exp Dermatol* 2003;28:2–7.
- 3 Swartling C, Naver H, Lindberg M: Botulinum A toxin improves life quality in severe primary focal hyperhidrosis. *Eur J Neurol* 2001;8:247–252.
- 4 Campanati A, Penna L, Guzzo T, Menotta L, Silvestri B, Legalla G, Gesuita R, Offidani A: Quality-of-life assessment in patients with hyperhidrosis before and after treatment with botulinum toxin: results of an open-label study. *Clin Ther* 2003;25:298–308.
- 5 Naumann M, Lowe NJ, Kumar CR, Hamm H: Botulinum toxin type A is a safe and effective treatment for axillary hyperhidrosis over 16 months: a prospective study. *Arch Dermatol* 2003;139:731–736.
- 6 Strutton DR, Kowalski JW, Glaser DA, Stang PE: US prevalence of hyperhidrosis and impact on individuals with axillary hyperhidrosis: results from a national survey. *J Am Acad Dermatol* 2004;51:241–248.
- 7 Hund M, Kinkelin I, Naumann M, Hamm H: Definition of axillary hyperhidrosis by gravimetric assessment. *Arch Dermatol* 2002;138:539–541.
- 8 Lau WT, Lee JD, Dang CR, Lee L: Improvement in quality of life after bilateral transthoracic endoscopic sympathectomy for palmar hyperhidrosis. *Hawaii Med J* 2001;60:126–137.
- 9 Swan MC, Paes T: Quality of life evaluation following endoscopic transthoracic sympathectomy for upper limb and facial hyperhidrosis. *Ann Chir Gynaecol* 2001;90:157–159.
- 10 Naumann MK, Hamm H, Lowe NJ: Effect of botulinum toxin type A on quality of life measures in patients with excessive axillary sweating: a randomized controlled trial. *Br J Dermatol* 2002;147:1218–1226.
- 11 Tan SR, Solish N: Long-term efficacy and quality of life in the treatment of focal hyperhidrosis with botulinum toxin A. *Dermatol Surg* 2002;28:495–499.
- 12 Solish N, Benohanian A, Kowalski JW, Canadian Dermatology Study Group on Health-Related Quality of Life in Primary Axillary Hyperhidrosis: Prospective, open-label, multicenter, study of Botox (botulinum toxin type A) for the treatment of patients with primary axillary hyperhidrosis: effects on functional impairment and health-related quality of life. *Dermatol Surg* 2005;31:405–413.
- 13 Finlay AY, Khan GK: Dermatology Life Quality Index (DLQI) – A simple practical measure for routine clinical use. *Clin Exp Dermatol* 1994;19:210–216.
- 14 Ware J Jr, Kosinski M, Keller SD: A 12-item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34:220–233.
- 15 Lai YT, Yang LH, Chio CC, Chen HH: Complications in patients with palmar hyperhidrosis treated with transthoracic endoscopic sympathectomy. *Neurosurgery* 1997;41:110–115.
- 16 Ro KM, Cantor RM, Lange KL, Ahn SS: Palmar hyperhidrosis: evidence of genetic transmission. *J Vasc Surg* 2002;35:382–386.
- 17 Weber A, Heger S, Sinkgraven R, Heckmann M, Elsner P, Rzany B: Psychosocial aspects of patients with focal hyperhidrosis: marked reduction of social phobia, anxiety and depression and increased quality of life after treatment with botulinum toxin A. *Br J Dermatol* 2005;152:342–345.
- 18 Kurwa HA, Finlay AY: Dermatology in-patient management greatly improves life quality. *Br J Dermatol* 1995;133:575–578.
- 19 Badia X, Mascaro JM, Lozano R: Measuring health-related quality of life in patients with mild to moderate eczema and psoriasis: clinical validity, reliability and sensitivity to change of the DLQI. The Cavide Research Group. *Br J Dermatol* 1999;141:698–702.
- 20 Harlow D, Poyner T, Finlay AY, Dykes PJ: Impaired quality of life of adults with skin disease in primary care. *Br J Dermatol* 2000;143:979–982.
- 21 Jobanputra R, Bachmann M: The effect of skin diseases on quality of life in patients from different social and ethnic groups in Cape Town, South Africa. *Int J Dermatol* 2000;39:826–831.
- 22 Lundberg L, Johannesson M, Silverdahl M, Hermansson C, Lindberg M: Health-related quality of life in patients with psoriasis and atopic dermatitis measured with SF-36, DLQI and a subjective measure of disease activity. *Acta Derm Venereol* 2000;80:430–434.
- 23 Hahn HB, Melfi CA, Chuang TY, Lewis CW, Gonin R, Hanin MP, Farmer ER: Use of the Dermatology Life Quality Index (DLQI) in a midwestern US urban clinic. *J Am Acad Dermatol* 2001;45:44–48.
- 24 Touw CR, Hakkaart-Van Roijen L, Verboom P, Paul C, Rutten FF, Finlay AY: Quality of life and clinical outcome in psoriasis patients using intermittent cyclosporin. *Br J Dermatol* 2001;144:967–972.
- 25 Harris A, Burge SM, Dykes PJ, Finlay AY: Handicap in Darier's disease and Hailey-Hailey disease. *Br J Dermatol* 1996;135:959–963.
- 26 Newton JN, Mallon E, Klassen A, Ryan TJ, Finlay AY: The effectiveness of acne treatment: an assessment by patients of the outcome of therapy. *Br J Dermatol* 1997;137:563–567.
- 27 Kiebert G, Sorensen SV, Revicki D, Fagan SC, Doyle JJ, Cohen J, Fivenson D: Atopic dermatitis is associated with a decrement in health-related quality of life. *Int J Dermatol* 2002;41:151–158.
- 28 Salmanpoor R, Rahmanian MJ: Treatment of axillary hyperhidrosis with botulinum-A toxin. *Int J Dermatol* 2002;41:428–430.
- 29 Poon E, Seed PT, Greaves MW, Kobza-Black A: The extent and nature of disability in different urticarial conditions. *Br J Dermatol* 1999;140:667–671.
- 30 Thompson TR, Belsito DV: Regional variation in prevalence and etiology of allergic contact dermatitis. *Am J Contact Dermatitis* 2002;13:177–182.