Cost-of-illness study for axillary hyperhidrosis in Japan

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Funding information
Kaken Pharmaceutical

Abstract
The prevalence of primary axillary hyperhidrosis in Japan is 5.75% (males, 6.60%; females, 4.72%) in the population aged 5–64 years. No study on comprehensively evaluated direct medical costs, hygiene product costs, and productivity loss in axillary hyperhidrosis patients has been published in Japan. The aim of this study was to estimate the cost of illness for axillary hyperhidrosis in Japan by conducting a nationwide insurance claims database analysis and a cross-sectional Web-based survey. Among patients diagnosed with primary axillary hyperhidrosis at least once between November 2012 and October 2019, health insurance receipt data of 1447 patients were analyzed. A cross-sectional Web-based survey was conducted on 321 patients aged 16–59 years with axillary hyperhidrosis to calculate hygiene product costs and productivity loss using a Work Productivity and Activity Impairment questionnaire. Furthermore, nationwide estimation was performed for the hygiene product costs and productivity loss based on the number of patients estimated from the prevalence. The annual direct medical costs per axillary hyperhidrosis patient were ¥91,491 in 2016, ¥93,155 in 2017, and ¥75,036 in 2018. In all of these years, botulinum toxin type A injection accounted for approximately 90% of the total costs. The annual total cost of hygiene products per axillary hyperhidrosis patient was ¥93,250. The overall work impairment (%) of working patients with axillary hyperhidrosis was 30.52%, and its monthly productivity loss was ¥120,593/patient. The activity impairment (%) of full-time housewives with axillary hyperhidrosis was 49.05% and its monthly productivity loss was ¥176,368/patient. The significant cost associated with axillary hyperhidrosis was clarified. If out-of-pocket expenses for treatments not covered by health insurance are included in the estimation, the cost will further increase.

Keywords
axillary hyperhidrosis, cost of illness, direct medical cost, overall work impairment, self-medication cost
1 | INTRODUCTION

Primary axillary hyperhidrosis, a disease of unknown pathogenesis with no underlying disease, interferes with daily life because of excessive axillary sweating. It is primary focal hyperhidrosis classified as an intractable disease. A questionnaire survey conducted by Fujimoto et al. in a Japanese population aged 5–64 years (5807 valid responses) revealed the prevalence of primary axillary hyperhidrosis to be 5.75% (6.60% and 4.72% in males and females, respectively) between December 2009 and January 2010. The distribution of Hyperhidrosis Disease Severity Scale (HDSS) scores of 1, 2, and 3 or 4 (severe) was 5.6%, 47.6%, and 46.8%, respectively, suggesting that nearly half of the respondents had severe symptoms.

Cost-of-illness studies aim to identify and measure all of the costs of a particular disease, including the direct, indirect, and intangible dimensions. Direct costs consist of health-care costs and non-health-care costs like for transportation and household expenditure. Indirect cost generally refers to lost productivity resulting from morbidity or mortality in pharmacoconomics and outcomes research area. Intangible cost is the costs assigned to the amount of suffering that occurs because of the disease or health-care intervention. It is widely believed that estimating the total societal cost of an illness is a useful aid to policy making, and organizations such as the World Bank and the World Health Organization commonly use such studies. Many cost-of-illness studies targeted for various countries have been reported in the field of dermatology. Axillary hyperhidrosis causes psychological burdens, such as depression, loss of self-confidence, and weakness, suggesting significant emotional burdens. Moreover, a Work Productivity and Activity Impairment (WPAI) survey of hyperhidrosis patients who visited a university hospital demonstrated the presenteeism of hyperhidrosis patients to be 47.14%, suggesting the significant effects of hyperhidrosis on work performance. The productivity loss associated with hyperhidrosis in Japan in 2009 was estimated as ¥197 billion/month.

As axillary hyperhidrosis is treated at one’s own expense and by health insurance, only limited information is available on treatment methods and medical costs. Furthermore, little information is available on the costs of so-called self-medication, namely hygiene products such as sweat pads and antiperspirants.

The aim of this study was to estimate the cost associated with axillary hyperhidrosis in Japan by conducting a nationwide insurance claims database analysis and a cross-sectional Web-based survey.

2 | METHODS

2.1 | Study design

Direct medical costs, hygiene product costs, and productivity loss were estimated as a cost associated with axillary hyperhidrosis in Japan. Direct medical costs were estimated using a nationwide insurance claims database provided by JMDC. Hygiene product costs and productivity loss were estimated using the results of the cross-sectional Web-based survey.

2.2 | Direct medical costs

Direct medical costs were estimated using the receipt data from 31,412 patients who made at least one visit for hyperhidrosis (the corresponding ICD-10, International Classification of Diseases, 10th Revision, and the name of illness are shown in Table 1) between January 2005 and October 2019. Among the 1536 patients diagnosed with primary axillary hyperhidrosis at least once between November 2012 and October 2019 after the expansion of the indications for botulinum toxin type A injection (Botox®; GlaxoSmithKline), those diagnosed with hyperhidrosis at different sites (primary systemic hyperhidrosis, systemic hyperhidrosis, primary palmoplantar hyperhidrosis, palmoplantar hyperhidrosis, palmar hyperhidrosis, plantar hyperhidrosis, facial hyperhidrosis, and nervous hyperhidrosis) between January 2005 and October 2019 were excluded, and

### TABLE 1 ICD-10 codes and names of illnesses related to hyperhidrosis

| ICD-10 codes | Names of illnesses          |
|--------------|----------------------------|
| F45          | Nervous hyperhidrosis<sup>a</sup> |
| R61          | Facial hyperhidrosis<sup>a</sup> |
| R61          | Focal hyperhidrosis<sup>b</sup> |
| R61          | Primary focal hyperhidrosis<sup>b</sup> |
| R61          | Primary palmoplantar hyperhidrosis<sup>a</sup> |
| R61          | Primary axillary hyperhidrosis<sup>b,c</sup> |
| R61          | Palmar hyperhidrosis<sup>c</sup> |
| R61          | Palmoplantar hyperhidrosis<sup>d</sup> |
| R61          | Plantar hyperhidrosis<sup>a</sup> |
| R61          | Axillary hyperhidrosis<sup>b</sup> |
| R61          | Primary systemic hyperhidrosis<sup>a</sup> |
| R61          | Systemic hyperhidrosis<sup>a</sup> |
| R61          | Hyperhidrosis<sup>d</sup> |

Abbreviation: ICD-10, International Classification of Diseases, 10th Revision.

Selection criteria for the analysis population were: patients diagnosed with primary axillary hyperhidrosis<sup>a</sup> at least once between November 2012 and October 2019. Exclusion criteria were: patients diagnosed with hyperhidrosis<sup>a</sup> at other sites (primary systemic hyperhidrosis, systemic hyperhidrosis, primary palmoplantar hyperhidrosis, palmoplantar hyperhidrosis, palmar hyperhidrosis, plantar hyperhidrosis, facial hyperhidrosis, and nervous hyperhidrosis) between January 2005 and October 2019 for whom data were available.

Receipt data for analysis: receipts for the diagnoses of axillary hyperhidrosis or non-site-specific hyperhidrosis (axillary hyperhidrosis, focal hyperhidrosis, primary axillary hyperhidrosis, primary focal hyperhidrosis, and hyperhidrosis).
the remaining 1447 for whom health insurance receipt data were available were included in the analysis.

Medical costs associated with axillary hyperhidrosis were defined as the total costs of receipts for the diagnoses of axillary hyperhidrosis or non-site-specific hyperhidrosis (primary axillary hyperhidrosis, axillary hyperhidrosis, primary focal hyperhidrosis, focal hyperhidrosis, and hyperhidrosis) among all receipts in the 1447 analysis population. The annual total medical costs associated with axillary hyperhidrosis were calculated by fiscal year (FY) from 2016 to 2018. The annual total medical costs, including drug costs (e.g., botulinum toxin type A injection), examination costs (Code D of the Medical Fee Classification), surgery costs (Code K of the Medical Fee Classification), and medical treatment costs (Codes other than D and K of the Medical Fee Classification), were separately calculated.

2.3 | Self-medications costs and productivity loss

Hygiene product costs and productivity loss in 321 patients aged 16–59 years with HDSS score 2 or above (adjusting HDSS 2:3:4 to approximately 1:1:1) who met the diagnostic criteria for primary axillary hyperhidrosis were estimated based on the cross-sectional Web-based survey conducted in April 2020.

Hygiene product costs were defined as annual costs for purchasing clothes/towels, sweat pads, antiperspirants (sprays, sheets, and creams), body cleansers (soap and body soap), foods, and supplements.

Using a WPAI survey questionnaire which is a well-validated instrument to measure impairments in work and activities, productivity loss was determined as absenteeism (%), presenteeism (%), and overall work impairment (OWI) (%) in working patients with axillary hyperhidrosis and activity impairment (AI) (%) in full-time housewives with axillary hyperhidrosis. To calculate productivity loss in working patients with axillary hyperhidrosis, each score was multiplied by monthly wages by sex and age, and converted into productivity loss (¥/month). To calculate productivity loss in full-time housewives with axillary hyperhidrosis, each score was multiplied by the monthly housework activity evaluation value and converted into productivity loss (¥/month).

In general, to estimate productivity loss, annual costs are calculated on the assumption that such productivity loss based on a WPAI survey continues for 1 year. However, seasonal fluctuations in productivity loss should be considered in view of the characteristics of hyperhidrosis. Therefore, to avoid overestimation/underestimation due to the fluctuations, the estimation period was set as 1 month.

2.4 | Nationwide estimation

Nationwide estimations were performed on hygiene product costs and productivity loss in axillary hyperhidrosis patients with HDSS 2 or above.

2.4.1 | Estimation of the number of patients

To calculate the numbers of axillary hyperhidrosis patients by sex and HDSS, populations (31 325 000 males, 30 406 000 females) aged 20–59 years were multiplied by the prevalence of axillary hyperhidrosis, namely 6.60% and 4.72% in males and females, respectively, and additionally by the HDSS rates of primary focal hyperhidrosis (HDSS 1, 5.68%; HDSS 2, 46.11%; HDSS 3, 35.58%; and HDSS 4, 12.63% in males; and HDSS 1, 5.31%; HDSS 2, 50.61%; HDSS 3, 32.65%; and HDSS 4, 11.43% in females).

To calculate the numbers of working patients by sex and HDSS, the numbers of workers aged 20–59 (28 190 000 males and 23 300 000 females) were multiplied by the prevalence of axillary hyperhidrosis and by the HDSS rates of primary focal hyperhidrosis. To calculate the numbers of full-time housewives with axillary hyperhidrosis and HDSS, the number of full-time housewives aged 20–59 (5 907 258 persons) was multiplied similarly.

2.4.2 | Self-medications costs

Hygiene products costs (¥/year) per patient by sex and HDSS adjusted for age distribution were estimated by multiplying the annual hygiene product costs (¥) per patient by sex, age, and HDSS obtained in the Web-based survey by the patient age distribution (20s, 25.1%; 30s, 30.9%; 40s, 31.7%; and 50s, 12.3%) (Web-based survey 2017 by Macromill and inhouse data of Kaken Pharmaceutical). The obtained hygiene product costs were multiplied by the total numbers of patients by sex and HDSS to estimate nationwide hygiene product costs (¥/year).

2.4.3 | Productivity loss

Productivity loss for OWI

The productivity losses (¥/month) per patient, corresponding to OWI (%), by sex and HDSS, adjusted by statuses of employment and age distributions, were estimated by multiplying the productivity loss (¥/month) per patient by sex, statuses of employment, age, and HDSS obtained in the Web-based survey by the rates of statuses of employment by age of all workers (Labor Force Survey 2019) and the age distribution of patients (inhouse data from the Web-based survey conducted by Macromill in 2017). The obtained productivity loss was multiplied by the numbers of working patients by sex and HDSS to estimate the nationwide productivity loss (¥/month), corresponding to OWI.

Productivity loss for AI

The productivity loss (¥/month) per patient, corresponding to AI (%), by HDSS adjusted by age distribution was estimated by multiplying the productivity loss (¥/month) per patient by age and HDSS obtained in the Web-based survey by the age distribution of patients. The resulting productivity loss was multiplied by the number of
full-time housewives by HDSS to estimate the nationwide productivity loss (¥/month), corresponding to AI.

3 | RESULTS

3.1 | Direct medical costs

The characteristics of the analysis population are summarized in Table 2. Males accounted for 28.8% of all and mean age was 35.7 years at the earliest diagnosis of hyperhidrosis. The age distribution exhibited peaks at 30s and 40s (27.9% and 28.1%, respectively). Of the earliest diagnoses of hyperhidrosis, primary axillary hyperhidrosis was the most common (91.2%). Of the analysis population, 1074 (74%) received at least one dose of botulinum toxin type A injection.

The annual direct medical costs per axillary hyperhidrosis patient were ¥91,491 in 2016, ¥93,155 in 2017, and ¥75,036 in 2018. Drug costs for botulinum toxin type A injection accounted for approximately 90% of the total costs. They decreased in 2018 compared with the previous year, probably because of the drug price revision for botulinum toxin type A injection.

3.2 | Self-medication costs

The patient backgrounds revealed in the Web-based survey are summarized in Table 3. Females accounted for 60.1% of all and the age distribution peaked at 40s (43.9%). The most common status of employment was regular worker (33.6%), followed by temporary or part-time worker (27.1%).

The annual total cost of hygiene products per axillary hyperhidrosis patient was ¥9325 (Table 4). The highest cost (¥13,786) per purchaser was associated with foods and supplements. The annual total cost of hygiene products by sex and HDSS was ¥10,510 in males, being higher than the ¥8539 in females. Both males and females spent more at a higher HDSS level.

3.3 | Productivity losses

The OWI (%) in working patients with axillary hyperhidrosis was 30.52% (Table 5). It was 32.18% in females, being higher than the 29.03% in males. Both males and females had a slightly higher OWI (%) in regular workers (29.66% and 33.18%, respectively). Patients with HDSS 3–4 had a slightly higher OWI (%) than those with HDSS 2.

Absenteeism (%) and presenteeism (%) of working patients with axillary hyperhidrosis were 0.49% and 30.03%, respectively. Presenteeism accounted for the majority of OWI. The AI (%) of full-time housewives with axillary hyperhidrosis was 49.05%. Patients with HDSS 3–4 had a slightly higher AI (%) than those with HDSS 2.

The monthly productivity loss per patient, corresponding to OWI (%), was ¥267.7 billion (¥188.6 and ¥79 billion in males and females, respectively). The estimated costs by HDSS were ¥9.1 billion for HDSS 2, ¥11.3 billion for HDSS 3, and ¥4 billion for HDSS 4. The monthly productivity loss, corresponding to AI (%), was ¥44.4 billion. The estimated costs by HDSS were ¥18.9 billion for HDSS 2, ¥20.6 billion for HDSS 3, and ¥4.8 billion for HDSS 4. The monthly productivity loss for axillary hyperhidrosis in Japan was estimated to be ¥312 billion (¥188.6 and ¥123.4 billion in males and females, respectively).

3.4 | Nationwide estimation

Nationwide estimates in axillary hyperhidrosis patients with HDSS 2 or above are summarized in Table 6.

The annual hygiene product cost was ¥24.5 billion (¥15 and ¥9.5 billion in males and females, respectively). The estimated costs by HDSS were ¥9.1 billion for HDSS 2, ¥11.3 billion for HDSS 3, and ¥4 billion for HDSS 4.

The monthly productivity loss, corresponding to OWI (%), was ¥267.7 billion (¥188.6 and ¥79 billion in males and females, respectively). The estimated costs by HDSS were ¥69.4 billion for HDSS 2, ¥140.1 billion for HDSS 3, and ¥58.2 billion for HDSS 4. The monthly productivity loss, corresponding to AI (%), was ¥44.4 billion. The estimated costs by HDSS were ¥18.9 billion for HDSS 2, ¥20.6 billion for HDSS 3, and ¥4.8 billion for HDSS 4. The monthly productivity loss for axillary hyperhidrosis in Japan was estimated to be ¥312 billion (¥188.6 and ¥123.4 billion in males and females, respectively).

| TABLE 2 | Patient background in analysis population of health insurance receipt data |
| --- | --- |
| Items | Values (n = 1447) |
| Sex (male %) | 417 (28.8%) |
| Age (mean ± SD) | 35.7 ± 11.5 |
| Age distribution |  |
| 10–19 years | 120 (8.3%) |
| 20–29 years | 350 (24.2%) |
| 30–39 years | 404 (27.9%) |
| 40–49 years | 407 (28.1%) |
| 50–59 years | 146 (10.1%) |
| 60–69 years | 20 (1.4%) |
| Oldest diagnosis of hyperhidrosis (multiple answers allowed) |  |
| Focal hyperhidrosis | 10 (0.7%) |
| Primary focal hyperhidrosis | 3 (0.2%) |
| Primary axillary hyperhidrosis | 1320 (91.2%) |
| Hyperhidrosis | 142 (9.8%) |
| Axillary hyperhidrosis | 62 (4.3%) |

Abbreviation: SD, standard deviation.  
*Age at the oldest diagnosis of hyperhidrosis.
| TABLE 3  | Patient background in the Web-based survey |
|----------|------------------------------------------|
|          | Total | HDSS 2 | HDSS 3 | HDSS 4 |
|          | n (%) | n (%) | n (%) | n (%) |
| Whole population | 321 100.0 | 107 100.0 | 108 100.0 | 106 100.0 |
| Sex | | | | |
| Male | 128 39.9 | 47 43.9 | 35 32.4 | 46 43.4 |
| Female | 192 60.1 | 60 56.1 | 73 67.6 | 60 56.6 |
| Age distribution | | | | |
| ≥29 years | 29 9.0 | 14 13.1 | 7 6.5 | 8 7.5 |
| 30–39 years | 81 25.2 | 20 18.7 | 32 29.6 | 29 27.4 |
| 40–49 years | 141 43.9 | 52 48.6 | 49 45.4 | 40 37.7 |
| 50–59 years | 70 21.8 | 21 19.6 | 20 18.5 | 29 27.4 |
| Status of employment | | | | |
| Regular worker | 108 33.6 | 35 32.7 | 41 38.0 | 32 30.2 |
| Company executive | 5 1.6 | 2 1.9 | 1 0.9 | 2 1.9 |
| Self-employed worker or family worker | 17 5.3 | 6 5.6 | 4 3.7 | 7 6.6 |
| Temporary staff or part-time worker | 87 27.1 | 31 29.0 | 28 25.9 | 28 26.4 |
| Full-time housewife/househusband | 44 13.7 | 14 13.1 | 18 16.7 | 12 11.3 |
| Displaced/unemployed | 49 15.3 | 16 15.0 | 12 11.1 | 21 19.8 |
| Student | 5 1.6 | 2 1.9 | 2 1.9 | 1 0.9 |
| Others | 6 1.9 | 1 0.9 | 2 1.9 | 3 2.8 |

Abbreviation: HDSS, Hyperhidrosis Disease Severity Scale.

| TABLE 4  | Annual hygiene product costs (¥/patient) in patients with axillary hyperhidrosis (by sex and HDSS) |
|----------|---------------------------------------------------------------|
| Items | HDSS n | Annual hygiene product cost (¥/patient) |
| | | Mean | SD | Median |
| Overall population | | 321 | 9325 | 22452 | 4000 |
| Breakdown: | Clothes/towels, a and sweat pads | 135 | 6125 | 10709 | 3000 |
| | Antiperspirants (spray, sheets, and cream) | 265 | 5455 | 11808 | 3000 |
| | Body cleansers (soap and body soap) | 137 | 3613 | 3484 | 2000 |
| | Foods and supplements | 14 | 13786 | 28397 | 4500 |
| | Others | 5 | 6620 | 13080 | 1000 |
| Male | Total | 128 | 10510 | 31475 | 3750 |
| | 2 | 47 | 5785 | 13625 | 2500 |
| | 3 | 35 | 10957 | 17270 | 5500 |
| | 4 | 46 | 14999 | 48339 | 5000 |
| Female | Total | 193 | 8539 | 13539 | 4500 |
| | 2 | 60 | 4884 | 5094 | 3000 |
| | 3 | 73 | 9226 | 12251 | 4500 |
| | 4 | 60 | 11360 | 19109 | 6000 |

Abbreviations: HDSS, Hyperhidrosis Disease Severity Scale; SD, standard deviation.

a Newly purchased or replaced clothes because of sweating.
|       | Status of employment | HDSS | n  | Productivity loss (%) | Monthly productivity loss (¥/patient) |
|-------|----------------------|------|----|------------------------|--------------------------------------|
|       |                      |      |    | Mean  | SD   | Median | Mean  | SD   | Median |
| OWI   | Overall population  | –    | 195| 30.52 | 30.39 | 20.00  | 120  | 593  |
|       | Male Total           | –    | 103| 29.03 | 31.26 | 20.00  | 146  | 164  |
|       | Regular Total        | –    | 88 | 29.66 | 31.96 | 20.00  | 159  | 328  |
|       | 2                    | 30   | 12.74| 21.99 | 0.00  | 70.005 | 127 | 425  |
|       | 3                    | 27   | 39.30| 30.53 | 30.00  | 205.773 | 163 | 947  |
|       | 4                    | 31   | 37.64| 35.38 | 30.00  | 205.316 | 193 | 307  |
|       | Non-regular Total    | –    | 15 | 25.33 | 27.48 | 10.00  | 68.941 | 74 | 429  |
|       | 2                    | 8    | 8.75 | 13.56 | 5.00  | 24.890 | 39 | 488  |
|       | 3                    | 2    | 40.00| 28.28 | 40.00  | 110.978 | 74 | 547  |
|       | 4                    | 5    | 46.00| 30.50 | 60.00  | 122.607 | 83 | 104  |
| Female| Total                | –    | 92 | 32.18 | 29.47 | 25.00  | 91.965 | 92 | 035  |
|       | Regular Total        | –    | 38 | 33.18 | 29.25 | 30.00  | 125.819 | 113 | 204  |
|       | 2                    | 12   | 25.90| 26.20 | 25.00  | 101.851 | 104 | 824  |
|       | 3                    | 17   | 25.29| 24.01 | 20.00  | 94.444 | 91 | 293  |
|       | 4                    | 9    | 57.78| 31.14 | 60.00  | 217.040 | 123 | 196  |
|       | Non-regular Total    | –    | 54 | 31.48 | 29.87 | 20.00  | 81.415 | 85 | 635  |
|       | 2                    | 18   | 18.33| 19.78 | 15.00  | 39.013 | 41 | 756  |
|       | 3                    | 20   | 38.50| 25.81 | 30.00  | 83.739 | 56 | 126  |
|       | 4                    | 16   | 37.50| 39.41 | 20.00  | 83.739 | 56 | 126  |
|       | Absenteeism Overall  | –    | 195| 0.49  | 3.30  | 0.00   | 2011  | 11 | 288  |
|       | Male Total           | –    | 103| 0.52  | 2.28  | 0.00   | 2883  | 12 | 906  |
|       | Regular Total        | –    | 88 | 0.60  | 2.45  | 0.00   | 3374  | 13 | 915  |
|       | 2                    | 30   | 0.09 | 0.49  | 0.00   | 330.00  | 181 | 0  |
|       | 3                    | 27   | 0.09 | 0.48  | 0.00   | 519.00  | 269 | 0  |
|       | 4                    | 31   | 1.55 | 3.95  | 0.00   | 8805.00 | 22 | 471  |
|       | Non-regular Total    | –    | 15 | 0.00  | 0.00  | 0.00   | 0.00  | 0  |
|       | 2                    | 8    | 0.00 | 0.00  | 0.00   | 0.00  | 0  |
|       | 3                    | 2    | 0.00 | 0.00  | 0.00   | 0.00  | 0  |
|       | 4                    | 5    | 0.00 | 0.00  | 0.00   | 0.00  | 0  |
|       | Presenteeism Overall | –    | 195| 0.46  | 4.17  | 0.00   | 1036  | 91 | 118  |
|       | Male Total           | –    | 103| 0.52  | 2.28  | 0.00   | 2883  | 12 | 906  |
|       | Regular Total        | –    | 88 | 0.60  | 2.45  | 0.00   | 3374  | 13 | 915  |
|       | 2                    | 30   | 0.09 | 0.49  | 0.00   | 330.00  | 181 | 0  |
|       | 3                    | 27   | 0.09 | 0.48  | 0.00   | 519.00  | 269 | 0  |
|       | 4                    | 31   | 1.55 | 3.95  | 0.00   | 8805.00 | 22 | 471  |
|       | Non-regular Total    | –    | 15 | 0.00  | 0.00  | 0.00   | 0.00  | 0  |
|       | 2                    | 8    | 0.00 | 0.00  | 0.00   | 0.00  | 0  |
|       | 3                    | 2    | 0.00 | 0.00  | 0.00   | 0.00  | 0  |
|       | 4                    | 5    | 0.00 | 0.00  | 0.00   | 0.00  | 0  |

(Continues)
In the present study, the cost associated with axillary hyperhidrosis in Japan was estimated by conducting a nationwide insurance claims database analysis for direct medical costs, and a cross-sectional Web-based survey for hygiene product costs and productivity loss.

As a result, the direct medical cost required for axillary hyperhidrosis was estimated to be ¥75,036/year (FY 2018) per patient. The use of botulinum toxin type A injection is limited for only severe cases of primary axillary hyperhidrosis under universal health insurance coverage in Japan. Health insurance-covered treatment using botulinum toxin type A injection accounts for only 20% (doctors in private practice) and 33% (doctors in public practice) in Japan. Therefore, many patients visit a department of cosmetic dermatology at their own expense, suggesting that the actual medical costs are even higher.

The hygiene product cost per patient was ¥9325/year (¥10,510 and ¥8539/year in males and females, respectively), suggesting that males spend more than females. The cost slightly increased at a higher HDSS level. As productivity loss, the absenteeism (%) and presenteeism (%) of working patients with axillary hyperhidrosis were 0.49% and 30.03%, respectively, suggesting approximately 30% decrease in work performance due to symptoms. The performance was slightly lower in patients with HDSS 3–4 than in those with HDSS 2. Based on these results, the annual hygiene product cost for axillary hyperhidrosis was estimated to be ¥24.5 billion, and

| Status of employment | Sex | HDSS | n  | Mean | SD  | Median | Mean | SD  | Median |
|----------------------|-----|------|----|------|-----|--------|------|-----|--------|
|                       |     |      |    |      |     |        |      |     |        |
| Non-regular Total     | Female | 15   | 25.33 | 27.48 | 10.00 | 68,941 | 74,429 | 27,924 |
| 2                    | 8   | 8.75 | 13.56 | 5.00 | 24,890 | 39,488 | 13,641 |
| 3                    | 2   | 40.00 | 28.28 | 40.00 | 110,978 | 74,547 | 110,978 |
| 4                    | 5   | 46.00 | 30.50 | 60.00 | 122,607 | 83,104 | 130,740 |
| Regular Total        |     | 92   | 31.73 | 28.72 | 25.00 | 90,929 | 91,024 | 65,608 |
| 2                    | 12  | 25.73 | 25.95 | 25.00 | 101,174 | 103,858 | 100,621 |
| 3                    | 17  | 25.29 | 24.01 | 20.00 | 94,444 | 91,293 | 79,603 |
| 4                    | 9   | 57.78 | 31.14 | 60.00 | 217,040 | 123,196 | 238,810 |
| Non-regular Total    |     | 54   | 30.74 | 28.61 | 20.00 | 66,527 | 62,010 | 43,738 |
| 2                    | 18  | 18.33 | 19.78 | 15.00 | 39,013 | 41,756 | 32,725 |
| 3                    | 20  | 38.50 | 25.81 | 30.00 | 83,739 | 56,126 | 65,608 |
| 4                    | 16  | 35.00 | 36.33 | 20.00 | 75,967 | 78,878 | 42,995 |
| AIb                  | Female | 42   | 49.05 | 32.79 | 50.00 | 176,368 | 124,117 | 187,333 |
| 2                    | 13  | 35.39 | 29.33 | 40.00 | 121,185 | 100,851 | 139,433 |
| 3                    | 18  | 57.22 | 28.66 | 60.00 | 207,095 | 108,967 | 207,375 |
| 4                    | 11  | 51.82 | 41.43 | 40.00 | 191,302 | 157,691 | 153,400 |

Abbreviations: AI, activity impairment; HDSS, Hyperhidrosis Disease Severity Scale; OWI, overall work impairment; SD, standard deviation; WPAI, Work Productivity and Activity Impairment.

WPAI Questionnaire:
Q1. During the past 7 days, how many hours did you miss from work because of problems associated with your underarm sweating?
Q2. During the past 7 days, how many hours did you actually work?
Q3. During the past 7 days, how much did your underarm sweating affect your productivity while you were working? (Answered on a 0–10 score, with 0 = underarm sweating had no effect on my work and 10 = underarm sweating completely prevented me from working.)
Q4. During the past 7 days, how much did your underarm sweating affect your ability to perform your normal daily activities, other than work at a job? (Answered on a 0–10 score, with 0 = underarm sweating had no effect on my daily activities and 10 = underarm sweating completely prevented me from doing my daily activities.)

Calculating productivity loss (%):
OWI = Q1 / (Q1 + Q2) + (1 − Q1 / (Q1 + Q2)) * (Q3/10).
Absenteeism = Q1 / (Q1 + Q2).
Presenteeism = (1 − Q1 / (Q1 + Q2)) * (Q3 / 10).
AI = Q4 / 10.

aStatuses of employment are as follows: "regular", regular worker, company executive, and self-employed worker and family worker; "non-regular", temporary staff and part-time worker.
bSince there were only two males, AI was not calculated for males.

4 | DISCUSSION

In the present study, the cost associated with axillary hyperhidrosis in Japan was estimated by conducting a nationwide insurance claims database analysis for direct medical costs, and a cross-sectional Web-based survey for hygiene product costs and productivity loss.

As a result, the direct medical cost required for axillary hyperhidrosis was estimated to be ¥75,036/year (FY 2018) per patient. The use of botulinum toxin type A injection is limited for only severe cases of primary axillary hyperhidrosis under universal health insurance coverage in Japan. Health insurance-covered treatment using botulinum toxin type A injection accounts for only 20% (doctors in private practice) and 33% (doctors in public practice) in Japan. Therefore, many patients visit a department of cosmetic dermatology at their own expense, suggesting that the actual medical costs are even higher.

The hygiene product cost per patient was ¥9,325/year (¥10,510 and ¥8,539/year in males and females, respectively), suggesting that males spend more than females. The cost slightly increased at a higher HDSS level. As productivity loss, the absenteeism (%) and presenteeism (%) of working patients with axillary hyperhidrosis were 0.49% and 30.03%, respectively, suggesting approximately 30% decrease in work performance due to symptoms. The performance was slightly lower in patients with HDSS 3–4 than in those with HDSS 2. Based on these results, the annual hygiene product cost for axillary hyperhidrosis was estimated to be ¥24.5 billion, and
the societal loss associated with the productivity loss (OWI [%] and AI [%]) to be ¥312 billion/month.

Hamm et al.\textsuperscript{22} examined disease characteristics and functional impairment using the Hyperhidrosis Impact Questionnaire, Dermatology Life Quality Index, and 12-item Short Form Health Survey in 345 hyperhidrosis patients, revealing that primary hyperhidrosis affected productivity, daily activity, patient well-being, and human relationship formation. The WPAI survey by Yokozeki et al.\textsuperscript{12} demonstrated the same tendency (0% absenteeism and 47.14% presenteeism) as our survey, although their findings cannot be simply compared to ours because their survey was conducted 10 years ago on a wider range of patients with hyperhidrosis, including axillary hyperhidrosis, who visited a university hospital.

In Japan, several reports have been published on the estimated societal loss associated with productivity loss based on a WPAI survey. Working patients with hyperhidrosis had a 46.8% reduction in productivity, with more severe disabilities due to urticaria (33.8%), atopic dermatitis (38.7%), eczema/dermatitis (41.0%), and psoriasis (26.7%).\textsuperscript{23} Murota et al.\textsuperscript{24} recently conducted a WPAI survey on 400 patients with atopic dermatitis in Japan, and noted absenteeism of 2.1–5.5% and presenteeism of 31.4–31.8%, demonstrating similarly declined work performance to that observed in our survey. Furthermore, the annual societal loss associated with productivity loss was ¥2.5 trillion (approximately ¥208.3 billion/month). Igarashi et al.\textsuperscript{25} reported presenteeism of 32.73% and absenteeism of 6.95% in patients diagnosed with migraine, and the same decline in work performance in axillary hyperhidrosis patients as observed in our survey. Sruamsiri et al.\textsuperscript{26} conducted a Web-based survey on 500 patients with rheumatoid arthritis in Japan, and reported presenteeism of 23% and absenteeism of 1%. As previously reported, we quantitatively demonstrated a significant societal loss associated with axillary hyperhidrosis.

Regarding direct medical costs, medical costs for treatments covered by health insurance can be comprehended using a nationwide insurance claims database. However, the percentage of axillary hyperhidrosis patients receiving treatment not covered by health insurance remained unknown. Therefore, only the cost per patient was evaluated instead of making a nationwide estimate. This should be further considered because the out-of-pocket expenses for treatments not covered by health insurance cannot be ignored in the evaluation of the medical cost associated with axillary hyperhidrosis. Moreover, the severity rates in focal hyperhidrosis patients were utilized in our analysis because no data are available on HDSS-based severity rates in axillary hyperhidrosis patients.\textsuperscript{18} We considered it possible to substitute axillary hyperhidrosis because it belongs to focal hyperhidrosis. However, as it will provide important evidence for making nationwide estimation, future investigation is awaited. Although WPAI (%) in each disease level (i.e., HDSS level) was evaluated, the possibility that disease duration also affects the degree of WPAI cannot be denied. Future studies evaluating the relationship between disease duration and WPAI (%) are expected. The Web-based questionnaire survey was conducted in an emergency state due to the spread of COVID-19 infection. Therefore, the unusual living environment may have affected the survey. However, the impact on hygiene product costs may have been limited because the recall period of the survey on hygiene costs was set as the past 1 year. The period for estimating the productivity loss was set as 1 month to avoid over- and underestimations.

The cost associated with primary axillary hyperhidrosis in Japan was clarified. Active interventions are needed for hyperhidrosis patients because improving the symptoms should reduce the societal loss by increasing productivity and improve the individual’s quality of life.

As estimated in our survey, the direct medical cost per patient with axillary hyperhidrosis in Japan was ¥75 036/year (FY 2018), the annual hygiene product cost was ¥24.5 billion, and the societal loss associated with the productivity loss was ¥312 billion/month. The hygiene product cost and the productivity loss slightly increased at
a higher HDSS level. Considering the out-of-pocket expenses for treatments not covered by health insurance, the cost associated with axillary hyperhidrosis is even higher.

ACKNOWLEDGMENT
This study was funded by Kaken Pharmaceutical.

CONFLICT OF INTEREST
H.M., T.F., and H.Y. received fees as resource speakers from Kaken Pharmaceutical; H.O. and H.M. are employees of Kaken Pharmaceutical and have a stock in Kaken Pharmaceutical; and S.I. is an employee of CRECON Medical Assessment. CRECON Medical Assessment was paid by Kaken Pharmaceutical to conduct analyses for the study.

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How to cite this article: Murota H, Fujimoto T, Oshima Y, Tamada Y, Yanagishita T, Murayama N, et al. Cost-of-illness study for axillary hyperhidrosis in Japan. J Dermatol. 2021;48:1482–1490. https://doi.org/10.1111/1346-8138.16050