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Sex-specific differences in prevention and treatment of institutional-acquired pressure ulcers in hospitals and nursing homes

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ABSTRACT

Introduction: Gender and/or sex have a major impact on staying healthy, becoming ill, or care dependent. Differences between men and women have been described for socioeconomic positions, health behaviors, courses and severities of diseases and mortality rates. Consequently, sex and/or gender need to be adequately taken into account while developing and implementing evidence-based healthcare. Evidence regarding differences between men and women in pressure ulcer care is limited. Our research aim was to measure possible differences between male and female hospital patients and nursing home residents in prevention and treatment of institutional-acquired pressure ulcers.

Methods: A secondary data analysis was conducted including data sets collected in nursing homes and hospitals in Germany annually from 2001 to 2016. Relevant variables were compared according to biological sex (men/woman).

Results: The study included 38,655 nursing home residents (mean age 85.4 years women, 77.3 years men) and 58,760 hospital patients (mean age 66.7 years women, 63.4 years men). More women were underweight and at pressure ulcer risk in both settings. The proportion of institutional-acquired pressure ulcers was higher for men in hospitals. Slightly more men had a PU category 2 to 4 (OR 0.87, 95% CI 0.76 to 0.99) in nursing homes or developed an institutional-acquired pressure ulcers category 2 to 4 in both settings (OR 0.85, 95% CI 0.76 to 0.95). Special mattresses were more often used by women at PU risk. More men with an institutional-acquired pressure ulcer in hospitals received counseling of relatives (OR 0.53, 95% CI 0.39 to 0.72).

Conclusion: Although slightly more men had institutional-acquired pressure ulcers than women, overall differences regarding pressure ulcer occurrence were minor. Gender and/or sex can rather not be considered as an independent risk factor for pressure ulcer development and differences regarding pressure ulcer prevention interventions seem to be minor.

1. Introduction

There is increasing empirical evidence that gender and sex have a major impact on staying healthy, becoming ill, or care dependent. The concept of gender is often referred to differences that are primarily socially or culturally determined while sex is often used for genetically determined difference in humans [1]. However, there is a huge overlap between both concepts because sex strongly affects gender and both terms are often used synonymously. The present manuscript focuses on biological characteristics of men and women and therefore the term sex will be used [2].

Sex differences have been described for socioeconomic positions, health behaviors, psychological and physiological states, courses and severities of diseases and mortality rates [3–6]. Consequently, sex needs to be adequately taken into account while developing and implementing evidence-based healthcare. Evidence regarding sex differences in nursing care is limited.

McDonald and Bridge (1991) evaluated gender stereotyping in nursing care. In three of five nursing interventions, nurses planned different care for men and women. Women were less encouraged to be active, they were given fewer analgesics and nurses spent insufficient time for psychological support. Regarding the nursing interventions

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"patient ambulation", "analgesic administration" and "emotional support" the male patients were favored [7]. A further investigation stated, that women are more demanding regarding nursing interventions [8]. A survey by Foss et al. (2002) revealed that gender-related differences in nursing care exist [9]. Using patient satisfaction questionnaires female patients showed significantly lower satisfaction scores compared to male patients. The most significant difference between sexes was observed for the question of personal commitment. Further sex-specific differences were reported for "caring behavior", "time to talk", "time to help", "nursing skills" and "continuity of care". An evaluation in primary care patients suggested that women report more pain than men [10]. Another study evaluated the influence of gender on physicians' pain management decision. Female physicians prescribed lower doses of analgesics to male patients in chronic back pain [11].

Bowden (1997) introduced the concept of "gender sensitive care" and Miers et al. (2002) described this as involving understanding the particular needs of individual men and women in the context of understanding of regularities against the background of own experiences and own concepts. In institutionalized health care settings such as hospitals and long-term care facilities, little is known about the actual impact of sex on the functional and cognitive needs and the frequency, severity and triggered nursing care interventions. In health research, men are often defined as the norm, the woman as the exception [12]. Medical research is criticized for sex bias, that only few studies deal with how such bias affect medical/nursing education and textbooks. For example, the safety and effectiveness of cardiovascular devices differ by sex, but the majority of high-risk cardiovascular devices do not contain information regarding sex differences [13]. Subgroup analyses may be performed to investigate possible sex differences e.g. regarding heterogeneous responses to drug treatments or surgical interventions. However, results of subgroup analyses in clinical trials should be interpreted with caution [14]. Several initiatives and guidelines attempted to increase the amount of available sex-specific data for drugs and devices.

The relationship between sex and pressure ulcer (PU) development was investigated in numerous studies. The International Clinical Practice Guideline for Prevention and Treatment of Pressure Ulcers 2014 [15] included 20 studies addressing this relationship, but only six studies reported significant results in a multivariable model that were contradictory to each other [16]. However, for example the very commonly used Waterlow Pressure Ulcer Risk Assessment Scale considers sex as an independent risk factor on PU development [17].

Irrespectively from the possible impact of sex on PU development, there is no evidence regarding sex-specific differences regarding PU prevention and/or treatment. Therefore, our research aim was to measure possible differences between male and female hospital patients and nursing home residents in prevention and treatment of institutional-acquired PUs.

2. Methods

2.1. Study design

A secondary data analysis was conducted including data sets collected in two care settings in Germany annually from 2001 to 2016. The annual prevalence surveys evaluated health problems among patients in hospitals and residents in nursing homes using a highly standardized data collection and analysis method [18–20]. The design and procedures are based on the Dutch National Registration Project of Pressure Ulcers [21] and it is conducted in Germany since 2001 [22].

2.2. Ethical considerations

The ethics commission of the Medical Association of Berlin approved the prevalence study (Eth-837-262/00).

2.3. Setting and participants

All nursing homes and hospitals across Germany were invited to participate once a year. Institutions who are interested to participate, received written and digital material about the survey. One responsible person per institution coordinated the data collection. The coordinator was also the contact person at each included organization. Eligible were all patients or residents from the age of 18 years and older and when they gave their informed consent, either personally or by legal representative. The participation was anonymously. For this secondary data analysis, the following additional criteria applied: clear assignment of sex, age $\geq$18 years, information regarding degree of mobility, height (cm) and weight (kg).

2.4. Data collection

The institutional coordinator was trained by the researchers. Afterwards the coordinator selected and trained a nursing team per institution. The training based on written instruction materials and digital presentations. It included explanations of all instruments and assessments including images of e.g. different PU categories. Every data collecting nurse received a detailed data collection manual with explanations, variables and assessment tools. At the day of data collection, the patient or resident records were reviewed and interviews and assessments were conducted. Trained nursing staff performed the data collection applying head-to-toe skin inspections. Demographic, social and health variables, standardized scores and assessment instruments were recorded in the data collection forms.

For our study, the following variables were considered: "demographics and general information", "mobility", "care dependency" and "pressure ulcers". The status of mobility was assessed using the Care Dependency Scale [23]. This assessment instrument measures the degree of care dependency based on physical abilities, e.g. incontinence, body posture, eating/drinking and psychological aspects, e.g. social contacts, mobility, communication, learning ability. The items of the scale ranged between 1 "complete dependent'' to 5 "complete independent''. The validity and reliability of the German version of the Care Dependency Scale is supported [24]. The items of the Care Dependency Scale are reliable in the German-speaking area [25]. Every subject assigned to mainly or completely dependent regarding mobility was determined to be at pressure ulcer risk. BMI values were summarized into BMI <18.5 as underweight, BMI 18.5 to 25 as normal, BMI >25 and $<$ 30 as pre-obesity and obesity from a value $\geq$ 30.

The classification of pressure ulcers was conducted using the NPUAP/EPUAP classification system [26]. The category 1 is described as a non-blanchable redness of a localized area, category 2 is partial thickness loss of epidermis, dermis or both. Full thickness skin loss of the pressure ulcer is referred to category 3. Subcutaneous fat may be visible here but bone, tendon or muscle are not exposed. Category 4 was extensive tissue destruction with exposed bone, tendon or muscle. Deep Tissue Injury (DTI) refers to purple or maroon discoloured localized area with intact skin or blood-filled blister. This discolouring is due to damage of underlying soft tissue. Two body locations were assessed for the occurrence of pressure ulcer, the sacrum/trochanter and heel/ankle.

Pressure ulcer prevention measures were assessed as done or not done. Prevention measures included counseling of patient or relatives, the use of sheepskin, positioning, positioning not possible, heel protection, skin assessment and the use of special mattresses.

2.5. Data analysis

Our study focused on patients and residents at risk of the development of PUs and with institutional -acquired pressure ulcer (IAPUs). The variables and characteristics of the participants were described using

Table 1
Characteristics of participants in nursing homes and hospitals, pressure ulcer risk, prevalence and preventive measures by sex and bivariate analysis of differences in BMI and between men and women (dependent variable: man = 0, woman = 1).

	Nursing home[a] (n = 38655, 39.7%)				Hospital[b] (n = 58760, 60.3%)				Total
	Women (n = 29516, 76.4%)	**Men** (n = 8331, 21.6%)	**OR (95% CI)**	**p-value**	**Women** (n = 31631, 53.8%)	**Men** (n = 25741, 43.8%)	**OR (95% CI)**	**p-value**	n = 97415 (100%)
Mean age, years (SD)	85.4 (9.4)	77.3 (13.1)	**1.066 (1.064 to 1.068)**	**p < 0.001**	66.7 (18.0)	63.4 (16.0)	**1.011 (1.010 to 1.012)**	**p < 0.001**	72.5 (17.5)
PU risk (completely and mainly dependent regarding mobility) (n, %)(0 = no, 1 = yes)	13093 (44.4)	3401 (40.8)	**1.158 (1.102 to 1.217)**	**p < 0.001**	6480 (20.5)	4560 (17.7)	**1.199 (1.150 to 1.251)**	**p < 0.001**	27534 (28.3)
Pressure ulcer prevalence									
PU category 1 to 4 (n, %, 95% CI)	1535 (5.2, 5.0 to 5.5)	467 (5.6, 5.1 to 6.1)	0.924 (0.830–1.028)	p = 0.145	2956 (9.3, 9.1 to 9.7)	2138 (8.3, 8.0 to 8.6)	**1.138 (1.074 to 1.206)**	**p < 0.001**	7096 (7.3)
PU category 2 to 4 (n, %, 95% CI)	930 (3.2, 3.0 to 3.4)	302 (3.6, 3.2 to 4.0)	0.865 (0.758–0.987)	p = 0.031	1472 (4.7, 4.4 to 4.9)	1120 (4.4, 4.1 to 4.6)	1.073 (0.991–1.162)	p = 0.083	3824 (3.9, 3.8 to 4.0)
Pu category 3 to 4 (n, %, 95% CI)	389 (1.3, 1.2 to 1.5)	124 (1.5, 1.2 to 1.8)	0.884 (0.721–1.084)	p = 0.235	550 (1.7, 1.6 to 1.9)	456 (1.8, 1.6 to 1.9)	0.981 (0.866–1.112)	p = 0.767	1519 (1.6, 1.5 to 1.6)
Pressure ulcers institutional-acquired									
Institutional-acquired PU (category 1 to 4) (n, %, 95% CI)	987 (3.3, 3.1 to 3.6)	278 (3.3, 3.0 to 3.7)	1.002 (0.875–1.147)	p = 0.975	1562 (4.9, 4.7 to 5.2)	1205 (4.7, 4.4 to 4.9)	1.058 (0.979–1.142)	p = 0.153	4032
Institutional-acquired PU (category 2 to 4) (n, %, 95% CI)	529 (1.8, 1.6 to 1.9)	165 (2.0, 1.7 to 2.3)	0.903 (0.757–1.078)	p = 0.258)	630 (2.0, 1.8 to 2.2)	602 (2.3, 2.2 to 2.5)	**0.849 (0.758 to 0.950)**	**p = 0.004**	1926 (2.0)
Body mass index, kg/m^2 (mean, SD) (n = 4187 missing)	24.5 (5.3)	25.4 (4.8)	**0.968 (0.963 to 0.972)**	**p < 0.001**	26.4 (4.8)	26.1 (5.8)	**0.989 (0.986 to 0.992)**	**p < 0.001**	25.6
BMI - underweight (BMI < 18.5) (n, %) (0 = no, 1 = yes)	2932 (9.9)	361 (4.3)	**2.452 (2.191 to 2.743)**	**p < 0.001**	1645 (5.2)	750 (2.9)	**1.839 (1.684 to 2.008)**	**p < 0.001**	5688 (5.8)
BMI – normal (BMI 18.5 to 25) (n, %) (0 = no, 1 = yes)	14238 (48.2)	3832 (46.0)	**1.104 (1.051 to 1.160)**	**p < 0.001**	13256 (41.9)	9717 (37.8)	**1.201 (1.160 to 1.242)**	**p < 0.001**	41046 (42.1)
BMI – preobesity (BMI >25 and < 30) (n, %) (0 = no, 1 = yes)	7519 (25.5)	2726 (32.7)	**0.703 (0.667 to 0.741)**	**p < 0.001**	9274 (29.3)	9810 (38.1)	**0.671 (0.648 to 0.695)**	**p < 0.001**	30023 (30.8)
BMI – obesity (BMI ≥ 30) (n, %) (0 = no, 1 = yes)	4046 (13.7)	1218 (14.6)	**0.932 (0.870 to 0.999)**	**p < 0.001**	6447 (20.4)	4760 (18.5)	**1.136 (1.090 to 1.185)**	**p < 0.001**	16471 (16.9)
Pressure ulcer prevention measures									
Positioning (individual mobility plan) (n, %) (0 = no, 1 = yes)	6033 (20.4)	1603 (19.2)	**1.078 (1.014 to 1.147)**	**p = 0.016**	2932 (9.3)	2045 (7.9)	**1.184 (1.116 to 1.256)**	**p < 0.001**	12613 (12.9)
Positioning not possible (n, %) (0 = no, 1 = yes)	981 (3.3)	351 (4.2)	**0.782 (0.690 to 0.885)**	**p < 0.001**	364 (1.2)	332 (1.3)	0.891 (0.767–1.035)	p = 0.131	2028 (2.1)
Regular skin assessment (n, %) (0 = no, 1 = yes)	21292 (72.1)	5790 (69.5)	**1.136 (1.077 to 1.198)**	**p < 0.001**	10478 (33.1)	7422 (28.8)	**1.223 (1.180 to 1.267)**	p < 0.001	44982 (46.2)
Counseling of patients/ residents (n, %)(0 = no, 1 = yes)	11250 (38.1)	2997 (36.0)	**1.096 (1.042 to 1.153)**	**p < 0.001**	7082 (22.4)	4985 (19.4)	**1.201 (1.153 to 1.251)**	p < 0.001	26314 (27.0)
Counseling of relatives (n, %) (0 = no, 1 = yes)	9815 (33.3)	2491 (29.9)	**1.168 (1.108 to 1.231)**	**p < 0.001**	1614 (5.1)	1381 (5.4)	**0.948 (0.881 to 1.021)**	**p = 0.160**	15301 (15.7)
(Sheep) skin (n, %) (0 = no, 1 = yes)	693 (2.3)	137 (1.6)	**1.438 (1.195 to 1.730)**	**p < 0.001**	185 (0.6)	115 (0.4)	**1.311 (1.038 to 1.655)**	**p < 0.001**	1130 (1.2)
Heel protections (n, %) (0 = no, 1 = yes)	1155 (3.9)	929 (11.2)	1.121 (0.984–1.278)	p = 0.086	1165 (3.7)	783 (3.0)	**1.219 (1.112 to 1.336)**	**p < 0.001**	4032 (4.1)
Mattresses									
Alternating pressure (n, %) (0 = no, 1 = yes)	3383 (11.5)	827 (9.9)	**1.175 (1.084 to 1.273)**	**p < 0.001**	1201 (3.8)	971 (3.8)	1.007 (0.924–1.097)	p = 0.877	6382 (6.6)
Soft positioning (n, %)(0 = no, 1 = yes)	5728 (19.4)	1513 (18.9)	**1.085 (1.019 to 1.155)**	**p = 0.011**	3845 (12.2)	2566 (10.0)	**1.250 (1.185 to 1.318)**	**p < 0.001**	13652 (14.0)
No special mattress (n, %)(0 = no, 1 = yes)	20405 (69.1)	5991 (71.9)	**0.875 (0.829 to 0.923)**	**p < 0.001**	26585 (84.0)	22204 (86.3)	**0.839 (0.801 to 0.879)**	**p < 0.001**	72185 (74.1)

[a] (n = 808 missing values).
[b] (n = 1388 missing values).

means and standard deviations, numbers, proportions and 95% confidence intervals (CI). The variables age and BMI were processed as continuous variables. The ordinal variable mobility was treated as categorical. Missing variables were stated and excluded from the subsequent analysis.

For the description of bivariate associations between men and women at pressure ulcer risk and with institutional-acquired pressure ulcers odds ratios (OR) including 95% CI were calculated.

Comparisons were made for BMI and pressure ulcer prevention measures.

3. Results

3.1. Main characteristics of participants

In the years 2001–2016, n = 99,374 subjects participated in the prevalence studies. Of those, n = 97,415 subjects of about 350 institutions were included in this secondary data analysis. The main characteristics of participants are described in Table 1. In total 38,655 nursing home residents were included. Most of these were women (76.4%). The mean age was 85.4 years for women and 77.3 years for men (OR 1.07 (95% CI 1.06 to 1.07)). Nearly 59,000 hospital patients were included in the final analysis, comprising slightly more women (54% vs. 44%). The mean age of the hospital patients was comparable for both sexes (66.7 years women vs. 63.4 years men).

Men in nursing homes had a higher BMI than female residents. For hospital patients, the mean BMI was comparable for both sexes. Significantly, more women were underweight (BMI <18.5 kg/m^2) in both settings (OR 2.45 (95% CI 2.19 to 2.74) nursing home, OR 1.84 (95% CI 1.68 to 2.01) hospital). Slightly more men in nursing homes and hospitals were pre-obese with a BMI between >25 and < 30.

More women were at PU risk in both settings (OR 1.16 (95% CI 1.10 to 1.22) nursing home, OR 1.20 (95% CI 1.15 to 1.25) hospital). In hospitals, the proportion of IAPUs was 2.0% in women and 2.3% in men. The prevalence of PUs category 2 to 4 was 3.2% in women, 3.6% in men in nursing homes and 4.7% in women, and 4.4% in men in the included hospitals. The incidence of IAPUs category 2 to 4 was 1.8% in female nursing home residents and 2.0% in male residents. Slightly more men had a PU category 2 to 4 in nursing homes or developed a IAPU category 2 to 4 in both settings (OR 0.90 (95% CI 0.76 to 1.08) in nursing homes, OR 0.85 (95% CI 0.76 to 0.95) in hospitals).

Regarding PU preventive measures, the four largest differences between men and women were observed for "sheepskin" (OR 1.44 (95% CI 1.20 to 1.73) nursing home and OR 1.31 (95% CI 1.04 to 1.66) hospital) followed by "soft positioning" (OR 1.25 (95% CI 1.19 to 1.32) hospital), "regular skin assessment" (OR 1.22 (95% CI 1.18 to 1.27) hospital) and "heel protections" (OR 1.22 (95% CI 1.11 to 1.34) hospital). Counseling of patients or residents was more often conducted in women. Alternating pressure mattresses were more often used in female nursing home residents.

3.2. Subjects with pressure ulcer risk

Subjects with PU risk per setting and sex are presented in Table 2. In

Table 2
Comparisons between BMI, pressure ulcer prevention measures and sex in hospitals and nursing homes in individuals at pressure ulcer risk (man = 0, woman = 1).

Variable	Nursing home (n = 16494)				Hospital (n = 11040)				Total
	Women (n = 13093, 79.4%)	**Men** (n = 3401, 20.6%)	p-value	OR (95% CI)	**Women** (n = 6480, 58.7%)	**Men** (n = 4560, 41.3%)	p-value	OR (95% CI)	**n = 27534** (28.3% from the total sample)
Mean age, years (SD)	85.5 (10.0)	76.1 (14.5)	**p < 0.001**	**1.063 (1.060 to 1.067)**	76.9 (13.8)	70.0 (14.6)	**p < 0.001**	**1.034 (1.031 to 1.037)**	–
BMI-underweight (n, %) (BMI < 18.5)	1862 (14.2)	235 (6.9)	**p < 0.001**	**2.252 (1.955 to 2.594)**	493 (7.6)	232 (5.1)	**p < 0.001**	**1.543 (1.313 to 1.813)**	2.822 (10.3)
BMI-normal (n, %) (BM 18.5 to 25)	6728 (51.4)	1789 (52.6)	p = 0.356	0.959 (0.888–1.036)	2791 (43.1)	1893 (41.5)	p = 0.096	1.071 (0.990–1.159)	13.201 (47.4)
BMI – preobesity (BMI >25 and < 30) (n, %) (0 = no, 1 = yes)	2836 (21.7)	917 (27.0)	**p < 0.001**	**0.751 (0.688 to 0.819)**	1690 (26.1)	1463 (32.1)	**p < 0.001**	**0.740 (0.680 to 0.805**	6906 (25.1)
BMI-obesity (n, %) (BMI ≥ 30)	1273 (9.7)	371 (10.9)	**p = 0.048**	**0.884 (0.782 to 0.999)**	1094 (16.9)	691 (15.2)	**p = 0.012**	**1.143 (1.029 to 1.268)**	3429 (12.5)
Positioning (n, %) (individual mobility plan)	5453 (41.6)	1418 (41.7)	p = 0.962	0.962 (0.925–1.077)	2422 (37.4)	1698 (37.2)	p = 0.881	1.006 (0.930–1.088)	10991 (39.9)
Positioning not possible (n, %)	538 (4.1)	204 (6.0)	**p < 0.001**	**0.672 (0.569 to 0.793)**	239 (3.7)	228 (5.0)	**p = 0.001**	**0.728 (0.604 to 0.876)**	1209 (4.4)
Regular skin assessment (n, %)	11276 (86.1)	2903 (85.4)	p = 0.252	1.065 (0.956–1.185)	4612 (71.2)	3186 (69.9)	p = 0.138	1.065 (0.980–1.157)	21977 (79.8)
Counseling of patients/residents (n, %)	5285 (40.4)	1339 (39.4)	p = 0.292	1.042 (0.965–1.126)	2400 (37.0)	1540 (33.8)	**p < 0.001**	**1.154 (1.065 to 1.249)**	10564 (38.4)
Counseling of relatives (n, %)	5892 (45.0)	1479 (43.5)	p = 0.114	1.063 (0.985–1.147)	937 (14.5)	809 (17.7)	**p < 0.001**	**0.784 (0.707 to 0.869)**	9117 (33.1)
(Sheep) skin (n, %)	549 (4.2)	111 (3.3)	**p = 0.014**	**1.297 (1.054 to 1.596)**	110 (1.7)	73 (1.6)	p = 0.695	1.061 (0.788–1.430)	843 (3.1)
Heel protections (n, %)	973 (7.4)	258 (7.6)	p = 0.760	0.978 (0.848–1.128)	693 (10.7)	456 (10.0)	p = 0.239	1.078 (0.951–1.221)	2380 (8.6)
Mattresses									
Alternating pressure (n, %)	2939 (22.4)	708 (20.8)	**p < 0.001**	**1.175 (1.084 to 1.273)**	931 (14.4)	766 (16.8)	p = 0.877	1.007 (0.924–1.097)	5344 (19.4)
Soft positioning (n, %)	3642 (27.8)	924 (27.2)	**p = 0.011**	**1.085 (1.019 to 1.155)**	1533 (23.7)	985 (21.6)	**p < 0.001**	**1.250 (1.185 to 1.318)**	7084 (25.7)
No special mattress (n, %)	6512 (49.7)	1769 (52.0)	**p = 0.001**	**0.875 (0.829 to 0.923)**	4016 (62.0)	2809 (61.6)	**p < 0.001**	**0.875 (0.829 to 0.923)**	15106 (54.9)

Table 3
Comparisons between men and women with IAPUs category 2 to 4 in pressure ulcer prevention measures (man = 0, woman = 1).

	Nursing home (n = 694; missings n = 16)				Hospital (n = 1232; missings n = 27)				Total
	Women (n = 529, 76.2%)	**Men** (n = 165, 23.8%)	**OR (95% CI)**	**p-value**	**Women** (n = 630, 51.1%)	**Men** (n = 602, 48.9%)	**OR (95% CI)**	**p-value**	n = 1926
Mean age, years (SD)	86.2 (8.1)	77.4 (12.8)	**1.090 (1.069 to 1.112)**	**p < 0.001**	76.0 (13.4)	73.0 (13.8)	**1.036 (1.026 to 1.045)**	**p < 0.001**	–
BMI - underweight (BMI < 18.5) (n, %) (0 = no, 1 = yes)	101 (19.6)	28 (17.0)	1.164 (0.733–1.848)	p = 0.519	52 (8.3)	46 (7.6)	1.084 (0.716–1.641)	p = 0.702	227 (11.8)
BMI – normal (BM 18.5 to 25) (n, %) (0 = no, 1 = yes)	265 (50.1)	85 (51.5)	0.954 (0.669–1.362)	p = 0.797	269 (42.7)	242 (40.2)	1.101 (0.873–1.390)	p = 0.417	861 (44.7)
BMI – preobesity (BMI > 25 and < 30) (n, %) (0 = no, 1 = yes)	105 (19.9)	36 (21.8)	0.893 (0.582–1.371)	p = 0.605	145 (23.0)	191 (31.2)	**0.629 (0.487 to 0.813)**	**p < 0.001**	477 (24.8)
BMI – obesity (BMI ≥ 30) (n, %) (0 = no, 1 = yes)	40 (7.7)	11 (6.7)	1.153 (0.577–2.304)	p = 0.687	128 (20.3)	82 (13.6)	**1.622 (1.195 to 2.200)**	**p = 0.002**	261 (13.6)
Positioning (n, %) (0 = no, 1 = yes)	284 (53.7)	83 (50.3)	1.145 (0.807–1.625)	p = 0.447	257 (40.8)	268 (44.5)	0.859 (0.685–1.076)	p = 0.186	892 (46.3)
Positioning not possible (n, %) (0 = no, 1 = yes)	35 (6.6)	17 (10.3)	0.617 (0.336–1.133)	p = 0.119	26 (4.1)	34 (5.7)	0.719 (0.426–1.214)	p = 0.131	112 (5.8)
Skin assessment (n, %) (0 = no, 1 = yes)	468 (88.5)	154 (93.3)	0.548 (0.281–1.068)	p = 0.077	477 (75.7)	451 (74.9)	1.044 (0.806–1.353)	p = 0.746	1550 (80.5)
Counseling of patients/ residents (n, %) (0 = no, 1 = yes)	239 (45.2)	81 (49.1)	0.822 (0.602–1.213)	p = 0.379	251 (39.8)	242 (40.2)	0.985 (0.784–1.237)	p = 0.989	813 (42.2)
Counseling of relatives (n, %) (0 = no, 1 = yes)	266 (50.3)	79 (47.9)	1.101 (0.776–1.562)	p = 0.590	87 (13.8)	139 (23.1)	**0.534 (0.397 to 0.717)**	**p < 0.001**	571 (29.7)
Heel protection (n, %) (0 = no, 1 = yes)	109 (20.6)	30 (18.2)	1.168 (0.746–1.828)	p = 0.497	98 (15.6)	103 (17.1)	0.892 (0.660–1.207)	p = 0.461	340 (17.7)
(Sheep) skin (n, %) (0 = no, 1 = yes)	35 (6.6)	10 (6.1)	1.098 (0.532–2.269)	p = 0.800	17 (2.7)	27 (4.5)	0.591 (0.319–1.095)	p = 0.095	89 (4.6)
Mattresses									
Alternating pressure (n, %) (0 = no, 1 = yes)	221 (41.8)	69 (41.8)	0.998 (0.700–1.423)	p = 0.993	153 (24.3)	177 (29.4)	**0.770 (0.598 to 0.992)**	**p = 0.043**	620 (32.2)
Soft positioning (n, %) (0 = no, 1 = yes)	144 (27.2)	45 (27.3)	0.997 (0.674–1.477)	p = 0.990	177 (28.1)	143 (23.8)	1.254 (0.971–1.620)	p = 0.083	509 (26.4)
No special mattress (n, %) (0 = no, 1 = yes)	164 (31.0)	51 (30.9)	1.004 (0.688–1.466)	p = 0.982	300 (47.6)	282 (46.8)	1.032 (0.825–1.290)	p = 0.785	797 (41.4)

total n = 16,494 nursing home residents (about 80% women and 29% men) and n = 11,040 hospital patients (59% women and 41% men) were at PU risk. Overall women at PU risk were older than men in both settings (85.5 years nursing homes, 76.9 years hospitals). More women were underweight (OR 2.25 (95% CI 1.96 to 2.59) nursing home, OR 1.54 (95% CI 1.31 to 1.81) hospital) and more men were pre-obese. "Positioning not possible" was more often determined in men in both settings (OR 0.67 (95% CI 0.57 to 0.79) nursing home, OR 0.73 (95% CI 0.60 to 0.88) hospital). Soft positioning mattresses were more often applied in women (OR 1.25 (95% CI 1.19 to 1.32) hospital) as well as alternating pressure (OR 1.18 (95% CI 1.09 to 1.27) nursing homes). Counseling of patients or residents was more often conducted in women in hospitals (OR 1.15 (95% CI 1.07 to 1.25) whereas more male hospital patients received counseling of relatives (OR 0.78 (95% CI 0.71 to 0.87).

3.3. Evaluation of subjects with institutional-acquired pressure ulcers

The description of subjects with institutional-acquired pressure ulcers category 2 to 4 is presented in Table 3. In nursing homes, n = 694 residents and in hospitals n = 1232 patients had IAPUs category 2 to 4. The women with an IAPU were older in nursing homes (86.2 years women vs. 77.4 years men) and in hospitals (76.0 years women vs. 73.0 years men). In hospitals, significantly more men with an IAPU received counseling of relatives (OR 0.53 (95% CI 0.40 to 0.72)) and were pre-obese (OR 0.63 (95% CI 0.49 to 0.81)). In contrast, more women with IAPUs in hospitals were obese (OR 1.62 (95% CI 1.20 to 2.20)). Alternating pressure mattresses were more often applied in male patients.

4. Discussion

The aim of this study was to analyze sex-specific differences in PU prevention and treatment of institutional-acquired pressure ulcers in German hospitals and nursing homes. We included a large representative sample of nursing home residents and hospital patients. In summary, the differences between men and women regarding PU occurrence and development were minor. This finding is supported by the results of a systematic review by Coleman et al., 2013, who found only limited evidence that sex is an important PU risk factor. Fifteen studies were included, which analyzed sex as a predictor for PU development. Only four studies out of these demonstrated a relationship whereas three studies identified men at increased risk to develop PUs, one study suggested that men were at decreased risk [27]. A recently published

secondary data analysis evaluated data from acute care hospitals in the USA comprising 6 years and included about 217,000 patients. Men were more probably to have superficial (OR 1.29) and severe pressure ulcers (OR 1.38) [28].

A clear finding of our work is that women at PU risk and with a IAPU were older than men and it is well-known that increased age is associated with increased PU or IAPU development [28,29]. In addition, more women at PU risk in both settings were underweight with a BMI <18.5 kg/m^2 that is also an important indirect PU risk factor [18,28,29]. However, differences between men and women regarding PU and IAPU prevalence were minor possibly indicating that prevention was more effective in women. Indeed, sex related differences regarding PU prevention in residents and patients at PU risk were obvious (Table 2). Women were more like to receive sheepskin in nursing homes and to receive more often special mattresses for PU prevention on both settings.

In subjects with IAPUs category 2 to 4 there were only minor sex related differences (Table 3). The main difference was that male patients more often received counseling of relatives. Perhaps men were considered to need more support compared to women. Gender stereotypes in nurses and nursing care could also influence planning of nursing interventions [30]. However, whether the observed differences actually explain the similar IAPU proportions, although women are clearly at higher risk, is unclear.

It is also possible that body-related nursing interventions like positioning or skin assessment are to a lesser extent sex-related. Interventions such as emotional support, analgesic administration, time to talk or time to help might be more influenced by sex [9]. This is supported by results from Rahn et al. (2016), who did not detect relevant sex differences regarding basic hygiene interventions [31].

4.1. Generalizability

The results are based on a population based approach. Demographic characteristics of the included subjects, e.g. mean age and sex, are comparable to setting specific population parameters. Institutions across the Germany were included in this analysis, which supported the generalizability. In addition, the characteristics of the sample are similar to comparable studies conducted in this population [19,20].

4.2. Limitations

The establishment of causal relationships was not possible due to the cross-sectional design.

The voluntary participation of the institutions, patients and residents could lead to selection and non-response bias. It is possible that only institutions interested in examining and increasing their quality of care participated. Possible cluster effects of this multicenter study were ignored but are assumed to be low in these annual studies [32]. A further limitation were the items and questions on the data collection form. Precise but easy items, procedures and answer categories were used to reduce the misinterpretation and error rate, but it limits the depth of details and information. The large sample size increases the likelihood of statistically significant differences, but overall the effect sizes were small.

5. Conclusion

Although slightly more men had a IAPU, overall differences regarding PU occurrence were minor. Despite the above-mentioned methodological limitations, gender and/or sex can rather not be considered as an independent risk factor for pressure ulcer development. However, there were some differences regarding pressure ulcer prevention. More women were at PU risk, underweight and received a special support surface mattress. Men in hospitals with IAPUs category 2 to 4 received more often counseling of relatives. Overall, gender and/or sex related differences regarding PU prevention interventions seem to be minor.

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Declaration of competing interest

The authors declare that they have no conflict of interest.

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