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The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study

Running Head: Skin health in nursing home residents

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Abstract

Objectives: The aim of this study was to measure the prevalence of skin diseases in aged nursing home residents and to explore possible associations with demographic and medical characteristics.

Design: Descriptive multicentre prevalence study.

Setting and Participants: The study was conducted in a random sample of ten institutional long-term care facilities in the federal state of Berlin, Germany. In total, n = 223 residents were included.

Results: In total 62 dermatological diseases were diagnosed. The most frequently diagnosed skin disease was xerosis cutis (99.1%, 95% CI 97.7% - 100.0%) followed by tinea ungium (62.3%, 95% CI 56.0% - 69.1%) and seborrheic keratosis (56.5%, 95% CI 50.2% - 63.0%). Only few bivariate associations have been detected between skin diseases and demographic and medical characteristics.

Conclusion: Study results indicate, that almost every nursing home resident is affected by adverse skin conditions. Dermatological findings range from highly prevalent xerosis and cutaneous infection up to skin cancer. Not all conditions require immediate dermatological treatment and can be managed by targeted skin care interventions. Caregivers need knowledge and diagnostic skills to make appropriate clinical decisions. It is unlikely that specialized dermatological care will be delivered widely in the growing long-term care sector.

Registration: This study is registered at https://clinicaltrials.gov/ct2/show/NCT02216526.

Key words: prevalence, dermatology, nursing homes, skin diseases, elderly

Article summary

Strengths and limitations of this study:

- This was the largest randomly selected sample of nursing home residents aged 65 years or older undergoing a head-to-toe skin examination by board certified dermatologists.
- Medical and functional parameters were measured and instrumental skin barrier measurements were conducted.
- Skin diseases, medications and concomitant diseases were classified according to international definitions and functional assessments were assessed according to established methods to support the generalisability of results.
- Exploratory data analyses were conducted to describe possible associations between demographic, medical, and cutaneous characteristics of the residents.
- Although three additional nursing homes were included, the anticipated sample size of n = 280 was not achieved.

Conflict of interest

I confirm, that the authors have no conflict of interest regarding financial conflicts, personal conflicts or potential conflict. All Authors address each of the specific categories of financial and personal conflicts in a full disclosure.

INTRODUCTION

Background

Skin ageing, functional limitations, chronic diseases, polypharmacy, personal skin care and hygiene habits in populations aged 65 years or older cause an increased vulnerability to skin diseases and cutaneous problems.[1-3] Epidemiological studies suggest that skin diseases are highly prevalent in the elderly population.[4-6] For example, the prevalence's of xerosis cutis range up to 85.5%, benign skin tumours up to 74.5%, fungal infections up to 77% and pressure ulcer (PU) up to 46%.[7, 8] However, most published epidemiology figures were obtained in hospital settings. The epidemiology of cutaneous diseases in institutional long-term care settings is largely unknown,[7] although the number of multimorbid nursing home residents is increasing.[9]

In addition to the high prevalence, the burden of skin diseases also increases with age.[6] They are associated with reduced quality of life.[10] It was shown that geriatric patients with dermatological diseases have an increased risk for mental and behavioural disorders, primarily depression.[11] The medical treatment of the mulitmorbidities in nursing home residents may also result in polypharmacy.[12] Associated adverse drug reactions, nonadherence or drug-drug interactions are common[13, 14] and linked to dermatological disorders. Immobility, cognitive impairment and organizational or reimbursement factors may also limit the opportunity for these population to receive specialized dermatological care. Traditionally, nurses and other health care professionals focus on PUs and incontinence-associated dermatitis (IAD) but may ignore other skin problems which may also require attention. On the other hand, not all dermatological conditions require specialized pharmaceutical treatment. In order to gain a detailed picture about the epidemiology of skin diseases in institutional long-term care this study was conducted.

Objectives

The aim of this study was to measure the prevalence of skin conditions and diseases in aged nursing home residents and to explore possible associations with demographic and medical characteristics.

MATERIALS AND METHODS

Study design

This was an observational, cross-sectional prevalence study and was approved by the ethics committee of the Charité-Universitätsmedizin Berlin (EA1/190/14). The study protocol was published previously.[15]

Setting

The study was conducted from September 2014 to May 2015 in ten institutional long-term care facilities in Berlin, Germany. Using computer generated random numbers, nursing homes from a list of all existing nursing homes (n = 291) in the federal state of Berlin, Germany were contacted. In case of non-response the next randomly selected nursing home was invited.

Participants

The inclusion criteria were (1) being resident of the respective nursing home, (2) aged ≥ 65 years, and (3) written informed consent given personally or by legal representative. Residents at the end of life were not considered eligible.

Variables

Skin diseases were classified according to the international coding of diseases (ICD 10) classification. Xerosis cutis was measured using the Overall Dry Skin score (ODS) with a five-point scale ranging from '0' (no skin dryness) to '4' (advanced skin roughness, large scales, inflammation and cracks).[16, 17] Concomitant diseases (ICD 10 classification level 1) and medications were extracted from the medical records. Demographic variables of the nursing home residents (e.g. age, gender) were collected. The physical function related to the

daily activities was assessed using the Barthel – Index. The scores range from 0 (very care dependent) to 100 (not care dependent).[18] The Braden scale was used to measure PU risk. Scores ranges from 6 (high PU risk) to 23 (no PU risk).[19] The educational qualification was classified into the following six categories: 'no school qualification', 'primary school', 'secondary school', 'grammar school/ A-level', 'vocational training' and 'university qualification'.

Data sources and measurement

All participating nursing home residents underwent a head-to-toe skin examination conducted by a board certified dermatologist (UBP, NGB, IJ). Demographic characteristics (e.g. age, gender) and information regarding school qualification were extracted from the medical records by trained study assistants or the residents were interviewed, if possible. PU risk and care dependency (Braden scale and Barthel-Index) were extracted from the medical records or assessed by a registered nurse. All study data was continuously documented in data collection forms by the investigator and authorized staff.

Bias

Nursing homes were randomly selected from all nursing homes of the state of Berlin to ensure generalisability. All study related procedures and measurements were conducted by trained dermatologists and study assistants according to standard operating procedures.

Study size

Assuming a prevalence of 0.5 of skin diseases, approximately 280 residents would have been needed to measure this proportion with a desired width of a 95% confidence interval of ±

0.06. According to the latest Nursing Care Statistics (2013), the size of the nursing home population in Berlin was approximately 30.000.[20] Assuming 80 residents per institution and a participation rate of 50% (n = 40) it was planned to include seven institutions which results in n = 280 (7 x n = 40) cases.

Quantitative variables

The duration of residency was measured in months. The Barthel-Index and Braden scale scores were used as metric variables. In order to investigate possible associations with skin diseases the variable 'educational qualification' was dichotomized into 'university qualification' (yes/no). Residents taking four or more medications were regarded as having 'polypharmacy'.[12]

Statistical methods

Depending on the level of measurement (nominal, ordinal, continuous) demographic characteristics, functional assessment scores and dermatological diseases were described using means, medians, proportions, frequencies and associated spread estimates, standard deviations, ranges and interquartile ranges. The 95% confidence intervals were calculated around point estimates of dermatological diseases. Exploratory data analysis to investigate possible bivariate associations were conducted using logistic regression analysis for all skin diseases with a prevalence of at least 8%. Odds ratios being statistically significant or with values lower than 0.5 or higher than 2.0 were considered to be likely associated. In case of multiple bivariate associations multivariable logistic regression analyses were conducted. Models were built iteratively to increase model fit indicated by Nagelkerke's R^2.

RESULTS

Participants

Fifty-five nursing homes were contacted. Finally, ten nursing homes agreed to participate. Compared to participating institutions, non-participating institutions were larger in terms of number of beds (mean beds per institution: 104.5 vs. 73.7) privately owned (76% vs. 60%) and non-profit (30% vs. 22%).

All residents of the eligible nursing homes were invited, but participation rate was lower than 50%. In order to achieve the planned number, three additional nursing homes were recruited (in total ten). In total, n = 811 nursing home residents were assessed for eligibility, n = 252 residents (31.1%) provided written informed consent and n = 223 were included (Fig. 1).

> Fig. 1<

Descriptive data

Sample characteristics are shown in table 1. Most residents were female (67.7 %) and the mean age was 83.6 (SD 8.0) years. Mean Barthel – Index score was 45.1 (SD 23.8) and mean Braden scale score was 17.3 (SD 3.7). The median time of nursing home residence until data collection was 27 months. A vocational training was the highest educational degree for the majority (48.9 %). The most common concomitant diseases (ICD 10 system level 1) were diseases of the circulatory system (82.5 %) and mental and behavioural disorders (70.4 %). In total 84.6% of the residents received four or more medications (polypharmacy). The mean number of medications used was 6.8 (SD 3.4) per resident.

> Table 1 <

Main results

In total 62 dermatological diseases were diagnosed. The complete list of dermatological findings is shown in the online supplementary table S1. Xerosis cutis was most frequent (99.1%, 95% CI 97.7% to 100.0%) followed by tinea ungium (62.3%, 95% CI 56.0% to 69.1%), and seborrheic keratosis (56.5%, 95% CI 50.2% to 63.0%). Thirty-two dermatological diseases were diagnosed for five residents or fewer (e.g. Bowen´s disease, 5/223, allergic contact dermatitis, 2/223, atopic dermatitis 1/223).

The results of the bivariate associations are shown in table 2. Higher age was associated with the increased prevalence of seborrheic keratosis (OR = 1.041, 95% CI 1.007 to 1.077), intertrigo (OR = 1.052, 95% 1.004 to 1.102) and neoplasm (OR = 1.065, 95% CI 0.999 to 1.134). On the other hand, the occurrence of seborrheic dermatitis decreased with increasing age (OR = 0.951, 95% CI 0.909 to 0.996). Female gender showed a decreased occurrence of androgenetic alopecia (OR 0.187, 95% CI 0.099 to 0.354), tinea pedis (OR = 0.435, 95% CI 0.241 to 0.786) and actinic keratosis (OR = 0.321, 95% CI 0.165 to 0.622). There were statistically significant associations between the Barthel - Index and tinea pedis (OR = 1.013, 95% CI 1.001 to 1.025) as well as venous insufficiency (OR = 1.019, 95% CI 1.005 to 1.034); and between the duration of residency and tinea ungium (OR = 0.992, 95% CI 0.987 to 0.998) as well as tinea pedis (OR = 0.987, 95% CI 0.978 to 0.996), but the strength of association were small. Having a university qualification was associated with less occurrence of xerosis cutis (OR = 0.462, 95% CI 0.175 to 1.223). The number of medications used was associated with the occurrence of venous insufficiency (OR = 1.108, 95% CI 1.011 to 1.214) and scar and fibrosis (OR 1.103, 95% CI 1.000 to 1.217).

>Table 2<

Results of the multivariable logistic regression model with tinea pedis as dependent

variable is displayed in the supplementary table S2. Adjusted to the Barthel - Index and the duration of residency, the occurrence of tinea pedis was lower in female residents (OR = 0.454, 95% CI 0.245 to 0.893). Results of multivariable logistic regression model with venous insufficiency as dependent variable is displayed in the supplementary table S3. The occurrence of venous insufficiency was more likely in residents with higher Barthel - Index scores (OR = 1.019, 95% CI 1.004 to 1.033) and higher numbers of drugs (OR = 1.110, 95% CI 1.010 to 1.220). None of the other skin diseases showed multiple associations in the bivariate regression.

DISCUSSION

Key results

This prevalence study showed, that nearly every nursing home resident in institutional long-term care is affected by at least one dermatological disease. In total, 62 dermatological diseases were diagnosed, which was unexpectedly high. The highest prevalence was observed for xerosis cutis followed by tinea unguium, seborrheic keratosis, androgenetic alopecia, IAD and tinea pedis. Only few bivariate associations have been detected between skin diseases and demographic and other characteristics. Male gender was strongly associated with androgenetic alopecia, tinea pedis and actinic keratosis. A university qualification may cause a higher sensitivity to prevent xerosis cutis. Increasing age leads to increased risks of seborrheic keratosis, intertrigo and neoplasm and to decreased risks of having seborrheic dermatitis. Overall, the Barthel - Index and the duration of residency seem to be unrelated to the occurrence of skin diseases in this population.

Limitations

Although three additional nursing homes were included, the anticipated sample size of n = 280 was not achieved. Even though we performed a randomized selection of all nursing homes there were differences between participating and non - participating nursing homes. Whether this has an effect on the results is unclear. We also excluded residents at the end of life which may have led to a selection bias. Although we collected numerous data, the systemic diseases were not further specified. This permits detailed analyses of possible associations. Furthermore, we do not perform laboratory or histology analysis besides the clinical diagnosis by the board certified dermatologist.

Interpretation

In addition to a study published in Turkey in 2007 by Kilic et al.[21], this was the largest randomly selected sample of nursing home residents aged 65 years or older undergoing a head-to-toe skin examination by board certified dermatologists, compared to previous studies.[5, 22, 23] In our study prevalence estimates are higher compared to previous studies in this setting, for instance the prevalence of xerosis cutis, IAD, and actinic keratosis.[5, 21, 24-26] Otherwise the study of Kilic et al. reported a lower prevalence for actinic keratosis[21], which may be explained by the geographic region and the assumed darker skin types of examined nursing home residents. Prevalence's for tinea pedis, pruritus and candidiasis were similar to previous reports.[21, 23] The PU prevalence of 9% was substantially higher compared to previous studies[27, 28] of the German nursing home setting indicating that PUs are a substantial problem in German nursing home settings.

We diagnosed a broad spectrum of dermatological conditions in our study population with a total number of 62 diagnoses, which is unexpectedly high. A study by Makrantonaki et al. reported 72 dermatological disorders in a sample of 110 hospitalized elderly patients.[29] These findings underscore the importance of dermatological examinations in geriatric patients and long-term care residents. However, the prevalence of >50% of the reported skin diseases was 2% or lower. Looking at the clinical spectrum of the diagnosed conditions a large number are benign, easy to manage or seem to be of minor pathological relevance. Empirical evidence suggests the significant improvement of xerosis cutis in the elderly when using structured skin care regimens.[30-34] Therefore our data may suggest a possible undersupply. Untreated dry skin is most often related to enhanced pruritus[32], and may lead to superficial injuries or wounds with superinfection.[35] IAD or intertrigo may also be addressed by basic skin care interventions and/or antimycotic therapies.[33, 36] Other diseases like androgenetic alopecia, seborrheic keratosis or pigmentary disorders may be aesthetically disturbing but they do not require imperatively medical treatment. However, also psychosocial well-being may be affected

possibly leading to restrictions in mental health.[35, 37] Thus in the elderly and especially in aged nursing home residents we do have different challenges: realization of regular dermatological examinations, detecting clinically relevant dermatoses obligatory to be treated, benign skin conditions for facultative treatment and aesthetically disturbing skin conditions with direct implications for physical and psychological well-being. Handling and management of the two latter situations needs further analysis and discussion.

Some of the conditions identified in our study, like PUs, neoplasm, stasis dermatitis, venous insufficiency or superficial wounds require immediate medical attention. These diseases are frequently observed in this elderly population and may lead to several complications (e.g. basal cell carcinoma, ulcus cruris, osteomyelitis) if not treated appropriately. It is important that healthcare practitioners are trained to screen for the most important and significant dermatological conditions in order to path the way for correct and adequate management.

In our study we also identified conditions which may be considered borderline, and may be of lower or no importance but others may be simple and frequent conditions with severe consequences if not treated adequately. For instance, tinea pedis is frequent, with frequent relapses and often takes a chronic course. If tinea pedis is not treated properly, it bears the risk to spread to tinea corporis or to lead to onychomycosis and subsequent complications.[38] The dermatophytes disturb the natural defence of the skin barrier, whereby bacteria and viruses can penetrate into deeper skin layers more easily. The risk of developing lower extremities cellulitis[39] is increased. Another example of borderline conditions is actinic keratosis, which is a carcinoma in situ with the risk of progressing to squamous cell carcinoma.[40] The distinction between actinic keratosis and squamous cell carcinoma can be challenging[40], but actinic keratosis may progress to a malignant disease.[41]

Interestingly, only few associations between skin diseases and demographic characteristics have been detected. Overall, the presence of skin diseases seems not to be

associated with care dependency (Barthel-Index) and the duration of residency. This indicates that residents are already affected by the skin disease when being admitted. Apparently they do not develop these conditions *de novo* in the institutions, but may only develop them as a consequence to lifetime exposure to well known risk factors such as UV exposure increasing the risk of skin cancer.[42] Furthermore, work in metal industry or exposures to wet trades, for example hairdressers or medical professions can play a role in the development of hand eczema[43, 44] or contact dermatitis.[45, 46] The reason why higher education is associated with less dry skin is unclear. The educational level may be also considered as predictor for this condition which was not described before.

The association of male gender and androgenetic alopecia and actinic keratosis may be explained by genetic and biological processes. Men have a greater incidence of pattern baldness, with reduced natural UV protection on the scalp. Also increased manifestation of tinea pedis in the male gender may possibly be explained to increased hyperhidrosis, lower awareness for skin care (e.g. regularly drying between toes, regularly checking feet, inappropriate hygiene habits).[47]

During the last decades many studies were published reporting the high occurrence of dermatological disorders and the necessity to pay increasing attention to specialized dermatological care in the elderly population. However, is more specialized medical (dermatological) care feasible in this setting and also is this from the economic standpoint possible to realize? A discussion of prioritization in this vulnerable population is missing so far. Although there is an obvious need of dermatological care in institutional long-term care, it is unlikely that board certified dermatologists will solve this problem.[48] Telemedicine applications and better medical training of healthcare providers in the nursing homes were assumed as adequate suitable solution strategies.[48, 49] Frequent examinations by a dermatologists, as proposed by others,[29, 50] are unlikely to be affordable and manageable in this setting. Caregivers might be the key and do have a gatekeeper function. They need to

have skills to decide whether to observe, to identify residents needing medical or basic care or to decide when to refer to a specialist. They need to have an evidence based algorithm for skin care and diagnostic skills to distinguish whether the skin condition is a cosmetic issue, whether it is crucial for skin care, whether it is a borderline disease needing observation or special attention and if it needs urgent medical attention. Therefore we strongly recommend an algorithm which clarifies the 'who?', 'what?' and 'when' regarding skin care interventions and treatment for nursing and clinical decision making.

Generalisability

Using a population-based approach, n = 223 aged nursing home residents were included. Demographic data like age, gender and care dependency are well comparable with the general German nursing home population statistics (e.g. females 67.7% vs. 72.7%; care-level I: 38.6% vs. 39%; care-level II: 40.8% vs. 40.5%; care-level III 18.4% vs. 21%)[20] which supports the generalisability of the study results.

CONTRIBUTORSHIP STATEMENT

I, the corresponding author, confirm that I have listed all Coauthors contributed significantly to the work.

Author Contribution

1. Elisabeth Hahnel: research associate and coordinator of the conducted study, substantial contributions to conception and design and acquisition, analysis and interpretation of data, preparation of manuscript
2. Ulrike Blume-Peytavi: substantial contributions to conception and design, dermatological examinations, preparation and review of the manuscript
3. Carina Trojahn: research associate and coordinator of the conducted study, substantial contributions to conception and design, preparation and review of the manuscript
4. Gábor Dobos: dermatological examinations, medical and scientific advice, review of the manuscript
5. Irina Jahnke: dermatological examinations, medical advice, review of the manuscript
6. Vera Kanti: dermatological examinations, medical and scientific advice, review of the manuscript
7. Claudia Richter: review of the manuscript
8. Andrea Lichterfeld-Kottner: review of the manuscript
9. Natalie Garcia Bartels: dermatological examinations, review of the manuscript
10. Jan Kottner: substantial contributions to conception and design, analysis and interpretation of data, preparation and review of the manuscript

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FIGURE

TABLES

INFORMATION

Supplementary Table S1: Prevalence of skin conditions

Supplementary Table S2: Logistic regression, dependent variable: Tinea pedis (B35.3)

Supplementary Table S1: Logistic regression, dependent variable: Venous insufficiency (I87.2)

Figure 1: Flow Chart of Participants

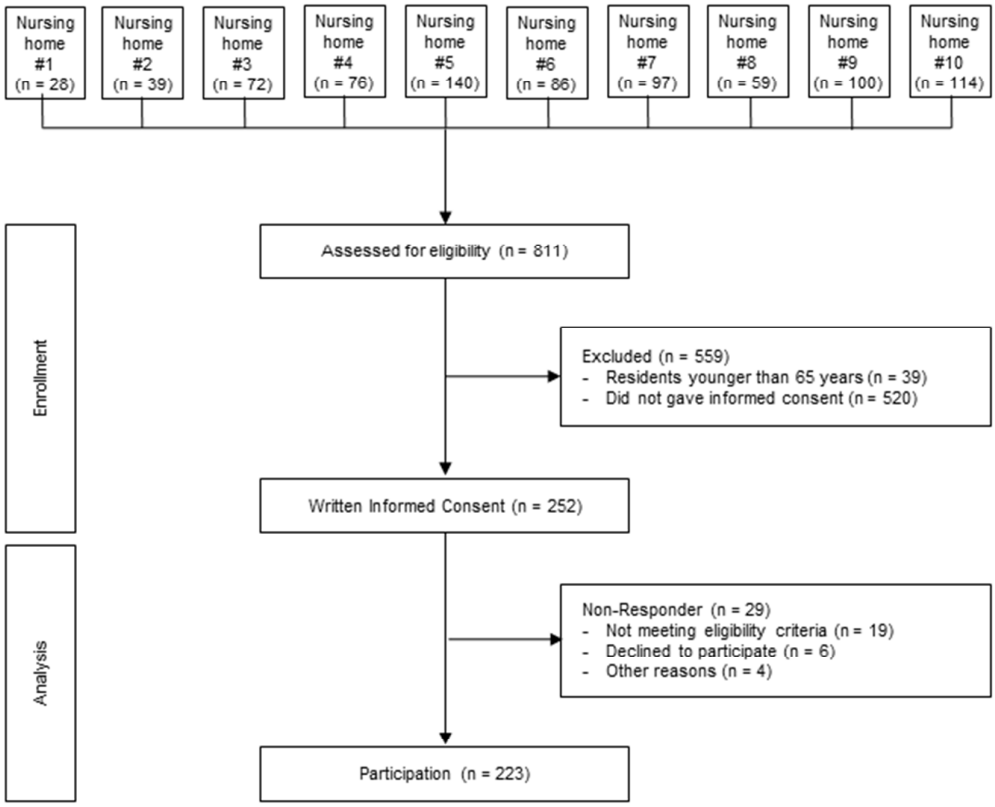

Table 1: Demographic characteristics of participants (n = 223)

Female, n (%)	151 (67.7)
Age [years]	
Mean (SD)	83.6 (8.0)
Median (IQR)	84 (78-89)
Barthel-Index Total Score[a]	
Mean (SD)	45.1 (23.8)
Median (IQR)	45.0 (25.0-65.0)
Braden score[a]	
Mean (SD)	17.3 (3.7)
Median (IQR)	18.0 (14.0-21.0)
BMI [kg/m²][b]	
Mean (SD)	25.3 (5.1)
Median (IQR)	24.6 (21.9-28.3)
Duration of residency [months]	
Mean (SD)	42.6 (49.1)
Median (IQR)	27.0 (14.0-52.0)
Highest educational qualification, n (%)	
No school qualification	3/184 (1.6)
Primary school	34/184 (18.5)
Secondary school	24/184 (10.8)
Grammar school/A-level	7/184 (3.8)
Vocational training	90/184 (48.9)
University	26/184 (14.1)
Number of medications per resident[c]	
Mean (SD)	6.84 (3.41)
Median (IQR)	6.0 (4.0 – 9.0)
Polypharmacy (≥ 4 medications), n (%)	186/221 (84.2)
Common concomitant diseases, ICD 10 system level 1, n (%)	
Diseases of the circulatory system (I.00 – I.99)	184/223 (82.5)
Mental and behavioural Disorders (F.00 – F.99)	157/223 (70.4)
Endocrine, nutritional and metabolic diseases (E.00 – E.99)	122/223 (54.7)
Diseases of the genitourinary system (N.00 – N.99)	106/223 (47.5)
Diseases of the nervous system (G.00 – G.99)	99/223 (44.4)
Diseases of the musculoskeletal system and connective tissue (M.00 – M.99)	96/223 (43.0)

SD: standard deviation; IQR: interquartile range; $n^a = 222$; $n^b = 216$; $n^c = 221$

Table 2: Associations between skin diseases and demographic characteristics (bivariate)

Skin diseases (ICD-10)	Age (OR, 95% CI)	Gender (OR, 95% CI) (0 = male, 1 = female)	Barthel-Index (OR, 95% CI)	University qualification (OR, 95% CI) (0 = no, 1 =yes)	Duration of residency (OR, 95% CI)	Number of medications used (OR, 95% CI)
Xerosis cutis (L85.3) ODS >0	-	-	-	-	-	-
Xerosis cutis (L85.3) ODS >1	1.037 (0.991 to 1.084)	1.166 (0.555 to 2.449)	1.001 (0.986 to 1.016)	0.462* (0.175 to 1.223)	0.998 (0.991 to 1.005)	1.012 (0.911 to 1.123)
Xerosis cutis (L85.3) ODS >2	1.027 (0.993 to 1.063)	1.039 (0.583 to 1.855)	1.008 (0.996 to 1.020)	0.636 (0.261 to 1.550)	0.998 (0.992 to 1.004)	0.934 (0.860 to 1.015)
Xerosis cutis (L85.3) ODS >3	1.022 (0.969 to 1.078)	1.178 (0.465 to 2.982)	1.005 (0.987 to 1.023)	0.610 (0.133 to 2.788)	0.988 (0.974 to 1.003)	0.971 (0.854 to 1.103)
Tinea unguium (B35.1)	1.022 (0.988 to 1.057)	0.829 (0.462 to 1.489)	0.998 (0.987 to 1.010)	1.253 (0.526 to 2.985)	**0.992*** (0.987 to 0.998)	0.969 (0.895 to 1.049)
Seborrheic keratosis (L82)	**1.041*** (1.007 to 1.077)	0.896 (0.507 to 1.580)	1.002 (0.991 to 1.014)	1.542 (0.648 to 3.667)	0.997 (0.991 to 1.002)	1.076 (0.992 to 1.166)
Androgenetic alopecia (L64.9)	0.984 (0.952 to 1.017)	**0.187*** (0.099 to 0.354)	0.999 (0.988 to 1.010)	1.028 (0.447 to 2.362)	0.998 (0.993 to 1.004)	1.026 (0.949 to 1.109)
Incontinence associated dermatitis	1.003 (0.969 to 1.037)	0.801 (0.448 to 1.434)	0.998 (0.986 to 1.009)	1.873 (0.812 to 4.319)	0.996 (0.989 to 1.002)	0.991 (0.914 to 1.074)
Tinea pedis (B35.3)	0.989 (0.955 to 1.024)	**0.435*** (0.241 to 0.786)	**1.013*** (1.001 to 1.025)	1.569 (0.663 to 3.717)	**0.987*** (0.978 to 0.996)	0.997 (0.917 to 1.083)
Other pigmentation disorders (L81.-)	1.028 (0.989 to 1.068)	1.305 (0.673 to 2.527)	1.006 (0.993 to 1.019)	0.856 (0.322 to 2.279)	0.996 (0.989 to 1.003)	0.998 (0.913 to 1.091)
Venous insufficiency (I87.2)	1.007 (0.968 to 1.047)	0.807 (0.417 to 1.562)	**1.019*** (1.005 to 1.034)	0.837 (0.294 to 2.379)	0.998 (0.992 to 1.005)	**1.108*** (1.011 to 1.214)
Actinic keratosis (L57.0)	1.029 (0.988 to 1.071)	**0.321*** (0.165 to 0.622)	1.004 (0.991 to 1.018)	1.017 (0.380 to 2.723)	0.993 (0.984 to 1.001)	1.034 (0.942 to 1.134)
Scar and fibrosis (L90.5)	1.022 (0.978 to 1.067)	1.262 (0.589 to 2.705)	0.993 (0.979 to 1.008)	0.882 (0.281 to 2.767)	0.997 (0.989 to 1.005)	**1.103*** (1.00 to 1.217)
Seborrheic dermatitis (L21.-)	**0.951*** (0.909 to 0.996)	0.992 (0.467 to 2.108)	0.993 (0.978 to 1.008)	0.809 (0.259 to 2.526)	0.996 (0.987 to 1.004)	0.991 (0.893 to 1.100)
Intertrigo (B37.2)	**1.052*** (1.004 to 1.102)	1.290 (0.585 to 2.842)	1.002 (0.987 to 1.017)	0.766 (0.212 to 2.758)	1.001 (0.994 to 1.008)	1.099 (0.994 to 1.216)
Haemangioma (D18.0)	0.997 (0.932 to 1.024)	1.057 (0.472 to 2.369)	1.008 (0.992 to 1.024)	1.067 (0.337 to 3.382)	0.998 (0.990 to 1.006)	1.091 (0.982 to 1.212)
Melanocytic naevi (D22.9)	0.955 (0.908 to 1.004)	0.634 (0.285 to 1.411)	1.008 (0.992 to 1.025)	1.255 (0.392 to 4.018)	0.994 (0.984 to 1.005)	1.080 (0.968 to 1.205)
Haemorrhage (R23.3)	1.031 (0.981 to 1.083)	0.538 (0.243 to 1.189)	1.003 (0.987 to 1.020)	1.553 (0.529 to 4.565)	1.001 (0.993 to 1.009)	0.985 (0.877 to 1.106)
Rosacea (L71.9)	0.974 (0.927 to 1.024)	0.704 (0.311 to 1.592)	1.004 (0.987 to 1.021)	1.255 (0.392 to 4.018)	0.996 (0.986 to 1.006)	0.987 (0.878 to 1.111)
Pressure ulcer (L89.-, all categories)	1.034 (0.974 to 1.097)	1.369 (0.473 to 3.961)	0.986 (0.966 to 1.007)	0.857 (0.183 to 4.012)	1.006 (0.998 to 1.013)	1.049 (0.918 to 1.198)
Neoplasm (C44.9)	**1.065*** (0.999 to 1.134)	1.737 (.0551 to 5.479)	1.001 (0.981 to 1.022)	1.587 (0.416 to 6.057)	1.002 (0.993 to 1.011)	0.957 (0.825 to 1.109)

OR: odds ratio; CI: confidence interval; ODS: Overall dry skin score, ICD 10: international coding of diseases classification

***Bold type** indicates statistical significance, underlined text indicate OR ≥2.0; OR ≤ 0.5

OTHER INFORMATION

This study was approved by the ethics committee of the Charité-Universitätsmedizin Berlin (EA1/190/14).

Registration

This study is registered at https://clinicaltrials.gov/ct2/show/NCT02216526.

Protocol

A Protocol was previously published in the International Journal of Nursing Studies 52 (2015), pp. 598-604 DOI information: 10.1016/j.ijnurstu.2014.11.007.

Funding

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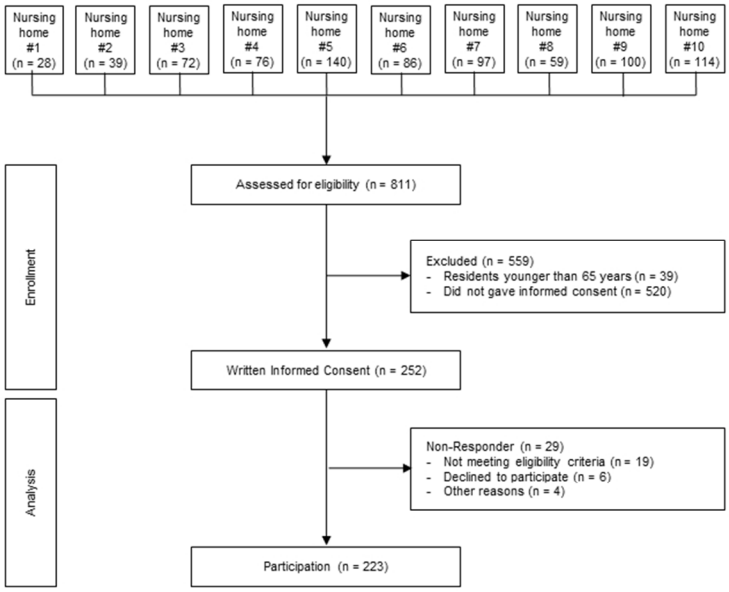

Flow-Chart

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Supplementary Table S1: Prevalence of skin conditions

Skin conditions and diseases (ICD-10)	Prevalence (%, 95% CI)
Xerosis cutis (L85.3) ODS >0	221/223 (99.1%, 97.7% - 100.0%)
Xerosis cutis (L85.3) ODS >1	186/223 (83.4%, 78.0% - 88.2%)
Xerosis cutis (L85.3) ODS >2	85/223 (38.1%, 31.7% - 44.5%)
Xerosis cutis (L85.3) ODS >3	24/223 (10.8%, 6.7% - 14.8%)
Tinea unguium (B35.1)	139/223 (62.3%, 56.0% - 69.1%)
Seborrheic keratosis (L82)	126/223 (56.5%, 50.2% - 63.0%)
Androgenetic alopecia (L64.9)	112/223 (50.2%, 43.8% - 57.5%)
Incontinence associated dermatitis	79/223 (35.4%, 29.9% - 42.2%)
Tinea pedis (B35.3)	71/223 (31.8%, 25.8% - 38.1%)
Other pigmentation disorders (L81.-)	57/223 (25.6%, 20.4% - 31.5%)
Venous insufficiency (I87.2)	50/223 (22.4%, 17.0% - 27.6%)
Actinic keratosis (L57.0)	47/223 (21.1%, 16.2% - 26.5%)
Scar and fibrosis (L90.5)	39/223 (17.5%, 12.5% - 22.7%)
Seborrheic dermatitis (L21.-)	37/223 (16.6%, 11.8% - 21.6%)
Intertrigo (B37.2)	36/223 (16.1%, 11.6% - 21.2%)
Haemangioma (D18.0)	32/223 (14.3%, 9.9% - 19.1%)
Melanocytic naevi (D22.9)	29/223 (13.0%, 8.5% - 17.3%)
Haemorrhage (R23.3)	29/223 (13.0%, 8.9% - 17.5%)
Rosacea (L71.9)	28/223 (12.6%, 8.5% - 17.0%)
Pressure ulcer (L89.-, all categories)	20/223 (9.0%, 5.0% - 13.0%)
Neoplasm (C44.9)	18/223 (8.1%, 4.5% - 12.2%)
Pruritus (L29.9)	17/223 (7.6%, 4.1% - 11.1%)
Skin tags	14/223 (6.3%, 3.1% - 9.8%)
Stasis dermatitis (I83.1)	14/223 (6.3%, 3.2% - 9.9%)
Skin tears	14/223 (6.3%, 3.2% - 9.5%)
Superficial injury open wounds (S00 to S99)	13/223 (5.8%, 2.7% - 9.3%)
Follicular cysts (L72.9)	11/223 (4.9%, 2.2% - 7.7%)
Corn and callosites (L84)	9/223 (4.0%, 1.8% - 6.8%)
Irritant contact dermatitis (L24.9)	8/223 (3.6%, 1.3% - 6.3%)
Folliculitis (L73.9)	8/223 (3.6%, 1.4% - 6.3%)
Contact dermatitis (L25.9)	7/223 (3.1%, 0.9% - 5.8%)
Candidiasis (B37.9)	6/223 (2.7%, 0.9% - 4.9%)
Cheilitis angularis (K13.0)	6/223 (2.7%, 0.9% - 5.0%)
Hypertrichosis (L68.9)	5/223 (2.2%, 0.4% - 4.5%)
Erythrasma (L08.1)	5/223 (2.2%, 0.4% - 4.1%)
Bowen disease (D04.9)	5/223 (2.2%, 0.5% - 4.4%)
Psoriasis (L40.8)	4/223 (1.8%, 0.4% - 3.6%)
Fibroma (D21.9)	4/223 (1.8%, 0.4% - 4.0%)
Cicatricial alopecia (L66)	3/223 (1.3%, 0.0% - 3.1%)
Allergic contact dermatitis (L23.9)	2/223 (0.9%, 0.0% - 2.3%)
Alopecia areata (L63.-)	2/223 (0.9%, 0.0% - 2.3%)
Ectropium (H02.1)	2/223 (0.9%, 0.0% - 2.3%)
Cornu cutaneum (L85.8)	2/223 (0.9%, 0.0% - 2.3%)
Hyperhidrosis (R61.9)	2/223 (0.9%, 0.0% - 2.2%)
Cellulitis (L03.9)	1/223 (0.4%, 0.0% - 1.4%)
Atopic dermatitis (L20.9)	1/223 (0.4%, 0.0% - 1.4%)
Lichen simplex chronicus and prurigo (L28.-)	1/223 (0.4%, 0.0% - 1.4%)
Vitiligo (L80)	1/223 (0.4%, 0.0% - 1.4%)
Atrophic disorders (L90.9)	1/223 (0.4%, 0.0% - 1.4%)
Granulomatous disorders (L92.9)	1/223 (0.4%, 0.0% - 1.4%)
Tinea corporis (B35.4)	1/223 (0.4%, 0.0% - 1.4%)
Varicosis (I83.9)	1/223 (0.4%, 0.0% - 1.4%)
Verruca (B07)	1/223 (0.4%, 0.0% - 1.4%)
Aphta, mucosal (K12.0)	1/223 (0.4%, 0.0% - 1.4%)
Comedo (L70.0)	1/223 (0.4%, 0.0% - 1.4%)

Ichthyosis (L85.0)	1/223 (0.4%, 0.0% - 1.4%)
Ulcus cruris (L97)	1/223 (0.4%, 0.0% - 1.4%)
Dermatitis nummularis (L30.0)	1/223 (0.4%, 0.0% - 1.4%)
Ecthyma (L08.0)	1/223 (0.4%, 0.0% - 1.4%)
Pityriasis versicolor (B36.0)	1/223 (0.4%, 0.0% - 1.4%)
Lentigo maligna (D03.9)	1/223 (0.4%, 0.0% - 1.4%)
Eczema craquelé (L30.8)	1/223 (0.4%, 0.0% - 1.4%)
Abrasion (T14.01)	1/223 (0.4%, 0.0% - 1.4%)
Oral apthosis (K12.0)	1/223 (0.4%, 0.0% - 1.4%)
Diabetic foot syndrome (E13.74)	1/223 (0.4%, 0.0% - 1.4%)

CI: confidence interval; ICD: international code of diseases

Supplementary Table S2: Logistic regression, dependent variable: Tinea pedis (B35.3)

Independent variable	Standardized Beta coefficient	Standard error	Wald statistic	OR (95% CI)	P value	VIF	Nagelkerke R^2
Gender (0 = male, 1 = female)	-0.672	0.312	4.644	0.511 (0.277 to 0.941)	0.031	1.0	0.116
Barthel-Index	0.012	0.007	3.254	1.012 (0.999 to 1.025)	0.062	1.0	
Duration of residency	-0.011	0.004	5.904	0.989 (0.980 to 0.998)	0.015	1.0	
Constant	0.206	0.626	0.108	1.228	0.742	-	

VIF: Variance inflation factor

Supplementary Table S1: Logistic regression, dependent variable: Venous insufficiency (I87.2)

Independent variable	Standardized Beta coefficient	Standard error	Wald statistic	OR (95% CI)	P value	VIF	Nagelkerke R^2
Barthel-Index	0.019	0.007	6.586	1.019 (1.004 to 1.033)	0.010	1.0	0.078
Number of medications used	0.105	0.048	4.718	1.110 (1.010 to 1.220)	0.030	1.0	
Constant	-2.888	0.554	27.169	0.056	<0.001	-	

VIF: Variance inflation factor

Title of the manuscript: The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study.

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**1**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**3**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**4**
Objectives	3	State specific objectives, including any prespecified hypotheses	**5**
Methods			
Study design	4	Present key elements of study design early in the paper	**6**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**6**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	**6**
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**6-7**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**7**
Bias	9	Describe any efforts to address potential sources of bias	**7**
Study size	10	Explain how the study size was arrived at	**7-8**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**8**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**8**
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**9**
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**9**
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	-

Title of the manuscript: The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study.

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	**10-11**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	**12**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**12**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**13-16**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**16**
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**25**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study.

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Primary Subject Heading:	Dermatology
Secondary Subject Heading:	Epidemiology, Dermatology, Nursing
Keywords:	Prevalence, DERMATOLOGY, nursing homes, skin diseases, elderly

The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study

Running Head: Skin health in nursing home residents

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Abstract

Objectives: The aim of this study was to measure the prevalence of skin diseases in aged nursing home residents and to explore possible associations with demographic and medical characteristics.

Design: Descriptive multicentre prevalence study.

Setting and Participants: The study was conducted in a random sample of ten institutional long-term care facilities in the federal state of Berlin, Germany. In total, n = 223 residents were included.

Results: In total 60 dermatological diseases were diagnosed. The most frequently diagnosed skin disease was xerosis cutis (99.1%, 95% CI 97.7% - 100.0%) followed by tinea ungium (62.3%, 95% CI 56.0% - 69.1%) and seborrheic keratosis (56.5%, 95% CI 50.2% - 63.0%). Only few bivariate associations have been detected between skin diseases and demographic and medical characteristics.

Conclusion: Study results indicate, that almost every resident living in residential care has at least one dermatological diagnosis. Dermatological findings range from highly prevalent xerosis and cutaneous infection up to skin cancer. Not all conditions require immediate dermatological treatment and can be managed by targeted skin care interventions. Caregivers need knowledge and diagnostic skills to make appropriate clinical decisions. It is unlikely that specialized dermatological care will be delivered widely in the growing long-term care sector.

Registration: This study is registered at https://clinicaltrials.gov/ct2/show/NCT02216526.

Key words: prevalence, dermatology, nursing homes, skin diseases, elderly

Article summary

Strengths and limitations of this study:

- This was the largest randomly selected sample of long-term care residents aged 65 years or older undergoing a head-to-toe skin examination by board certified dermatologists.
- Skin diseases, medications and concomitant diseases were classified according to international definitions and functional assessments were conducted according to established methods to support the generalisability of results.
- Although three additional institutional long-term care facilities were included, the anticipated sample size of n = 280 was not achieved.
- There were differences between participating and non-participating long-term care institutions.
- Systemic diseases were not specified and laboratory and histology data were not available

Conflict of interest

I confirm, that the authors have no conflict of interest regarding financial conflicts, personal conflicts or potential conflict. All Authors address each of the specific categories of financial and personal conflicts in a full disclosure.

INTRODUCTION

Background

Skin ageing, functional limitations, chronic diseases, polypharmacy, personal skin care and hygiene habits in populations aged 65 years or older cause an increased vulnerability to skin diseases and cutaneous problems.[1-3] Epidemiological studies suggest that skin diseases are highly prevalent in the elderly population.[4-6] For example, the prevalence of xerosis cutis range up to 85.5%, benign skin tumours up to 74.5%, fungal infections up to 77% and pressure ulcer (PU) up to 46%.[7, 8] However, most published epidemiologic figures were obtained in hospital settings. The epidemiology of cutaneous diseases in institutional long-term care settings is largely unknown,[7] although the number of multimorbid residents living in institutional long-term care is increasing.[9]

In addition to the high prevalence, the burden of skin diseases also increases with age.[6] They are associated with reduced quality of life.[10] It was shown that geriatric patients with dermatological diseases have an increased risk for mental and behavioural disorders, primarily depression.[11] The medical treatment of the mulitmorbidities in nursing home residents may also result in polypharmacy.[12] Associated adverse drug reactions, nonadherence or drug-drug interactions are common[13, 14] and linked to dermatological disorders. Immobility, cognitive impairment and organizational or reimbursement factors may also limit the opportunity for these population to receive specialized dermatological care. Traditionally, nurses and other health care professionals focus on PUs and incontinence-associated dermatitis (IAD) but may ignore other skin problems which may also require attention. On the other hand, not all dermatological conditions require specialized pharmaceutical treatment.

According to the latest statistics there are 800.000 residents living in 13.600 long-term care institutions in Germany[15] and these figures are expected to increase. At the same time the prevalence of skin diseases in this care setting is largely unknown. In order to gain a detailed

picture about the epidemiology of skin diseases in institutional long-term care this study was conducted.

Objectives

The aim of this study was to measure the prevalence of skin conditions and diseases in aged residents living in institutional long-term care facilities and to explore possible associations with demographic and medical characteristics.

MATERIALS AND METHODS

Study design

This was an observational, cross-sectional prevalence study and it was approved by the ethics committee of the Charité-Universitätsmedizin Berlin (EA1/190/14). The study protocol was published previously.[16]

Setting

The study was conducted from September 2014 to May 2015 in ten institutional long-term care facilities in Berlin, Germany. In Germany, institutional long-term care facilities or residential care facilities are full-time accommodations with professional care. The staff is a mix between registered nurses and nursing assistants. Using computer generated random numbers, institutional long-term care facilities from a list of all existing facilities (n = 291) in the federal state of Berlin, Germany were contacted. In case of non-response the next randomly selected nursing home was invited.

Participants

The inclusion criteria were (1) being resident of the respective residential care facility, (2) aged ≥ 65 years, and (3) written informed consent given personally or by legal representative. Only residents being able to give informed consent by themselves or having a legal representative who decided on behalf of the resident took part in this study. The exclusion criteria was residents at the end of life to avoid unnecessary burden due to the examinations. All residents (or their legal representatives) living in the residential care facility at time of data collection were invited to participate.

Variables

Skin diseases were classified according to the international coding of diseases (ICD 10) classification, with the exception of IAD and skin tears. IAD was diagnosed according to the IAD-IT classification of Junkin 2008.[17] According to an international consensus skin tears are caused by shear, friction and/or blunt force causing the separation of the layers of the skin (partial or full thickness wound) most common on the extremities.[18] Skin tears were recorded as present/absent. Xerosis cutis was measured using the Overall Dry Skin score (ODS) with a five-point scale ranging from '0' (no skin dryness) to '4' (advanced skin roughness, large scales, inflammation and cracks).[19, 20] Concomitant diseases (ICD 10 classification level 1) and medications were extracted from the medical records. These contain documentation of anamnesis, diagnoses, examination results, therapies and results, interventions, consents and medical letters. Demographic variables of the nursing home residents (e.g. age, sex) were collected. The physical function related to the daily activities was assessed using the Barthel – Index. The scores range from 0 (very care dependent) to 100 (not care dependent).[21] The Braden scale was used to measure PU risk. Scores range from 6 (high PU risk) to 23 (no PU risk).[22] The educational qualification was classified into the following six categories: 'no school qualification', 'primary school', 'secondary school', 'grammar school/ A-level', 'vocational training' and 'university qualification'.

Data sources and measurement

All participating nursing home residents underwent a head-to-toe skin examination conducted by a board certified dermatologist (UBP, NGB, IJ). Examinations were done by clinical evaluation and using dermatoscopes (Dermogenius basic, DermoScan GmbH, Germany). Demographic characteristics (e.g. age, sex) and information regarding school qualification were extracted from the medical records by trained study assistants or the residents were

interviewed, if possible. PU risk and care dependency (Braden scale and Barthel-Index) were extracted from the medical records or assessed by a registered nurse. All study data was continuously documented in data collection forms by the investigator and authorized staff.

Bias

Institutional long-term care facilities in the state of Berlin differ in terms of ownership, size, and specialization. In order to reduce selection bias institutions were randomly selected from all facilities of the state of Berlin. All study related procedures and measurements were conducted by trained dermatologists and study assistants according to standard operating procedures. The board certified dermatologists had no access to medical history data of the residents prior and during examinations to reduce the risk of detection bias.

Study size

Assuming a prevalence of 0.5 of skin diseases, approximately 280 residents would have been needed to measure this proportion with a desired width of a 95% confidence interval of ± 0.06. According to the latest Nursing Care Statistics (2013), the size of the long-term care population in Berlin was approximately 30.000.[23] Assuming 80 residents per institution and a participation rate of 50% (n = 40) it was planned to include seven institutions which results in n = 280 (7 x n = 40) cases.

Quantitative variables

The duration of residency was measured in months. The Barthel-Index and Braden scale scores were used as metric variables. In order to investigate possible associations with skin diseases the variable ‘educational qualification’ was dichotomized into ‘university

qualification' (yes/no). Residents taking four or more medications were regarded as having 'polypharmacy'.[12]

Statistical methods

Depending on the level of measurement (nominal, ordinal, continuous) demographic characteristics, functional assessment scores and dermatological diseases were described using means, medians, proportions, frequencies and associated spread estimates, standard deviations, ranges and interquartile ranges. The 95% confidence intervals were calculated around point estimates of dermatological diseases. Exploratory data analysis to investigate possible bivariate associations were conducted using logistic regression analysis for all skin diseases with a prevalence of at least 8%. 95% confidence intervals of the odds ratios excluding 1 were considered to be statistically significant. Odds ratios being statistically significant or with values lower than 0.5 or higher than 2.0 were considered to be likely associated. In case of multiple bivariate associations multivariable logistic regression analyses were conducted. Models were built iteratively to increase model fit indicated by Nagelkerke's R^2.

RESULTS

Participants

Fifty-five long-term care facilities were contacted. Finally, ten long-term care facilities agreed to participate. Compared to participating institutions, non-participating institutions were larger in terms of number of beds (mean beds per institution: 104.5 vs. 73.7) privately owned (76% vs. 60%) and non-profit (30% vs. 22%).

All residents of the eligible long-term care facilities were invited, but participation rate was lower than 50%. In order to achieve the planned number, three additional long-term care facilities were recruited (in total ten). In total, n = 811 long-term care residents were assessed for eligibility, n = 58 residents (23%) provided written informed consent by themselves and for n = 194 residents (77%) the legal representative gave consent for participation. In total n = 29 residents declined participation prior examination resulting in n = 223 included long-term care residents (Fig. 1).

> Fig. 1<

Descriptive data

Sample characteristics are shown in table 1. Most residents were female (67.7 %) and the mean age was 83.6 (SD 8.0) years. Mean Barthel – Index score was 45.1 (SD 23.8) and mean Braden scale score was 17.3 (SD 3.7). The median time of long-term care residence until data collection was 27 months. A vocational training was the highest educational level for the majority (48.9 %). The most common concomitant diseases (ICD 10 system level 1) were diseases of the circulatory system (82.5 %) and mental and behavioural disorders (70.4 %). In total 84.6% of the residents received four or more medications (polypharmacy). The mean number of medications used was 6.8 (SD 3.4) per resident.

Table 1: Demographic characteristics of participants (n = 223)

Female, n (%)	151 (67.7)
Age [years]	
Mean (SD)	83.6 (8.0)
Median (IQR)	84 (78-89)
Barthel-Index Total Score[a]	
Mean (SD)	45.1 (23.8)
Median (IQR)	45.0 (25.0-65.0)
Braden score[a]	
Mean (SD)	17.3 (3.7)
Median (IQR)	18.0 (14.0-21.0)
BMI [kg/m²][b]	
Mean (SD)	25.3 (5.1)
Median (IQR)	24.6 (21.9-28.3)
Duration of residency [months]	
Mean (SD)	42.6 (49.1)
Median (IQR)	27.0 (14.0-52.0)
Highest educational qualification, n (%)	
No school qualification	3/184 (1.6)
Primary school	34/184 (18.5)
Secondary school	24/184 (10.8)
Grammar school/A-level	7/184 (3.8)
Vocational training	90/184 (48.9)
University	26/184 (14.1)
Number of medications per resident[c]	
Mean (SD)	6.84 (3.41)
Median (IQR)	6.0 (4.0 – 9.0)
Polypharmacy (≥ 4 medications), n (%)	186/221 (84.2)
Common concomitant diseases, ICD 10 system level 1, n (%)	
Diseases of the circulatory system (I.00 – I.99)	184/223 (82.5)
Mental and behavioural Disorders (F.00 – F.99)	157/223 (70.4)
Endocrine, nutritional and metabolic diseases (E.00 – E.99)	122/223 (54.7)
Diseases of the genitourinary system (N.00 – N.99)	106/223 (47.5)
Diseases of the nervous system (G.00 – G.99)	99/223 (44.4)
Diseases of the musculoskeletal system and connective tissue (M.00 – M.99)	96/223 (43.0)

SD: standard deviation; IQR: interquartile range; $n^a = 222$; $n^b = 216$; $n^c = 221$

Main results

In total 60 dermatological diseases were diagnosed. The complete list of dermatological findings is shown in the online supplementary table S1. Xerosis cutis was most frequent (99.1%, 95% CI 97.7% to 100.0%) followed by tinea ungium (62.3%, 95% CI 56.0% to 69.1%), and seborrheic keratosis (56.5%, 95% CI 50.2% to 63.0%). Thirty-two dermatological diseases were diagnosed for five residents or fewer (e.g. Bowen´s disease, 5/223, allergic contact dermatitis, 2/223, atopic dermatitis 1/223).

The results of the bivariate associations are shown in table 2. Higher age was associated with the increased prevalence of seborrheic keratosis (OR = 1.041, 95% CI 1.007 to 1.077) and intertrigo (OR = 1.052, 95% 1.004 to 1.102). On the other hand, the occurrence of seborrheic dermatitis decreased with increasing age (OR = 0.951, 95% CI 0.909 to 0.996). Female sex showed a decreased occurrence of androgenetic alopecia (OR 0.187, 95% CI 0.099 to 0.354), tinea pedis (OR = 0.435, 95% CI 0.241 to 0.786) and actinic keratosis (OR = 0.321, 95% CI 0.165 to 0.622). There were statistically significant associations between the Barthel - Index and tinea pedis (OR = 1.013, 95% CI 1.001 to 1.025) as well as venous insufficiency (OR = 1.019, 95% CI 1.005 to 1.034); and between the duration of residency and tinea ungium (OR = 0.992, 95% CI 0.987 to 0.998) as well as tinea pedis (OR = 0.987, 95% CI 0.978 to 0.996), but the strength of association were small. Having a university qualification was associated with less occurrence of xerosis cutis (OR = 0.462, 95% CI 0.175 to 1.223). The number of medications used was associated with the occurrence of venous insufficiency (OR = 1.108, 95% CI 1.011 to 1.214) and scar and fibrosis (OR 1.103, 95% CI 1.000 to 1.217).

Table 2: Associations between skin diseases and demographic characteristics (bivariate)

Skin diseases (ICD-10)	Age (OR, 95% CI)	Gender (OR, 95% CI) (0 = male, 1 = female)	Barthel-Index (OR, 95% CI)	University qualification (OR, 95% CI) (0 = no, 1 =yes)	Duration of residency (OR, 95% CI)	Number of medications used (OR, 95% CI)
Xerosis cutis (L85.3) ODS >0	-	-	-	-	-	-
Xerosis cutis (L85.3) ODS >1	1.037 (0.991 to 1.084)	1.166 (0.555 to 2.449)	1.001 (0.986 to 1.016)	0.462* (0.175 to 1.223)	0.998 (0.991 to 1.005)	1.012 (0.911 to 1.123)
Xerosis cutis (L85.3) ODS >2	1.027 (0.993 to 1.063)	1.039 (0.583 to 1.855)	1.008 (0.996 to 1.020)	0.636 (0.261 to 1.550)	0.998 (0.992 to 1.004)	0.934 (0.860 to 1.015)
Xerosis cutis (L85.3) ODS >3	1.022 (0.969 to 1.078)	1.178 (0.465 to 2.982)	1.005 (0.987 to 1.023)	0.610 (0.133 to 2.788)	0.988 (0.974 to 1.003)	0.971 (0.854 to 1.103)
Tinea unguium (B35.1)	1.022 (0.988 to 1.057)	0.829 (0.462 to 1.489)	0.998 (0.987 to 1.010)	1.253 (0.526 to 2.985)	**0.992*** (0.987 to 0.998)	0.969 (0.895 to 1.049)
Seborrheic keratosis (L82)	**1.041*** (1.007 to 1.077)	0.896 (0.507 to 1.580)	1.002 (0.991 to 1.014)	1.542 (0.648 to 3.667)	0.997 (0.991 to 1.002)	1.076 (0.992 to 1.166)
Androgenetic alopecia (L64.9)	0.984 (0.952 to 1.017)	**0.187*** (0.099 to 0.354)	0.999 (0.988 to 1.010)	1.028 (0.447 to 2.362)	0.998 (0.993 to 1.004)	1.026 (0.949 to 1.109)
Incontinence associated dermatitis	1.003 (0.969 to 1.037)	0.801 (0.448 to 1.434)	0.998 (0.986 to 1.009)	1.873 (0.812 to 4.319)	0.996 (0.989 to 1.002)	0.991 (0.914 to 1.074)
Tinea pedis (B35.3)	0.989 (0.955 to 1.024)	**0.435*** (0.241 to 0.786)	**1.013*** (1.001 to 1.025)	1.569 (0.663 to 3.717)	**0.987*** (0.978 to 0.996)	0.997 (0.917 to 1.083)
Other pigmentation disorders (L81.-)	1.028 (0.989 to 1.068)	1.305 (0.673 to 2.527)	1.006 (0.993 to 1.019)	0.856 (0.322 to 2.279)	0.996 (0.989 to 1.003)	0.998 (0.913 to 1.091)
Venous insufficiency (I87.2)	1.007 (0.968 to 1.047)	0.807 (0.417 to 1.562)	**1.019*** (1.005 to 1.034)	0.837 (0.294 to 2.379)	0.998 (0.992 to 1.005)	**1.108*** (1.011 to 1.214)
Actinic keratosis (L57.0)	1.029 (0.988 to 1.071)	**0.321*** (0.165 to 0.622)	1.004 (0.991 to 1.018)	1.017 (0.380 to 2.723)	0.993 (0.984 to 1.001)	1.034 (0.942 to 1.134)
Scar and fibrosis (L90.5)	1.022 (0.978 to 1.067)	1.262 (0.589 to 2.705)	0.993 (0.979 to 1.008)	0.882 (0.281 to 2.767)	0.997 (0.989 to 1.005)	**1.103*** (1.00 to 1.217)
Seborrheic dermatitis (L21.-)	**0.951*** (0.909 to 0.996)	0.992 (0.467 to 2.108)	0.993 (0.978 to 1.008)	0.809 (0.259 to 2.526)	0.996 (0.987 to 1.004)	0.991 (0.893 to 1.100)
Intertrigo (B37.2)	**1.052*** (1.004 to 1.102)	1.290 (0.585 to 2.842)	1.002 (0.987 to 1.017)	0.766 (0.212 to 2.758)	1.001 (0.994 to 1.008)	1.099 (0.994 to 1.216)
Haemangioma (D18.0)	0.997 (0.932 to 1.024)	1.057 (0.472 to 2.369)	1.008 (0.992 to 1.024)	1.067 (0.337 to 3.382)	0.998 (0.990 to 1.006)	1.091 (0.982 to 1.212)
Melanocytic naevi (D22.9)	0.955 (0.908 to 1.004)	0.634 (0.285 to 1.411)	1.008 (0.992 to 1.025)	1.255 (0.392 to 4.018)	0.994 (0.984 to 1.005)	1.080 (0.968 to 1.205)
Haemorrhage (R23.3)	1.031 (0.981 to 1.083)	0.538 (0.243 to 1.189)	1.003 (0.987 to 1.020)	1.553 (0.529 to 4.565)	1.001 (0.993 to 1.009)	0.985 (0.877 to 1.106)
Rosacea (L71.9)	0.974 (0.927 to 1.024)	0.704 (0.311 to 1.592)	1.004 (0.987 to 1.021)	1.255 (0.392 to 4.018)	0.996 (0.986 to 1.006)	0.987 (0.878 to 1.111)
Pressure ulcer (L89.-, all categories)	1.034 (0.974 to 1.097)	1.369 (0.473 to 3.961)	0.986 (0.966 to 1.007)	0.857 (0.183 to 4.012)	1.006 (0.998 to 1.013)	1.049 (0.918 to 1.198)
Neoplasm (C44.9)	1.065 (0.999 to 1.134)	1.737 (0.551 to 5.479)	1.001 (0.981 to 1.022)	1.587 (0.416 to 6.057)	1.002 (0.993 to 1.011)	0.957 (0.825 to 1.109)

OR: odds ratio; CI: confidence interval; ODS: Overall dry skin score, ICD 10: international coding of diseases classification

***Bold type** indicates statistical significance, underlined text indicate OR ≥2.0; OR ≤ 0.5

Results of the multivariable logistic regression model with tinea pedis as dependent variable is displayed in the supplementary table S2. Adjusted to the Barthel - Index and the duration of residency, the occurrence of tinea pedis was lower in female residents (OR = 0.454, 95% CI 0.245 to 0.893). Results of the multivariable logistic regression model with venous insufficiency as dependent variable is displayed in the supplementary table S3. The occurrence of venous insufficiency was more likely in residents with higher Barthel - Index scores (OR = 1.019, 95% CI 1.004 to 1.033) and higher numbers of drugs (OR = 1.110, 95% CI 1.010 to 1.220). None of the other skin diseases showed multiple associations in the bivariate regression.

DISCUSSION

Key results

This prevalence study showed, that nearly every resident in institutional long-term care is affected by at least one dermatological disease. In total, 60 dermatological diseases were diagnosed, which was unexpectedly high. The highest prevalence was observed for xerosis cutis followed by tinea unguium, seborrheic keratosis, androgenetic alopecia, IAD and tinea pedis. Only few bivariate associations have been detected between skin diseases and demographic and other characteristics. In the majority the strengths of associations were small. Male sex was strongly associated with androgenetic alopecia, tinea pedis and actinic keratosis. A university qualification may be protective against xerosis cutis. Increasing age leads to increased risks of seborrheic keratosis and intertrigo and to decreased risks of having seborrheic dermatitis. Overall, the Barthel - Index and the duration of residency seem to be unrelated to the occurrence of skin diseases in this population.

Limitations

Although three additional long-term care facilities were included, the anticipated sample size of n = 280 was not achieved. In total, n = 559/811 residents living in the institutional long-term care at time of data collection did not responded, which may had led to a possible selection bias. Even though we performed a randomized selection of all long-term care facilities there were differences between participating and non - participating institutions. Whether this has an effect on the results is unclear. We also excluded residents at the end of life which may have led to a selection bias. Although we collected numerous data, the systemic diseases were not further specified. This permits detailed analyses of possible associations. Furthermore, we did not perform laboratory or histology. We also had no control over the documentation quality of the medical records.

Interpretation

Research in this setting is challenging due to difficulties of gathering written informed consent (e.g. due to dementia and associated cognitive impairments).[24] Irrespectively from that, besides a study published in Turkey in 2007 by Kilic et al.[25], this was the largest randomly selected sample of residents aged 65 years or older undergoing a head-to-toe skin examination by board certified dermatologists in institutional long-term care facilities, compared to previous studies.[5, 26, 27] In our study prevalence estimates are higher compared to previous studies in this setting, for instance the prevalence of xerosis cutis, IAD, and actinic keratosis.[5, 25, 28-30] Otherwise the study of Kilic et al. reported a lower prevalence for actinic keratosis[25], which may be explained by the geographic region and the assumed darker skin types of examined nursing home residents. Prevalences for tinea pedis, pruritus and candidiasis were similar to previous reports.[25, 27]

The PU prevalence of 9% was substantially higher compared to previous studies[31, 32] of the German long-term care setting. The main reason for this finding is unclear. Underreporting is a well-known phenomenon in epidemiological PU research.[33, 34] The full head-to-toe skin examination supports the internal validity and the accuracy of this point estimate. This indicates that PUs are a substantial problem in German long-term care settings.

We diagnosed a broad spectrum of dermatological conditions in our study population with a total number of 60 diagnoses, which is unexpectedly high. A study by Makrantonaki et al. reported 72 dermatological disorders in a sample of 110 hospitalized elderly patients.[35] These findings underscore the importance of dermatological examinations in geriatric patients and long-term care residents. However, the prevalence of >50% of the reported skin diseases was 2% or lower. Looking at the clinical spectrum of the diagnosed conditions a large number are benign, easy to manage or seem to be of minor pathological relevance. Empirical evidence suggests the significant improvement of xerosis cutis in the elderly when using structured skin care regimens.[36-40] Therefore our data may suggest a possible undersupply. Untreated dry skin

is most often related to enhanced pruritus[38], and may lead to superficial injuries or wounds with superinfection.[41] IAD or intertrigo may also be addressed by basic skin care interventions and/or antimycotic therapies.[39, 42] Other diseases like androgenetic alopecia, seborrheic keratosis or pigmentary disorders may be aesthetically disturbing but they do not require imperative medical treatment. However, also psychosocial well-being may be affected possibly leading to restrictions in mental health.[41, 43] Thus in the elderly and especially in aged long-term care residents we do have different challenges: realization of regular dermatological examinations, detecting clinically relevant dermatoses obligatory to be treated, benign skin conditions for facultative treatment and aesthetically disturbing skin conditions with direct implications for physical and psychological well-being.

Some of the conditions identified in our study, like PUs, neoplasm, stasis dermatitis, venous insufficiency or superficial wounds require immediate medical attention. These diseases are frequently observed in this elderly population and may lead to several complications (e.g. basal cell carcinoma, ulcus cruris, osteomyelitis) if not treated appropriately. It is important that healthcare practitioners are trained to screen for the most important and significant dermatological conditions in order to path the way for correct and adequate management.

In our study we also identified conditions which may be considered borderline, and may have lower or no importance but others may be simple and frequent conditions with severe consequences if not treated adequately. For instance, tinea pedis is frequent, with frequent relapses and often takes a chronic course. If tinea pedis is not treated properly, it bears the risk to spread to tinea corporis or to lead to onychomycosis and subsequent complications.[44] The dermatophytes disturb the natural defence of the skin barrier, whereby bacteria and viruses can penetrate into deeper skin layers more easily. The risk of developing lower extremities cellulitis[45] is increased. Another example of borderline conditions is actinic keratosis, which is a carcinoma in situ with the risk of progressing to squamous cell

carcinoma.[46] The distinction between actinic keratosis and squamous cell carcinoma can be challenging[46], but actinic keratosis may progress to a malignant disease.[47]

Interestingly, only few associations between skin diseases and demographic characteristics have been detected. Overall, the presence of skin diseases seems not to be associated with care dependency (Barthel-Index) and the duration of residency. This indicates that residents are already affected by the skin disease when being admitted. Apparently they do not develop these conditions *de novo* in the institutions, but may only develop them as a consequence to lifetime exposure to well known risk factors such as UV exposure increasing the risk of skin cancer.[48] The reason why higher education is associated with less dry skin is unclear. The educational level may be associated with skin self-care behaviour like the regular application of leave-on products.

The association of male sex and androgenetic alopecia was expected, because in the Caucasian population the prevalence increases with age in men up to 80% and in women up to 42%.[49] This may be also associated with actinic keratosis. Because men have a higher prevalence of pattern baldness, there is a reduced natural UV protection on the scalp skin which caused a higher occurrence of actinic keratosis. Also increased manifestation of tinea pedis in the male gender may possibly be explained to increased hyperhidrosis, lower awareness for skin care (e.g. regularly drying between toes, regularly checking feet, inappropriate hygiene habits).[50]

During the last decades many studies were published reporting the high occurrence of dermatological disorders and the necessity to pay increasing attention to specialized dermatological care in the elderly population. However, is more specialized medical (dermatological) care feasible in this setting and is it cost-effective? A discussion of prioritization in this vulnerable population is missing so far. Although there is an obvious need of dermatological care in institutional long-term care, it is unlikely that board certified dermatologists will solve this problem.[51] Telemedicine applications and better medical

training of healthcare providers in the institutional long-term care facilities were assumed as adequate suitable solution strategies.[51, 52] Frequent examinations by a dermatologists, as proposed by others,[35, 53] are unlikely to be affordable and manageable in this setting. Caregivers might be the key and because they may have a gatekeeper function. They need to have skills to decide whether residents need medical or basic care and they need to decide when to refer to a specialist. They need to have an evidence based algorithm for skin care and diagnostic skills to distinguish whether the skin condition is a cosmetic issue, whether it is crucial for skin care, whether it is a borderline disease needing observation or special attention and if it needs urgent medical attention. Therefore we strongly recommend an algorithm which clarifies the 'who?', 'what?' and 'when' regarding skin care interventions and treatment for nursing and clinical decision making.

Generalisability

Using a population-based approach, n = 223 residents living in institutional long-term care facilities were included. In comparison to the German care statistics, the participating institutional long-term care facilities were more private owned (60% vs. 40.8% in the German care statistic) and there were less non-profit institutions (30% vs. 55.8% in the German care statistic) which may limit the generalisability of results.[54] Despite a response rate of 27.5% of residents living in the residential care facilities at time of data collection, demographic data like age, sex and care dependency are well comparable with the general German long-term care population statistics (e.g. females 67.7% vs. 72.7%; care-level I: 38.6% vs. 39%; care-level II: 40.8% vs. 40.5%; care-level III 18.4% vs. 21%)[23] which supports the generalisability of the study results. However, a systematic exclusion of for instance highly care depended residents who might also been at higher PU risk may have introduced non-response bias. A response bias due to the informed consent procedure cannot be excluded as well.

CONTRIBUTORSHIP STATEMENT

I, the corresponding author, confirm that I have listed all Coauthors contributed significantly to the work.

Author Contribution

1. Elisabeth Hahnel: research associate and coordinator of the conducted study, substantial contributions to conception and design and acquisition, analysis and interpretation of data, preparation of manuscript
2. Ulrike Blume-Peytavi: substantial contributions to conception and design, dermatological examinations, preparation and review of the manuscript
3. Carina Trojahn: research associate and coordinator of the conducted study, substantial contributions to conception and design, preparation and review of the manuscript
4. Gábor Dobos: dermatological examinations, medical and scientific advice, review of the manuscript
5. Irina Jahnke: dermatological examinations, medical advice, review of the manuscript
6. Vera Kanti: dermatological examinations, medical and scientific advice, review of the manuscript
7. Claudia Richter: review of the manuscript
8. Andrea Lichterfeld-Kottner: review of the manuscript
9. Natalie Garcia Bartels: dermatological examinations, review of the manuscript
10. Jan Kottner: substantial contributions to conception and design, analysis and interpretation of data, preparation and review of the manuscript

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INFORMATION

Figure 1: Flow Chart of Participants

Supplementary Table S1: Prevalence of skin conditions

Supplementary Table S2: Logistic regression, dependent variable: Tinea pedis (B35.3)

Supplementary Table S1: Logistic regression, dependent variable: Venous insufficiency (I87.2)

OTHER INFORMATION

This study was approved by the ethics committee of the Charité-Universitätsmedizin Berlin (EA1/190/14).

Registration

This study is registered at https://clinicaltrials.gov/ct2/show/NCT02216526.

Protocol

A Protocol was previously published in the International Journal of Nursing Studies 52 (2015), pp. 598-604 DOI information: 10.1016/j.ijnurstu.2014.11.007.

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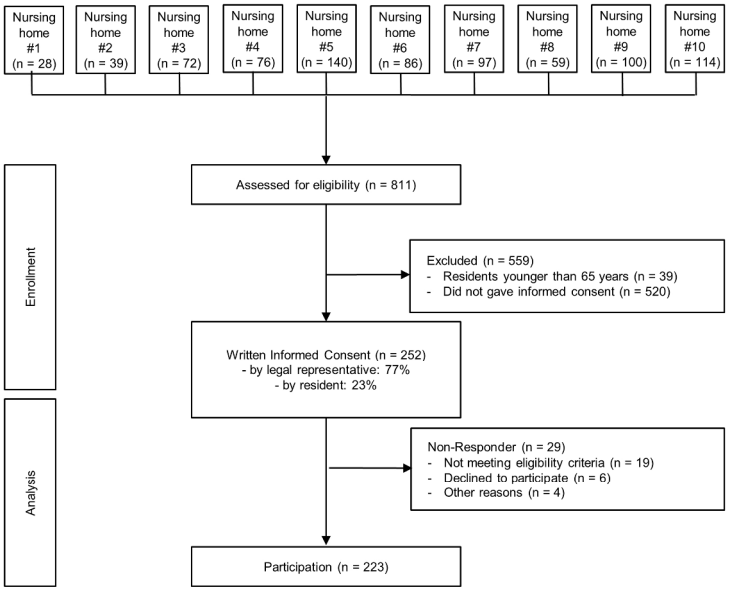
Data sharing

Additional data on this study is available at clinicaltrials.gov: https://clinicaltrials.gov/ct2/show/NCT02216526 and the study protocol is published in the International Journal for Nursing studies: DOI 10.1016/j.ijnurstu.2017.02.006. At the moment there are no plans to share the individual patient data collected.



Flow Chart

190x275mm (300 x 300 DPI)

Supplementary Table S1: Prevalence of skin conditions

Skin conditions and diseases (ICD-10)	Prevalence (%, 95% CI)
Xerosis cutis (L85.3) ODS >0	221/223 (99.1%, 97.7% - 100.0%)
Xerosis cutis (L85.3) ODS >1	186/223 (83.4%, 78.0% - 88.2%)
Xerosis cutis (L85.3) ODS >2	85/223 (38.1%, 31.7% - 44.5%)
Xerosis cutis (L85.3) ODS >3	24/223 (10.8%, 6.7% - 14.8%)
Tinea unguium (B35.1)	139/223 (62.3%, 56.0% - 69.1%)
Seborrheic keratosis (L82)	126/223 (56.5%, 50.2% - 63.0%)
Androgenetic alopecia (L64.9)	112/223 (50.2%, 43.8% - 57.5%)
Incontinence associated dermatitis	79/223 (35.4%, 29.9% - 42.2%)
Tinea pedis (B35.3)	71/223 (31.8%, 25.8% - 38.1%)
Other pigmentation disorders (L81.-)	57/223 (25.6%, 20.4% - 31.5%)
Venous insufficiency (I87.2)	50/223 (22.4%, 17.0% - 27.6%)
Actinic keratosis (L57.0)	47/223 (21.1%, 16.2% - 26.5%)
Scar and fibrosis (L90.5)	39/223 (17.5%, 12.5% - 22.7%)
Seborrheic dermatitis (L21.-)	37/223 (16.6%, 11.8% - 21.6%)
Intertrigo (L30.4)	36/223 (16.1%, 11.6% - 21.2%)
Haemangioma (D18.0)	32/223 (14.3%, 9.9% - 19.1%)
Melanocytic naevi (D22.9)	29/223 (13.0%, 8.5% - 17.3%)
Haemorrhage (R23.3)	29/223 (13.0%, 8.9% - 17.5%)
Rosacea (L71.9)	28/223 (12.6%, 8.5% - 17.0%)
Pressure ulcer (L89.-, all categories)	20/223 (9.0%, 5.0% - 13.0%)
Neoplasm (C44.9)	18/223 (8.1%, 4.5% - 12.2%)
Pruritus (L29.9)	17/223 (7.6%, 4.1% - 11.1%)
Acrochordon (L91.8)	14/223 (6.3%, 3.1% - 9.8%)
Stasis dermatitis (I83.1)	14/223 (6.3%, 3.2% - 9.9%)
Skin tears	14/223 (6.3%, 3.2% - 9.5%)
Superficial injury open wounds (S00 to S99)	13/223 (5.8%, 2.7% - 9.3%)
Follicular cysts (L72.9)	11/223 (4.9%, 2.2% - 7.7%)
Corn and callosites (L84)	9/223 (4.0%, 1.8% - 6.8%)
Irritant contact dermatitis (L24.9)	8/223 (3.6%, 1.3% - 6.3%)
Folliculitis (L73.9)	8/223 (3.6%, 1.4% - 6.3%)
Contact dermatitis (L25.9)	7/223 (3.1%, 0.9% - 5.8%)
Candidiasis (B37.9)	6/223 (2.7%, 0.9% - 4.9%)
Cheilitis angularis (K13.0)	6/223 (2.7%, 0.9% - 5.0%)
Hypertrichosis (L68.9)	5/223 (2.2%, 0.4% - 4.5%)
Erythrasma (L08.1)	5/223 (2.2%, 0.4% - 4.1%)
Bowen disease (D04.9)	5/223 (2.2%, 0.5% - 4.4%)
Psoriasis (L40.-)	4/223 (1.8%, 0.4% - 3.6%)
Fibroma (D21.9)	4/223 (1.8%, 0.4% - 4.0%)
Cicatricial alopecia (L66)	3/223 (1.3%, 0.0% - 3.1%)
Allergic contact dermatitis (L23.9)	2/223 (0.9%, 0.0% - 2.3%)
Alopecia areata (L63.-)	2/223 (0.9%, 0.0% - 2.3%)
Ectropium (H02.1)	2/223 (0.9%, 0.0% - 2.3%)
Cornu cutaneum (L85.8)	2/223 (0.9%, 0.0% - 2.3%)
Hyperhidrosis (R61.9)	2/223 (0.9%, 0.0% - 2.2%)
Aphta, mucosal (K12.0)	2/223 (0.9%, 0.0% - 2.2%)
Cellulitis (L03.9)	1/223 (0.4%, 0.0% - 1.4%)
Atopic dermatitis (L20.9)	1/223 (0.4%, 0.0% - 1.4%)
Lichen simplex chronicus and prurigo (L28.-)	1/223 (0.4%, 0.0% - 1.4%)
Vitiligo (L80)	1/223 (0.4%, 0.0% - 1.4%)
Atrophic disorders (L90.9)	1/223 (0.4%, 0.0% - 1.4%)
Granulomatous disorders (L92.9)	1/223 (0.4%, 0.0% - 1.4%)
Tinea corporis (B35.4)	1/223 (0.4%, 0.0% - 1.4%)
Varicosis (I83.9)	1/223 (0.4%, 0.0% - 1.4%)
Verruca (B07)	1/223 (0.4%, 0.0% - 1.4%)
Comedo (L70.0)	1/223 (0.4%, 0.0% - 1.4%)

Ichthyosis (L85.0)	1/223 (0.4%, 0.0% - 1.4%)
Ulcus cruris (L97)	1/223 (0.4%, 0.0% - 1.4%)
Dermatitis nummularis (L30.0)	1/223 (0.4%, 0.0% - 1.4%)
Ecthyma (L08.0)	1/223 (0.4%, 0.0% - 1.4%)
Pityriasis versicolor (B36.0)	1/223 (0.4%, 0.0% - 1.4%)
Lentigo maligna (D03.9)	1/223 (0.4%, 0.0% - 1.4%)
Abrasion (T14.01)	1/223 (0.4%, 0.0% - 1.4%)
Diabetic foot syndrome (E13.74)	1/223 (0.4%, 0.0% - 1.4%)

CI: confidence interval; ICD: international code of diseases

Supplementary Table S2: Logistic regression, dependent variable: Tinea pedis (B35.3)

Independent variable	Standardized Beta coefficient	Standard error	Wald statistic	OR (95% CI)	P value	VIF	Nagelkerke R^2
Gender (0 = male, 1 = female)	-0.672	0.312	4.644	0.511 (0.277 to 0.943)	0.031	1.0	0.116
Barthel-Index	0.012	0.007	3.254	1.012 (0.999 to 1.025)	0.062	1.0	
Duration of residency	-0.011	0.004	5.904	0.989 (0.980 to 0.998)	0.015	1.0	
Constant	0.206	0.626	0.108	1.228	0.742	-	

VIF: Variance inflation factor

Supplementary Table S1: Logistic regression, dependent variable: Venous insufficiency (I87.2)

Independent variable	Standardized Beta coefficient	Standard error	Wald statistic	OR (95% CI)	P value	VIF	Nagelkerke R^2
Barthel-Index	0.019	0.007	6.586	1.019 (1.004 to 1.033)	0.010	1.0	0.078
Number of medications used	0.105	0.048	4.718	1.110 (1.010 to 1.220)	0.030	1.0	
Constant	-2.888	0.554	27.169	0.056	<0.001	-	

VIF: Variance inflation factor

Title of the manuscript: The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study.

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**1**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**2**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**4**
Objectives	3	State specific objectives, including any prespecified hypotheses	**5**
Methods			
Study design	4	Present key elements of study design early in the paper	**6**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**6**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	**6**
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**7**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**7-8**
Bias	9	Describe any efforts to address potential sources of bias	**8**
Study size	10	Explain how the study size was arrived at	**8**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**8-9**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**9**
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**10**
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**10-11**
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	-

Title of the manuscript: The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study.

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	**12-14**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	**15**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**15**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**16-19**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**19**
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**25**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

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The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study

Running Head: Skin health in nursing home residents

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Abstract

Objectives: The aim of this study was to measure the prevalence of skin diseases in aged nursing home residents and to explore possible associations with demographic and medical characteristics.

Design: Descriptive multicentre prevalence study.

Setting and Participants: The study was conducted in a random sample of ten institutional long-term care facilities in the federal state of Berlin, Germany. In total, n = 223 residents were included.

Results: In total 60 dermatological diseases were diagnosed. The most frequently diagnosed skin disease was xerosis cutis (99.1%, 95% CI 97.7% - 100.0%) followed by tinea ungium (62.3%, 95% CI 56.0% - 69.1%) and seborrheic keratosis (56.5%, 95% CI 50.2% - 63.0%). Only few bivariate associations have been detected between skin diseases and demographic and medical characteristics.

Conclusion: Study results indicate, that almost every resident living in residential care has at least one dermatological diagnosis. Dermatological findings range from highly prevalent xerosis and cutaneous infection up to skin cancer. Not all conditions require immediate dermatological treatment and can be managed by targeted skin care interventions. Caregivers need knowledge and diagnostic skills to make appropriate clinical decisions. It is unlikely that specialized dermatological care will be delivered widely in the growing long-term care sector.

Registration: This study is registered at https://clinicaltrials.gov/ct2/show/NCT02216526.

Key words: prevalence, dermatology, nursing homes, skin diseases, elderly

Article summary

Strengths and limitations of this study:

- This was the largest randomly selected sample of long-term care residents aged 65 years or older undergoing a head-to-toe skin examination by board certified dermatologists.
- Skin diseases, medications and concomitant diseases were classified according to international definitions and functional assessments were conducted according to established methods to support the generalisability of results.
- Although three additional institutional long-term care facilities were included, the anticipated sample size of n = 280 was not achieved.
- There were differences between participating and non-participating long-term care institutions.
- Systemic diseases were not specified and laboratory and histology data were not available

Conflict of interest

I confirm, that the authors have no conflict of interest regarding financial conflicts, personal conflicts or potential conflict. All Authors address each of the specific categories of financial and personal conflicts in a full disclosure.

INTRODUCTION

Background

Skin ageing, functional limitations, chronic diseases, polypharmacy, personal skin care and hygiene habits in populations aged 65 years or older cause an increased vulnerability to skin diseases and cutaneous problems.[1-3] Epidemiological studies suggest that skin diseases are highly prevalent in the elderly population.[4-6] For example, the prevalence of xerosis cutis range up to 85.5%, benign skin tumours up to 74.5%, fungal infections up to 77% and pressure ulcer (PU) up to 46%.[7, 8] However, most published epidemiologic figures were obtained in hospital settings. The epidemiology of cutaneous diseases in institutional long-term care settings is largely unknown,[7] although the number of multimorbid residents living in institutional long-term care is increasing.[9]

In addition to the high prevalence, the burden of skin diseases also increases with age.[6] They are associated with reduced quality of life.[10] It was shown that geriatric patients with dermatological diseases have an increased risk for mental and behavioural disorders, primarily depression.[11] The medical treatment of the mulitmorbidities in nursing home residents may also result in polypharmacy.[12] Associated adverse drug reactions, nonadherence or drug-drug interactions are common[13, 14] and linked to dermatological disorders. Immobility, cognitive impairment and organizational or reimbursement factors may also limit the opportunity for these population to receive specialized dermatological care. Traditionally, nurses and other health care professionals focus on PUs and incontinence-associated dermatitis (IAD) but may ignore other skin problems which may also require attention. On the other hand, not all dermatological conditions require specialized pharmaceutical treatment.

According to the latest statistics there are 800.000 residents living in 13.600 long-term care institutions in Germany[15] and these figures are expected to increase. At the same time the prevalence of skin diseases in this care setting is largely unknown. In order to gain a detailed

picture about the epidemiology of skin diseases in institutional long-term care this study was conducted.

Objectives

The aim of this study was to measure the prevalence of skin conditions and diseases in aged residents living in institutional long-term care facilities and to explore possible associations with demographic and medical characteristics.

MATERIALS AND METHODS

Study design

This was an observational, cross-sectional prevalence study and it was approved by the ethics committee of the Charité-Universitätsmedizin Berlin (EA1/190/14). The study protocol was published previously.[16]

Setting

The study was conducted from September 2014 to May 2015 in ten institutional long-term care facilities in Berlin, Germany. In Germany, institutional long-term care facilities or residential care facilities are full-time accommodations with professional care. The staff is a mix between registered nurses and nursing assistants. Using computer generated random numbers, institutional long-term care facilities from a list of all existing facilities (n = 291) in the federal state of Berlin, Germany were contacted. In case of non-response the next randomly selected nursing home was invited.

Participants

The inclusion criteria were (1) being resident of the respective residential care facility, (2) aged ≥ 65 years, and (3) written informed consent given personally or by legal representative. Only residents being able to give informed consent by themselves or having a legal representative who decided on behalf of the resident took part in this study. The exclusion criteria was residents at the end of life to avoid unnecessary burden due to the examinations. All residents (or their legal representatives) living in the residential care facility at time of data collection were invited to participate.

Variables

Skin diseases were classified according to the international coding of diseases (ICD 10) classification, with the exception of IAD and skin tears. IAD was diagnosed according to the IAD-IT classification of Junkin 2008.[17] According to an international consensus skin tears are caused by shear, friction and/or blunt force causing the separation of the layers of the skin (partial or full thickness wound) most common on the extremities.[18] Skin tears were recorded as present/absent. Xerosis cutis was measured using the Overall Dry Skin score (ODS) with a five-point scale ranging from '0' (no skin dryness) to '4' (advanced skin roughness, large scales, inflammation and cracks).[19, 20] Concomitant diseases (ICD 10 classification level 1) and medications were extracted from the medical records. These contain documentation of anamnesis, diagnoses, examination results, therapies and results, interventions, consents and medical letters. Demographic variables of the nursing home residents (e.g. age, sex) were collected. The physical function related to the daily activities was assessed using the Barthel – Index. The scores range from 0 (very care dependent) to 100 (not care dependent).[21] The Braden scale was used to measure PU risk. Scores range from 6 (high PU risk) to 23 (no PU risk).[22] The educational qualification was classified into the following six categories: 'no school qualification', 'primary school', 'secondary school', 'grammar school/ A-level', 'vocational training' and 'university qualification'.

Data sources and measurement

All participating nursing home residents underwent a head-to-toe skin examination conducted by a board certified dermatologist (UBP, NGB, IJ). Examinations were done by clinical evaluation and using dermatoscopes (Dermogenius basic, DermoScan GmbH, Germany). Demographic characteristics (e.g. age, sex) and information regarding school qualification were extracted from the medical records by trained study assistants or the residents were

interviewed, if possible. PU risk and care dependency (Braden scale and Barthel-Index) were extracted from the medical records or assessed by a registered nurse. All study data was continuously documented in data collection forms by the investigator and authorized staff.

Bias

Institutional long-term care facilities in the state of Berlin differ in terms of ownership, size, and specialization. In order to reduce selection bias institutions were randomly selected from all facilities of the state of Berlin. All study related procedures and measurements were conducted by trained dermatologists and study assistants according to standard operating procedures. The board certified dermatologists had no access to medical history data of the residents prior and during examinations to reduce the risk of detection bias.

Study size

Assuming a prevalence of 0.5 of skin diseases, approximately 280 residents would have been needed to measure this proportion with a desired width of a 95% confidence interval of ± 0.06. According to the latest Nursing Care Statistics (2013), the size of the long-term care population in Berlin was approximately 30.000.[23] Assuming 80 residents per institution and a participation rate of 50% (n = 40) it was planned to include seven institutions which results in n = 280 (7 x n = 40) cases.

Quantitative variables

The duration of residency was measured in months. The Barthel-Index and Braden scale scores were used as metric variables. In order to investigate possible associations with skin diseases the variable ‘educational qualification’ was dichotomized into ‘university

qualification' (yes/no). Residents taking four or more medications were regarded as having 'polypharmacy'.[12]

Statistical methods

Depending on the level of measurement (nominal, ordinal, continuous) demographic characteristics, functional assessment scores and dermatological diseases were described using means, medians, proportions, frequencies and associated spread estimates, standard deviations, ranges and interquartile ranges. The 95% confidence intervals were calculated around point estimates of dermatological diseases. Exploratory data analysis to investigate possible bivariate associations were conducted using logistic regression analysis for all skin diseases with a prevalence of at least 8%. 95% confidence intervals of the odds ratios excluding 1 were considered to be statistically significant. Odds ratios being statistically significant or with values lower than 0.5 or higher than 2.0 were considered to be likely associated. In case of multiple bivariate associations multivariable logistic regression analyses were conducted. Models were built iteratively to increase model fit indicated by Nagelkerke's R^2.

RESULTS

Participants

Fifty-five long-term care facilities were contacted. Finally, ten long-term care facilities agreed to participate. Compared to participating institutions, non-participating institutions were larger in terms of number of beds (mean beds per institution: 104.5 vs. 73.7) privately owned (76% vs. 60%) and non-profit (30% vs. 22%).

All residents of the eligible long-term care facilities were invited, but participation rate was lower than 50%. In order to achieve the planned number, three additional long-term care facilities were recruited (in total ten). In total, n = 811 long-term care residents were assessed for eligibility, n = 58 residents (23%) provided written informed consent by themselves and for n = 194 residents (77%) the legal representative gave consent for participation. In total n = 29 residents declined participation prior examination resulting in n = 223 included long-term care residents (Fig. 1).

> Fig. 1<

Descriptive data

Sample characteristics are shown in table 1. Most residents were female (67.7 %) and the mean age was 83.6 (SD 8.0) years. Mean Barthel – Index score was 45.1 (SD 23.8) and mean Braden scale score was 17.3 (SD 3.7). The median time of long-term care residence until data collection was 27 months. A vocational training was the highest educational level for the majority (48.9 %). The most common concomitant diseases (ICD 10 system level 1) were diseases of the circulatory system (82.5 %) and mental and behavioural disorders (70.4 %). In total 84.6% of the residents received four or more medications (polypharmacy). The mean number of medications used was 6.8 (SD 3.4) per resident.

Table 1: Demographic characteristics of participants (n = 223)

Female, n (%)	151 (67.7)
Age [years]	
Mean (SD)	83.6 (8.0)
Median (IQR)	84 (78-89)
Barthel-Index Total Score[a]	
Mean (SD)	45.1 (23.8)
Median (IQR)	45.0 (25.0-65.0)
Braden score[a]	
Mean (SD)	17.3 (3.7)
Median (IQR)	18.0 (14.0-21.0)
BMI [kg/m²][b]	
Mean (SD)	25.3 (5.1)
Median (IQR)	24.6 (21.9-28.3)
Duration of residency [months]	
Mean (SD)	42.6 (49.1)
Median (IQR)	27.0 (14.0-52.0)
Highest educational qualification, n (%)	
No school qualification	3/184 (1.6)
Primary school	34/184 (18.5)
Secondary school	24/184 (10.8)
Grammar school/A-level	7/184 (3.8)
Vocational training	90/184 (48.9)
University	26/184 (14.1)
Number of medications per resident[c]	
Mean (SD)	6.84 (3.41)
Median (IQR)	6.0 (4.0 – 9.0)
Polypharmacy (≥ 4 medications), n (%)	186/221 (84.2)
Common concomitant diseases, ICD 10 system level 1, n (%)	
Diseases of the circulatory system (I.00 – I.99)	184/223 (82.5)
Mental and behavioural Disorders (F.00 – F.99)	157/223 (70.4)
Endocrine, nutritional and metabolic diseases (E.00 – E.99)	122/223 (54.7)
Diseases of the genitourinary system (N.00 – N.99)	106/223 (47.5)
Diseases of the nervous system (G.00 – G.99)	99/223 (44.4)
Diseases of the musculoskeletal system and connective tissue (M.00 – M.99)	96/223 (43.0)

SD: standard deviation; IQR: interquartile range; $n^a = 222$; $n^b = 216$; $n^c = 221$

Main results

In total 60 dermatological diseases were diagnosed. The complete list of dermatological findings is shown in the online supplementary table S1. Xerosis cutis was most frequent (99.1%, 95% CI 97.7% to 100.0%) followed by tinea ungium (62.3%, 95% CI 56.0% to 69.1%), and seborrheic keratosis (56.5%, 95% CI 50.2% to 63.0%). Thirty-two dermatological diseases were diagnosed for five residents or fewer (e.g. Bowen´s disease, 5/223, allergic contact dermatitis, 2/223, atopic dermatitis 1/223).

The results of the bivariate associations are shown in table 2. Higher age was associated with the increased prevalence of seborrheic keratosis (OR = 1.041, 95% CI 1.007 to 1.077) and intertrigo (OR = 1.052, 95% 1.004 to 1.102). On the other hand, the occurrence of seborrheic dermatitis decreased with increasing age (OR = 0.951, 95% CI 0.909 to 0.996). Female sex showed a decreased occurrence of androgenetic alopecia (OR 0.187, 95% CI 0.099 to 0.354), tinea pedis (OR = 0.435, 95% CI 0.241 to 0.786) and actinic keratosis (OR = 0.321, 95% CI 0.165 to 0.622). There were statistically significant associations between the Barthel - Index and tinea pedis (OR = 1.013, 95% CI 1.001 to 1.025) as well as venous insufficiency (OR = 1.019, 95% CI 1.005 to 1.034); and between the duration of residency and tinea ungium (OR = 0.992, 95% CI 0.987 to 0.998) as well as tinea pedis (OR = 0.987, 95% CI 0.978 to 0.996), but the strength of association were small. Having a university qualification was associated with less occurrence of xerosis cutis (OR = 0.462, 95% CI 0.175 to 1.223). The number of medications used was associated with the occurrence of venous insufficiency (OR = 1.108, 95% CI 1.011 to 1.214) and scar and fibrosis (OR 1.103, 95% CI 1.000 to 1.217).

Table 2: Associations between skin diseases and demographic characteristics (bivariate)

Skin diseases (ICD-10)	Age (OR, 95% CI)	Gender (OR, 95% CI) (0 = male, 1 = female)	Barthel-Index (OR, 95% CI)	University qualification (OR, 95% CI) (0 = no, 1 =yes)	Duration of residency (OR, 95% CI)	Number of medications used (OR, 95% CI)
Xerosis cutis (L85.3) ODS >0	-	-	-	-	-	-
Xerosis cutis (L85.3) ODS >1	1.037 (0.991 to 1.084)	1.166 (0.555 to 2.449)	1.001 (0.986 to 1.016)	0.462* (0.175 to 1.223)	0.998 (0.991 to 1.005)	1.012 (0.911 to 1.123)
Xerosis cutis (L85.3) ODS >2	1.027 (0.993 to 1.063)	1.039 (0.583 to 1.855)	1.008 (0.996 to 1.020)	0.636 (0.261 to 1.550)	0.998 (0.992 to 1.004)	0.934 (0.860 to 1.015)
Xerosis cutis (L85.3) ODS >3	1.022 (0.969 to 1.078)	1.178 (0.465 to 2.982)	1.005 (0.987 to 1.023)	0.610 (0.133 to 2.788)	0.988 (0.974 to 1.003)	0.971 (0.854 to 1.103)
Tinea unguium (B35.1)	1.022 (0.988 to 1.057)	0.829 (0.462 to 1.489)	0.998 (0.987 to 1.010)	1.253 (0.526 to 2.985)	**0.992*** (0.987 to 0.998)	0.969 (0.895 to 1.049)
Seborrheic keratosis (L82)	**1.041*** (1.007 to 1.077)	0.896 (0.507 to 1.580)	1.002 (0.991 to 1.014)	1.542 (0.648 to 3.667)	0.997 (0.991 to 1.002)	1.076 (0.992 to 1.166)
Androgenetic alopecia (L64.9)	0.984 (0.952 to 1.017)	**0.187*** (0.099 to 0.354)	0.999 (0.988 to 1.010)	1.028 (0.447 to 2.362)	0.998 (0.993 to 1.004)	1.026 (0.949 to 1.109)
Incontinence associated dermatitis	1.003 (0.969 to 1.037)	0.801 (0.448 to 1.434)	0.998 (0.986 to 1.009)	1.873 (0.812 to 4.319)	0.996 (0.989 to 1.002)	0.991 (0.914 to 1.074)
Tinea pedis (B35.3)	0.989 (0.955 to 1.024)	**0.435*** (0.241 to 0.786)	**1.013*** (1.001 to 1.025)	1.569 (0.663 to 3.717)	**0.987*** (0.978 to 0.996)	0.997 (0.917 to 1.083)
Other pigmentation disorders (L81.-)	1.028 (0.989 to 1.068)	1.305 (0.673 to 2.527)	1.006 (0.993 to 1.019)	0.856 (0.322 to 2.279)	0.996 (0.989 to 1.003)	0.998 (0.913 to 1.091)
Venous insufficiency (I87.2)	1.007 (0.968 to 1.047)	0.807 (0.417 to 1.562)	**1.019*** (1.005 to 1.034)	0.837 (0.294 to 2.379)	0.998 (0.992 to 1.005)	**1.108*** (1.011 to 1.214)
Actinic keratosis (L57.0)	1.029 (0.988 to 1.071)	**0.321*** (0.165 to 0.622)	1.004 (0.991 to 1.018)	1.017 (0.380 to 2.723)	0.993 (0.984 to 1.001)	1.034 (0.942 to 1.134)
Scar and fibrosis (L90.5)	1.022 (0.978 to 1.067)	1.262 (0.589 to 2.705)	0.993 (0.979 to 1.008)	0.882 (0.281 to 2.767)	0.997 (0.989 to 1.005)	**1.103*** (1.00 to 1.217)
Seborrheic dermatitis (L21.-)	**0.951*** (0.909 to 0.996)	0.992 (0.467 to 2.108)	0.993 (0.978 to 1.008)	0.809 (0.259 to 2.526)	0.996 (0.987 to 1.004)	0.991 (0.893 to 1.100)
Intertrigo (L30.4)	**1.052*** (1.004 to 1.102)	1.290 (0.585 to 2.842)	1.002 (0.987 to 1.017)	0.766 (0.212 to 2.758)	1.001 (0.994 to 1.008)	1.099 (0.994 to 1.216)
Haemangioma (D18.0)	0.997 (0.932 to 1.024)	1.057 (0.472 to 2.369)	1.008 (0.992 to 1.024)	1.067 (0.337 to 3.382)	0.998 (0.990 to 1.006)	1.091 (0.982 to 1.212)
Melanocytic naevi (D22.9)	0.955 (0.908 to 1.004)	0.634 (0.285 to 1.411)	1.008 (0.992 to 1.025)	1.255 (0.392 to 4.018)	0.994 (0.984 to 1.005)	1.080 (0.968 to 1.205)
Haemorrhage (R23.3)	1.031 (0.981 to 1.083)	0.538 (0.243 to 1.189)	1.003 (0.987 to 1.020)	1.553 (0.529 to 4.565)	1.001 (0.993 to 1.009)	0.985 (0.877 to 1.106)
Rosacea (L71.9)	0.974 (0.927 to 1.024)	0.704 (0.311 to 1.592)	1.004 (0.987 to 1.021)	1.255 (0.392 to 4.018)	0.996 (0.986 to 1.006)	0.987 (0.878 to 1.111)
Pressure ulcer (L89.-, all categories)	1.034 (0.974 to 1.097)	1.369 (0.473 to 3.961)	0.986 (0.966 to 1.007)	0.857 (0.183 to 4.012)	1.006 (0.998 to 1.013)	1.049 (0.918 to 1.198)
Neoplasm (C44.9)	1.065 (0.999 to 1.134)	1.737 (0.551 to 5.479)	1.001 (0.981 to 1.022)	1.587 (0.416 to 6.057)	1.002 (0.993 to 1.011)	0.957 (0.825 to 1.109)

OR: odds ratio; CI: confidence interval; ODS: Overall dry skin score, ICD 10: international coding of diseases classification

***Bold type** indicates statistical significance, underlined text indicate OR ≥2.0; OR ≤ 0.5

Results of the multivariable logistic regression model with tinea pedis as dependent variable is displayed in the supplementary table S2. Adjusted to the Barthel - Index and the duration of residency, the occurrence of tinea pedis was lower in female residents (OR = 0.454, 95% CI 0.245 to 0.893). Results of the multivariable logistic regression model with venous insufficiency as dependent variable is displayed in the supplementary table S3. The occurrence of venous insufficiency was more likely in residents with higher Barthel - Index scores (OR = 1.019, 95% CI 1.004 to 1.033) and higher numbers of drugs (OR = 1.110, 95% CI 1.010 to 1.220). None of the other skin diseases showed multiple associations in the bivariate regression.

DISCUSSION

Key results

This prevalence study showed, that nearly every resident in institutional long-term care is affected by at least one dermatological disease. In total, 60 dermatological diseases were diagnosed, which was unexpectedly high. The highest prevalence was observed for xerosis cutis followed by tinea unguium, seborrheic keratosis, androgenetic alopecia, IAD and tinea pedis. Only few bivariate associations have been detected between skin diseases and demographic and other characteristics. In the majority the strengths of associations were small. Male sex was strongly associated with androgenetic alopecia, tinea pedis and actinic keratosis. A university qualification may be protective against xerosis cutis. Increasing age leads to increased risks of seborrheic keratosis and intertrigo and to decreased risks of having seborrheic dermatitis. Overall, the Barthel - Index and the duration of residency seem to be unrelated to the occurrence of skin diseases in this population.

Limitations

Although three additional long-term care facilities were included, the anticipated sample size of n = 280 was not achieved. In total, n = 559/811 residents living in the institutional long-term care at time of data collection did not responded, which may had led to a possible selection bias. Even though we performed a randomized selection of all long-term care facilities there were differences between participating and non - participating institutions. Whether this has an effect on the results is unclear. We also excluded residents at the end of life which may have led to a selection bias. Although we collected numerous data, the systemic diseases were not further specified. This restricts detailed analyses of possible associations. Furthermore, we did not perform laboratory or histology. We also had no control over the documentation quality of the medical records.

Interpretation

Research in this setting is challenging due to difficulties of gathering written informed consent (e.g. due to dementia and associated cognitive impairments).[24] Irrespectively from that, besides a study published in Turkey in 2007 by Kilic et al.[25], this was the largest randomly selected sample of residents aged 65 years or older undergoing a head-to-toe skin examination by board certified dermatologists in institutional long-term care facilities, compared to previous studies.[5, 26, 27] In our study prevalence estimates are higher compared to previous studies in this setting, for instance the prevalence of xerosis cutis, IAD, and actinic keratosis.[5, 25, 28-30] Otherwise the study of Kilic et al. reported a lower prevalence for actinic keratosis[25], which may be explained by the geographic region and the assumed darker skin types of examined nursing home residents. Prevalences for tinea pedis, pruritus and candidiasis were similar to previous reports.[25, 27]

The PU prevalence of 9% was substantially higher compared to previous studies[31, 32] of the German long-term care setting. The main reason for this finding is unclear. Underreporting is a well-known phenomenon in epidemiological PU research.[33, 34] The full head-to-toe skin examination supports the internal validity and the accuracy of this point estimate. This indicates that PUs are a substantial problem in German long-term care settings.

We diagnosed a broad spectrum of dermatological conditions in our study population with a total number of 60 diagnoses, which is unexpectedly high. A study by Makrantonaki et al. reported 72 dermatological disorders in a sample of 110 hospitalized elderly patients.[35] These findings underscore the importance of dermatological examinations in geriatric patients and long-term care residents. However, the prevalence of >50% of the reported skin diseases was 2% or lower. Looking at the clinical spectrum of the diagnosed conditions a large number are benign, easy to manage or seem to be of minor pathological relevance. Empirical evidence suggests the significant improvement of xerosis cutis in the elderly when using structured skin care regimens.[36-40] Therefore our data may suggest a possible undersupply. Untreated dry skin

is most often related to enhanced pruritus[38], and may lead to superficial injuries or wounds with superinfection.[41] IAD or intertrigo may also be addressed by basic skin care interventions and/or antimycotic therapies.[39, 42] Other diseases like androgenetic alopecia, seborrheic keratosis or pigmentary disorders may be aesthetically disturbing but they do not require imperative medical treatment. However, also psychosocial well-being may be affected possibly leading to restrictions in mental health.[41, 43] Thus in the elderly and especially in aged long-term care residents we do have different challenges: realization of regular dermatological examinations, detecting clinically relevant dermatoses obligatory to be treated, benign skin conditions for facultative treatment and aesthetically disturbing skin conditions with direct implications for physical and psychological well-being.

Some of the conditions identified in our study, like PUs, neoplasm, stasis dermatitis, venous insufficiency or superficial wounds require immediate medical attention. These diseases are frequently observed in this elderly population and may lead to several complications (e.g. basal cell carcinoma, ulcus cruris, osteomyelitis) if not treated appropriately. It is important that healthcare practitioners are trained to screen for the most important and significant dermatological conditions in order to path the way for correct and adequate management.

In our study we also identified conditions which may be considered borderline, and may have lower or no importance but others may be simple and frequent conditions with severe consequences if not treated adequately. For instance, tinea pedis is frequent, with frequent relapses and often takes a chronic course. If tinea pedis is not treated properly, it bears the risk to spread to tinea corporis or to lead to onychomycosis and subsequent complications.[44] The dermatophytes disturb the natural defence of the skin barrier, whereby bacteria and viruses can penetrate into deeper skin layers more easily. The risk of developing lower extremities cellulitis[45] is increased. Another example of borderline conditions is actinic keratosis, which is a carcinoma in situ with the risk of progressing to squamous cell

carcinoma.[46] The distinction between actinic keratosis and squamous cell carcinoma can be challenging[46], but actinic keratosis may progress to a malignant disease.[47]

Interestingly, only few associations between skin diseases and demographic characteristics have been detected. Overall, the presence of skin diseases seems not to be associated with care dependency (Barthel-Index) and the duration of residency. This indicates that residents are already affected by the skin disease when being admitted. Apparently they do not develop these conditions *de novo* in the institutions, but may only develop them as a consequence to lifetime exposure to well known risk factors such as UV exposure increasing the risk of skin cancer.[48] The reason why higher education is associated with less dry skin is unclear. The educational level may be associated with skin self-care behaviour like the regular application of leave-on products.

The association of male sex and androgenetic alopecia was expected, because in the Caucasian population the prevalence increases with age in men up to 80% and in women up to 42%.[49] This may be also associated with actinic keratosis. Because men have a higher prevalence of pattern baldness, there is a reduced natural UV protection on the scalp skin which caused a higher occurrence of actinic keratosis. Also increased manifestation of tinea pedis in the male gender may possibly be explained to increased hyperhidrosis, lower awareness for skin care (e.g. regularly drying between toes, regularly checking feet, inappropriate hygiene habits).[50]

During the last decades many studies were published reporting the high occurrence of dermatological disorders and the necessity to pay increasing attention to specialized dermatological care in the elderly population. However, is more specialized medical (dermatological) care feasible in this setting and is it cost-effective? A discussion of prioritization in this vulnerable population is missing so far. Although there is an obvious need of dermatological care in institutional long-term care, it is unlikely that board certified dermatologists will solve this problem.[51] Telemedicine applications and better medical

training of healthcare providers in the institutional long-term care facilities were assumed as adequate suitable solution strategies.[51, 52] Frequent examinations by a dermatologists, as proposed by others,[35, 53] are unlikely to be affordable and manageable in this setting. Caregivers might be the key and because they may have a gatekeeper function. They need to have skills to decide whether residents need medical or basic care and they need to decide when to refer to a specialist. They need to have an evidence based algorithm for skin care and diagnostic skills to distinguish whether the skin condition is a cosmetic issue, whether it is crucial for skin care, whether it is a borderline disease needing observation or special attention and if it needs urgent medical attention. Therefore we strongly recommend an algorithm which clarifies the 'who?', 'what?' and 'when' regarding skin care interventions and treatment for nursing and clinical decision making.

Generalisability

Using a population-based approach, n = 223 residents living in institutional long-term care facilities were included. In comparison to the German care statistics, the participating institutional long-term care facilities were more private owned (60% vs. 40.8% in the German care statistic) and there were less non-profit institutions (30% vs. 55.8% in the German care statistic) which may limit the generalisability of results.[54] Despite a response rate of 27.5% of residents living in the residential care facilities at time of data collection, demographic data like age, sex and care dependency are well comparable with the general German long-term care population statistics (e.g. females 67.7% vs. 72.7%; care-level I: 38.6% vs. 39%; care-level II: 40.8% vs. 40.5%; care-level III 18.4% vs. 21%)[23] which supports the generalisability of the study results. However, a systematic exclusion of for instance highly care depended residents who might also been at higher PU risk may have introduced non-response bias. A response bias due to the informed consent procedure cannot be excluded as well.

CONTRIBUTORSHIP STATEMENT

I, the corresponding author, confirm that I have listed all Coauthors contributed significantly to the work.

Author Contribution

1. Elisabeth Hahnel: research associate and coordinator of the conducted study, substantial contributions to conception and design and acquisition, analysis and interpretation of data, preparation of manuscript
2. Ulrike Blume-Peytavi: substantial contributions to conception and design, dermatological examinations, preparation and review of the manuscript
3. Carina Trojahn: research associate and coordinator of the conducted study, substantial contributions to conception and design, preparation and review of the manuscript
4. Gábor Dobos: dermatological examinations, medical and scientific advice, review of the manuscript
5. Irina Jahnke: dermatological examinations, medical advice, review of the manuscript
6. Vera Kanti: dermatological examinations, medical and scientific advice, review of the manuscript
7. Claudia Richter: review of the manuscript
8. Andrea Lichterfeld-Kottner: review of the manuscript
9. Natalie Garcia Bartels: dermatological examinations, review of the manuscript
10. Jan Kottner: substantial contributions to conception and design, analysis and interpretation of data, preparation and review of the manuscript

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INFORMATION

Figure 1: Flow Chart of Participants

Supplementary Table S1: Prevalence of skin conditions

Supplementary Table S2: Logistic regression, dependent variable: Tinea pedis (B35.3)

Supplementary Table S1: Logistic regression, dependent variable: Venous insufficiency (I87.2)

OTHER INFORMATION

This study was approved by the ethics committee of the Charité-Universitätsmedizin Berlin (EA1/190/14).

Registration

This study is registered at https://clinicaltrials.gov/ct2/show/NCT02216526.

Protocol

A Protocol was previously published in the International Journal of Nursing Studies 52 (2015), pp. 598-604 DOI information: 10.1016/j.ijnurstu.2014.11.007.

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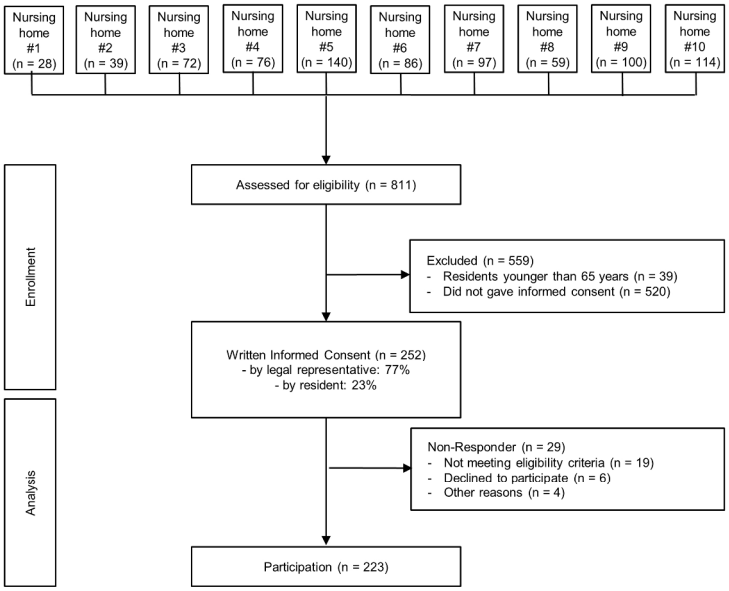
Data sharing

Additional data on this study is available at clinicaltrials.gov: https://clinicaltrials.gov/ct2/show/NCT02216526 and the study protocol is published in the International Journal for Nursing studies: DOI 10.1016/j.ijnurstu.2017.02.006. At the moment there are no plans to share the individual patient data collected.



Flow Chart

190x275mm (300 x 300 DPI)

Supplementary Table S1: Prevalence of skin conditions

Skin conditions and diseases (ICD-10)	Prevalence (%, 95% CI)
Xerosis cutis (L85.3) ODS >0	221/223 (99.1%, 97.7% - 100.0%)
Xerosis cutis (L85.3) ODS >1	186/223 (83.4%, 78.0% - 88.2%)
Xerosis cutis (L85.3) ODS >2	85/223 (38.1%, 31.7% - 44.5%)
Xerosis cutis (L85.3) ODS >3	24/223 (10.8%, 6.7% - 14.8%)
Tinea unguium (B35.1)	139/223 (62.3%, 56.0% - 69.1%)
Seborrheic keratosis (L82)	126/223 (56.5%, 50.2% - 63.0%)
Androgenetic alopecia (L64.9)	112/223 (50.2%, 43.8% - 57.5%)
Incontinence associated dermatitis	79/223 (35.4%, 29.9% - 42.2%)
Tinea pedis (B35.3)	71/223 (31.8%, 25.8% - 38.1%)
Other pigmentation disorders (L81.-)	57/223 (25.6%, 20.4% - 31.5%)
Venous insufficiency (I87.2)	50/223 (22.4%, 17.0% - 27.6%)
Actinic keratosis (L57.0)	47/223 (21.1%, 16.2% - 26.5%)
Scar and fibrosis (L90.5)	39/223 (17.5%, 12.5% - 22.7%)
Seborrheic dermatitis (L21.-)	37/223 (16.6%, 11.8% - 21.6%)
Intertrigo (L30.4)	36/223 (16.1%, 11.6% - 21.2%)
Haemangioma (D18.0)	32/223 (14.3%, 9.9% - 19.1%)
Melanocytic naevi (D22.9)	29/223 (13.0%, 8.5% - 17.3%)
Haemorrhage (R23.3)	29/223 (13.0%, 8.9% - 17.5%)
Rosacea (L71.9)	28/223 (12.6%, 8.5% - 17.0%)
Pressure ulcer (L89.-, all categories)	20/223 (9.0%, 5.0% - 13.0%)
Neoplasm (C44.9)	18/223 (8.1%, 4.5% - 12.2%)
Pruritus (L29.9)	17/223 (7.6%, 4.1% - 11.1%)
Acrochordon. (L91.8)	14/223 (6.3%, 3.1% - 9.8%)
Stasis dermatitis (I83.1)	14/223 (6.3%, 3.2% - 9.9%)
Skin tears	14/223 (6.3%, 3.2% - 9.5%)
Superficial injury open wounds (S00 to S99)	13/223 (5.8%, 2.7% - 9.3%)
Follicular cysts (L72.9)	11/223 (4.9%, 2.2% - 7.7%)
Corn and callosites (L84)	9/223 (4.0%, 1.8% - 6.8%)
Irritant contact dermatitis (L24.9)	8/223 (3.6%, 1.3% - 6.3%)
Folliculitis (L73.9)	8/223 (3.6%, 1.4% - 6.3%)
Contact dermatitis (L25.9)	7/223 (3.1%, 0.9% - 5.8%)
Candidiasis (B37.9)	6/223 (2.7%, 0.9% - 4.9%)
Cheilitis angularis (K13.0)	6/223 (2.7%, 0.9% - 5.0%)
Hypertrichosis (L68.9)	5/223 (2.2%, 0.4% - 4.5%)
Erythrasma (L08.1)	5/223 (2.2%, 0.4% - 4.1%)
Bowen disease (D04.9)	5/223 (2.2%, 0.5% - 4.4%)
Psoriasis (L40.)	4/223 (1.8%, 0.4% - 3.6%)
Fibroma (D21.9)	4/223 (1.8%, 0.4% - 4.0%)
Cicatricial alopecia (L66)	3/223 (1.3%, 0.0% - 3.1%)
Allergic contact dermatitis (L23.9)	2/223 (0.9%, 0.0% - 2.3%)
Alopecia areata (L63.-)	2/223 (0.9%, 0.0% - 2.3%)
Ectropium (H02.1)	2/223 (0.9%, 0.0% - 2.3%)
Cornu cutaneum (L85.8)	2/223 (0.9%, 0.0% - 2.3%)
Hyperhidrosis (R61.9)	2/223 (0.9%, 0.0% - 2.2%)
Aphta, mucosal (K12.0)	2/223 (0.9%, 0.0% - 2.2%)
Cellulitis (L03.9)	1/223 (0.4%, 0.0% - 1.4%)
Atopic dermatitis (L20.9)	1/223 (0.4%, 0.0% - 1.4%)
Lichen simplex chronicus and prurigo (L28.-)	1/223 (0.4%, 0.0% - 1.4%)
Vitiligo (L80)	1/223 (0.4%, 0.0% - 1.4%)
Atrophic disorders (L90.9)	1/223 (0.4%, 0.0% - 1.4%)
Granulomatous disorders (L92.9)	1/223 (0.4%, 0.0% - 1.4%)
Tinea corporis (B35.4)	1/223 (0.4%, 0.0% - 1.4%)
Varicosis (I83.9)	1/223 (0.4%, 0.0% - 1.4%)
Verruca (B07)	1/223 (0.4%, 0.0% - 1.4%)
Comedo (L70.0)	1/223 (0.4%, 0.0% - 1.4%)

Ichthyosis (L85.0)	1/223 (0.4%, 0.0% - 1.4%)
Ulcus cruris (L97)	1/223 (0.4%, 0.0% - 1.4%)
Dermatitis nummularis (L30.0)	1/223 (0.4%, 0.0% - 1.4%)
Ecthyma (L08.0)	1/223 (0.4%, 0.0% - 1.4%)
Pityriasis versicolor (B36.0)	1/223 (0.4%, 0.0% - 1.4%)
Lentigo maligna (D03.9)	1/223 (0.4%, 0.0% - 1.4%)
Abrasion (T14.01)	1/223 (0.4%, 0.0% - 1.4%)
Diabetic foot syndrome (E13.74)	1/223 (0.4%, 0.0% - 1.4%)

CI: confidence interval; ICD: international code of diseases

Supplementary Table S2: Logistic regression, dependent variable: Tinea pedis (B35.3)

Independent variable	Standardized Beta coefficient	Standard error	Wald statistic	OR (95% CI)	P value	VIF	Nagelkerke R^2
Gender (0 = male, 1 = female)	-0.672	0.312	4.644	0.511 (0.277 to 0.943)	0.031	1.0	0.116
Barthel-Index	0.012	0.007	3.254	1.012 (0.999 to 1.025)	0.062	1.0	
Duration of residency	-0.011	0.004	5.904	0.989 (0.980 to 0.998)	0.015	1.0	
Constant	0.206	0.626	0.108	1.228	0.742	-	

VIF: Variance inflation factor

Supplementary Table S3: Logistic regression, dependent variable: Venous insufficiency (I87.2)

Independent variable	Standardized Beta coefficient	Standard error	Wald statistic	OR (95% CI)	P value	VIF	Nagelkerke R^2
Barthel-Index	0.019	0.007	6.586	1.019 (1.004 to 1.033)	0.010	1.0	0.078
Number of medications used	0.105	0.048	4.718	1.110 (1.010 to 1.220)	0.030	1.0	
Constant	-2.888	0.554	27.169	0.056	<0.001	-	

VIF: Variance inflation factor

Title of the manuscript: The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study.

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**1**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**2**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**4**
Objectives	3	State specific objectives, including any prespecified hypotheses	**5**
Methods			
Study design	4	Present key elements of study design early in the paper	**6**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**6**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	**6**
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**7**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**7-8**
Bias	9	Describe any efforts to address potential sources of bias	**8**
Study size	10	Explain how the study size was arrived at	**8**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**8-9**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**9**
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**10**
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**10-11**
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	-

Title of the manuscript: The prevalence and associated factors of skin diseases in aged nursing home residents: a multicentre prevalence study.

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	**12-14**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	**15**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**15**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**16-19**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**19**
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**25**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.