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Differential associations of the stages of pressure and stasis ulcers and social engagement among nursing home residents

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ABSTRACT

Background: Social engagement is an important determinant of health in older adults. Skin ulcers may adversely impact social engagement among nursing home residents. This study sought to quantify the differential associations between pressure and stasis ulcers and social engagement among long-stay US nursing home residents.
Methods: Cross-sectional, nationally representative data was obtained from the Minimum Data Set 2.0 on US nursing home residents aged ≥ 50 years with an annual assessment between Oct 1, 2009 and Sept 30, 2010. Adjusted prevalence ratios (aPR) of low social engagement among residents with the four stages of pressure and stasis ulcers and 95 % confidence intervals (CI) were estimated from multivariable Poisson models using a generalized estimating equation approach to account for residents nested within nursing homes.
Results: Among the 771,634 residents, 4.5 % had pressure ulcers, and 1.1 % had stasis ulcers. The presence of pressure ulcers, regardless of the stage, was associated with an increased risk of low social engagement (stage 1 aPR: 1.05 (95 % CI: 1.03–1.07); stage 4 aPR: 1.07 (95 % CI: 1.05–1.08)). Residents with stage 1 to 3 stasis ulcers were less likely than those without any skin ulcers to have low social engagement. In contrast, those with stage 4 stasis ulcers had an increased prevalence of low social engagement (aPR: 1.10 (95 % CI: 1.06–1.14)).
Conclusion: Social engagement should be monitored and addressed in residents with skin ulcers. Since pressure and stasis ulcers have different etiologies and treatment modalities, they should be considered separately in the empirical work on their association with social engagement.

1. Introduction

Social engagement facilitates mutual social support between individuals, which is essential for optimal health [1]. Evidence highlights the importance of social engagement in older adults' physical health, mental health, and overall wellbeing [2,3]. As older adults transition to nursing homes or assisted living facilities, the new social environments, often distanced from family and/or community support, can be challenging for their social engagement. Key impediments to social engagement common in older adults include functional and physical limitations [4–8], depression [6,8–10], poor cognition [4–7,10], vision or hearing impartment [4,6,9,11], urinary incontinence [5], and comorbidities [10]. Two descriptive studies broadly characterizing risk factors for poor social engagement identified skin ulcers as factors [4,5] but failed to differentiate between stasis and pressure ulcers, the most common types of skin ulcers in older adults, and adjusted for attributes that likely mediate associations between skin ulcers and social engagement. In this study, we sought to evaluate stasis and pressure ulcers separately to improve our understanding of the extent to which the two types of skin ulcers differ in their magnitude of association with social engagement among nursing home residents.

Pressure ulcers or bed sores are caused by reduced blood flow from sustained pressure over bony prominences such as heels, hip or tail bones, shoulder blades, elbows, or back of the head [12]. In contrast, stasis ulcers result from poor blood circulation due to underlying vascular pathology, usually in the venous system of the lower extremities [13]. Pressure ulcers are common in older adults who are bedridden or use wheelchairs, but people with obesity and in professions requiring prolonged standing are at heightened risk of developing venous insufficiency and stasis ulcers [12,13]. Treatment of pressure ulcers focuses on relieving pressure through periodic repositioning or special devices and improving nutrition; the treatment of stasis ulcers aims to improve

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blood circulation through compression stockings, exercise, and weight reduction [12,13]. Clinical presentation of the two types of skin ulcers is quite similar, progressing in four stages: skin discoloration/local temperature elevation (Stage 1), partial thickness skin loss (stage 2), full thickness skin loss (stage 3), and underlying muscle/tendon or bone tissue exposed (stage 4).

Because of pain and odorous discharge, more advanced stages of pressure ulcers and stasis ulcers may limit residents' ability to socialize with others [14–16]. However, given distinct treatment modalities between stasis and pressure injuries, there may be differential associations with social engagement in early ulcer stages. For example, pressure-relieving devices for pressure ulcers may restrict mobility and reduce social engagement, while encouraging mobility to improve blood circulation for early-stage stasis ulcers may increase social engagement. Social engagement may be reduced for higher stage ulcers of either type due to pain and malodorous discharge. Differential associations of early and late stages of pressure and stasis ulcers with social engagement has not been examined. To address this research gap, we conducted a cross-sectional analysis of national nursing home data to quantify the magnitude of associations between differing stages of pressure and stasis ulcers and low social engagement. As a cross-sectional analysis, this study will be able to identify correlations between skin ulcers and social engagement but will be limited in its ability to evaluate the directionality of the association. However, analytical decisions were made with the intent to prioritize the development of skin ulcers as the potential cause of social isolation.

2. Methods

2.1. Data source

The most recent year of the Centres for Medicare and Medicaid Services (CMS) Minimum Data Set (MDS 2.0) to include social engagement items was 10/2009- 9/2010 [17]. We used MDS 2.0 from this year for this analysis. The MDS is a standardized assessment tool capturing information on all residents of all Medicare/Medicaid eligible nursing homes, representing the majority of US nursing homes. A team of health professionals completes the admission, quarterly, annual, and "significant change" assessments by referring to medical records, talking to residents and their families, and observing the residents. Our reliance on data from 2009 to 2010 is supported by the comprehensiveness of the data and the expectation that the association between skin ulcers and social engagement is mediated through mechanisms that have remained consistent over time (e.g., wound associated pain, aesthetics, odor, embarrassment). University of Massachusetts Chan Medical School IRB approved the study with waivers of consent and HIPPA authorization.

2.2. Study sample

We identified long-stay residents aged ≥ 50 years with annual assessments. If residents had multiple assessments, we considered the earliest. We excluded comatose residents (see Fig. 1). After removing individuals with missing data on skin ulcers, social engagement, or key covariates, 771,634 residents were eligible.

2.3. Measures

2.3.1. Skin ulcers

The primary determinant of interest was the presence of skin ulcers. The MDS 2.0 documents the number and stage of pressure and stasis ulcers. We created two separate sets of dummy indicators for pressure and stasis ulcers based on their highest stage – none (reference group), stage 1, stage 2, stage 3, and stage 4. Since wound manifestations such as pain, odor, and discharge increase at higher stages, we hypothesized that the association between the presence of skin ulcers and low social engagement would be stronger with higher stages of both ulcer types. Because immobility is a strong risk factor for pressure ulcers, we hypothesized that residents with pressure ulcers may be more susceptible to social disengagement. Given that stasis ulcers may occur in highly mobile residents, we hypothesized that stasis ulcers would have a lesser impact on social engagement.

2.3.2. Social engagement

The primary outcome was low social engagement. Embedded within the MDS 2.0, the Index of Social Engagement (ISE) is a sum of six affirmative statements that captured nursing home residents' ability to initiate and engage in social interactions and activities, each coded as 0 or 1. The six items are: 1) resident is at ease interacting with others, 2) resident is at ease doing planned or structured activities, 3) resident is at ease doing self-initiated activities, 4) resident establishes own goals, 5) resident pursues involvement in the life of the facility, and 6) resident accepts invitations into most group activities. Nursing home staff used their judgment to assess nursing home residents' social engagement. The sum score ranges from 0–6, with a higher score indicating higher social engagement. The psychometric properties of this index have been well established [18]. We dichotomized social engagement (0–2 (low

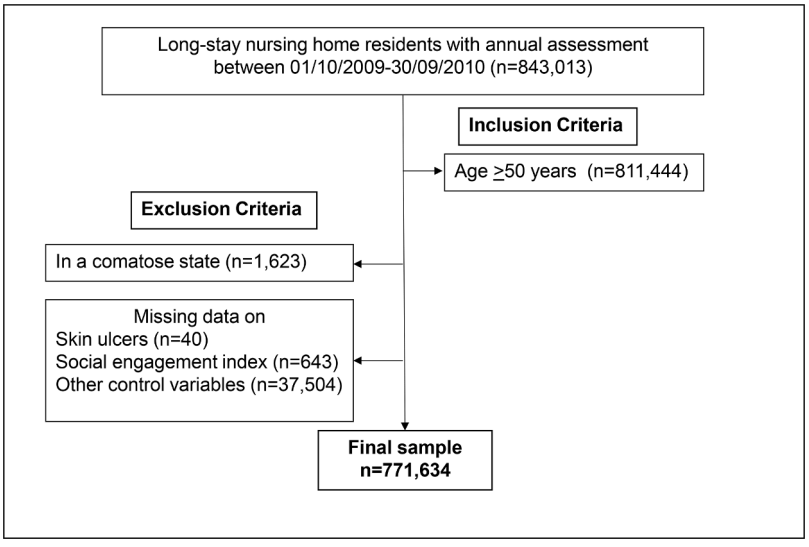

Fig. 1. Sample construction flowchart.

engagement) vs. 3–6 (not low)), an operationalization that has been conceptually substantiated and used previously [8,9,11].

2.3.3. Confounders

Demographic characteristics included *age* (50 - 64 years, 65 - 74, 75 - 84, and ≥85 years); *sex* as reported by nursing staff; *race and ethnicity* (non-Hispanic White only (reference group), non-Hispanic Black only, Hispanic of any race(s), non-Hispanic Asian/Pacific Islander only, and non-Hispanic American Indian/Alaskan Native only); and *marital status* (married, not married). *Cognitive impairment* was assessed with the Cognitive Performance Scale (CPS), a seven-point summary scale scored based on the resident's comatose status, short-term memory, decision-making skills, being understood by others, and their ability to feed themselves. Morris and colleagues [19] describe the algorithm for the summary scale and its psychometric properties. Residents were classified as having intact/mild (0–2), moderate (3–4), or severe cognitive impairment (5–6). *Depression* was determined based on an active clinical diagnosis (yes/no). Residents were classified as having *delirium* if they had any of the six symptoms in CAM (Short Confusion Assessment Method): "easily distracted, periods of altered perception, disorganized speech, periods of restlessness, periods of lethargy, and mental function varies over the course of a day" [20]. *Body Mass Index (BMI)* was calculated as weight in kilograms divided by height in meters squared ($< 18.5\ kg/m^2$, $18.5\ kg/m^2 \leq BMI < 25.0\ kg/m^2$ (reference), $25.0\ kg/m^2 \leq BMI < 30.0\ kg/m^2$, $\geq 30.0\ kg/m^2$). Active comorbid conditions included *heart failure, anemia, hypertension, hypotension, Alzheimer's disease, Parkinson's disease, multiple sclerosis, peripheral vascular disease, pneumonia, urinary tract infection, multidrug-resistant organisms, and septicemia* (each yes/no).

We used a seven-category hierarchical measure of residents' *functional ability*. Four activities of daily living (ADL): personal hygiene, toileting, locomotion, and eating, were graded on a scale ranging from full independence to total dependence [21]. Residents were classified as independent/few limitations (0–2), moderately dependent (3–4), and dependent (5–6). We noted if residents have an active diagnosis of *arthritis, recent fractures, recent history of falls, balance problems,* or *unsteady gait* (each yes/no). *Vision* and *hearing* abilities were measured as a set of dichotomous variables (1 = adequate, 0 = impaired) after compensating with glasses or hearing aids. We also considered if residents had *urinary incontinence or catheterization, fecal incontinence, ostomy, feeding tube,* or *IV line* (each yes/no). We did not adjust for measures of pain and mood since we hypothesized that these are primary mechanisms through which skin ulcers may impact social engagement.

2.4. Statistical analysis

We performed descriptive statistics stratified by skin ulcer status (no ulcers, with pressure ulcers, and with stasis ulcers). Residents with both pressure and stasis ulcers were included in both skin ulcers categories. Given the large sample size, we considered absolute differences of 5 % between groups to be noteworthy. We also characterized the number and highest grade of pressure and stasis ulcers among residents, history of resolved ulcers, and various treatments administered. To quantify associations between skin ulcers and social engagement, we relied on unadjusted and multivariable-adjusted modified Poisson models to calculate prevalence ratios (PR and aPR, respectively) and 95 % confidence intervals (CI). Since the detection of pressure and stasis ulcers in a given nursing home may have shared influences across residents, we employed a generalized estimating equation approach to account for within-nursing home variation.

Models were run separately for pressure and stasis ulcers to quantify crude associations between skin ulcers and social engagement. Due to differences in etiology and treatment, we hypothesize that residents with early-stage pressure ulcers are more likely to have low social engagement, and residents with early-stage stasis ulcers will be less likely to have low social engagement. However, due to pain and discharge, both types of skin ulcers in advanced stages will be associated with low social engagement. The model for pressure ulcers included 763,417 residents [those with at least one pressure ulcer ($n = 34,745$) or no skin ulcers ($n = 728,672$)]. The model for stasis ulcers included 737,947 residents [those with at least one stasis ulcer ($n = 9275$) or no skin ulcers ($n = 728,672$)]. For the multivariable-adjusted models, potential confounders were based on clinical knowledge and the construction of a directed acyclic graph. Each multivariable model was developed iteratively by evaluating the extent to which each covariate impacted the effect estimate for the skin ulcer indicators. Covariates selected *a priori* (age group, sex, race/ethnicity), and those resulting in a further 5 % change or greater in odds ratios for skin ulcer indicators were selected for inclusion. Using a linear model with each outcome, we estimated variance inflation factors to examine multicollinearity. None had a variance inflation factor of 2.5 or higher.

3. Results

Overall, 5.5 % of residents had any skin ulcer: 4.5 % had at least one pressure ulcer, and 1.2 % had at least one stasis ulcer. Tables 1 and 2 show nursing home residents' demographic characteristics and clinical profiles by skin ulcer status. The prevalence of skin ulcers increases with advancing age, and they are more common among women. More non-Hispanic Black residents were in the skin ulcer groups than the non-skin ulcer group. There are notable clinical differences in the way in which nursing home residents with pressure ulcers and stasis ulcers

Table 1
Demographic and clinical measures of long-stay residents in US nursing homes by presence of skin ulcers.

	With Pressure Ulcers (N = 34,745)	With Stasis Ulcers (N = 9275)	With Neither Ulcers (N = 728,672)
	Percentage		
Age (years)			
50- 65	13.2	13.5	11.4
65 – 74	14.6	16.6	13.5
75 – 84	29.3	28.9	28.5
85 and above	43.0	41.0	46.6
Men	31.7	40.9	28.4
Race/Ethnicity			
Non-Hispanic White	76.2	76.3	79.9
Non-Hispanic Black	17.2	18.6	13.6
Hispanic, of any race (s)	4.8	3.7	4.4
Non-Hispanic Asian/ Pacific Islander	1.3	0.8	1.7
Non-Hispanic American India/ Alaskan Native	0.5	0.6	0.4
Married	21.6	16.7	17.2
Body mass index			
$< 18.5\ kg/m^2$	10.5	5.7	5.9
$\geq 18.5\ kg/m^2$ and $< 25.0\ kg/m^2$	39.2	29.6	36.7
$\geq 25.0\ kg/m^2$ and $< 30.0\ kg/m^2$	26.7	27.2	30.3
$\geq 30.0\ kg/m^2$	23.6	37.6	27.2
Cognitive impairment			
Mild or intact	27.8	44.9	30.8
Moderate	43.8	43.5	51.6
Severe	28.4	11.7	17.5
Activities of daily living limitations			
Independent or few limitations	5.3	23.1	27.1
Moderately dependent	36.7	47.6	44.8
Dependent	58.0	29.3	28.1

Notes: Columns for pressure ulcers and stasis ulcers are not mutually exclusive; 1058 residents had both pressure and stasis ulcers documented.

Table 2
Comorbidities and symptoms of long-stay residents in US nursing homes by presence of skin ulcers.

	With Pressure Ulcers (N = 34,745)	With Stasis Ulcers (N = 9275)	With Neither Ulcers (N = 728,672)
	Percentage		
Clinical diagnoses			
Depression	54.4	53.6	56.3
Delirium	1.1	0.8	1.0
Heart failure	24.6	33.1	21.5
Anaemia	35.1	36.7	28.5
Hypertension	70.8	74.9	71.9
Hypotension	1.8	1.3	1.3
Peripheral vascular disease	21.0	52.2	14.6
Alzheimer's/other dementias	55.8	44.4	59.2
Parkinson's disease	8.9	4.8	7.0
Multiple sclerosis	4.5	1.2	1.3
Pneumonia	3.3	1.7	1.2
Urinary tract infection	13.2	7.2	6.3
Multidrug-resistant organism	3.6	5.1	0.7
Septicemia	0.9	0.6	0.1
Vision problems	46.6	38.1	40.0
Hearing problems	29.9	27.9	30.5
Arthritis	35.0	36.8	36.2
History of recent falls	23.0	28.2	30.3
Recent fractures	2.2	1.4	1.1
Balance/gait problems	99.0	96.3	92.0
Bowel incontinence/ ostomy			
Continent	14.1	39.5	39.3
Usually continent	4.9	8.2	8.0
Occasionally incontinent	4.4	5.3	6.0
Frequently incontinent	8.8	9.2	10.0
Incontinent	62.0	35.0	34.9
Ostomy	5.9	2.7	1.9
Urinary incontinence/ catheterisation			
Continent	6.7	22.4	22.6
Usually continent	2.9	7.4	7.3
Occasionally incontinent	4.5	8.7	9.0
Frequently incontinent	12.6	18.1	19.5
Incontinent	51.7	34.5	37.9
Catheterised	21.6	9.0	3.8
Feeding tube	14.2	5.1	4.5
Intravenous line	1.8	1.2	0.4

Notes: Columns for pressure ulcers and stasis ulcers are not mutually exclusive; 1058 residents had both pressure and stasis ulcers documented.

Table 3
Characteristics of skin ulcers and skin ulcer management among long-stay residents in US nursing homes.

	Pressure Ulcer (N = 34,745)	Stasis Ulcer (N = 9275)	Neither Ulcers (N = 728,672)
	Percentage		
Total number of skin ulcers			–
One	70.0	55.6	–
Two	19.1	24.9	–
≥ Three	10.9	19.5	–
Highest Stage of Skin Ulcer Reported			–
Stage 1	16.0	6.1	–
Stage 2	54.3	58.5	–
Stage 3	11.5	16.4	–
Stage 4	18.2	19.0	–
History of resolved ulcers	30.6	33.4	5.6
Skin treatments			
Pressure relieving device for chair	72.2	67.1	51.7
Pressure relieving device for bed	91.1	86.8	79.1
Turning/ repositioning	62.2	45.1	35.0
Nutrition/hydration	55.1	49.2	10.7
Ulcer care	80.6	81.6	0.5*
Dressings	60.4	60.2	8.6
Ointments	69.5	64.6	28.1
Other protective skincare	77.2	74.6	62.3

Notes: Missing data: total number of stasis ulcers (n = 1); history of resolved ulcers – pressure ulcers (n = 24), stasis ulcers (n = 9), no skin ulcer (n = 368); Pressure relieving device for chair – pressure ulcers (n = 3), no skin ulcer (n = 76); Pressure relieving device for bed – pressure ulcers (n = 1), stasis ulcers (n = 1), no skin ulcer (n = 38); Turning/repositioning – pressure ulcers (n = 2), no skin ulcer (n = 35); Nutrition/hydration – pressure ulcers (n = 1), no skin ulcers (n = 46); Ulcer care – pressure ulcers (n = 3), no skin ulcers (n = 44); Dressings – pressure ulcers (n = 3), stasis ulcers (n = 1), no skin ulcer (60); Ointments – pressure ulcers (n = 1), stasis ulcers (n = 2), no skin ulcers (n = 79); Other protective skincare – pressure ulcers (n = 2), stasis ulcer (n = 1), no skin ulcer (n = 36).
Columns for pressure ulcers and stasis ulcers are not mutually exclusive; 1058 residents experienced both pressure and stasis ulcers.
* Refers to ulcers due to abrasions, burns, cancer lesions, cuts, or other skin conditions.

differed from those with no skin ulcers, reflecting the distinct etiopathogenesis of the two types of skin ulcers.

Residents with pressure ulcers fared worse on nutritional health outcomes, and were more likely to have medical issues that curtail mobility. On the other hand, residents with stasis ulcers had poorer cardiovascular outcomes. For example, residents with pressure ulcers had lower BMI, whereas those with stasis ulcers were more likely to have a BMI of 30 kg/m^2 or more; both ulcer groups were more likely to be anemic than the no ulcer group. Residents with pressure ulcers had higher rates of severe cognitive impairment, ADL dependence, vision problems, urinary tract infection, urinary and bowel incontinence, and feeding tubes. Whereas heart failure and peripheral vascular disease were more common among those with stasis ulcers relative to residents with pressure ulcers or no skin ulcers.

Thirty percent of residents with pressure ulcers had multiple ulcers; 44.4 % of those with stasis ulcers had more than one (Table 3). Stage 2 ulcers were most common (pressure ulcers: 54.3 %; stasis ulcers: 58.5 %). A third of those with a pressure or stasis ulcer had a history of resolved skin ulcers, compared to 5.6 % among those with no current skin ulcer. Preventive treatment for pressure ulcers is also widely administered to residents with no skin ulcers. Most residents used pressure-relieving devices for chairs or beds regardless of the presence of skin ulcers. While 62.2 % of those with pressure ulcers had repositioning programs documented, 45.1 % of those with stasis ulcers and 35.0 % of those without skin ulcers had this treatment documented. Eight in ten residents with skin ulcers received ulcer care. Ointments and dressings were used in six of ten residents with skin ulcers.

Results from the unadjusted and adjusted multivariable modified Poisson models are shown in Table 4. In the pressure ulcer analysis, more than half of residents had low social engagement. The unadjusted prevalence ratios between pressure ulcer stage and low social engagement ranged from 1.20 (95 % CI: 1.18–1.23) for stage 1 to 1.30 (95 % CI: 1.28–1.33) for stage 4. Adjustment for age, gender, race/ethnicity, cognitive impairment, body mass index, and bowel incontinence attenuated these associations (stage 1 aPR: 1.05 (95 % CI: 1.03–1.07;) stage 4: 1.07 (95 % CI: 1.05–1.08)), with further attenuation when adjusting for ADLs. In the stasis ulcer analysis, 50.8 % of those without skin ulcers had low social engagement. The prevalence of low social engagement was reduced in residents with stage 1 to 3 stasis ulcers (41.9 % (stage 2) to 45.6 % (stage 1 and 3) and higher in residents with stage 4

Table 4
Association between skin ulcer and low social engagement of long-stay residents in US nursing homes.

		Prevalence ratios (95 % confidence intervals)		
Highest Stage	% with low social engagement	Unadjusted	Partially adjusted*	Fully adjusted**
Pressure Ulcer (n = 771,634)				
None	50.1	Reference	Reference	Reference
Stage 1	60.7	1.20 (1.18 - 1.23)	1.05 (1.03 - 1.07)	1.02 (1.00 - 1.04)
Stage 2	61.4	1.22 (1.21 - 1.24)	1.04 (1.03 - 1.05)	1.01 (1.00 - 1.02)
Stage 3	67.4	1.29 (1.26 - 1.32)	1.08 (1.06 - 1.10)	1.04 (1.02 - 1.06)
Stage 4	69.0	1.30 (1.28 - 1.33)	1.07 (1.05 - 1.08)	1.02 (1.00 - 1.04)
Stasis Ulcer (n = 737,947)				
None	50.8	Reference	Reference	Reference
Stage 1	45.6	0.92 (0.85 - 1.00)	0.98 (0.91 - 1.06)	0.95 (0.88 - 1.02)
Stage 2	41.9	0.86 (0.83 - 0.88)	0.98 (0.95 - 1.00)	0.96 (0.93 - 0.99)
Stage 3	45.6	0.86 (0.82 - 0.91)	0.98 (0.93 - 1.03)	0.97 (0.92 - 1.01)
Stage 4	55.3	1.07 (1.02 - 1.11)	1.10 (1.06 - 1.14)	1.04 (1.00 - 1.08)

* Partially adjusted models- Pressure ulcer: age, sex, race/ethnicity, cognition, body mass index, and bowel incontinence; Stasis ulcer: age, sex, race/ethnicity, cognition, and peripheral vascular disease.
** Fully adjusted models also included activities of daily living in addition to the variables included in the partially adjusted models.

stasis ulcers (55.3 %)). Residents with stasis ulcers in stages 1 to 3 were less likely to have low social engagement. Residents with stage 4 stasis ulcers had an increased prevalence of low social engagement compared to those with no skin ulcers (partially adjusted PR: 1.10 (95 % CI: 1.06–1.14); fully adjusted PR: 1.04 (95 % CI: 1.00–1.08)). The shared covariance within nursing homes was between 18.9 % - 20.4 %.

4. Discussion

Despite the longstanding availability of the MDS 2.0 data, this is the first study to investigate the differential association between the stages of pressure ulcers, stasis ulcers, and social engagement among nursing home residents. In our cross-sectional analyses, residents with early stages (1, 2, and 3) of pressure and stasis ulcers had opposite associations with social engagement, but in stage four, both types of skin ulcers were associated with increased risk of low social engagement. Nursing home residents with pressure ulcers of all stages had lower social engagement compared to those with no ulcers. However, for stasis ulcers, early stages were associated with decreased social engagement, and only stage 4 ulcers were associated with an increased likelihood of low social engagement.

In advanced stages, pressure and stasis ulcers have similar trajectories of more severe pain and discomfort, which may interfere with residents' ability and desire to participate in social activities. The social stigma associated with unsightly wound/bandage aesthetics and odor for higher stage skin ulcers may also result in social avoidance. Past qualitative studies support these potential explanations [14,16].

The distinct risk factors and treatments for pressure and stasis ulcers may explain the divergent association with social engagement in the early stages of ulcer development. Residents with pressure ulcers suffer from poor overall health, as evidenced by a greater likelihood of lower body mass index and anemia. Limitations in ADLs were more common among residents with pressure ulcers, reflective of restricted mobility. Poor health and restricted mobility are known risk factors for pressure ulcers [22]. Treatments for pressure ulcers include pressure relieving devices (chairs/mattresses/dressings) and in-room manual manipulation through all four stages, likely restricting their social engagement. In contrast, individuals with stasis ulcers are more likely to have peripheral vascular disease. They are likely to be more mobile and are encouraged to increase physical activity to limit ulcer progression. For early-stage stasis ulcers, the guidance to increase physical activity may result in increased opportunities for social engagement. This may explain why we observed slightly improved associations with social engagement for stage 1–3 stasis ulcers and reduced social engagement with stage 4 stasis ulcers when pain and other wound manifestations are more severe.

Skin ulcers are common and consequential complications in nursing home residents, which can lead to increased social isolation. These residents, living with multiple health conditions and separated from familiar surroundings and connections, are already at a heightened risk of low social engagement [5,10,23]. Maintaining adequate social engagement is important to mental and physical health and to prevent the detrimental effects of loneliness [2,3]. Further research into effective tailored approaches aimed at improving social engagement for residents with skin ulcers, matched to their type and stage, is needed.

Low grade pressure and stasis ulcers are not always recognized in nursing home residents [24]. This is particularly problematic in residents with darker pigmented skin when staff look for skin reddening rather than purplish shades and/or feel for locally elevated temperatures [25]. Thus, low-grade ulcers may have been underreported in our study. However, since low grade ulcers are unlikely to evoke some of the more relevant side effects affecting social engagement (e.g., unsightliness, discharge, or odor), this under detection may not influence our findings substantially, particularly in relation to higher grade skin ulcers.

As a cross-sectional analysis, it was not possible to investigate potential reverse causation between low social engagement and skin ulcers. For example, social disengagement may lead to reduced mobility and, thus, to an increased risk of pressure ulcers. Regardless, our finding that residents with higher stage skin ulcers are at risk for social disengagement provides valuable information that can be used to improve the quality of care provided to nursing home residents. Given the cross-sectional nature of our data, we did not perform formal mediation analyses of ADLs. However, our analysis suggests that further exploration of ADL limitations as a mediator in longitudinal studies of the association between skin ulcers and low social engagement may be warranted.

We used the most recent available MDS data capturing social engagement. This limited us to MDS version 2.0 during 2009 and 2010 since the social engagement measure was not assessed in MDS 3.0. Though it is possible that treatment and prevention measures may have changed or improved since these data were collected, our hypothesized mechanisms of association would remain relevant today. Specifically, pain, discomfort, and wound manifestations associated with skin injuries are anticipated to contribute to an association with social engagement consistently over time. However, our data does not reflect changes in social engagement of nursing home residents with the growth of digital communication tools since 2010. Residents with skin ulcers may have physical limitations, but continue to be socially engaged through video calls or social media. Incorporating social engagement measures in future versions of the MDS would help document evolving social interaction patterns.

Since skin ulcers often have negative downstream effects, it is essential to continue to screen and administer preventive treatments for all nursing home residents. When treating pressure ulcers with pressure relieving devices, caregivers must be mindful of the potential impact on resident social engagement. Susceptible residents may benefit from targeted interventions to facilitate and encourage social engagement. There is a need for longitudinal study designs to explore the extent to which reduced social engagement is associated with the development of pressure ulcers. Our study findings underscore the importance of differentiating pressure ulcers from stasis ulcers in empirical work as is done in clinical practice. Given the growing recognition of social engagement as a key determinant of health, the re-introduction of the

social engagement index to an updated version of the MDS 3.0 could add valuable information about a resident's well-being and overall health status.

5. Conclusion

Residents with pressure ulcers of any stage or higher stage stasis ulcers had reduced social engagement after adjustment for key confounders. For stasis ulcers, those with lower grade ulcers were less likely to have reduced social engagement, which may reflect a difference in treatment/prevention strategies, encouraging residents to get up, move around, and thus engage more with other residents and staff. Facilitating social engagement among nursing home residents is a critical aspect of care to maintain physical and mental health.

CRediT authorship contribution statement

Anyah Prasad: Writing – original draft, Investigation, Formal analysis, Conceptualization. **Anthony P. Nunes:** Writing – original draft, Visualization, Supervision, Investigation, Formal analysis, Conceptualization. **Bill M. Jesdale:** Validation, Supervision, Formal analysis, Data curation, Conceptualization. **Natalia N. Nielsen:** Writing – review & editing, Conceptualization. **Catherine E. Dubé:** Writing – review & editing, Conceptualization. **Deborah S. Mack:** Writing – review & editing. **Kate L. Lapane:** Writing – review & editing, Validation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

None of the authors have conflicts of interest.

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