The high prevalence of skin diseases in subjects aged over 70 years

Running head: The skin diseases in the older people

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1) We certify that this work is novel

3) Skin diseases are common in the older people but epidemiological studies of this topic are sparse. This study shows that nearly 80% of the older population had at least one skin disease requiring further treatment. Skin diseases were more common in males.

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Abbreviations:

NFBC: Northern Finland Birth Cohort

SES: sosioeconomical status

OR: odds ratio

MASD: moisture-associated skin damage

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Abstract

OBJECTIVES

To determine the prevalence of skin findings and skin diseases in subjects aged over 70 years and to study the association between cutaneous diseases and socioeconomic status (SES), sex and living status in the older population.

DESIGN

Cross-sectional study of Finnish subjects aged between 70 and 93 years as part of the Northern Finland Birth Cohort 1966 Study.

MEASUREMENTS

A whole-body skin examination was performed by dermatologists. The associations between skin diseases and SES, sex and living status were analyzed.

PARTICIPANTS

Skin examination data were available for 552 subjects.

RESULTS

Nearly 80% of the subjects had at least one skin disease that required further treatment or follow-up. Over a third of the study cases (39.1%) had three or more simultaneous skin diseases. Skin diseases were more common in males than in females (p<0.001). The most common skin diseases were tinea pedis (48.6%), onychomycosis (29.9%), rosacea (25.6%), actinic keratosis (22.3%) and asteatotic eczema (20.8%). There was some association between skin diseases and SES and living status.

CONCLUSIONS

A whole body clinical skin examination should not be diminished as it reveals important diagnoses.

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Introduction

The proportion of older individuals is growing rapidly, especially in developed countries. Globally, approximately 1.5 billion people are estimated to be age 65 or older in 2050 [1]. Aging causes a variety of intrinsic and extrinsic changes in the skin, making it more prone to cutaneous diseases [2]. Skin diseases decrease quality of life and worsen active aging [3,4].

Although skin disorders are common in the older population, few epidemiological studies have detailed cutaneous diseases among the older persons. Furthermore, most available data have been collected from selected geriatric populations, such as residents of nursing homes or those treated in the tertiary care setting. Studies in the general population are lacking [5]. Two large hospital record-based studies of 4 000 Turkish and 16 924 Taiwanese older persons revealed that the most common skin diseases in the older people are eczemas, skin infections and pruritus [6,7]. Two other studies carried out in dermatological clinics in India (n= 300) and in Turkey (n= 7 092) reported similar findings in patients aged between 60 and 99 years, consisting mainly of cases of xerosis, skin infections and vascular diseases [8,9]. Xerosis and dermatophytosis were also the most prevalent skin diseases in a study of 233 nursing home residents in Germany [5]. Other cutaneous disorders common in the older people include benign and malignant skin tumors, infestations and chronic wounds [5,10,11].

Since few epidemiological studies based on clinical examination have been conducted in older populations, the present study was designed primarily to determine the prevalence of abnormal skin findings and cutaneous diseases in a population of individuals aged >70 years. The other aim was to determine whether the prevalence of skin diseases in the older persons is associated with socioeconomic status (SES), sex and living status.

Methods

Study cohort and dermatological examination

The Northern Finland Birth Cohort 1966 (NFBC1966) is an epidemiological and longitudinal research program in the two northernmost provinces in Finland (Oulu and Lapland). The NFBC1966 is comprised of the offspring of the mothers, who lived in either province and whose expected delivery date fell between 1st January and 31st December 1966[12]. The 12 058 subjects belonging to the NFBC1966 have been followed regularly since their birth and their mothers had been followed during the pregnancy[13]. The surviving mothers and fathers of the subjects in the NFBC1966 have participated in a comprehensive health study (Keränen et al., unpublished observations) including skin examination.

By the end of the skin study a total of 12027 parents of members of the NFBC1966 were sent a diverse health questionnaire. Of these, 5559 (46%) responded. All responders who were living in the Oulu area (n=1239) were invited to participate in the clinical examination. A whole-body skin examination was performed on 552 (346 females and 206 males) and this subpopulation was included in the final skin study analysis. The skin data was collected between May 2018 and March 2019 on the premises of the Faculty of Medicine of the University of Oulu.

All areas of the skin including the nails, hair and scalp were observed during a 20-minute visit. All skin diseases which were observable at the study moment were recorded. Numbers of skin tumors were calculated and skin tumors were further observed using a dermatoscope. Diagnoses of skin disorders were based on internationally accepted criteria and classified by the International Classification of Diseases (ICD-10). The International classification was utilized for rosacea[14,15]. The presence of moisture-associated skin damage (MASD) covering incontinence-associated dermatitis, intertriginous dermatitis, periwound moisture-associated dermatitis and peristomal moisture-

111 associated dermatitis[16] was notified. Diagnoses of fungal, bacterial, and viral skin infections were

112 based on clinical findings and partly on microbiological diagnostic.

113

114 *Analytical methodology for the present study*

115 In order to analyze the severity of skin diseases or skin findings, study subjects with such findings

116 were classified into three subgroups according to their need of further intervention: I) no further care

117 needed, II) expected to recover with self-treatment, III) need medical care by physician. If a study

118 case showed any skin disease that required treatment (e.g. untreated eczema) or had any suspected

119 skin malignancy, the subject was referred to a primary health care unit. The group "no further care

120 needed" included subjects with benign skin tumors or male/female pattern hair loss and no other

121 diagnosis.

122 The SES of the study subjects was defined by their educational level [17]. Individuals were classified

123 into three subgroups of education: primary school, secondary school, post-secondary level

124 education/vocational college/university. The information on subjects' education level and living

125 status (living alone or with a spouse/other family member) of study subjects was self-reported.

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127 *Statistical methods*

128 The data gathered from the clinical examination were used to calculate the overall prevalence of all

129 common skin diseases as well as the prevalence of each individual condition. The Chi-Square test, or

130 Fisher's exact test, were used appropriately to test difference in categorial variables. Logistic

131 regression analysis was used to estimate crude and adjusted odds ratios and their 95% confidence

132 intervals. The adjusted model included sex, SES and educational level as variables. All statistical

133 analyses were performed with SAS 9.4 for Windows (The SAS Institute, Cary, NC, USA). All

134 significance tests were two-tailed, and values of $P < 0.05$ were considered statistically significant.

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136 *Ethical Approval*

137 The Ethical Committee of the Northern Ostrobothnia Hospital District approved the study (115/2012)

138 which was performed according to the principles of the Helsinki Declaration of 1983.

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Results

Prevalence of skin diseases

Subjects' demographics and skin disease status are presented in Table 1. The overall finding of the clinical evaluation was that 75.7% of the study population had at least one skin disease that required treatment or follow-up. Over one third of the study cases (39.1%) had three or more skin diseases, with fungal skin infections being the most common. Tinea pedis (Figure 1A-B) was seen in 48.6% and onychomycosis in 29.9% of participants. To test the consistency of clinically described onychomycosis with microbiological diagnosis of the same condition, randomly selected clinically diagnosed individuals (n=20) were sampled for microbiological dermatophyte samples (dermatophyte polymerase chain reaction [PCR]). Nineteen of these twenty samples were positive. The prevalence of moisture-associated skin damage[18] was 9.1%. Folliculitis was diagnosed in 3.6%. (Table 2).

The most frequent eczema subtype was asteatotic eczema (Figure 1C), found in 20.8% of the population. Seborrheic dermatitis (Figure 1D) affected 10.1% of the participants and nummular eczema 9.2%. Hand eczema was seen in 8.5%. The prevalence of rosacea was 25.0% and 65% of rosacea cases were erythematotelangiectatic, 13.9% papulopustular (Figure 1E) and 8.0% phymatous. Cutaneuous autoimmune diseases were generally infrequent, but lichen planus was the most common (2.5%) and there were no cases with bullous pemphigoid.

Previously undiagnosed actinic keratosis was found in 22.3% of the population. The prevalence of basal cell carcinoma was 5% (n=28). Bowen's disease was diagnosed in nine, squamous cell carcinoma in two and malignant melanoma in three study cases.

163 Overall, benign skin tumors were the most common skin findings in this study. Of those, seborrheic

164 keratoses were found most often, with 78.8 % of the population having at least one, and 15.8% having

165 at least 50. Nearly as common were lentigo senilis (69.5%) and cherry angiomas (63.2%), followed

166 by melanocytic nevi (50.1%). Multiple ($\geq$50) melanocytic nevi were found in 7.4% of study cases.

167 (Table 2).

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169 *Prevalence of skin diseases in the population stratified by sex*

170 Table 3 shows the sex distribution of all the studied skin disorders. Seborrheic dermatitis, nummular

171 eczema, tinea pedis, onychomycosis, folliculitis and actinic keratosis were more frequent in males,

172 while asteatotic eczema, cherry angiomas and lentigo senilis were more common in females. Males

173 had also more simultaneous cutaneous findings than females. Female pattern hair loss was seen in

174 22.5% of the females and male pattern hair loss in 83.0% of males. In an adjusted model, SES and

175 living status did not have any effect on these results (data not shown).

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177 *Distribution of skin diseases according to SES and living status*

178 Cherry angiomas were more frequent in high SES individuals than in those with low SES (p<0.05)

179 whereas urticaria and psoriasis were more common in those with low education status (p<0.05). Male

180 pattern hair loss (p<0.05) and folliculitis (p<0.05) were more usual in those living with the spouse

181 when compared with those living alone. In comparison, female pattern hair loss was found more often

182 in those living alone when compared with those living with a spouse (p<0.05). (data not shown).

183

184 *The need for treatment*

185   Nearly half (43.1%) of the study subjects had at least one skin disease that was considered severe

186   enough to require further treatment by a physician. In addition, one in three (32.6%) had a

187   dermatological finding classified as curable by self-treatment. Overall, male subjects were more

188   likely than females to be in need of treatment (OR 1.63, $p < 0.01$).

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191 # Discussion

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193   To the best of our knowledge, ours is the largest study to date in the field of geriatric dermatology to

194   be based on a whole-body skin examination. A previous German study of 223 persons aged over 65

195   years found that skin diseases were common and almost every participant had at least one

196   dermatological diagnosis, xerosis being the most common[19]. In our study, as many as 80%

197   participants had a skin disease requiring treatment, but rather than dry skin, the most common

198   dermatological conditions were fungal skin infections, rosacea, actinic keratosis and asteatotic

199   eczema. This difference in findings could be explained by the fact that the German study assessed

200   residents of nursing homes, while ours was a general population of older people. Furthermore, the

201   mean age of our population (78.4 years) was lower than that of the population of the German study

202   (83.6 years). One of the largest epidemiological studies in geriatric dermatology (n=4099) was

203   conducted in Turkey in 2006[20]. The study data were register based and collected from dermatological

204   clinics, which may have caused selection bias. Furthermore, rather than reporting the exact incidences

205   of individual skin conditions, the study grouped the conditions and reported the incidence of each

206   category, making it impossible to compare the results with those of other studies.

207   We report a high frequency of tinea pedis (49%) and oncyhomycosis (30%). Our data support earlier

208   findings that fungal skin infections are particularly common in the older populations[8,19,20]. The

209   increased susceptibility of older individuals to infections, including dermatological infections,

210   probably arises from functional changes driven by the aging process of the immune system, known

211   as immunosenescence[21]. This is noteworthy from a clinical point of view, since tinea pedis is a known

212   risk factor for severe bacterial infections such as cellulitis[22]. Previous studies have found that fungal

213   skin infections are also common in the NFBC1966 study (comprised of the individuals born in

214   1966)[23].

215   The most common eczema in the present study was asteatotic eczema, seen principally in the geriatric

216   population. The development of asteatotic eczema is driven by the depletion of lipids and free fatty

217   acids in the epidermis, which is seen as part of the aging process[24]. It is characterized by dry, fissured

218   skin, most often on the limbs and is worsened by excessive bathing with soaps. The prevalence of

219   asteatotic eczema has been reported to be approximately 15% in patients aged over 60 years[25,26]. The

220   other common eczema noted in the present study was seborrheic dermatitis (10%) which is a

221   particular source of morbidity in the older individuals[10]. Seborrheic dermatitis affects the areas of the

222   body that are rich in sebaceous glands, such as the face and trunk. Sebocyte activity diminishes with

223   advanced age, and in light of this, seborrheic dermatitis being common in the older persons may

224   appear to be an unexpected finding[27]. Previous reports suggest that the incidence of atopic dermatitis

225   is increasing in the geriatric population[28], but the present study was unable to confirm this, with the

226   condition being diagnosed in only 0.36% of subjects. However, other eczemas (i.e. nummular

227   eczema) that may partially overlap with atopic dermatitis were more common.

228   MASD conditions are common in the older people, whose skin barrier function is weakened and

229   easily irritated by several factors, including chemical irritants, moisture in the environment,

230   mechanical friction and micro-organisms such as Candida albicans. In geriatric care, incontinence-

231   associated dermatitis is a particularly common finding in the geriatric care setting, affecting up to

50% of patients[29,30]. In our study population MASD was diagnosed in 9%. The lower prevalence reflects the fact that most of our study cases had still relatively good health, lived at home and had no major mobility issues.

Rosacea affected 25% of the population, a far greater proportion than the 2–8% found in previous studies in older populations[31,32]. However, the high rate of rosacea in the present study reflects the 15% found by a previous study of the NFBC1966 study[23]. These high rates in a predominantly ethnic Finnish population may be explained by the association of rosacea with fair skin types[33]. It is known that in men, rosacea is uncommon before the age of 50 years and reaches its peak prevalence between the ages of 75 and 80 years. This peak occurs at an earlier age in women[32]. Rosacea has several deleterious effects on the patient's life: it can cause embarrassment, decreased self-esteem and isolation from society because of the visibility of facial symptoms[34]. Prevalence of ocular rosacea was surprisingly low (0.72%) in our study. This may reflect the fact that most cases had erythematotelangiectatic rosaca and thus milder disease. However, it is currently not clear how ocular rosacea associates with other rosacea types[35]. In our opinion, the epidemiology of rosacea in the older people and its effects on patients' everyday lives require further study.

The finding of previously undiagnosed actinic keratosis or skin cancer in 22.3% of our subjects was surprising, even in light of the rapid worldwide increase of the prevalence of nonmelanoma skin cancers[36]. The rate of benign skin tumors also increases with advanced age[11,19,31,37], and therefore the recognition of pre-malignant and malignant skin findings may be challenging for individuals and for physicians. In our study benign tumors were very common, seen in 70–80% of subjects. With the exception of melanocytic nevi, the rates of these tumors were higher in the present population than in the NFBC1966 study[23]; half of the study cases in the this parents cohort had at least one melanocytic nevus but only 7% had over 50. This is consistent with the fact that at the individual level, the number of melanocytic nevi increases with age in childhood but the rate at which new nevi appear begins to decrease after middle age[38].

257   We found several differences in the prevalence of skin diseases between the sexes. A higher

258   proportion of males had fungal skin infections and females more benign tumors, which is in

259   accordance with the previous epidemiological studies[23,26,39,40]. In our population, males were also

260   more likely than females to be affected by seborrheic dermatitis and nummular eczema, actinic

261   keratosis and folliculitis. The male predominance in some skin diseases may partly be explained by

262   hormonal differences between men and women. For example, seborrheic dermatitis is associated with

263   androgen levels - its incidence in males peaks during puberty when androgen levels are high[41]. In

264   addition, sex differences in the use of cosmetics can have an influence of the appearance of skin

265   diseases, since the use of cosmetics may alter cutaneous pH and further change microbial colonization

266   and barrier integrity[42].

267   The associations between SES and skin diseases are poorly studied. In general, people with a lower

268   SES have an increased risk of general morbidity[43] but when it comes to skin diseases, findings vary[44-

269   [46]. Skin infections, widespread nummular eczema ("eczema infectiosum") and folliculitis have

270   previously been reported to more common among people with low SES[23]. According to our present

271   findings, the influence of SES on the presence of skin diseases diminishes with advanced age.

272   However, this finding may be partially explained by the Finnish national health insurance system

273   which covers every Finnish citizen. We found only weak associations: psoriasis and urticaria affected

274   more subjects with low SES than those with high SES but the numbers of study cases in these disease

275   groups was low and the results cannot be generalized. To our knowledge, the association between

276   SES and skin diseases in the older persons has previously been studied only in one multicenter clinical

277   study, which revealed no association[19]. However, this German study population consisted only of

278   residents of long-term care facilities, in which setting the effect of SES might be considered

279   meaningless.

280   The primary strength of the present study is its population. In comparison, previous studies have

281   focused on narrower, more selected populations, such as patients at dermatologic clinics or tertiary

282 care centers – approaches that may have been prone to selection bias [8,20]. The present study also

283 benefitted from the whole-body clinical skin examination that was performed by experienced

284 dermatologists on all subjects. Interobserver reliability was tested between the two main researchers

285 (SPS, LH) and its degree was high[47]. Furthermore, we comprehensively analyzed the prevalence of

286 all the most common skin diseases in population subgroups based on the need for further treatment.

287 Although all population candidates were invited to participate in the study, not all did – this must be

288 acknowledged as a potential source of sample selection bias, and therefore, as a weakness. Due to the

289 study setting, only point prevalences were determined, which can be considered as a limitation. The

290 fact that all our study subjects were Caucasian may limit the generalizability of our results to those

291 with skin of color.

292 In conclusion, this study provides new data about the epidemiology of skin diseases in the older

293 people. Our principal finding is that dermatological disorders are extremely common in the older

294 individuals, and this should be taken into account by physicians treating geriatric patients. A whole

295 body clinical skin examination should not be diminished as it may reveal hidden cutaneous symptoms

296 and ensures timely diagnoses and appropriate treatment.

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420 **Table 1** Subject demographics and skin disease status

Sex (N=552)	n (%)
Male	206 (37.3%)
Female	346 (62.7%)
Ethnicity	
White	552 (100%)
Living status (N=549)*:	
Living alone	164 (29.9%)
Living with spouse or with other family member	385 (70.1%)
Institutionalized	0 (0.0%)
Education (N=487)*	
No education/Primary school	104 (21.4%)
Secondary school	193 (39.6%)
Post-secondary level education/vocational college/university	190 (39.0%)
Age, years (N=552)	
Mean (SD)	78.4 (4.18)
Age range:	
70 to 75	108 (19.6%)
75 to 80	234 (42.4%)
80 to 85	162 (29.3%)
85 to 90	43 (7.79%)
90 to 93	5 (0.91%)
Number of simultaneous skin diseases (N=552)[#]	
None	70 (12.7%)
One or two	266 (48.2%)
Three or more	216 (39.1%)
Treatment requirement (N=543)[#]	
No further care needed	132 (24.3%)
Self treatment needed	177 (32.6%)
Requires further care by physician	234 (43.1%)

421 SD, standard deviation

422 # Not including benign skin tumors and male/female pattern hair loss

423 *All study cases did not report information on health questionnaires

424

425

426 **Table 2. Prevalence of skin diseases**

Condition	Patients N=552
Benign and malign skin tumors	
Melanocytic nevi	276 (50.1%)
Cherry angiomas	348 (63.2%)
Seborrheic keratosis	434 (78.8%)
Lentigo senilis	383 (69.5%)
Actinic keratosis	123 (22.3%)
Bowen's disease	9 (1.63%)
Melanoma	3 (0.54%)
Basal cell carcinoma	28 (5.07%)
Squamous cell carcinoma	2 (0.36%)
Eczemas and psoriasis	
Atopic dermatitis	2 (0.36%)
Hand eczema	47 (8.51%)
Seborrheic dermatitis	56 (10.1%)
Nummular eczema	51 (9.24%)
Contact eczema	4 (0.72%)
Neurodermatitis	7 (1.27%)
Asteatotic eczema	115 (20.8%)
Psoriasis	6 (1.09%)
Psoriasis with nail symptoms	1 (0.18%)
Psoriasis with joint symptoms	1 (0.18%)
Autoimmune diseases	
Lichen planus	14 (2.54%)
Dermatitis herpetiformis	0 (0.0)
Discoid lupus erytematosus	0 (0.0)
Vitiligo	11 (1.99%)
Urticaria	4 (0.73%)
Bullous pemphigoid	0 (0.0)
Sebaceous gland diseases	
Rosacea	137 (25.0%)
Erythematotelangiectatic	90 (64.7%)
Papulopustular	19 (13.7%)
Phymatic	12 (8.63%)
Ocular	1 (0.72%)
Several types	17 (12.2%)
Skin infections	
Pityriasis versicolor	6 (1.09%)
Onychomycosis	165 (29.9%)
Tinea pedis	268 (48.6%)
Tinea corporis	8 (1.45%)
Folliculitis	20 (3.62%)
Moisture-associated skin damage	50 (9.06%)
Verruca plantaris	21 (3.80%)
Verruca palmaris	13 (2.36%)
Hair follicle and sweat glands diseases	

Alopecia areata	5 (0.91%)
Androgenetic alopecia*	171 (83.0%)
Female pattern hair loss#	78 (22.5%)
Hyperhidrosis	3(0.54%)
Hidradenitis suppurativa	1 (0.18%)

427 ***The proportion of the males (n=206)**

428 **#The proportion of the females (n=346)**

429

430

Table 3. Prevalence of skin diseases by sex and analysis of sex differences.

Condition	Prevalence, n (%)		OR (95% CI)
	Males (n=206)	**Females (n=346)**	
Melanocytic nevi	99 (48.3)	177 (51.5)	0.88 (0.62 - 1.25)
Cherry angiomas	117 (57.1)	230 (66.9)	0.66 (0.46 - 0.94)
Seborrheic keratosis	169 (82.4)	264 (76.7)	1.42 (0.92 - 2.20)
Lentigo senilis	115 (56.1)	266 (77.3)	0.37 (0.26 - 0.54)
Actinic keratosis	61 (29.6)	62 (18.0)	1.91 (1.27 - 2.87)
Bowen's disease	4 (1.9)	5 (1.5)	1.34 (0.36 - 5.06)
Malignant melanoma	3 (1.5)	0 (0.0)	–
Basal cell carcinoma	13 (6.3)	15 (4.4)	1.48 (0.69 - 3.17)
Squamous cell carcinoma	1 (0.5)	1 (0.3)	1.67 (0.10 - 26.9)
Atopic dermatitis	1 (0.5)	1 (0.3)	1.67 (0.10 - 26.9)
Hand eczema	15 (7.3)	32 (9.3)	0.77 (0.40 - 1.45)
Seborrheic dermatitis	40 (19.4)	16 (4.7)	4.94 (2.69 - 9.08)
Nummular eczema	26 (12.6)	25 (7.3)	1.84 (1.03 - 3.29)
Contact eczema	2 (1.0)	2 (0.6)	1.68 (0.23 - 12.0)
Neurodermatitis	4 (1.9)	3 (0.9)	2.25 (0.50 - 10.2)
Asteatotic eczema	30 (14.6)	84 (24.4)	0.53 (0.33 - 0.83)
Psoriasis	3 (1.5)	3 (0.9)	1.68 (0.34 - 8.40)
Lichen planus	5 (2.4)	9 (2.6)	0.93 (0.31 - 2.80)
Vitiligo	6 (2.9)	5 (1.5)	2.03 (0.61 - 6.75)
Urticaria	1 (0.5)	3 (0.9)	0.56 (0.06 - 5.38)
Rosacea	58 (28.2)	78 (22.9)	1.32 (0.89 - 1.96)
Pityriasis versicolor	4 (1.9)	2 (0.6)	3.39 (0.61 - 18.7)
Onychomycosis	79 (38.3)	84 (24.4)	1.93 (1.33 - 2.80)
Tinea pedis	124 (60.2)	143 (41.6)	2.13 (1.50 - 3.02)
Tinea corporis	8 (3.9)	0 (0.0)	–
Folliculitis	19 (9.2)	1 (0.3)	34.8 (4.63 - 262)
Moisture associated skin damage	21 (10.2)	29 (8.4)	1.23 (0.68 - 2.22)
Verruca palmaris	5 (2.4)	8 (2.3)	1.05 (0.34 - 3.24)
Alopecia areata	0 (0.0)	5 (1.5)	–
Androgenetic alopecia	171 (83.0)	–	–
Female pattern hair loss	–	76 (22.1)	–
Hyperhidrosis	3 (1.5)	0 (0.0)	–
Hidradenitis suppurativa	0 (0.0)	1 (0.3)	–

CI, confidence interval; OR, odds ratio

437   Figure legend (Figure 1)

438   Clinical presentations of the most common skin diseases. A-B) Tinea pedis (*T. rubrum* (A), *T.*

439   *interdigita* (B)) C) Asteatotic eczema D) Seborrheic dermatitis E) Papulopustular rosacea.