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Title page

Pressure injury prevalence and predictors among older adults in the first 36-hours of hospitalisation

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Abstract

Aims and objective: To describe the prevalence and predictors of pressure injuries among older adults with limited mobility, within the first 36-hours of their hospital admission in Australia.

Background: Pressure injuries are significant health, safety and quality of care issues for patients and healthcare organisations. The early implementation of the recommended pressure injury prevention international clinical practice guidelines is a way to reduce hospital-acquired pressure injuries. There is a paucity of evidence on the number of older persons who are admitted hospital with a pre-existing pressure injury.

Design: Prospective correlational study conducted in eight tertiary referral hospitals across Australia. Our sample comprised of 1047 participants aged ≥65 years with limited mobility, drawn from a larger Australian pragmatic cluster randomised trial.

Methods: Using the STROBE statement, observational data were collected on participants' age, gender, presence of a pressure injury, Body Mass Index score, number of comorbidities and place of residence. These variables were analysed as potential predictors for pressure injuries within the first 36-hours of hospitalisation.

Results: From our sample, 113/1047 (10.8%) participants were observed to have a pressure injury within the first 36-hours of hospital admission. Age, multiple comorbidities, and living in an aged care facility predicted the prevalence of pressure injury among older people within the first 36-hours of hospitalisation.

Conclusions: Our findings confirm that older adults, those with multiple comorbidities, and individuals living in aged care facilities are more likely to come to hospital with a pre-existing pressure injury or develop one soon after admission.

Relevance to clinical practice: Many older patients come to hospital with a community-acquired pressure injury or develop a pressure injury soon after admission. This highlights the importance of the early detection of pressure injuries among older persons so that timely management strategies can be implemented along with the potential to reduce unnecessary financial penalties.

What does this paper contribute to the wider global clinical community?

- Some older adults with limited mobility come to hospital with a pre-existing pressure injury or develop one soon after admission
- Undertaking a skin assessment soon after hospital admission allows for the early detection of pressure injuries among older patients, and clinicians' subsequent implementation of appropriate treatment and management strategies
- Prompt skin assessment for pressure injuries on hospital admission allows clinicians to accurately determine if these are community-acquired or hospital-acquired; potentially avoiding unwarranted financial penalties.

Introduction

Globally, people are living longer (UNFPA and HelpAge International, 2012), which is often associated with chronic disease (Hahnel, Lichterfeld, Blume-Peytavi, & Kottner, 2017). For adults aged 65 years and older, chronic illness such as cardiovascular and respiratory disease account for almost one quarter of the total burden of disease (Prince et al., 2015). Appropriate community care models allow many older adults with complex health needs to live well at home (Cohen-Mansfield & Jensen, 2005; Prince et al., 2015; World Health Organisation, 2016). However, advancing age can result in skin changes, and when coupled with reduced mobility and multiple comorbidities, increases the risk of pressure injury (PI) development (Hahnel et al., 2017).

Background

PIs, or pressure ulcers, are skin or tissue injuries caused by shear, friction and/or unrelieved pressure (European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel, & Pan Pacific Pressure Injury Alliance, 2014). Internationally, PIs are a safety and care quality issue (Australian Commission for Safety and Quality in Healthcare, 2017; Cooper, Vellodi, Stansby, & Avital, 2015; Power, Stewart, & Brotherton, 2012) that can increase hospital length of stay (Worsley, Smith, Schoonhoven, & Bader, 2016), healthcare costs (Demarré, Van Lancker, et al., 2015; Nguyen, Chaboyer, & Whitty, 2015) and adversely affect patient outcomes (Latimer, Chaboyer, & Gillespie, 2014). Experts agree most PIs are avoidable (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016), with some organisations instigating financial penalties for hospital-acquired pressure

injuries (HAPI) (Agency for Healthcare Research and Quality, 2014; Queensland Government, 2013; Sanada et al., 2010). For example, in the United States of America (USA) the Centers for Medicare and Medicaid Services (2018) may reduce payments to healthcare facilities with reported HAPIs, while some Australian hospitals impose financial penalties of between $30,000-$50,000 for each Stage III, IV and unstageable HAPI (Queensland Government, 2013).

International clinical practice guidelines (CPG) for pressure injury prevention (PIP) recommend that patients have a skin inspection and a risk assessment soon after, or within the first eight-hours of hospitalisation (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). This allows nurses to identify and document PIs and implement targeted PIP strategies such as support surfaces, repositioning and skin care (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). The ageing process is known to increase older adults' vulnerability to PI development, so undertaking these assessments soon after hospital admission can help expedite the implementation of individualised PIP strategies (Latimer, Chaboyer, & Gillespie, 2016; Latimer, Gillespie, & Chaboyer, 2015).

Generally, patients develop PIs in hospital or at home (Graves & Zheng, 2014). For example, some patients develop a HAPI during their admission, while others present to hospital with a pre-existing PI; known as a community-acquired pressure injury (CAPI) (Graves & Zheng, 2014). Considerable research is published on HAPI prevalence (Bredesen, Bjøro, Gunningberg, & Hofoss, 2015; Mallah, Nassar, & Kurdahi Badr, 2015; Miles, Fulbrook, Nowicki, & Franks, 2013; Moore et al., 2015) which some claim ranges between 1%-27% (Graves & Zheng, 2014), however a lack of consistent methods for determining prevalence,

as recommended by the EPUAP (Defloor et al., 2005) means reported prevalence can vary widely. Less is known about the numbers and profiles of patients admitted to hospital with a CAPI (Graves & Zheng, 2014; Hahnel et al., 2017); estimated at 6%-26% (Asimus & Li, 2011; Corbett, Funk, Fortunato, & O'Sullivan, 2017; Keelaghan, Margolis, Zhan, & Baumgarten, 2008; Sardo et al., 2016). Yet often, CAPIs are not the primary reason for a patient's hospitalisation, rather they are a secondary health concern (Hahnel et al., 2017) frequently occurring on the sacrum and heels (Asimus & Li, 2011; Corbett et al., 2017; Sardo et al., 2016; Worsley et al., 2016) with a stage I or II (Asimus & Li, 2011; Sardo et al., 2016).

Hospitals receive patients from the community or aged care facilities (Corbett et al., 2017; Keelaghan et al., 2008; Worsley et al., 2016). A United Kingdom (UK) study found 81% (*n* = 1026) of older patients with a CAPI on hospital admission lived at home and were on average aged 80 years (Worsley et al., 2016). Similar findings have been reported in the USA (*n* = 1022; 76%), with one third (31%) of study participants living alone; suggesting older community-dwelling people are a vulnerable group (Corbett et al., 2017). In another study comparing two different populations, the PI prevalence on hospital admission was higher among aged care residents (26.2%) than community-dwellers (4.8%) (Keelaghan et al., 2008). These studies confirm that older adults living in the community are vulnerable to developing CAPIs, with increasing age, multiple comorbidities (Hahnel et al., 2017), reduced mobility (Keelaghan et al., 2008; Worsley et al., 2016) and home care support gaps (Corbett et al., 2017; Prince et al., 2015) likely contributors. Compounding this, delaying a patient's skin inspection following hospitalisation, could impede the prompt identification of a pre-existing CAPI or areas of skin experiencing prolonged pressure, shear or friction. There is limited empirical data exists on PI prevalence among older adults on or soon after hospital

admission including some of their predictors (Hahnel et al., 2017). Thus, this a vital research area.

The aim of this Australian study was to describe the prevalence, stage and predictors of PIs in adults aged ≥65 years, with reduced mobility, and within the first 36-hours of hospital admission. We hypothesised the following patient factors (age, gender, Body Mass Index [BMI], number of comorbidities, place of residence) predicted the prevalence of PIs in adults aged ≥65 years with limited mobility within the first 36-hours of hospital admission. The variables of age, gender, BMI and number of comorbidities were selected because these risk factors feature in the most commonly used validated PI risk assessment tools (Waterlow tool, Braden scale, Norton scale) (Moore & Patton, 2019).

Methods

This prospective correlational study is based on a sub-analysis of a larger Australian cluster randomised trial (c-RT) (INTACT Trial) of an evidence-informed PIP intervention delivered to hospitalised patients at risk of PI (Australian New Zealand Clinical Trials Registry: ACTRN12613001343796) (Chaboyer et al., 2016). The INTACT trial measured the effectiveness of a patient education care bundle on the prevention of HAPIs. The education care bundle comprised three simple messages, delivered to patients via a video, poster and brochure: keep moving; look after your skin; eat a healthy diet (Chaboyer et al., 2015).

The study settings were general medical and surgical clinical units across eight private and public tertiary Australian hospitals. These hospitals had between 270 and929 acute medical, surgical and rehabilitation beds.

Our sample, drawn from the c-RT participants (Figure 1) (Chaboyer et al., 2016), were: aged ≥65 years; had limited mobility; a minimum hospital stay of ≥48 hours and a hospital stay of >36 hours prior to recruitment; able to read English; and provide an informed, written consent. Patients could be recruited only once into the study. Exclusion criteria included: day surgery patients, critical care, emergency, maternity, paediatrics, mental health or dialysis and palliative care; or receiving end of life care. Limited mobility was a screening criterion because it is a major PI risk factor (European Pressure Ulcer Advisory Panel et al., 2014). We defined 'limited mobility' as the patient's use of human or equipment resources (e.g. staff, wheelchair) to mobilise or reposition (Chaboyer et al., 2015). Following initial screening, eligible participants received a verbal and written study overview, and if willing, provided a written consent. Human research ethics committee approvals were obtained from the hospitals and universities.

Data collection followed the STROBE statement for observational studies (see Supplementary File 1). Using a secure web-based platform, semi-structured observations and chart audits, informed by international CPG for PIP (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016), were used to collect participant data. Before data collection, all Research Assistants (RA), who were nurses or nursing students, undertook a one-day skin inspection training workshop, with a summative assessment undertaken to measure their competency (Stankiewicz, Webster, Wallis, Tallot, & Chaboyer, 2016). The site investigator and RA assigned to each recruited hospital were responsible for participant recruitment, which occurred between 0800-1600 Monday to Friday during the data collection period (June 2014 to May 2015) (Chaboyer et al., 2015). It is recommended that skin inspection is undertaken within the first 8-hours of admission (European Pressure

Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). However due to the study design and limited number of RAs available at each study site (unavailable 24-hours a day, 7-days a week), potential participants were recruited within the first 36-hours of their hospital admission. Following recruitment, a baseline skin assessment to detect PIs was completed by a trained RA.

Baseline assessment comprised of demographic and clinical data including age, gender, BMI, place of residence [community/aged care], number and type of comorbidities, a full visual skin inspection and the number of PIs. These factors were chosen because they are identified as increasing a person's risk of PI development (Dorner, Posthauer, & Thomas, 2009; European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). Continence status and management were excluded as variables because the patient education care bundle did not specifically address this issue.

BMI is an index used to measure an individuals' amount of body fat (Department of Health, 2009). In this study, BMI were classified as 'healthy' (18.5-25.0) and 'not healthy' (<18.5 and >25.0) (Chaboyer et al., 2015). Comorbidity data was collected on cardiovascular, pulmonary, neurological and chronic conditions because these conditions are identified risk factors in many validated risk assessment tools (Moore & Patton, 2019). 'Admission to hospital' was defined as the study recruitment time (i.e. ≤36 hours of hospitalisation) and not the actual hospital admission time documented in the medical file. Our study was undertaken in general medical and surgical clinical units with admission pathways of most of these patients being via the emergency department (medical/surgical patients) or post-anaesthetic care unit (PACU) for surgical patients. Therefore, we determined the ≤36 hours of hospitalisation period was an appropriate recruitment timeframe because it took into

account potential delays between hospital presentation and patients' actual admission to the recruited clinical unit. This timeframe also gave the RA sufficient time to undertake a full skin inspection of recruited participants. 'Place of residence' was defined as participants living in the community (independently ± support services) or an aged care facility.

The data extracted from the c-RT dataset (Chaboyer et al., 2016) was cleaned and its distribution checked using SPSS (version 24). Descriptive statistics were run to describe the sample, PI prevalence (number of people with an existing PI at study recruitment/number of population in this study sample x 100) and staging within the first 36-hours of hospital admission. Using Stata (version 14), a cluster adjusted univariate and multivariate logistic regression analysis was undertaken, with hospitals as the cluster. Cluster adjusted analyses were required because data from each hospital site are related to each other (i.e. the data from one hospital is expected to be similar because of various hospital practices in that particular site) and needs to be taken into consideration in analyses (Jayatillake, Sooriyarachchi, & Senarathna, 2011). This analysis used the binary dependent variable (PI at baseline: 0 = No; 1 = Yes) and five predictor independent variables (age, gender, BMI score, number of comorbidities, place of residence [community versus aged care]); with gender and place of residence dummy coded (0 = No; 1 = Yes). The following assumptions were checked prior to the regression analysis: sufficient outcome cases per predictor; multicollinearity between the independent variable predictors; and a visual inspection for outliers (Field, 2013). With limited research on this topic, a simultaneous model building approach was deemed appropriate for the regression because it gives researchers the freedom to select the predictors based on current evidence (Field, 2013). First, univariate analysis was completed between the dependent variable and each predictor variable (Field,

2013). Next, statistically significant ($p < 0.05$) predictor variables were simultaneously entered into the final regression analyses (Field, 2013). Sample size influences analysis accuracy (Field, 2013), hence 10-20 outcome cases per predictor variable are recommended (Polit, 2013). With five study predictors, we required 50-100 participants, to increase the stability and robustness of the regression model (Polit, 2013).

Results

In total, 1047/1598 (65.5%) participants aged ≥65 years with limited mobility were eligible for inclusion in our sub-sample analysis (Figure 1).

Our sample comprised of slightly more females (*n* = 562; 53.6%) compared to males. Two-thirds (*n* = 605; 57.8%) of participants had ≥2 comorbidities, with a mean age of 78 years (*SD* 8.1). Most lived independently in the community (*n* = 950; 90.7%), with an average BMI of 27.7 (*SD* 6.5) which is considered overweight.

The PI prevalence among our older adults with limited mobility, and within the first 36-hours of hospitalisation was 10.8% (*n* = 113; [95% CI: 9.0; 12.8]). This figure reflects the number of participants with one or more PIs identified at the baseline skin inspection undertaken by the RA. Most participants (*n* = 92/113; 81.4%) identified with a PI within ≤36 hours of hospitalisation lived in the community, compared to 21 participants who were admitted from an aged care facility. While slightly less than one-third (*n* = 31/113; 27.4%) of participants had two or more PIs, we reported data on the highest staged PI. Stage I PIs, where the skin remains intact and non-blanchable erythema is evident (European Pressure Ulcer Advisory Panel et al., 2014), were observed in 51/113 (45.1%) participants. The

remainder (*n* = 62/113; 54.9%) had a ≥Stage II PI, where skin integrity has been breached, and may involve a PI that is unstageable or the presence of a suspected deep tissue injury (European Pressure Ulcer Advisory Panel et al., 2014). Among participants admitted from aged care facilities, Stage I (*n* = 10/113; 8.8%) and II (*n* = 6/113; 5.3%) PIs were observed. Stages III, IV or unstageable PI were observed among 15/113 (13.3%) participants within the first 36-hours of hospitalisation, with most of these individuals (*n* = 13/113; 87.0%) living independently in the community. There were more males (*n* = 58/113; 51.3%) with a PI compared to females. Among both groups (community and aged care facility dwellers) two-thirds of participants with a PI (*n* = 49; 43.4%) had ≥3 comorbidities such as cardiovascular disease (*n* = 84; 74.3%) and diabetes mellitus (*n* = 31; 27.4%) (Table 1).

Cluster adjusted univariate analysis of the dependent variable (PI within the first 36-hours of hospital admission) and five predictor variables was undertaken. Except for gender (*p* = 0.298) and BMI score (*p* = 0.332), the remaining statistically significant predictors were simultaneously entered into the cluster adjusted multiple logistic regression model. Patient age, number of comorbidities and place of residence (aged care) were statistically significant for predicting PIs within the first 36-hours of hospital admission among older adults with limited mobility (Table 2). We found that as participants' age increased by one year, there was a 5% increased likelihood they would have or develop a PI within 36-hours of hospitalisation. For each additional comorbidity, older adults were 22% more likely to develop a PI within the first 36-hours of hospitalisation. Finally, aged care residents were 75% more likely to have a PI on admission or within the first 36-hours of hospital admission, compared to community-dwelling participants.

Discussion

The aim of this study was to describe the prevalence, stage and some predictors of PIs in a group of older hospital patients. Our sample consisted of participants aged ≥65 years with limited mobility; acknowledged PI risk factors (Coleman et al., 2013; European Pressure Ulcer Advisory Panel et al., 2014; Nonnemacher et al., 2009; Wounds Australia, 2016). We found a 10.8% PI prevalence among participants within ≤36-hours of hospitalisation; consistent with international findings (Asimus & Li, 2011; Corbett et al., 2017; Keelaghan et al., 2008; Sardo et al., 2016). For example, a USA study reported a 6.6% PI prevalence on hospital admission among their sample of patients aged ≥65 years (Keelaghan et al., 2008). Others have reported PI prevalence on hospitalisation among adult patients aged ≥18 years (Sardo et al., 2016) and those living in the community (Asimus & Li, 2011) ranging between 7.9% (Sardo et al., 2016) to 8.9% (Asimus & Li, 2011). While these two latter studies did not solely recruit patients aged ≥65 years, between 31.3% (Asimus & Li, 2011) and 95.8% (Sardo et al., 2016) of their samples were aged ≥60 years; reflecting contemporary patient populations. There is international consensus on the definition of PI prevalence (Baharestani et al., 2009), so while our results appear similar to these studies, we acknowledge that different data collection methods (our baseline skin assessment was undertaken within the first 36-hours of hospitalisation) and variations in study populations make it challenging to directly compare prevalence findings (Baharestani et al., 2009; Vanderwee, Clark, Dealey, Gunningberg, & Defloor, 2007). However, our results **(10.8%)** confirm that many older adults either present to hospital with PIs, or develop them soon after admission; demonstrating their pre-existing vulnerability and the need for early PI risk assessment, skin inspection and management.

More than half (54.9%) of our participants had a Stage ≥II PI; confirming previous studies that reported figures of 57.7% (Sardo et al., 2016) and 70.3% (Asimus & Li, 2011) among their community-dwelling participants. Keelaghen et al. (2008) found significantly higher numbers of Stage ≥II PI (93.8%) among aged care participants being admitted to hospital. Older aged care residents tend to have higher health and nursing care needs (Demarré et al., 2012) and a susceptibility for frailty (Prince et al., 2015). This somewhat accounts for the large difference in the Keelaghen et al. (2008) findings and may partly explain our results. Other factors such as reduced mobility, multiple comorbidities and age-related skin changes (Hahnel et al., 2017) may also explain our findings. However, it is clear many older individuals come to hospital with concerning skin integrity breaches (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016), with the presence of a PI ≥Stage III considered a measure of frailty (Sardo et al., 2016). This highlights the importance of detecting PIs on or within a few hours following hospital admission because early assessment allows clinicians to implement timely PIP strategies. Skin inspections should be completed within the first eight-hours of hospital admission (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). This is vital given some immobile and older adults have the propensity to develop a PI after only one-hour of unrelieved pressure (Gillespie et al., 2014). Delays in PI risk assessment, skin inspection, PIP and treatment among older adults may have detrimental impacts on their current medical or surgical health status (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). This is particularly important since PI are often not the primary reason for hospitalisation (Hahnel et al., 2017). Previous studies report that older adults regularly experience delays in receiving PIP resources such as support surfaces (Worsley et al., 2016) and repositioning (Latimer et al., 2015). Thus, PIP strategies can be implemented in a timely

manner that responds to the care needs of older individuals (Latimer et al., 2016; Latimer et al., 2015), while providing healthcare organisations with precise CAPI data.

Conducting a skin inspection within the first eight-hours of hospitalisation reflects current evidence-based practice (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). Yet, identifying a PI at the upper-limit of this timeframe (e.g. seven or eight-hours) increases the inaccuracy of its assessment as a HAPI or CAPI because some PIs develop within a few hours of unrelieved pressure (Gillespie et al., 2014). Inaccurate data can result in negative consequences for patients' nurses and healthcare organisations. In a recent qualitative study, nurses' reported feelings of guilt and shame when their patients developed PIs (Carlsson & Gunningberg, 2017). In some clinical settings, hefty financial penalties are imposed when patients develop a ≥Stage III HAPI (Padula, Mishra, Makic, & Sullivan, 2011; Queensland Government, 2013). Our findings show that many older adults are admitted to hospital with a ≥Stage II PI within the first 36-hours of hospitalisation, which could result in some of these PI being mistakenly assessed as a HAPI (Miles et al., 2013). This has serious consequences for organisations in terms of fiscal and resource allocation, and national and international PI prevalence benchmarking. Gathering timely data on CAPI will help avoid financial infringements.

In our study, the factors of patient age, number of comorbidities and place of residence (aged care facility) predicted the presence of PIs within 36-hours of hospitalisation among people aged ≥65 years with limited mobility. Advancing age and limited mobility are known HAPI risk factors (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016), however evidence around CAPIs or PIs present on hospital admission is lacking (Hahnel et al., 2017). We found that for every additional year of age,

older participants with limited mobility are 5% more likely to present to hospital with a PI, or develop one within the first 36-hours of hospitalisation. Our research confirms the results of a recent Portuguese study that identified advancing age as a CAPI predictor, with those aged ≥80 years most vulnerable (Sardo et al., 2016). Peoples' life expectancy is increasing (Prince et al., 2015), and this brings aged-related skin changes, which may partly explain our findings (Hahnel et al., 2017; Prince et al., 2015). Older adults frequently experience mobility restrictions, which can increase their PI risk due to reduced pressure load shifting capabilities (Cohen-Mansfield & Jensen, 2005; Hahnel et al., 2017; Prince et al., 2015). Many older adults admitted to hospital present with complex care needs (Cohen-Mansfield & Jensen, 2005; Prince et al., 2015), however some clinicians may overlook their frailty (Asimus & Li, 2011; Dellefield, Castle, McGilton, & Spilsbury, 2015).

Many older adults live in the community with chronic illness and multiple comorbidities (Hahnel et al., 2017; Prince et al., 2015); increasing their healthcare needs (Prince et al., 2015) and PI risk (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016). In our study, for every additional comorbidity, older adults with limited mobility are 22% more likely to develop a PI within 36-hours of hospitalisation. While no single factor explains our findings, comorbidities such as cardiovascular, neurological and respiratory disease are known PI risk factors (European Pressure Ulcer Advisory Panel et al., 2014; Wounds Australia, 2016) associated with frailty (Prince et al., 2015) and older populations (Latimer et al., 2015; Prince et al., 2015). Furthermore, multiple comorbidities often result in poly-pharmacy, with some medications such as corticosteroids potentially compromising the skin integrity of older adults (Jafferany, Huynh, Silverman, & Zaidi, 2012); although we did not collect this data. Providing older adults in

the community with individualised integrated care models and access to quality home health services that meet their specific needs (World Health Organisation, 2016) is the first step to reducing PIs. This may potentially improve the lives of older adults (Prince et al., 2015) and reduce hospital costs associated with PIs (Padula et al., 2011).

We found place of residence was a significant predictor, with older adults living in an aged care facility 75% more likely to present with or develop a PI within the first 36-hours of hospitalisation. Similar findings were reported in a USA study, with aged care residents 50% more likely to have a pre-existing CAPI on hospital admission (Keelaghan et al., 2008). In contrast, a recent UK study found most of their participants (81%) who presented to hospital with a CAPI, resided at home (Worsley et al., 2016). The different study locations may partly explain these findings. For example, Worsley et al's (2016) study was conducted on an island off the UK coast, with the local rural hospital the main provider of limited healthcare for residents. Meanwhile, the USA study was undertaken at two large inner city hospitals, with numerous local nursing homes in their catchment (Keelaghan et al., 2008); similar to our study settings. Older adults living in aged care facilities generally have complex healthcare needs (Demarré, Verhaeghe, et al., 2015), tend to require repositioning assistance (Keelaghan et al., 2008) and depend on others for their care (Cohen-Mansfield & Jensen, 2005). Furthermore, the rising cost of nursing home care has seen a reliance on paraprofessionals such as assistants in nursing to deliver residents' care, with suggestions that staff skill mix is closely linked to care quality (Dellefield et al., 2015). This highlights the vulnerability of this population and the need for clinicians to be vigilant in the early detection and management of PIs at the point of hospitalisation.

We acknowledge several caveats when interpreting these findings. The reported PI prevalence was detected through skin inspection, within the first 36-hours of hospitalisation. This means some of the reported PIs may have been CAPIs or developed during the period following admission; making them a HAPI. Our study examined predictive variables most commonly identified in validated risk assessment tools, and not all known risk factors associated with PI development. Additionally, our study participants were older adults with limited mobility; two recognised PI risk factors that could influence our findings and subsequent interpretations.

Conclusion

Many older adults with limited mobility and living in the community enter hospital with a pre-existing CAPI or develop a HAPI within the first 36-hours of hospitalisation. Aged care residents are more likely to have a PI on hospital admission; increasing their vulnerability and impacting their health outcomes. Skin inspection and assessment is recommended within the first eight-hours following hospitalisation to detect PI. Ensuring this patient assessment is undertaken as close to hospital admission as possible would improve older adults' access to PIP resources. Early risk assessment will also allow organisations to accurately gather and report PI prevalence, potentially avoiding unwarranted financial penalties.

Relevance to clinical practice

This study provides empirical evidence on PI prevalence, staging and predictors among older adults with limited mobility within the first 36-hours of hospital admission; important findings for clinicians and healthcare managers. This information can assist clinicians and managers to identify opportunities for the early detection and prompt management of PIs on hospital admission, potentially avoiding unnecessary penalties. Older adults living in aged care facilities, who are often immobile and experience complex care and medical needs, featured among those with PIs in our study. Undetected PIs are a major threat to older adults' health status. Therefore, completing a risk assessment through skin inspection on hospital admission will augment the delivery of targeted clinical strategies that may improve their health outcomes. Our study findings have the potential to provide the impetus to initiate a future study to incorporate skin inspection into the baseline observations undertaken when patients are admitted to hospital.

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Table 1 Frequency and stage of pressure injuries within 36-hours of hospital admission per patient (*n* =113)

Pressure Injury Stage	**I** **n (%)**	**II** **n (%)**	**III** **n (%)**	**IV** **n (%)**	**Unstageable** **n (%)**	**Suspected Deep Tissue Injury** **n (%)**
Overall	51 (45.1)	39 (34.5)	5 (4.4)	2 (1.8)	8 (7.1)	8 (7.1)
Gender						
Female (*n* = 55)	32 (58.2)	13 (23.6)	2 (3.6)	0 (0.0)	3 (5.5)	5 (9.1)
Male (*n* = 58)	19 (32.8)	26 (44.8)	3 (5.2)	2 (3.4)	5 (8.6)	3 (5.2)
Age Group						
65-74 (*n* = 23)	9 (39.2)	10 (43.5)	1 (4.3)	1 (4.3)	0 (0.0)	2 (8.7)
75-84 (*n* = 45)	17 (37.8)	19 (42.2)	3 (6.7)	1 (2.2)	1 (2.2)	4 (8.9)
≥85 (*n* = 45)	25 (55.6)	10 (22.2)	1 (2.2)	0 (0.0)	7 (15.6)	2 (4.4)
BMI Category						
Underweight (*n* = 7)	4 (57.1)	2 (28.6)	1 (14.3)	0 (0.0)	0 (0.0)	0 (0.0)
Healthy Weight (*n* = 50)	30 (60.0)	12 (24.0)	1 (2.0)	1 (2.0)	3 (6.0)	3 (6.0)
Overweight (*n* = 28)	9 (32.1)	11 (39.3)	1 (3.6)	0 (0.0)	4 (14.3)	3 (10.7)
Obese (*n* = 28)	8 (28.6)	14 (50.0)	2 (7.1)	1 (3.6)	1 (3.6)	2 (7.1)
Number of comorbidities						

Pressure Injury Stage						
	I **n (%)**	**II** **n (%)**	**III** **n (%)**	**IV** **n (%)**	**Unstageable** **n (%)**	**Suspected Deep Tissue Injury** **n (%)**
0 (*n* = 11)	5 (45.5)	5 (45.5)	0 (0.0)	0 (0.0)	1 (9.1)	0 (0.0)
1 (*n* = 24)	12 (50.0)	10 (41.7)	1 (4.2)	0 (0.0)	0 (0.0)	1 (4.2)
2 (*n* = 29)	15 (51.7)	9 (31.0)	0 (0.0)	0 (0.0)	2 (6.9)	3 (10.3)
≥3 (*n* = 49)	19 (38.8)	15 (30.6)	4 (8.2)	2 (4.1)	5 (10.2)	4 (8.2)
Place of residence						
Community (*n* = 92)	41 (44.6)	33 (35.9)	4 (4.3)	1 (1.1)	8 (8.7)	5 (5.4)
Aged Care (*n* = 21)	10 (47.6)	6 (28.6)	1 (3.6)	1 (3.6)	0 (0.0)	3 (10.7)

Table 2 Crude and cluster adjusted predictors of pressure injuries within 36-hours of hospital admission among participants aged ≥65 years

Predictors	**Crude OR [95% CI][1]**	***p* value**	**Cluster Adjusted OR [95% CI] [1]**	***p* value**
Age	1.05 [1.02, 1.08]	<0.001	1.05 [1.02, 1.08]	<0.001
Number of comorbidities	1.20 [1.07, 1.36]	0.002	1.22 [1.08, 1.37]	0.001
Place of residence				
Aged care	1.79 [1.34, 2.39]	<0.001	1.75 [1.32, 2.32]	<0.001
Community	Reference		Reference	
Gender				
Male	1.26 [0.81, 1.96]	0.298		
Female	Reference			
BMI score	0.97 [0.93, 1.02]	0.332		

[1] cluster adjusted univariate and multivariate logistic regression models

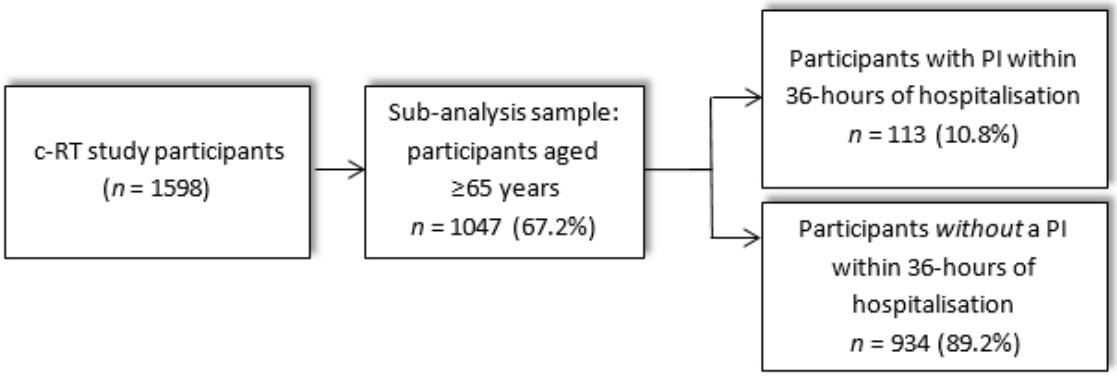

Figure 1. Sample participant recruitment