RESEARCH ARTICLE

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The impact of a national quality register in the analysis of risks and adverse events among older adults in nursing homes and hospital wards—a Swedish Senior Alert survey

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Abstract

Background: The proportion of elderly in the population in Sweden is increasing. Older adults are more vulnerable to disease and disability which in turn increases the prevalence of negative events as pressure ulcers, malnutrition, falls, and oral health problems.

Methods: By using Senior Alert (SA), a quality registry for care prevention, analyze data concerning risks and adverse events and show the potential of the register for quality improvement and research in nursing homes and hospitals.

Results: There are differences in the prevalence of pressure ulcers and weight loss in nursing homes compared to hospitals, explained by different risk scores in the assessment tools used as well as differences in the populations with regard to age and days to follow-up. Falls are more prevalent in nursing homes. Fall prevalence decreases more with higher pressure ulcer risk due to factors such as degree of mobility; the fall prevalence decreases for even higher pressure ulcer risk.

Conclusions: The team around the older person needs a more inter-professional profile including healthcare such as physiotherapists, occupational therapists, dietitians, and dental health professionals.

Trial registration: The study is an observational retrospective register-based study, using data from SA during 2015.

Keywords: Prevention, Care prevention, Nursing home, Hospital ward, Quality registry, Quality improvement

Background

In Sweden, the proportion of elderly in the population is increasing. Half of those born today will live to be 100 years, and, subsequently, life expectancy is predicted to rise from 84 to 89 years for women and from 80 to 87 years for men between 2017 and 2060 [1]. Despite recent positive findings that the elderly population is more active and healthy than ever [2], aging is still associated with declining function in physiological systems leading to the condition of frailty, which can be defined as a state of decreased reserve and resistance to stressors as a result of cumulative decline across multiple physiological systems, causing vulnerability to different outcomes [3]. Due to frailty, older adults are more vulnerable to disease and disability which in turn increases the prevalence of negative events such as pressure ulcers, malnutrition, falls, and oral health problems [4] [5].

Pressure ulcers are common in geriatric care; here, prevalence has been estimated at 18% in Europe and 21% in Sweden [6], causing reduced quality of life, pain, fear, and social isolation [7]. Evidence-based recommendations suggest the use of multifactorial interventions to meet individual needs [8] including, e.g., pressure relieving mattresses, mattresses for treatment, and nutrition intervention [7, 9, 10].

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Trinks *et al. Safety in Health*　　　(2018) 4:10

Page 2 of 11

The prevalence of malnutrition is well documented. A multinational study including 24 pooled studies (*n* = 4500) showed that the prevalence of malnutrition in persons ≥ 65 years old (mean age 82 years) varies between 6 and 51% depending on the type of care setting [11]. In a recent Swedish study of persons ≥ 65 years of age, the prevalence was more than 9% while 55% were at risk of malnutrition when admitted to hospital. Risk factors were overnight fast > 11 h, < 4 eating episodes per day, and not being able to cook independently [12]. Those at risk should undergo an individual assessment to find the cause/causes of malnutrition and enable decisions regarding appropriate treatment. Energy dense meals and oral nutritional supplements (ONS) have been shown to improve energy and protein intakes, increase body weight, improve nutritional status, and reduce complications and mortality [13–19]. Eating support through verbal encouragement and physical support may also be beneficial [20].

Falls are by far the most common type of accident resulting in a need for hospitalization among older adults with an estimated annual cost to society of approximately SEK 14 billion. In Sweden, approximately 17,000 persons per year suffer hip fractures and 1500 die as a result of falls. In addition, the psychological consequences can be devastating, since fear of falling may have a severe impact on a person's self-confidence and thereby affect quality of life, health, and activity level. About 40% of older persons who have suffered a hip fracture cannot return to their original residence [21]. The risk of falling is related to frailty, which has an impact on everyday activities, deterioration of balance, and vision in combination with the need for medication [22]. Multifactorial interventions are complex and comprise a combination of exercise and a review of medication, the home environment, feet and footwear, and vision and visual aids, carried out by a multidisciplinary team [23].

The oral health of older adults in Sweden has changed dramatically in recent decades with more people retaining their teeth. The proportion of toothless 80-year-olds has decreased over 30 years from 56 to 6% [24]. In frail older adults, the ability to manage oral hygiene often declines while risk factors for oral diseases increase [25–27]. Complicating factors include low competence in oral health and oral care among nursing home staff [28, 29]. In addition, older adults tend to lose contact with dental services [30, 25]. Based on the above, it is not surprising that poor oral health is commonly observed in frail and dependent older adults [27]. Good oral hygiene and fluoride supplements are effective preventive measures. If a person is unable to manage their oral hygiene, it should be included in the routines to be carried out by the nursing staff. Another, crucial preventive factor is maintaining or re-establishing regular dental care [31].

Senior Alert

In Sweden, there are more than 100 national quality registries. These registries contain individual data regarding health care interventions, procedures, and outcomes and are used for increasing the quality and improvements in care, and for research. Senior Alert (SA) is one such registry. Initially, the register focused pro-actively on three risk areas: malnutrition, pressure ulcers, and falls among people ≥ 65 years. In contrast to other registers in which data are registered retrospectively, Senior Alert is unique in that it also promotes quality improvement by stimulating staff to perform screening, action taking, and follow-up. It was started in the early 2000s and became a national quality registry in 2008. The risk areas are related, and it is mandatory to assess risks in all three risk areas in individual's ≥ 65 years [32].

In 2011, oral health was included as part of the preventive care process (Fig. 1). Registration of oral health is optional, but the proportion of assessments including oral health has increased with time. In 2014, assessment of bladder dysfunction, a global health problem affecting more than 50 million people, especially women, was included for Swedish municipalities. It is estimated that 500,000 people in Sweden suffer from this condition, which is probably an under estimate of the true prevalence [33, 34]. It can lead to a person needing to move to a nursing home, where the prevalence is 70–80% [35]. Bladder dysfunction is related to risk of falling, poly-pharmacy, frailty, and a lower quality of life (QoL) [36]; however, since this is a new risk area in the SA register, the number of registrations is still low and therefore not included in this paper.

The preventive care process starts with risk assessment, and if a risk is registered, this is followed by three steps (Fig. 1). In SA, the preventive care process should be repeated for the same individual over time and always when a new care contact is initiated (Fig. 1) [32].

Risk assessments in SA are made using evidence-based tools. Falls can be assessed by using one of two different tools in the registry, the Downton Fall Risk Index (DFRI) [37], or two screening questions recommended by the National Board of Health and Welfare [38] and the Swedish Association of Local Authorities and Regions [39]. For malnutrition and pressure ulcers, there are also two
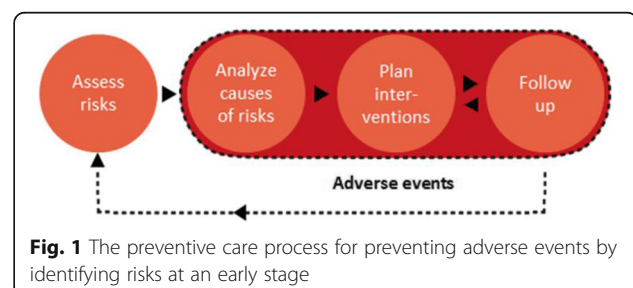

Fig. 1 The preventive care process for preventing adverse events by identifying risks at an early stage

Trinks *et al. Safety in Health* (2018) 4:10

Page 3 of 11

different risk assessment tools available. Malnutrition is assessed using either Minimal Nutrition Assessment—Short Form (MNA-SF) [40] or three screening questions recommended by [38]. Pressure ulcers are assessed using the Modified Norton [41] or the Risk Assessment Pressure Sore (RAPS) [42]. Oral health is performed using the Revised Oral Assessment Guide (ROAG) [43]. These screening tools all produce a risk score. For DFRI, the score is 0–11 points, for MNA-SF 0–14 points, for Norton 7–28 points, and for ROAG 0 2–27 points. Each instrument has a cutoff defining the risk. The cutoff for risk for DFRI is ≥ 3 points, for MNA-SF ≥ 11 points, for Norton ≥ 20 points, and for ROAG ≥ 2 points. If the screening questions are used for assessment, a response of yes to one question indicates risk.

The use of the registry has increased rapidly since it was started (Fig. 2). In 2016, about 90% ($n = 270$) of municipalities and about 70% ($n = 16$) of county councils in Sweden participated in order to evaluate and develop elderly care locally. However, the overall potential of the register as a tool to improve the care of older adults has so far not been recognized. The aim of this study is therefore to analyze baseline and follow-up data in terms of risks and adverse events on a national level to show the potential of the register for quality improvement of care and research.

Methods

This study is an observational retrospective register-based study using data from SA in 2015.

The exclusion criteria are shown in Fig. 3. The two largest types of care settings are nursing homes and hospital wards. Other settings are excluded in this study. Only the first preventive care process per person made during 2015 is included. Individuals with values out of range, e.g., weight measures of < 20 or > 200 kg, and missing values are excluded. There are $n = 63{,}811$ persons in nursing homes and $n = 96{,}677$ in hospital wards included, defined as the *total study population*. However,

oral health assessment is not used for all individuals and, since different assessment tools exists for measurement of falls, pressure ulcers and malnutrition, we needed to exclude individuals in order to obtain a sample where all four risk assessments had been made for the same individual; this is necessary to study the associations between risk areas. Thus, all risk assessments other than those consisting of DFRI, MNA-SF, Norton, and ROAG were excluded. This constitutes the *final study population*. For comparison of outcomes, we excluded individuals without follow-up during 2015. This constitutes the *final study outcome population*.

Sample size

Due to the large sample sizes in nursing home and hospital ward populations, very small differences in several variables between populations became statistically significant (Tables 1, 2, and 3). However, for length of stay, there is a striking difference between populations (Table 2).

Outcome measurements

The measurements used to define outcomes are falls, pressure ulcers, and weight. Falls, defined by Swedish Associations of Local Authorities and Regions (SALAR) [39], are registered as so-called events and may have occurred at any time in the process. We defined this outcome as 1 if there had been at least one fall recorded and 0 otherwise. Pressure ulcers are registered at base line risk assessment or at follow-up. We defined the outcome as 1 if at least one pressure ulcer existed either at baseline or at follow-up and 0 otherwise. Weight is registered at baseline risk assessment and at follow-up, which made it possible to define the outcome as 1 if weight loss > 5% had occurred and 0 otherwise.

Statistics

Due to the large sample sizes in all nursing home, and hospital ward populations, differences in age and BMI
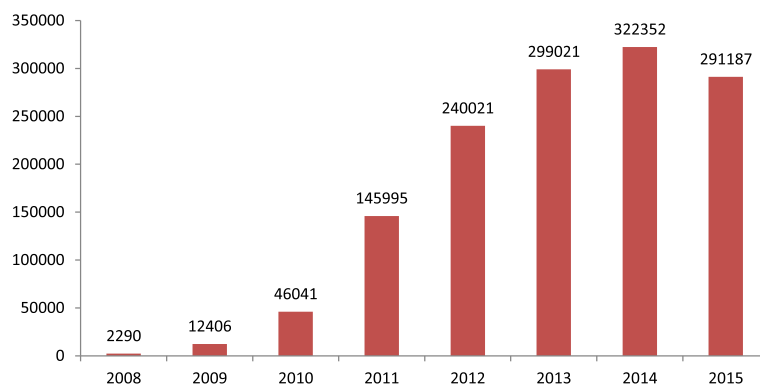

Fig. 2 Number of preventive care processes on persons 65 years or older 2008–2015
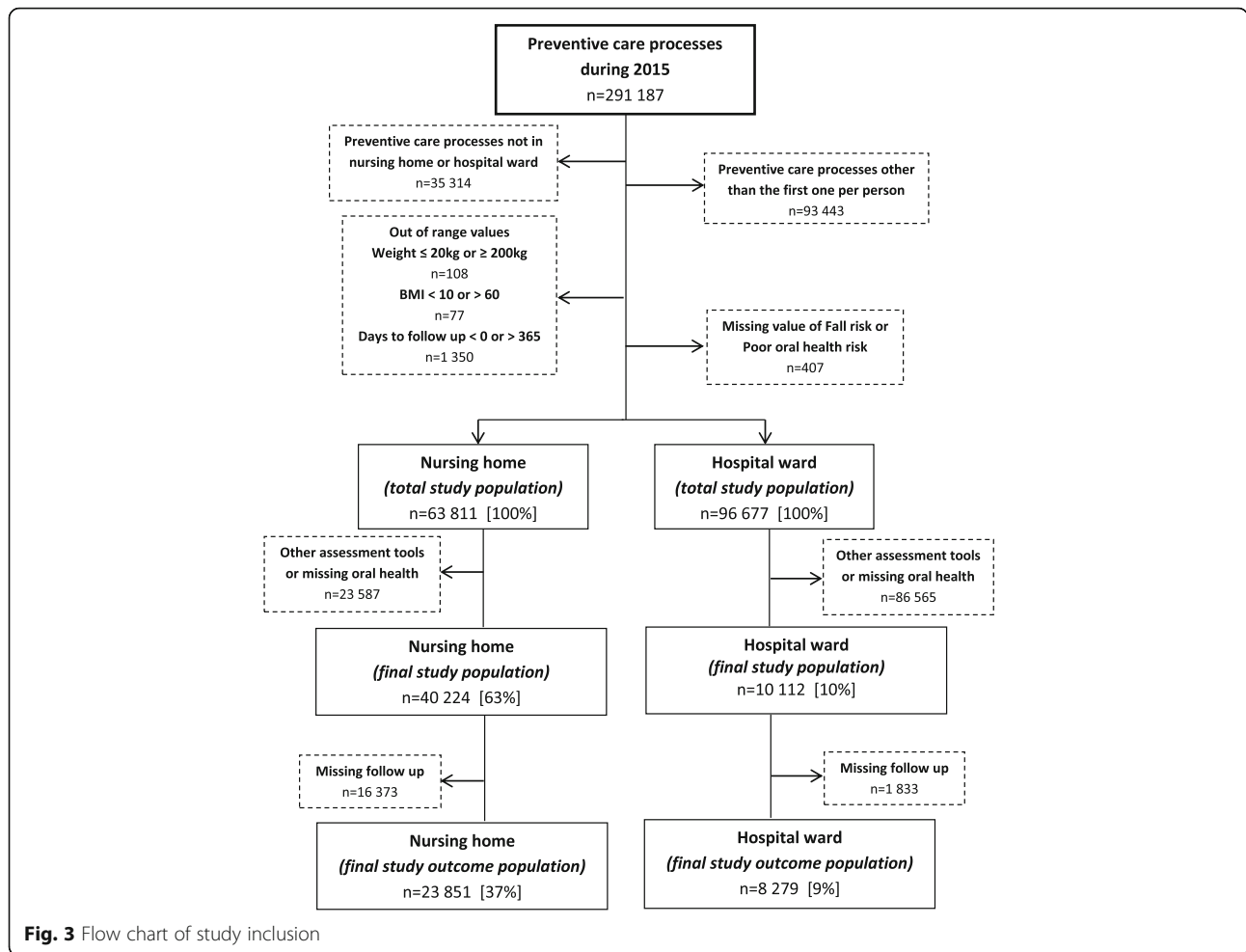
Fig. 3 Flow chart of study inclusion

Table 1 Representation of the final study population compared to total study population

	Nursing home					Hospital ward				
	Total study population (n = 63,811)		Final study population (n = 40,224)		p value	Total study population (n = 96,677)		Final study population (n = 10,112)		p value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Age (years)	85.4	7.5	85.4	7.5	0.768[a]	79.9	8.0	79.8	8.3	0.344[a]
BMI (kg/m^2)	25.0	5.1	25.0	5.1	0.148[a]	25.3	5.2	25.5	5.2	< 0.001[a]
	n	%	n	%		n	%	n	%	
Females	43,149	68	27,349	68	0.212[b]	52,042	54	5640	56	< 0.001[b]
Married	15,443	24	9798	24	0.564[b]	41,990	43	4103	41	< 0.001[b]
Fall risk	50,313	79	32,445	81	< 0.001[b]	54,933	57	5421	54	< 0.001[b]
Malnutrition risk	38,162	60	23,994	60	0.622[b]	52,219	54	6621	65	< 0.001[b]
Pressure ulcer risk	19,967	31	12,275	31	0.009[b]	16,590	17	1741	17	0.885[b]

Data are shown as mean (SD) or number (%)
[a]Student's *t* test
[b]Pearson's chi-square test

Table 2 Baseline characteristics for the final study population of nursing home and hospital wards

	Nursing homes (n = 40,224)		Hospital wards (n = 10,112)		p value
	Mean	SD	Mean	SD	
Age (years)	85.4	7.5	79.8	8.3	< 0.001[a]
BMI (kg/m^2)	25.0	5.1	25.5	5.2	< 0.001[a]
Days to follow-up	123	76	7	8	< 0.001[c]
	n	%	n	%	
Females	27,349	68	5640	56	< 0.001[b]
Married	9798	24	4103	41	< 0.001[b]
Fall risk	32,445	79	5421	54	< 0.001[b]
Malnutrition risk	23,994	60	6621	65	< 0.001[b]
Pressure ulcer risk	12,275	31	1741	17	< 0.001[b]
Poor oral health risk	16,500	41	2837	28	< 0.001[b]
Has any risk	37,011	92	8289	82	< 0.001[b]

Data are shown as mean (SD) or number (%)
[a]Student's *t* test
[b]Pearson's chi-square test
[c]Welch two sample *t* test

became statistically significant despite small numerical differences between females, married, fall risk, malnutrition risk, pressure ulcer risk, or risk for poor oral health. They are always reported as statistically significant (power 90%, significance level 5%); however, such small differences are not considered practically relevant.

Analysis at baseline (risk assessment) includes age, gender, married or not, BMI, risk for fall, malnutrition, pressure ulcer, and poor oral health. Data are presented as mean (SD) or number (%). Variables were analyzed by using Student's *t* test, Welch two sample *t* test, chi-square, or logistic regression tests. Data are presented as crude (unadjusted) data in order to see

Table 3 Non-response analysis

Total (n = 50,336)	With follow-up (n = 32,130)		Without follow-up (n = 18,206)		p value
	Mean	SD	Mean	SD	
Age (years)	84.2	8.0	84.5	8.0	< 0.001[a]
BMI (kg/m^2)	25.1	5.1	25.2	5.1	0.008[a]
	n	%	n	%	
Females	21,028	65	11,961	66	0.568[b]
Married	9114	28	4787	26	< 0.001[b]
Fall risk	25,181	78	12,685	70	< 0.001[b]
Malnutrition risk	20,823	65	9792	54	< 0.001[b]
Pressure ulcer risk	9240	29	4776	26	< 0.001[b]
Poor oral health risk	12,832	40	6505	36	< 0.001[b]

(SD) or number (%)
[a]Student's *t* test
[b]Pearson's chi-square test

differences when nursing homes are compared to hospital wards.

Comparisons of the outcomes at follow-up were performed. Chi-square or logistic regression tests and the crude (unadjusted) data are presented. In addition, baseline variables are used as covariates in the analysis of covariance and the adjusted data are presented.

In the case of missing data, case exclusion analysis by analysis was used. A non-response analysis was performed comparing all available baseline variables between those with and without follow-up.

Ethical considerations

Conducting research among people with frail health and reduced capacity requires specific consideration, and although such studies are urgently needed, it is important to place a strong emphasis on ethical awareness. The present project was conducted in accordance with the Helsinki Declaration [44]. The ethical principles of autonomy, beneficence, non-maleficence, and justice have guided the work. All persons included in the register have been informed by the care giver regarding registration in quality registers.

Results

Representativity of the final study population

The final study population comprised 63% of the total study population for the nursing homes. For the hospital wards, the final study population comprised 10% of the total study population (Fig. 3). Two reasons why the relative size is so much smaller for hospital wards are that they have a smaller percentage (24% compared to 71%) that use oral health assessment and a greater percentage (56% compared to 12%) that use other assessment tools, such as SALAR risk assessment, compared to those used in this study.

The final nursing home population does not differ significantly from the total study population (n = 63,811) other than regarding fall risk and pressure ulcer risk (Table 1), but these differences are small and not practically significant. As for the hospital ward population, we found five out of seven statistically significant differences, namely BMI, females, married, fall risk, and malnutrition risk. Among these, only the malnutrition risk difference is practically significant. Except for this difference, it seems that the final study populations have similar characteristics in comparison to the total study populations.

Baseline characteristics

There are profound differences between nursing homes and hospital wards regarding registered baseline characteristics (Table 2). Persons on hospital wards are generally younger, have higher BMI, are more often men, and

have lower prevalence of risk in all risk areas except malnutrition, which is instead somewhat higher.

Non-response analysis

The 32,130 preventive care processes with follow-up are compared to those without follow-up (Table 3). The significant differences in age, BMI, and marital status are not practically significant, but the proportion with risk is higher in the follow-up population in all four risk areas.

Adverse events are more common in nursing homes compared to hospital wards. The prevalence of recorded falls is almost 15 times higher in nursing homes, while the differences concerning other outcomes are more moderate (Table 4). One explanation could be the difference in follow-up frequency, with 123 days to follow-up in nursing homes compared to 7 days on hospital wards. However, when adjusting for days to follow-up, Norton points, DFRI points, MNA points, and age, the differences between the populations for weight loss and pressure ulcers are no longer significant (adjustment D, Table 4). This is in contrast to falls where after adjustment the difference in falls is still significant ($p < 0.001$). ROAG and gender have a weak association to negative events for malnutrition and falls and are therefore not included in the model.

The prevalence of weight loss and pressure ulcers increases by risk points in all four areas. The strongest association with weight loss and pressure ulcers was found with Norton points, and the weakest association was found with ROAG points (Figs. 4 and 5). The prevalence of negative event falls increases by identified risk only with DFRI points (Fig. 6).

Discussion

In this study, we present the potential for using a national quality register as a tool to identify common health risks in order to improve the care of older adults.

Females are in the majority among those of highest age in both nursing homes and hospital wards, mirroring Swedish demographics in this age group (Table 2) [1]. Not unexpectedly, in the younger hospital ward population, the proportions identified at risk are lower compared to the nursing home population with one exception, the risk of malnutrition. The reason for this might be the acute state of in-hospital patients, implying a higher prevalence of malnutrition risk.

A possible explanation as to why the proportion identified with malnutrition risk is higher in the final study population compared to the total study population in hospital wards might be methodological differences between the risk assessment tools MNA-SF and the National Board of Health and Welfare questions. The MNA-SF instrument includes questions related not only to appetite, nutritional status, and BMI, but also to mobility, acute disease, and neuropsychological disorders, meaning that a higher proportion could be classified as at risk when using MNA-SF compared to the National Board of Health and Welfare questions.

It should be stressed that cutoffs for classification of at risk are seemingly arbitrary (Figs. 4, 5, and 6) meaning that results are related to how the cutoff values are set. The Norton tool seems to be the most conservative among the assessment tools used, since it assesses only the most fragile persons as at risk.

The difference in days to follow-up (Table 2) explains the difference in weight loss between the nursing home compared to hospital ward populations. In hospital wards, there may simply not be enough time for weight loss to be observed. The scores from all three risk assessment tools MNA-SF, Norton, and DFRI are strongly associated with weight loss (Fig. 4). The ROAG score was not associated with fall (Fig. 6), but was associated with pressure ulcers and weight loss, however not to the same extent as the other risk assessments (Figs. 4 and 5). The weak association to weight loss and pressure ulcers is unlikely, since it can be expected that a bedridden person with pressure ulcers or a person with severe weight loss may also have oral health problems such as dry mouth and swallowing problems. A possible explanation is shortcomings in the implementation of the assessment.

The higher prevalence of pressure ulcers in nursing homes compared to hospitals is explained by the difference

Table 4 Outcomes for final study outcome population

Total (n = 32,130)	Nursing homes (n = 23,851)	Hospital wards (n = 8279)	p value[A]	p value[B]	p value[C]	p value[D]
Weight loss more than 5% (n)	2734 (11.5%)	367 (4.4%)	< 0.001[b]	< 0.001[d]	0.017[d]	0.085[d]
Pressure ulcer exists (n)	1451 (6.1%)	379 (4.6%)	< 0.001[b]	< 0.001[d]	0.464[d]	0.246[d]
Fall exists (n)	3491 (14.6%)	84 (1.0%)	< 0.001[b]	< 0.001[d]	< 0.001[d]	< 0.001[d]

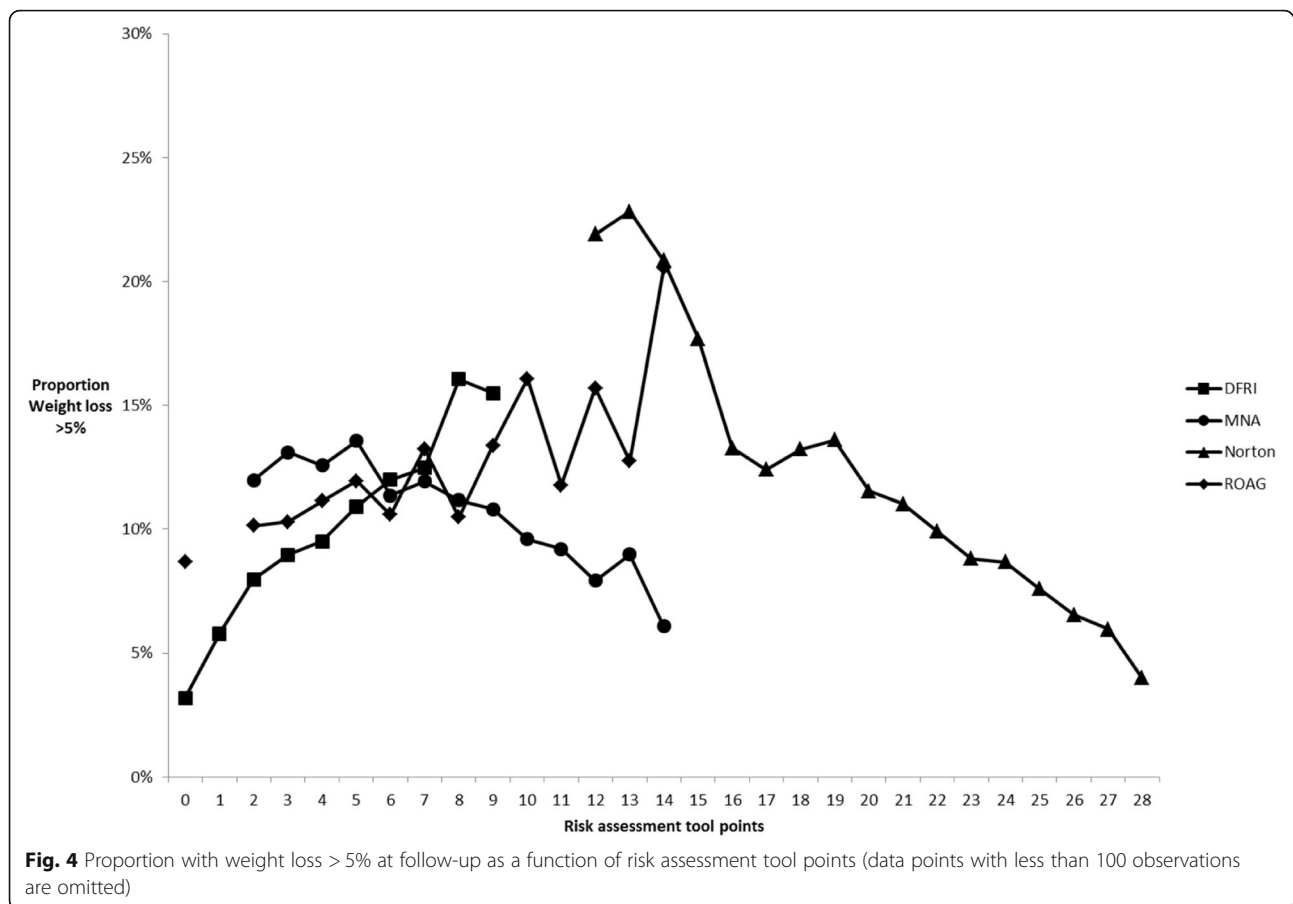Data are shown as number (%)
[A]Non-adjusted *p* value
[B]Adjustment for days to follow-up
[C]Adjustment for days to follow-up, Norton score
[D]Adjustment for days to follow-up, age, and Norton, DFRI, and MNA score
[b]Pearson's chi-square test
[d]Likelihood ratio chi-square test

Fig. 4 Proportion with weight loss > 5% at follow-up as a function of risk assessment tool points (data points with less than 100 observations are omitted)

in days to follow-up and Norton score (adjustment C, Table 4).

The main reason for the higher prevalence of falls in nursing homes compared to hospitals is that hospital wards do not routinely record falls in SA, but instead use other systems for reporting deviations, leading to an underreporting of falls in hospitals in SA (adjustment D, Table 4).

Weight loss and pressure ulcers are shown to be strong indicators of overall frail health, evident by the positive association with all four risk instruments used in SA. There is a well-known relationship between poor nutritional status and pressure ulcers [10, 45]. The lowest prevalence of falls was found among those with risk for malnutrition and pressure ulcers probably explained by these individuals being less mobile and more often bed ridden compared to the rest of the population, as was also shown in an earlier study [46].

In summary, the proportion identified as being at risks is higher for individuals with follow-up compared to those without (Table 3), explained by the fact that follow-up is needed according to identified risks, and indicating that the register is fulfilling its purpose.

Strengths and limitations

Strength of this study is the use of a national quality registry that includes many areas. The risk assessments are used worldwide but not at the same time for the same patients. In this study, we prove that pressure ulcers, malnutrition, falls, and oral health are connected to each other and using a quality registry is successful. The use of a national quality registry makes possibilities of comparisons in the whole country and between nations.

Another strength of this study is the large sample size and high number of registrations giving stable statistical associations. However, it also means that numerically small differences between variables give statistically significant results when using large databases. It is therefore important to consider the practical relevance of such small but significant differences.

Since it is mandatory to register weight loss, the register is most complete regarding this variable. However, a possible risk is that the same weight is registered both at follow-up and at baseline, resulting in a possible underestimation of the proportion with true weight loss. However, the registration of the same weight is not unlikely in hospital wards, since on average there are only few days between baseline and follow-up.

Fig. 5 Proportion pressure ulcer at risk assessment or follow-up as a function of risk assessment tool points (data points with less than 100 observations are omitted)
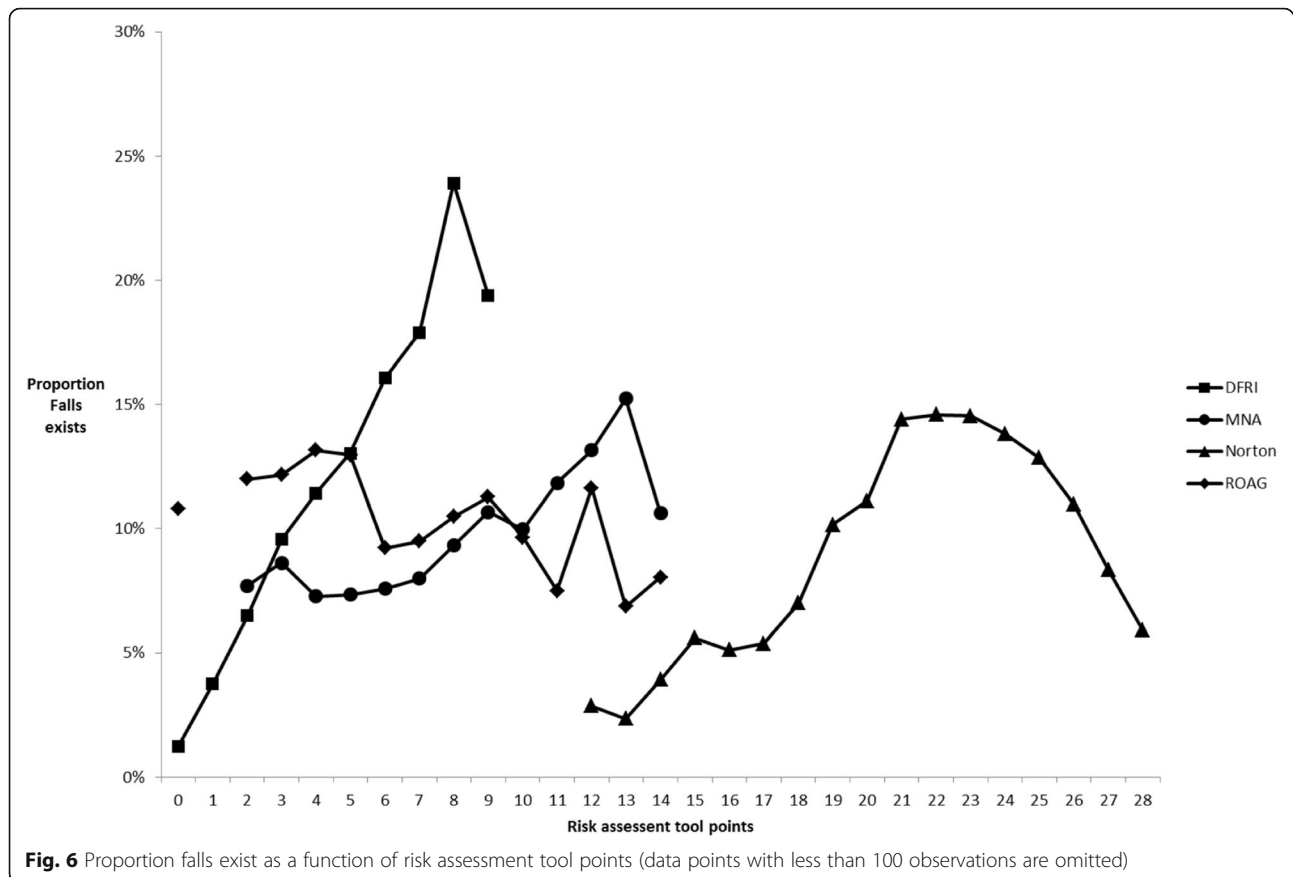
Nurses and assistant nurses are challenged by high workloads and lack of time, conditions which might negatively impact the completeness and quality of data. There are also care settings where decisions have been made to not perform more than baseline risk assessments and therefore not to consider follow-up. Another important aspect is competence, which may vary among staff. To decide which actions might be best for an individual requires professional skills and competences. Fewer registrations of actions probably mirror shortcomings in professional competence among nurses and assistant nurses, thus limiting decision-making in steps 2 and 3 in the care preventive process. It may be necessary to include other professionals, such as physiotherapists and occupational therapists, dietitians, and dental health professionals, to complete the care team in order to strengthen these steps in the care preventive process and to offer quality care.

Importance/implications

Frailty increases the need for preventive strategies, and research considering frequent negative outcomes in older adults such as pressure ulcers, malnutrition, falls, and poor oral health is therefore most warranted.

What makes SA unique compared to other quality registers is its pro-active approach. An on-going quality improvement of care is supported by the preventive care process [47]. Despite the weaknesses regarding quality and completeness, the register offers important information regarding risk areas with high prevalence among frail and sick older adults. So far, the focus has been on descriptive data and relationships to screening for risk. In the future, it is important to focus more on steps 2 to 4 in the care preventive process, meaning studying which actions and intervention have the greatest impact on outcomes. This will in turn contribute to development of best practice and evidence-based care of older adults.

The Swedish national quality registries are "gold mines" [48] for research since they comprise large data sets often with extensive follow-ups. In addition to SA, there are four more registers in Sweden within the care of older adults: the Swedish Dementia Registry (Sve-Dem), Behavioral and Psychological Symptoms in Dementia (BPSD), the Registry of Ulcer Treatment (RUT), and the Swedish Register of Palliative Care (SRPC). Together these registers have the potential to provide valuable data for research regarding aging and age-related disorders and for the quality of care.

Fig. 6 Proportion falls exist as a function of risk assessment tool points (data points with less than 100 observations are omitted)

Conclusion

This study shows that:

1. The populations in nursing homes and hospitals differ with regard to age, BMI, gender, and risks in all risk areas.
2. The differences between nursing homes and hospitals are explained by different risk scores in the assessment tools used, as well as age and days to follow-up.
3. Assessment using MNA-SF results in a higher proportion of persons with risk for malnutrition compared to assessments with the National Board of Health and Welfare questions.
4. Fall prevalence decreases with higher pressure ulcer risk due to factors such as degree of mobility, and fall prevalence decreases more with even higher pressure ulcer risks.

Future perspectives

To improve care, the team around the older person needs a more inter-professional profile including healthcare professions such as physiotherapists and occupational therapists, dietitians, and dental health professionals. An inter-professional team gives a more effective care and highlights the patient's situation and needs. It also leads to increased knowledge for the healthcare professionals [49].

Future studies could use the potential of analyzing data from SA, SveDem, BPSD, RUT, and the Swedish Register of Palliative Care together.

Authors' contributions
All authors wrote all text together but were responsible for some sections. AT is the main author and wrote the texts about pressure ulcers. CH wrote

the texts about oral health. DN made all the statistic work. ER wrote the texts about nutrition. HW wrote the text about falls. All authors read and approved the final manuscript.

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