BMJ Open

Elderly community-dwelling patients with low socioeconomic status are hospitalised more often after visiting the emergency department

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019318
Article Type:	Research
Date Submitted by the Author:	25-Aug-2017
Complete List of Authors:	Wachelder, Joyce; Maxima Medisch Centrum, Internal Medicine van Drunen, Isabelle ; Maxima Medisch Centrum, Internal Medicine Stassen, Patricia; Maastricht University CAPHRI School for Public Health and Primary Care; Maastricht Universitair Medisch Centrum+ Interne Geneeskunde, Internal Medicine Brouns , Steffie ; Maxima Medisch Centrum, Internal Medicine Lambooij, Suze ; Maxima Medisch Centrum, Internal Medicine Aarts, Mieke ; Netherlands Comprehensive Cancer Organisation Haak , Harm; Maxima Medisch Centrum, Eindhoven ; Maastricht University CAPHRI School for Public Health and Primary Care
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Geriatric medicine
Keywords:	Socioeconomic Status, Elderly, Emergency Department

Elderly community-dwelling patients with low socioeconomic status are hospitalised more often after visiting the emergency department

J.J.H. Wachelder[12], I.S. van Drunen[1#], P.M.Stassen[24#], S.H.A Brouns[12], S.L.E. Lambooij[1], M.J. Aarts[3], H.R. Haak[124]

1. Department of Internal Medicine, Máxima Medical Centre, 5631 BM Eindhoven/Veldhoven, the Netherlands.

2. Maastricht University, Department of Health Services Research, and CAPHRI School for Public Health and Primary Care, 6229 ER Maastricht, the Netherlands.

3. Netherlands Comprehensive Cancer Organisation, PO Box 19097, 3501DB Utrecht, the Netherlands.

4. Dept. of Internal Medicine, division of general medicine, section acute medicine, Maastricht University Medical Centre, 6229 HX Maastricht, the Netherlands.

# Authors contributed equally.

Correspondence should be addressed to: Joyce Wachelder, Department of Internal Medicine, Máxima Medical Centre, PO Box 90052, 5600 PD Eindhoven, The Netherlands; telephone number: +31408886300, fax number +31402450385, Email: joyce.wachelder@mmc.nl

Disclosure: There are no conflicts of interest. No funding was received.

Word count: 2909

Word count abstract: 228

Number of Tables: 3. Number of Figures: 1.

References: 42

Keywords: Socioeconomic Status; Elderly; Emergency Department

Abstract

Objectives: Elderly patients frequently visit the Emergency Department (ED). Socioeconomic State (SES) has an important impact on health and ED utilization, however, the association between SES and ED utilization in elderly remains unclear. The aim of this study was to investigate the association between SES in elderly patients visiting the ED on outcomes.

Design: A retrospective study.

Participants: elderly patients (≥65 years) visiting the ED. SES was stratified into tertiles based on average household income at zip code level; low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month).

Primary outcomes: hospitalisation, in-hospital mortality and 30-day ED-return visits.

Results: In total, 4828 elderly patients visited the ED during the study period. Low SES was associated with a higher risk of hospitalisation among community-dwelling patients compared with high SES (adjusted OR1.3 95%CI 1.1-1.7). This association was not present for intermediate SES (adjusted OR1.1 95%CI 0.95-1.4). In-hospital mortality was comparable between the low and high SES-group, even after adjustment for age, comorbidity and triage level (low OR 1.4 95%CI 0.8-2.6, intermediate OR 1.3 95%CI 0.8-2.2). Thirty-day ED-revisits among community-dwelling patients were also equal between the SES groups (low: adjusted OR 1.0 95%CI 0.7-1.4 and intermediate: adjusted OR 0.8 95%CI 0.6-1.1).

Conclusion: In elderly ED patients, low SES was associated with a higher risk of hospitalisation than high SES. However, SES had no impact on in-hospital mortality and 30-day ED-revisits after adjustment for confounders.

Strengths and limitations of this study

- This is one of the only studies to provide detailed insight into the impact of different socioeconomic status groups of elderly patients in the emergency care.
- Additionally, this study the living situation was used to differentiate between community-dwelling patients and institutionalized patients to observe differences in outcomes.
- This study used a retrospective cohort study and linked patient zip code with income data based on a well-defined database by Statistics Netherlands.
- A strength of our study is that we investigated a large undifferentiated group of elderly emergency care patients.
- Limitations were that we were not able to extract the data of cardiology and gynaecology patients and that we used zip code to define the socioeconomic status.

Introduction

The burden on the Emergency Department (ED) capacity is increasing over the past decades, which is mostly due to a substantially increasing number of elderly patients (≥65 years old) (1). Given the extent and complexity of the problems in these patients, it is essential to identify determinants that lead to the ED visits in order to maintain high quality of care of elderly ED patients (2).

Low socioeconomic status (SES) has already been identified as an important determinant of health status and is strongly associated with poor adverse health outcomes (3). Patients with a low SES visit the general practitioner more and the specialist less often than patients with a high SES (4,5). Moreover, patients with a low a SES use the ED more frequently and are admitted to the hospital more often than those with a high SES (4,6-8-10). However, most studies focused on the influence of SES on the quantity of ED utilization, rather than on the reasons for and outcomes of these ED visits in general (8,10-12) .

It is well-known that elderly patients are vulnerable and prone to adverse health outcomes, such as ED visits, ED return visits, hospitalisation and mortality (13). However, research on the effect of SES on ED visits and adverse health outcomes in these elderly patients is scarce (10,14,15). Some of these studies demonstrated contrasting results as where low SES patients had higher risk of adverse health outcomes (8,16,17), while other studies did not find such an increased risk (11,12,18). Moreover, most studies focused on patients with a specific diagnosis (e.g. heart failure, pneumonia or injury) and other studies merely studied ED utilization (10,14,18).

To understand the ED utilization patterns of elderly patients, it can be important to take their SES into account. Understanding the characteristics of elderly ED patients, including their SES, may be the first step to maintain or improve high quality of acute care. We hypothesize that low SES influences the risk of adverse health outcomes in the ED setting in a negative way and adds to the vulnerability of elderly ED patients even in a country in which health care access is organized for every inhabitant, regardless of SES.

The aim of this study was to determine differences between different SES groups among elderly patients and additionally and most importantly we investigated the association of SES with hospitalisation, in-hospital mortality and ED-revisits.

Method

Study design, setting and population

A retrospective cohort study was performed in the Maxima Medical Centre, a 550-bed teaching hospital in the Netherlands. Yearly, approximately 30,000 patients visit the ED (19), of whom 30% are elderly (≥65 years). In the Netherlands, patients are usually referred to the ED by a general practitioner. The general practitioners provide acute care all days of the week and every hour of the day, including out of office hours.

Elderly patients who visited the ED for all medical and surgical specialities in one year (between 1st of September 2011 and 31st of August 2012), were included. Data from the acute cardiac care unit and gynaecology unit were not available in the database, because these patients do not visit the ED .

Data of the ED visits were automatically extracted from the electronic patient records (Chipsoft-EZIS, version 5.2). The patients' zip code (on average 17 households per zip code) was used to determine the SES at a neighbourhood level by combining the median household income per month and mean value of the houses. Data on income were provided by Statistics Netherlands (20). This dataset excluded zip codes with less than 10 households to guarantee anonymity. The median income data derived from the zip codes were linked to our database and subsequently divided into tertiles (21): low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month). It was impossible to retrieve SES data for patients with unknown zip code or patients living abroad (Belgium), and therefore, these patients were excluded (N=511, 6.9%).

To investigate the effect of the living situation in the three SES groups, we made a subgroup analysis for the outcomes of community-dwelling patients and for patients who were institutionalized. Living situation was retrieved on basis of zip codes, including those of the nursing and care home facilities patients. The first ED visit in the study period was considered the index visit, other visits after the index visit were excluded to avoid duplicate analysis of the patients' characteristics and outcomes. The Institutional Review Board of Máxima Medical Centre approved this study and confirmed that the Medical Research Involving Human Subject Act (WMO) was not applicable.

Data collection & definitions

The following data were retrieved from the electronic patient record: age, gender, zip code, comorbidity, number of used medications. The Charlson comorbidity index (CCI) was used to quantify comorbidity (22). For 50% of the patients per SES group, comorbidity was retrieved. The patients' living situation was categorized into community-dwelling patients (living independently or with home care) and institutionalized patients (care home and nursing home).

To assess the severity of illness at presentation, the Manchester Triage Level (MTS) (23), vital parameters (systolic blood pressure, heart rate), laboratory tests (CRP and leukocytes) and the ED diagnoses were retrieved. The triage level based on the five-level MTS was categorised into 3 groups: urgent (red and orange), moderate (yellow), and low (green); in our ED the triage colour blue is not used. The diagnoses at the ED were classified according the International Classification of Disease-10 (ICD-10) (24). The group 'other', consisted out of diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.

Organizational factors retrieved were time of arrival, mode of referral (self-referral, GP, ambulance, specialist and other), specialism, number of diagnostic tests (sum of radiological tests, electrocardiogram, arterial blood gas analysis, laboratory tests, urine analysis, urine and blood culture), number of specialist consultations on the ED, ED-Length-of-Stay (LOS) and hospital-LOS. Time of presentation was classified into 3 shifts: day (8am-6pm), evening (6pm-12pm) and night (12pm-8am). The following specialties were considered surgical: (general) surgery, plastic surgery, urology, and orthopaedics. Pulmonology, neurology, internal medicine and gastroenterology were considered medical specialities. Hospital LOS was defined as the number of days between hospital admission and hospital discharge. Dates of death during hospital stay and of the ED-return visit were retrieved. The data were extracted by one trained medical abstractor who was blinded for the study hypothesis.

Statistical analyses

All statistical analyses were performed using SPSS 22.0 (New York, Armont, 2015). Comparisons to evaluate normally distributed differences between the SES groups were made using unpaired-t-tests for continuous data, and the Chi square test for categorical data. Continuous variables not normally distributed the Wilcoxon-Mann-Whitney-Test was used. Missing data were categorised as "unknown" and included in the analyses of categorical parameters, to explore the influence of missing values. To investigate the independent effect of SES on hospitalisation, in-hospital mortality, and 30-day ED-return visits, logistic regression analyses was performed. A difference of 10% in β-coefficient was used to determine confounders and was included into the multivariable regression analysis. Sensitivity analysis was performed to evaluate the effect of ED-revisits on mortality. For this analysis, those who died during hospitalisation were excluded (N=199). To estimate the effect of the living situation on the SES and their outcomes, patients were divided into community-dwelling

patients and institutionalized patients. Odds Ratios (OR) and corresponding 95% Confidence Intervals (CI) were calculated for each of the outcomes. A p-value was considered significant when <0.05.

Results

During the study period, 7205 ED visits by elderly patients were registered in our ED. In total, 511 patients (7.1%) were excluded because income data were missing and 1866 visits (25.9%) because the visit was a revisit. In total, 4828 index visits were included. Of these 1660 visits (33.1%) were classified as having a low SES, 1640 (34.0%) as intermediate and 1588 (32.9%) as having a high SES (Figure 1).

Patient characteristics

The mean age of the study population was 77±7.7 years, and slightly less patients were male (44.5%) (Table 1). In total, 4381 (90.7%) were community-dwelling patients and 9.2% lived institutionalized. Patients were mostly referred by a GP (58.5%) and were triaged as having moderate urgency (43.8%). More than half (56.5%) of the patients were hospitalised, and their median hospital-LOS was 5 days. In-hospital mortality was 4.1%.

Table 1. Patient characteristics and SES of elderly patients visiting the ED

Characteristics	Total population N = 4828	Socioeconomic Status			P-value
		Low N = 1660 (33.1%)	Intermediate N = 1640 (34.0%)	High N = 1588 (32.9%)	
Age, years					
Mean (SD)	77 (7.7)	80 (7.6)	76 (7.6)	75 (7.4)	<0.001#
Median (IQR)*	77 (12)	80 (11)	76 (12)	74 (12)	
Gender (%)*					<0.001
Male	2149 (44.5%)	618 (38.6%)	759 (46.3%)	772 (48.6%)	
Female	2679 (55.5%)	982 (61.4%)	881 (53.7%)	816 (51.4%)	
CCI, median (IQR)	1.2 (1.6)	1.0 (0-8)	1.0 (0-10)	1.0 (0-11)	0.09
Unknown		45 (5.3%)	49 (5.3%)	54 (6.2%)	
No. of medications, mean (SD)*	2.5 (4.3)	3.3 (4.7)	2.4 (4.2)	1.9 (3.9)	<0.001
Mode of referral*					
General Practitioner	2680 (55.5%)	937 (61.8%)	905 (57.8%)	838 (56.0%)	0.03
Self-referral	852 (17.6%)	215 (13.4%)	292 (17.8%)	345 (21.7%)	<0.001
Ambulance	664 (13.8%)	244 (15.3%)	237 (14.5%)	183 (11.5%)	0.01
Specialist	632 (13.1%)	204 (9.6%)	206 (9.9%)	222 (10.8%)	0.75
Living situation*					<0.001
Community-dwelling	4381 (90.7%)	1266 (79.1%)	1556 (94.9%)	1559 (98.2%)	
Institutionalized	443 (9.2%)	330 (20.6%)	84 (5.1%)	29 (1.8%)	
Missing	4 (100%)	4 (100%)	0	0	

SES = Socioeconomic status. SD = Standard deviation. CCI = Charlson comorbidity index. ED = Emergency Department. P-values P-values low, intermediate and high SES: using the Chi-square test, unpaired t-test and Mann-Whitney-U-test.

= p-value low vs. intermediate <0.001, low vs. high <0.001, intermediate vs. high <0.001.

* = p<0.05.

Patient characteristics and Socioeconomic status

Patients with a low or intermediate SES were older than patients with a high SES (80 vs. 76 and 75 years resp., p<0.001) (Table 1). Male patients less frequently had a low SES than intermediate and high SES patients (38.6% vs. 46.3% and 48.6% resp., p<0.001). The GP had referred patients in the low SES-group more often than in the intermediate and high SES-group (61.8% vs. 57.8% and 56.0% resp., p=0.03). Patients in the low SES-group used more medications than the high SES-group (3.3 vs. 1.9, p<0.001).

Organizational and clinical parameters in the ED and SES

There were no differences in the specialties (surgical vs. medical) that treated the patients nor in time of presentation between the three SES groups (Table 2). In addition, the vital parameters at presentation were comparable between the three groups. Patients with a low SES more often had a higher urgent triage level the high SES-group, however, this difference was not significant (15.4% vs. 12.1%, p=0.02). In the low and the intermediate SES-group, more diagnostics tests were performed than in the high SES-group (mean 2.3 vs. 2.1 vs. 2.0, resp., p<0.001). Patients with low SES had a longer ED-LOS than patients with intermediate and high SES (140 min vs. 133 vs. 133, resp. p=0.01). There were some differences in diagnoses between the three groups. Endocrine diagnoses were more common in the low SES group (3.1%) than the intermediate or high SES group (1.7% and 1.6%, p=0.03), and the same applied for infectious diseases. (Table 2).

Table 2. Organisational and clinical parameters of elderly ED patients within the different SES groups.

	Socioeconomic Status			
	Low N = 1660 (33.1%)	**Intermediate N = 1640 (34.0%)**	**High N = 1588 (32.9%)**	**P-value**
Specialism				0.16
Medical	879 (54.9%)	858 (52.3%)	822 (51.8%)	
Surgical	721 (45.1%)	782 (47.7%)	766 (48.2%)	

Shift				0.15
Morning	1130 (70.9%)	1148 (70.2%)	1169 (73.7%)	
Evening	240 (21.3%)	354 (21.7%)	318 (20.0%)	
Night	124 (7.8%)	133 (8.1%)	100 (6.3%)	
Level of triage				
Low	628 (39.8%)	640 (39.7%)	687 (44.0%)	0.02
Moderate	702 (44.5%)	730 (35.3%)	683 (43.7%)	0.69
Urgent	246 (15.4%)	242 (14.8%)	192 (12.1%)	0.02
No triage	24 (1.5%)	28 (1.7%)	26 (1.6%)	0.98
No. of extra consultations at ED				0.80
None	1376 (86.0%)	1407 (85.6%)	1365 (86.0%)	
1	200 (12.5%)	215 (13.1%)	199 (12.5%)	
≥2	24 (0.5%)	18 (1.1%)	24 (1.4%)	
Vital parameters				
Systolic blood pressure (mmHg), mean (SD)	152 (31.7)	153 (31.3)	152 (30.8)	0.98
Missing	428 (26.9%)	530 (32.4%)	545 (35.5%)	
Heart rate (min), mean (SD)	81.5 (17.0)	82.5 (18.1)	82.1 (17.7)	0.49
Missing	734 (45.9%)	806 (49.1%)	819 (51.6%)	
Medical procedures at ED				
No. of diagnostic tests, mean (SD)	2.3 (1.8)	2.1 (1.8)	2.0 (1.7)	0.003#
Laboratory test (%)*	1081 (67.9%)	1046 (64.1%)	974 (61.7%)	<0.001
CRP (mg/L), median (IQR)	16 (60)	14 (55)	15 (66)	0.47
Leukocytes (x10^9/L), median (IQR)	9.2 (6)	9.3 (5)	8.8 (5)	0.91
Diagnosis at ED				
Injury	487 (30.6%)	504 (30.8%)	508 (32.2%)	0.56
Otherwise	280 (17.6%)	286 (17.5%)	289 (18.3%)	0.79
Circulatory / Respiratory	232 (14.6%)	257 (15.7%)	201 (12.7%)	0.06
Other	202 (12.7%)	217 (13.3%)	218 (18.3%)	0.64

Digestive	163 (10.2%)	175 (10.8%)	169 (10.7%)	0.88
Genito-urinary	68 (4.3%)	73 (4.5%)	58 (3.7%)	0.51
Infectious	65 (4.1%)	52 (3.2%)	45 (2.8%)	0.14
Endocrine / Metabolic	50 (3.1%)	28 (1.7%)	25 (1.6%)	0.03&
Neoplasm / haematology	47 (2.9%)	52 (3.2%)	70 (4.4%)	0.05^
Missing	6 (0.4%)	3 (0.2%)	9 (0.6%)	
ED-LOS in minutes, median (IQR)*	140 (83)	133 (90)	133 (87)	0.01@

SES = Socioeconomic Status. SD = Standard deviation. ED = Emergency department. CRP = C-reactive protein. ED-Diagnosis 'other' (ICD-10 classification) = diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.
P-values low, intermediate and high SES: using the Chi-square test, unpaired t-test and Mann-Whitney-U-test.
* = p <0.05.
# = p-value low vs intermediate 0.003, low vs high <0.001, intermediate vs. high <0.01.
@ = p-value low vs intermediate 0.01, low vs high 0.004, intermediate vs. high <0.93.
^ = p-value low vs intermediate 0.01, low vs high 0.004, intermediate vs. high <0.93.
& = p-value low vs intermediate 0.70, low vs high 0.03, intermediate vs. high <0.06.

Patient outcomes and SES

Patients with a low SES were more frequently hospitalised than the intermediate and high SES-group (62.3% vs. 55.4% vs. 52.3%, resp., p<0.001, Table 3). In addition, patients with a low SES had a longer hospital-LOS than patients with a high SES (6.0 vs. 5.0 days, p<0.001). However, the hospital-LOS did not differ between intermediate SES and high SES patients (5 days in both groups, p=0.45). The finding that low SES patients were more often hospitalised than the high SES group turned out not to be independent of age and comorbidity (adjusted OR 1.3 95% CI 0.9–1.4, Table 3). When stratified according to living situation, low SES community-dwelling patients had a higher risk of hospitalisation with an OR of 1.3 (95% CI 1.1-1.7) compared with patients with a high SES. In contrast, institutionalized low SES patients had a lower risk of hospitalisation with an OR of 0.2 (95% CI:0.1-0.7). Intermediate SES patients did not have a higher odd for hospitalisation (OR 1.0 95% CI 0.95-1.4) than high SES patients.

Table 3. Multivariable analysis of the effect on SES on ED outcomes and within different living situations.

	Socioeconomic Status	Number (%)	All patients N = 4828 (OR 95%CI)	Community-dwelling patients N = 4381 (OR 95%CI)	Institutionalized patients N = 443 (OR 95%CI)
Hospitalisation[1]	Low	996/1660 (62.3%)	1.1 (0.9-1.4)	**1.3 (1.1-1.7)**	**0.2 (0.1–0.7)**
	Intermediate	909/1640 (55.4%)	1.1 (0.9-1.4)	1.1 (0.95-1.4)	0.4 (0.1-1.2)
	High	830/1588 (52.3%)	1.0	1.0	1.0
In-hospital mortality[2]	Low	86/996 (5.4%)	1.2 (0.7-2.0)	1.4 (0.8-2.6)	0.8 (0.1-6.8)
	Intermediate	58/909 (3.5%)	1.1 (0.6-1.9)	1.3 (0.8-2.2)	0.4 (0.1-4.0)
	High	55/830 (3.5%)	1.0	1.0	1.0
30-day ED-revisits[3#]	Low	184/1514 (11.5%)	1.0 (0.8-1.4)	1.0 (0.7-1.4)	1.0 (0.2-4.7)
	Intermediate	220/1582 (13.5%)	0.9 (0.7-1.1)	0.8 (0.6-1.1)	0.8 (0.2-4.6)
	High	196/1533 (12.3%)	1.0	1.0	1.0

ED = Emergency Department. OR = Odds Ratio. CI = confidence Interval.
1 = adjusted variable include age and Charlson comorbidity index.
2 = adjusted for age, Charlson comorbidity index, and triage level.
3 = adjusted for age, Charlson comorbidity index and gender. # = without patients who died during hospitalisation.

In-hospital mortality was higher for the low SES group (5.4%) compared with the intermediate (3.5%) and the high SES group (3.5%, p=0.01, unadjusted $OR_{low\_vs\_high}$:0.6 95% CI 0.4-0.9). The difference in in-hospital mortality between low and high SES patients was no longer significant when adjusted for age, comorbidity and triage level (adjusted OR 1.2 95% CI 0.7–2.0).

There was no difference in 30-day ED-revisit rate between the low, intermediate and high SES group (21.3%, 20.4% vs. 20.8%, resp., p=0.88). Neither was the 30-day ED-revisit rate different after correcting for age, comorbidity and gender (adjusted OR 1.0, 95% CI 0.8–1.4). Moreover, adjusting for the living situation did not alter the results significantly (Table 3).

Discussion

Our study was a large population-based study that investigated the association of SES with ED visits of elderly (≥65 years) patients. We found that elderly community-dwelling ED patients with a low SES have a higher risk

of hospitalisation than patients with a high SES. However, in-hospital mortality and the number of ED-return visits were not different between the three SES groups.

We hypothesized that patients with low SES would be less healthy than those with a higher SES, which indirectly would result in higher admission rates and in-hospital mortality after presentation at the ED. Our data allowed us to determine important confounders, such as comorbidity, organisational factors and the severity of illness at the ED, which makes it possible to contribute important information to already existing evidence on the topic of SES, where the majority of studies did not adjust for potential confounders. Our study indeed observed a higher chance of hospitalisation (OR 1.3 CI 1.1-1.7) for community-dwelling patients with a low SES than for patients with intermediate/high SES. This finding is in line with other studies (9,25,26). It may be possible that part of the community-dwelling frail patients are admitted for care problems, which is not a reason for admission in institutionalized patients. In addition, ED visits by institutionalized patients have been shown to be potentially preventable and inappropriate resulting in immediate discharge back (27)(28).

In-hospital mortality and ED-revisits within 30 days were not associated with SES. This contrasts with other studies that found a higher risk of in-hospital mortality and readmissions in elderly patients with a low SES (8, 16,17), but is in line with other studies that did not found an association (11,12,18). The association of low SES and adverse outcomes was found in studies that included patients with a specific diagnosis (e.g. pneumonia or heart failure) (18,29) or that analysed the amount of ED visits per SES category (4,6,9,30), whereas our study focused on an undifferentiated, and therefore, more generalizable, elderly ED population. Another reason not finding an association between low SES and outcomes might be that most studies did not account for differences in living situation (17,31,32). We found that care and nursing homes were mostly situated in low SES areas, while their inhabitants will probably belong to all three SES (28). Additionally, institutionalized patients may influence revisit rates, because they are treated by their own doctor in the nursing home. It may be useful to take the living situation into account when using SES based on zip code, because care facilities structures at home influence ED outcomes.

The fact that we did not find an association between SES and in-hospital mortality and revisits may be due to the organisation of the health care system in the Netherlands and may underscore/reflect that our health care is indeed accessible to all patients, regardless of their SES. In the Netherlands, the health care system consists of a well organised GP-network, with 24-hours a day access for acute care patients, which is equally accessible for every inhabitant (30). This network selects the most severely ill patients for referral to

the ED. The acute health care system differs over the countries, and in some countries, for instance the United States, the ED is used as a safety-net for underserved and uninsured patients (33). Also, evenly important, the financial health care structure is different worldwide. In the Netherlands, care provided by the general practitioner is fully covered by the basic obligatory health insurance (34). Therefore this system provides equal access to health care by the general practitioner to every resident, despite their SES (5,35-37). In short, specifically regarding acute care, differences in organization and financial coverage of acute care make comparisons between countries difficult (38).

Apart from the above mentioned, the following study limitations should be mentioned. Firstly, our results are not generalizable to cardiology and gynaecology patients as we excluded these patients. For these cardiology patients, it is known that low SES may have a stronger association with adverse outcomes (39), and excluding these form our study may explain that we did not find associations between SES and outcome (except for hospitalisation in community dwelling patients). Secondly, we retrieved SES on basis of zip codes, which may be imprecise and yield smaller associations of SES with adverse outcomes (40). However, one zip code covers only 17 households and therefore, we consider this way of retrieving SES rather reliable. Thirdly, retrieving SES of patients living in a nursing home or other care home facilities on basis of zip code is probably not reliable. Therefore, we made subgroup analysis of community dwelling patients and institutionalized patients, which is a strong point of our study. Lastly, coding for the living situation may not be precise, but we think that this does not lead to an underestimation since the percentage of institutionalized patients (9.1%) is almost similar as percentages given in another study (9.0%) (41).

In this study, we provided important information in terms of health outcomes on the SES in the acute health care setting in the vulnerable elderly population. We investigated a large unselected group of elderly ED patients stratified to living situation, which provides additional knowledge on the care and problems of elderly patients in the ED. Our study shows that in a country with assumed equal health care access only minor outcome differences were observed between different SES groups. Therefore, physicians should be aware of the potential differences between SES groups given the higher chance of hospitalisation. Improvement in adequately diagnosing and treating elderly patients is important, but the additional value of SES in the emergency care should be evaluated further to develop effective interventions to ensure high quality of care. Given the differences between community-dwelling and institutionalized patients, it seems fair to take the living situation into account in future studies.

In conclusion, low SES community-dwelling patients were more often hospitalised than high SES community-dwelling patients, but no differences in in-hospital mortality and ED-revisits between the SES groups.

Contributorship statement

JW and SB conceived the study and designed the protocol. SL contributed to the design for the overall elderly project. JW, PS and ID analyzed and interpreted the data. HH supervised the conduct of the study and data collection. JW, PS and ID drafted the manuscript. MA helped with the statistical analyses. JW designed the database. JW, ID, PS, SB, MA, SL and HH contributed substantially to its revision and approved the final manuscript.

Data sharing statement

Data of the study is available from the data governance board of Maxima Medical Centre Instituional Data Access / Ethics Committee for researchers who meet the criteria for access to confidential data. Data are from the non-specific complaints study when contacting the data governance board (Jolanda.Luime@mmc.nl).

References

(1) Hoogendijk EO, van Hout HP, Heymans MW, van der Horst HE, Frijters DH, Broese van Groenou MI, et al. Explaining the association between educational level and frailty in older adults: results from a 13-year longitudinal study in the Netherlands. Ann Epidemiol 2014 Jul;24(7):538-44.e2.

(2) Lowthian JA, Curtis AJ, Cameron PA, Stoelwinder JU, Cooke MW, McNeil JJ. Systematic review of trends in emergency department attendances: an Australian perspective. Emerg Med J 2011 May;28(5):373-377.

(3) Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008 Jun 5;358(23):2468-2481.

(4) Droomers M, Westert GP. Do lower socioeconomic groups use more health services, because they suffer from more illnesses? Eur J Public Health 2004 Sep;14(3):311-313.

(5) van Doorslaer E, Wagstaff A, van der Burg H, Christiansen T, De Graeve D, Duchesne I, et al. Equity in the delivery of health care in Europe and the US. J Health Econ 2000 Sep;19(5):553-583.

(6) Khan Y, Glazier RH, Moineddin R, Schull MJ. A population-based study of the association between socioeconomic status and emergency department utilization in Ontario, Canada. Acad Emerg Med 2011 Aug;18(8):836-843.

(7) Tozer AP, Belanger P, Moore K, Caudle J. Socioeconomic status of emergency department users in Ontario, 2003 to 2009. CJEM 2014 May;16(3):220-225.

(8) Begley C, Basu R, Lairson D, Reynolds T, Dubinsky S, Newmark M, et al. Socioeconomic status, health care use, and outcomes: persistence of disparities over time. Epilepsia 2011 May;52(5):957-964.

(9) Filc D, Davidovich N, Novack L, Balicer RD. Is socioeconomic status associated with utilization of health care services in a single-payer universal health care system? Int J Equity Health 2014 Nov 28;13:115-014-0115-1.

(10) Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur AM, Roberge D, Larouche D, et al. Continuity of primary care and emergency department utilization among elderly people. CMAJ 2007 Nov 20;177(11):1362-1368.

(11) Ho KM, Dobb GJ, Knuiman M, Finn J, Webb SA. The effect of socioeconomic status on outcomes for seriously ill patients: a linked data cohort study. Med J Aust 2008 Jul 7;189(1):26-30.

(12) Alter DA, Chong A, Austin PC, Mustard C, Iron K, Williams JI, et al. Socioeconomic status and mortality after acute myocardial infarction. Ann Intern Med 2006 Jan 17;144(2):82-93.

(13) Samaras N, Chevalley T, Samaras D, Gold G. Older patients in the emergency department: a review. Ann Emerg Med 2010 Sep;56(3):261-269.

(14) Ramos M. Impact of socioeconomic status on Brazilian elderly health. Rev Saude Publica 2007 Aug;41(4):616-624.

(15) Cournane S, Conway R, Byrne D, O'Riordan D, Coveney S, Silke B. Social deprivation and the rate of emergency medical admission for older persons. QJM 2016 Oct;109(10):645-651.

(16) Hutchings A, Raine R, Brady A, Wildman M, Rowan K. Socioeconomic status and outcome from intensive care in England and Wales. Med Care 2004 Oct;42(10):943-951.

(17) Rathore SS, Masoudi FA, Wang Y, Curtis JP, Foody JM, Havranek EP, et al. Socioeconomic status, treatment, and outcomes among elderly patients hospitalized with heart failure: findings from the National Heart Failure Project. Am Heart J 2006 Aug;152(2):371-378.

(18) Izquierdo C, Oviedo M, Ruiz L, Sintes X, Vera I, Nebot M, et al. Influence of socioeconomic status on community-acquired pneumonia outcomes in elderly patients requiring hospitalization: a multicenter observational study. BMC Public Health 2010 Jul 15;10:421-2458-10-421.

(19) Brouns SHA, Dortmans MKJ, Jonkers FS, Lambooij SLE, Kuijper A, Haak HR. Hyponatraemia in Elderly Emergency Department Patients: A Marker of Frailty. Neth J Med 2014;72(6):311-317.

(20) Centraal bureau voor de statistiek. Inhoud kerncijfers postcodegebieden 2008-2010. 2012.

(21) Kunst A.E. Bos V. Mackenback J.P. Monitoring socioeconomic inequalities in health in the european union: guidelines and illustrations. EU Working Group on Socio-economic Inequalities in Health 2011.

(22) Needham DM, Scales DC, Laupacis A, Pronovost PJ. A systematic review of the Charlson comorbidity index using Canadian administrative databases: a perspective on risk adjustment in critical care research. J Crit Care 2005 Mar;20(1):12-19.

(23) Zachariasse JM, Seiger N, Rood PP, Alves CF, Freitas P, Smit FJ, et al. Validity of the Manchester Triage System in emergency care: A prospective observational study. PLoS One 2017 Feb 2;12(2):e0170811.

(24) Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care 2005 Nov;43(11):1130-1139.

(25) Robert S. Stern M, Joel S. Weissman P, Arnold M. Epstein, MD, MA. The emergency department as a pathway to admission for poor and high cost patients. JAMA 1991;266(16):2238-2243.

(26) Raffaeke Antonelli-Incalzi, Carla Ancona, Francesco Forastiere, Valeria Belleudi, Andrea Corsonello, Carlo A Perucci. Socioeconomic status and hospitalization in the very old: a retrospective study. BMC Public Health 2007;7(227).

(27) Brownell J, Wang J, Smith A, Stephens C, Hsia RY. Trends in emergency department visits for ambulatory care sensitive conditions by elderly nursing home residents, 2001 to 2010. JAMA Intern Med 2014 Jan;174(1):156-158.

(28) Arendts G, Howard K. The interface between residential aged care and the emergency department: a systematic review. Age Ageing 2010 May;39(3):306-312.

(29) Bhayana R, Vermeulen MJ, Li Q, Hellings CR, Berdahl C, Schull MJ. Socioeconomic status and the use of computed tomography in the emergency department. CJEM 2014 Jul;16(4):288-295.

(30) van der Meer JB, van den Bos J, Mackenbach JP. Socioeconomic differences in the utilization of health services in a Dutch population: the contribution of health status. Health Policy 1996 Jul;37(1):1-18.

(31) Cressman AM, Macdonald EM, Yao Z, Austin PC, Gomes T, Paterson JM, et al. Socioeconomic status and risk of hemorrhage during warfarin therapy for atrial fibrillation: A population-based study. Am Heart J 2015 Jul;170(1):133-40, 140.e1-3.

(32) Govindarajan P, Gonzales R, Maselli JH, Johnston SC, Fahimi J, Poisson S, et al. Regional differences in emergency medical services use for patients with acute stroke (findings from the National Hospital Ambulatory Medical Care Survey Emergency Department Data File). J Stroke Cerebrovasc Dis 2013 Nov;22(8):e257-63.

(33) Di Somma S, Paladino L, Vaughan L, Lalle I, Magrini L, Magnanti M. Overcrowding in emergency department: an international issue. Intern Emerg Med 2015 Mar;10(2):171-175.

(34) van der Linden MC, Lindeboom R, de Haan R, van der Linden N, de Deckere ER, Lucas C, et al. Unscheduled return visits to a Dutch inner-city emergency department. Int J Emerg Med 2014 Jul 5;7:23-014-0023-6. eCollection 2014.

(35) Pines JM, Hilton JA, Weber EJ, Alkemade AJ, Al Shabanah H, Anderson PD, et al. International perspectives on emergency department crowding. Acad Emerg Med 2011;18(12):1358-1370.

(36) van der Linden MC, Lindeboom R, van der Linden N, van den Brand CL, Lam RC, Lucas C, et al. Self-referring patients at the emergency department: appropriateness of ED use and motives for self-referral. Int J Emerg Med 2014 Jul 16;7:28-014-0028-1. eCollection 2014.

(37) Holmes JL. Emergency medicine in the Netherlands. Emergency Medicine Australasia 2010;22(1):75-81.

(38) Grundy E, Holt G. The socioeconomic status of older adults: how should we measure it in studies of health inequalities? J Epidemiol Community Health 2001 Dec;55(12):895-904.

(39) Carlsson AC, Li X, Holzmann MJ, Wandell P, Gasevic D, Sundquist J, et al. Neighbourhood socioeconomic status and coronary heart disease in individuals between 40 and 50 years. Heart 2016 May 15;102(10):775-782.

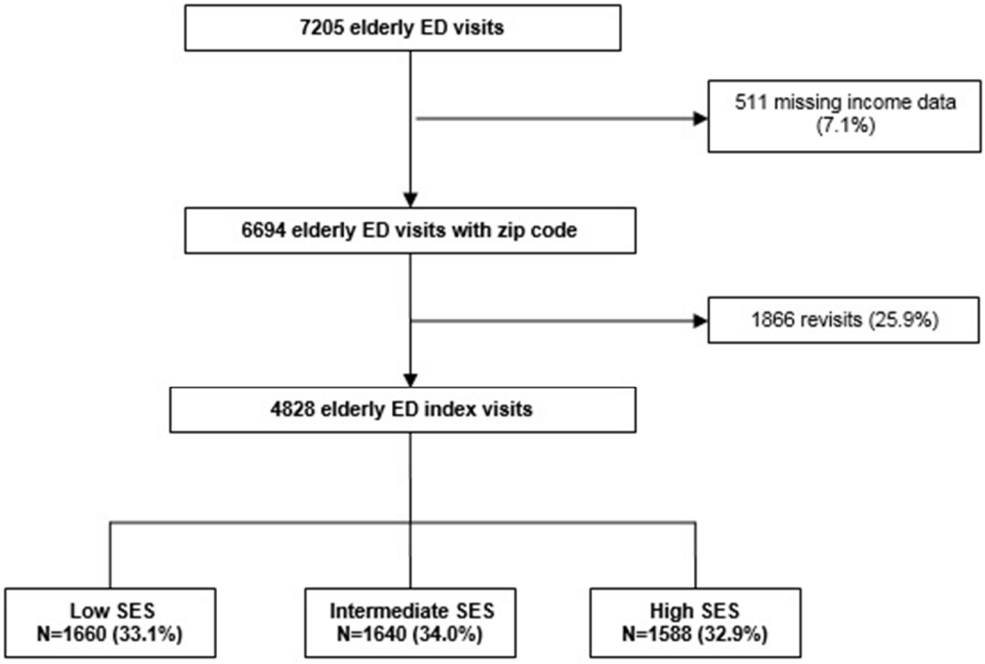
(40) Aarts MJ, van der Aa MA, Coebergh JW, Louwman WJ. Reduction of socioeconomic inequality in cancer incidence in the South of the Netherlands during 1996-2008. Eur J Cancer 2010 Sep;46(14):2633-2646.

(41) Ribbe MW, Ljunggren G, Steel K, Topinkova E, Hawes C, Ikegami N, et al. Nursing homes in 10 nations: a comparison between countries and settings. Age Ageing 1997 Sep;26 Suppl 2:3-12.

Figures

Figure 1. The Flow chart of elderly patients divided into three SES groups.

ED = Emergency department. SES = Socioeconomic Status



141x98mm (96 x 96 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5-6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-12
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations			12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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

BMJ Open

Older adult community-dwelling patients with low socioeconomic status are hospitalised more often after visiting the emergency department

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019318.R1
Article Type:	Research
Date Submitted by the Author:	17-Oct-2017
Complete List of Authors:	Wachelder, Joyce; Maxima Medisch Centrum, Internal Medicine van Drunen, Isabelle ; Maxima Medisch Centrum, Internal Medicine Stassen, Patricia; Maastricht University CAPHRI School for Public Health and Primary Care; Maastricht Universitair Medisch Centrum+ Interne Geneeskunde, Internal Medicine Brouns , Steffie ; Maxima Medisch Centrum, Internal Medicine Lambooij, Suze ; Maxima Medisch Centrum, Internal Medicine Aarts, Mieke ; Netherlands Comprehensive Cancer Organisation Haak , Harm; Maxima Medisch Centrum, Eindhoven ; Maastricht University CAPHRI School for Public Health and Primary Care
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Geriatric medicine
Keywords:	Socioeconomic Status, Elderly, Emergency Department

Older adult community-dwelling patients with low socioeconomic status are hospitalised more often after visiting the emergency department

J.J.H. Wachelder[12], I.S. van Drunen[1#], P.M.Stassen[24#], S.H.A Brouns[12], S.L.E. Lambooij[1], M.J. Aarts[3], H.R. Haak[124]

1. Department of Internal Medicine, Máxima Medical Centre, 5631 BM Eindhoven/Veldhoven, the Netherlands.

2. Maastricht University, Department of Health Services Research, and CAPHRI School for Public Health and Primary Care, 6229 ER Maastricht, the Netherlands.

3. Netherlands Comprehensive Cancer Organisation, PO Box 19097, 3501DB Utrecht, the Netherlands.

4. Dept. of Internal Medicine, division of general medicine, section acute medicine, Maastricht University Medical Centre, 6229 HX Maastricht, the Netherlands.

# Authors contributed equally.

Correspondence should be addressed to: Joyce Wachelder, Department of Internal Medicine, Máxima Medical Centre, PO Box 90052, 5600 PD Eindhoven, The Netherlands; telephone number: +31408886300, fax number +31402450385, Email: joyce.wachelder@mmc.nl

Disclosure: There are no conflicts of interest. No funding was received.

Word count: 4072 (including tables)

Word count abstract: 250

Number of Tables: 3. Number of Figures: 1.

References: 46

Keywords: Socioeconomic Status; Older adult; Emergency Department

Abstract

Objectives: Older adults frequently visit the Emergency Department (ED). Socioeconomic State (SES) has an important impact on health and ED utilization, however, the association between SES and ED utilization in elderly remains unclear. The aim of this study was to investigate the association between SES in older adult patients visiting the ED on outcomes.

Design: A retrospective study.

Participants: Older adults (≥65 years) visiting the ED, in the Netherlands. SES was stratified into tertiles based on average household income at zip code level; low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month).

Primary outcomes: hospitalisation, in-hospital mortality and 30-day ED-return visits. Effect of SES on outcomes for all groups were assessed by logistic regression and adjusted for confounders.

Results: In total, 4828 older adults visited the ED during the study period. Low SES was associated with a higher risk of hospitalisation among community-dwelling patients compared with high SES (adjusted OR1.3 95%CI 1.1-1.7). This association was not present for intermediate SES (adjusted OR1.1 95%CI 0.95-1.4). In-hospital mortality was comparable between the low and high SES-group, even after adjustment for age, comorbidity and triage level (low OR 1.4 95%CI 0.8-2.6, intermediate OR 1.3 95%CI 0.8-2.2). Thirty-day ED-revisits among community-dwelling patients were also equal between the SES groups (low: adjusted OR 1.0 95%CI 0.7-1.4 and intermediate: adjusted OR 0.8 95%CI 0.6-1.1).

Conclusion: In older adult ED patients, low SES was associated with a higher risk of hospitalisation than high SES. However, SES had no impact on in-hospital mortality and 30-day ED-revisits after adjustment for confounders.

Strengths and limitations of this study

- This is one of the only studies to provide detailed insight into the impact of different socioeconomic status groups of older adults in the emergency care.
- Additionally, this study the living situation was used to differentiate between community-dwelling patients and institutionalized patients to observe differences in outcomes.
- This study used a retrospective cohort study and linked patient zip code with income data based on a well-defined database by Statistics Netherlands.
- A strength of our study is that we investigated a large undifferentiated group of older adult emergency care patients.
- Limitations were that we were not able to extract the data of cardiology and gynaecology patients and that we used zip code to define the socioeconomic status.

Introduction

The burden on the Emergency Department (ED) capacity has been increasing over the past decades, which is mostly due to a substantially increasing number of older adults (≥65 years old) (1). Given the extent and complexity of the problems in these patients, it is essential to identify determinants that lead to the ED visits in order to maintain high quality of care of older adult ED patients (2).

Low socioeconomic status (SES) has already been identified as an important determinant of health status and is strongly associated with poor adverse health outcomes (3). Patients with a low SES visit the general practitioner more and the specialist less often than patients with a high SES (4,5). Moreover, patients with a low a SES use the ED more frequently and are admitted to the hospital more often than those with a high SES (4,6-10). However, most studies focused on the influence of SES on the quantity of ED utilization, rather than on the reasons for and outcomes of these ED visits in general (8,10-12) .

It is well-known that older adults are vulnerable and prone to adverse health outcomes, such as ED visits, ED return visits, hospitalisation and mortality (13). However, research on the effect of SES on ED visits and adverse health outcomes in these older adults is scarce (10,14,15). Some of these studies demonstrated conflicting results as where low SES patients showed higher risk of adverse health outcomes (8,16,17), while other studies did not find such an increased risk (11,12,18). Moreover, most studies focused on patients with a specific diagnosis (e.g. heart failure, pneumonia or injury) and other studies merely studied ED utilization (10,14,18).

To understand the ED utilization patterns of older adults, it can be important to take their SES into account. Understanding the characteristics of older adult ED patients, including their SES, may be the first step to maintain or improve high quality of acute care. We hypothesize that low SES influences the risk of adverse health outcomes in the ED setting in a negative way and adds to the vulnerability of older adult ED patients even in a country in which health care access is organized for every inhabitant, regardless of SES.

The aim of this study was to determine differences between different SES groups among older adults s and additionally and most importantly we investigated the association of SES with hospitalisation, in-hospital mortality and ED-revisits.

Method

Study design, setting and population

A retrospective cohort study was performed in the Maxima Medical Centre, a 550-bed teaching hospital in the Netherlands. Yearly, approximately 30,000 patients visit the ED (19), of whom 30% are older adults (≥65 years). In the Netherlands, patients are usually referred to the ED by a general practitioner. The general practitioners provide acute care all days of the week and every hour of the day, including out of office hours.

Older adults who visited the ED for all medical (including oncology) and surgical specialities in one year (between 1st of September 2011 and 31st of August 2012), were included. Data from the acute cardiac care unit and gynaecology unit were not available in the database, because these patients do not visit the ED .

Data of the ED visits were automatically extracted from the electronic patient records (Chipsoft-EZIS, version 5.2). Categorization of the data was done according a fixed data extraction form by one researcher (JW). A random sample of all variables was checked by another researcher (ID). The patients' zip code (on average 17 households per zip code) was used to determine the SES at a neighbourhood level by combining the median household income per month and mean value of the houses. Data on income were provided by Statistics Netherlands (20). This dataset excluded zip codes with less than 10 households to guarantee anonymity. The median income data derived from zip codes in the database from Statistics Netherlands were linked to our database and subsequently divided into tertiles (21): low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month). It was impossible to retrieve SES data for patients with unknown zip code or patients living abroad (Belgium), and therefore, these patients were excluded (N=511, 6.9%).

To investigate the effect of the living situation in the three SES groups, we conducted a subgroup analysis for the outcomes of community-dwelling patients and for patients who were institutionalized. Living situation was determined on basis of zip codes, including those of the nursing and care home patients. The first ED visit in the study period was considered the index visit, other visits after the index visit were excluded to avoid duplicate analysis of the patients' characteristics and outcomes. The Institutional Review Board of Máxima Medical Centre approved this study and confirmed that the Medical Research Involving Human Subject Act (WMO) was not applicable.

Data collection & definitions

The following data were retrieved from the electronic patient record: age, gender, zip code, comorbidity, number of used medications. The Charlson comorbidity index (CCI) was used to quantify comorbidity (22). All electronic patient (both ED and hospital) records were assessed to retrieve comorbidity. For a random sample

of 50% of the patients per SES group, comorbidity was manually retrieved. It was not feasible to do this for all patients. The patients' living situation was categorized into community-dwelling patients (living independently or with home care) and institutionalized patients (care home and nursing home).

To assess the severity of illness at presentation, the Manchester Triage Level (MTS) (23), vital parameters (systolic blood pressure, heart rate), laboratory tests (CRP and leukocytes) and the ED diagnoses were retrieved. The triage level based on the five-level MTS was categorised into 3 groups: urgent (red and orange), moderate (yellow), and low (green). In our ED the triage colour blue is not used, because these patients almost never visit our ED. Classification of ED diagnoses was done according the International Classification of Disease-10 (ICD-10)" (24). The group 'other', consisted out of diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.

Organizational factors retrieved were time of arrival, mode of referral (self-referral, GP, ambulance, specialist and other), specialty, number of diagnostic tests (sum of radiological tests, electrocardiogram, arterial blood gas analysis, laboratory tests, urine analysis, urine and blood culture), number of specialist consultations in the ED, ED-Length-of-Stay (LOS) and hospital-LOS. Time of presentation was classified into 3 shifts: day (8am-6pm), evening (6pm-12pm) and night (12pm-8am). The following specialties were considered surgical: (general) surgery, plastic surgery, urology, and orthopaedics. Pulmonology, neurology, internal medicine and gastroenterology were considered medical specialities. Hospital LOS was defined as the number of days between hospital admission and hospital discharge. Dates of death during hospital stay and of the ED-return visit were retrieved. The data were extracted by one trained medical abstractor who was blinded for the study hypothesis.

Statistical analyses

All statistical analyses were performed using SPSS 22.0 (Armonk, New York, 2015). Comparisons between two SES groups (low vs. intermediate, low vs. high and intermediate vs. high) were conducted using unpaired-t-tests for continuous data and the Chi square test for categorical data. For continuous variables that were not normally distributed, the Wilcoxon-Mann-Whitney-Test was used. Missing data were categorised as "unknown" and included in the analyses of categorical parameters, to explore the influence of missing values. To investigate the independent effect of SES on hospitalisation, in-hospital mortality, and 30-day ED-return

visits, logistic regression analyses was performed. Multivariable analysis was performed to calculate the adjusted Odds Ratio (OR) and in order to estimate the effect of confounders of age, gender, triage level and CCI. Age, CCI and medications were included as a linear variable in this analysis. For day of the week, a weekday was reference, and for sex, female was reference. Triage level was categorized as follows: urgent, intermediate and low (reference). Sensitivity analysis was performed to evaluate the effect of ED-revisits on mortality. For this analysis, those who died during hospitalisation were excluded (N=199). To estimate the effect of the living situation on the SES and their outcomes, patients were divided into community-dwelling patients and institutionalized patients. OR and corresponding 95% Confidence Intervals (CI) were calculated for each of the outcomes. A p-value was considered significant when <0.05.

Results

During the study period, 7205 ED visits by older adult patients were registered in our ED. In total, 511 patients (7.1%) were excluded because income data were missing and 1866 visits (25.9%) because the visit was a revisit. In total, 4828 index visits were included. Of these 1660 visits (33.1%) were classified as having a low SES, 1640 (34.0%) as intermediate and 1588 (32.9%) as having a high SES (Figure 1).

Patient characteristics

The mean age of the study population was 77±7.7 years, and slightly less patients were male (44.5%) (Table 1). In total, 4381 (90.7%) were community-dwelling patients and 9.2% lived institutionalized. Patients were mostly referred by a GP (58.5%) and were triaged as having moderate urgency (43.8%). More than half (56.5%) of the patients were hospitalised, and their median hospital-LOS was 5 days. In-hospital mortality was 4.1%.

Table 1. Patient characteristics and SES of older adult patients visiting the ED

Characteristics	Total population N = 4828	Socioeconomic Status			P-value
		Low N = 1660 (33.1%)	Intermediate N = 1640 (34.0%)	High N = 1588 (32.9%)	
Age, years					
Mean (SD)	77 (7.7)	80 (7.6)	76 (7.6)	75 (7.4)	<0.001#
Median (IQR)*	77 (12)	80 (11)	76 (12)	74 (12)	
Gender (%)*					<0.001
Male	2149 (44.5%)	618 (38.6%)	759 (46.3%)	772 (48.6%)	
Female	2679 (55.5%)	982 (61.4%)	881 (53.7%)	816 (51.4%)	
CCI, median (IQR)	1.2 (1.6)	1.0 (0-8)	1.0 (0-10)	1.0 (0-11)	0.09
Unknown		45 (5.3%)	49 (5.3%)	54 (6.2%)	
No. of medications, mean (SD)*	2.5 (4.3)	3.3 (4.7)	2.4 (4.2)	1.9 (3.9)	<0.001
Mode of referral*					
General Practitioner	2680 (55.5%)	937 (61.8%)	905 (57.8%)	838 (56.0%)	0.03
Self-referral	852 (17.6%)	215 (13.4%)	292 (17.8%)	345 (21.7%)	<0.001
Ambulance	664 (13.8%)	244 (15.3%)	237 (14.5%)	183 (11.5%)	0.01
Specialist	632 (13.1%)	204 (9.6%)	206 (9.9%)	222 (10.8%)	0.75
Living situation*					<0.001
Community-dwelling	4381 (90.7%)	1266 (79.1%)	1556 (94.9%)	1559 (98.2%)	
Institutionalized	443 (9.2%)	330 (20.6%)	84 (5.1%)	29 (1.8%)	
Missing	4 (100%)	4 (100%)	0	0	

SES = Socioeconomic status. SD = Standard deviation. CCI = Charlson comorbidity index. ED = Emergency Department. P-values P-values low, intermediate and high SES: using the Chi-square test, unpaired t-test and Mann-Whitney-U-test.

= p-value low vs. intermediate <0.001, low vs. high <0.001, intermediate vs. high <0.001.

* = p<0.05.

Patient characteristics and Socioeconomic status

Patients with a low or intermediate SES were older than patients with a high SES (80 vs. 76 and 75 years resp., p<0.001) (Table 1). Male patients less frequently had a low SES than intermediate and high SES patients (38.6% vs. 46.3% and 48.6% resp., p<0.001). The GP had referred patients in the low SES-group more often than in the intermediate and high SES-group (61.8% vs. 57.8% and 56.0% resp., p=0.03). Patients in the low SES-group used more medications than the high SES-group (3.3 vs. 1.9, p<0.001).

Organizational and clinical parameters in the ED and SES

There were no differences in the specialties (surgical vs. medical) that treated the patients nor in time of presentation between the three SES groups (Table 2). In addition, the vital parameters at presentation were comparable between the three groups. Patients with a low SES more often had a higher urgent triage level than the high SES-group, however, this difference was not significant (15.4% vs. 12.1%, p=0.02). In the low and the intermediate SES-group, more diagnostics tests were performed than in the high SES-group (mean 2.3 vs. 2.1 vs. 2.0, resp., p<0.001). Patients with low SES had a longer ED-LOS than patients with intermediate and high SES (140 min vs. 133 vs. 133, resp. p=0.01). Diagnoses differed between the three groups: endocrine diseases were more common in the low SES group (3.1%) than the intermediate or high SES group (1.7% and 1.6%, p=0.03), and the same was observed for infectious diseases. (Table 2).

Table 2. Organisational and clinical parameters of older adult ED patients within the different SES groups.

	Socioeconomic Status			
	Low N = 1660 (33.1%)	**Intermediate N = 1640 (34.0%)**	**High N = 1588 (32.9%)**	**P-value**
Specialism				0.16
Medical	879 (54.9%)	858 (52.3%)	822 (51.8%)	
Surgical	721 (45.1%)	782 (47.7%)	766 (48.2%)	
Shift				0.15
Morning	1130 (70.9%)	1148 (70.2%)	1169 (73.7%)	

Evening	240 (21.3%)	354 (21.7%)	318 (20.0%)	
Night	124 (7.8%)	133 (8.1%)	100 (6.3%)	
Level of triage				
Low*	628 (39.8%)	640 (39.7%)	687 (44.0%)	0.02
Moderate	702 (44.5%)	730 (35.3%)	683 (43.7%)	0.69
Urgent	246 (15.4%)	242 (14.8%)	192 (12.1%)	0.02
No triage	24 (1.5%)	28 (1.7%)	26 (1.6%)	0.98
No. of extra consultations at ED				0.80
None	1376 (86.0%)	1407 (85.6%)	1365 (86.0%)	
1	200 (12.5%)	215 (13.1%)	199 (12.5%)	
≥2	24 (0.5%)	18 (1.1%)	24 (1.4%)	
Vital parameters				
Systolic blood pressure (mmHg), mean (SD)	152 (31.7)	153 (31.3)	152 (30.8)	0.98
Missing	428 (26.9%)	530 (32.4%)	545 (35.5%)	
Heart rate (min), mean (SD)	81.5 (17.0)	82.5 (18.1)	82.1 (17.7)	0.49
Missing	734 (45.9%)	806 (49.1%)	819 (51.6%)	
Medical procedures at ED				
No. of diagnostic tests, mean (SD)	2.3 (1.8)	2.1 (1.8)	2.0 (1.7)	0.003#
Laboratory test (%)*	1081 (67.9%)	1046 (64.1%)	974 (61.7%)	<0.001
CRP (mg/L), median (IQR)	16 (60)	14 (55)	15 (66)	0.47
Leukocytes (x10^9/L), median (IQR)	9.2 (6)	9.3 (5)	8.8 (5)	0.91
Diagnosis at ED				
Injury	487 (30.6%)	504 (30.8%)	508 (32.2%)	0.56
Otherwise	280 (17.6%)	286 (17.5%)	289 (18.3%)	0.79
Circulatory / Respiratory	232 (14.6%)	257 (15.7%)	201 (12.7%)	0.06
Other	202 (12.7%)	217 (13.3%)	218 (18.3%)	0.64
Digestive	163 (10.2%)	175 (10.8%)	169 (10.7%)	0.88
Genito-urinary	68 (4.3%)	73 (4.5%)	58 (3.7%)	0.51

Infectious	65 (4.1%)	52 (3.2%)	45 (2.8%)	0.14
Endocrine / Metabolic	50 (3.1%)	28 (1.7%)	25 (1.6%)	0.03&
Neoplasm / haematology	47 (2.9%)	52 (3.2%)	70 (4.4%)	0.05^
Missing	6 (0.4%)	3 (0.2%)	9 (0.6%)	
ED-LOS in minutes, median (IQR)*	140 (83)	133 (90)	133 (87)	0.01@

SES = Socioeconomic Status. SD = Standard deviation. ED = Emergency department. CRP = C-reactive protein.
ED-Diagnosis 'other' (ICD-10 classification) = diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.
P-values low, intermediate and high SES: using the Chi-square test, unpaired t-test and Mann-Whitney-U-test.
* = p <0.05.
# = p-value low vs intermediate 0.003, low vs high <0.001, intermediate vs. high <0.01.
@ = p-value low vs intermediate 0.01, low vs high 0.004, intermediate vs. high <0.93.
^ = p-value low vs intermediate 0.01, low vs high 0.004, intermediate vs. high <0.93.
& = p-value low vs intermediate 0.70, low vs high 0.03, intermediate vs. high <0.06.

Patient outcomes and SES

Patients with a low SES were more frequently hospitalised than the intermediate and high SES-group (62.3% vs. 55.4% vs. 52.3%, resp., p<0.001, Table 3). In addition, patients with a low SES had a longer hospital-LOS than patients with a high SES (6.0 vs. 5.0 days, p<0.001). However, the hospital-LOS did not differ between intermediate SES and high SES patients (5 days in both groups, p=0.45). The finding that low SES patients were more often hospitalised than the high SES group turned out not to be independent of age and comorbidity (adjusted OR 1.3 95% CI 0.9–1.4, Table 3). When stratified according to living situation, low SES community-dwelling patients had a higher risk of hospitalisation with an OR of 1.3 (95% CI 1.1-1.7) compared with patients with a high SES. In contrast, institutionalized low SES patients had a lower risk of hospitalisation with an OR of 0.2 (95% CI:0.1-0.7). Intermediate SES patients did not have a higher odd for hospitalisation (OR 1.0 95% CI 0.95-1.4) than high SES patients.

Table 3. Multivariable analysis of the effect on SES on ED outcomes and within different living situations.

	Socioeconomic Status	Number (%)	All patients N = 4828 (OR 95%CI)	Community-dwelling patients N = 4381 (OR 95%CI)	Institutionalized patients N = 443 (OR 95%CI)
Hospitalisation[1]	Low	996/1660 (62.3%)	1.1 (0.9-1.4)	**1.3 (1.1-1.7)**	**0.2 (0.1–0.7)**
	Intermediate	909/1640 (55.4%)	1.1 (0.9-1.4)	1.1 (0.95-1.4)	0.4 (0.1-1.2)
	High	830/1588 (52.3%)	1.0	1.0	1.0
In-hospital mortality[2]	Low	86/996 (5.4%)	1.2 (0.7-2.0)	1.4 (0.8-2.6)	0.8 (0.1-6.8)
	Intermediate	58/909 (3.5%)	1.1 (0.6-1.9)	1.3 (0.8-2.2)	0.4 (0.1-4.0)
	High	55/830 (3.5%)	1.0	1.0	1.0
30-day ED-revisits[3#]	Low	184/1514 (11.5%)	1.0 (0.8-1.4)	1.0 (0.7-1.4)	1.0 (0.2-4.7)
	Intermediate	220/1582 (13.5%)	0.9 (0.7-1.1)	0.8 (0.6-1.1)	0.8 (0.2-4.6)
	High	196/1533 (12.3%)	1.0	1.0	1.0

ED = Emergency Department. OR = Odds Ratio. CI = confidence Interval.
1 = adjusted variable include age and Charlson comorbidity index.
2 = adjusted for age, Charlson comorbidity index, and triage level.
3 = adjusted for age, Charlson comorbidity index and gender. # = without patients who died during hospitalisation.

In-hospital mortality was higher for the low SES group (5.4%) compared with the intermediate (3.5%) and the high SES group (3.5%, p=0.01, unadjusted $OR_{low\_vs\_high}$:0.6 95% CI 0.4-0.9). The difference in in-hospital mortality between low and high SES patients was no longer significant when adjusted for age, comorbidity and triage level (adjusted OR 1.2 95% CI 0.7–2.0).

There was no difference in 30-day ED-revisit rate between the low, intermediate and high SES group (21.3%, 20.4% vs. 20.8%, resp., p=0.88). Neither was the 30-day ED-revisit rate different after correcting for age, comorbidity and gender (adjusted OR 1.0, 95% CI 0.8–1.4). Moreover, adjusting for the living situation did not alter the results significantly (Table 3).

Discussion

Our study was a large population-based study that investigated the association of SES with ED visits of older adult (≥65 years) patients. We found that older adult community-dwelling ED patients with a low SES have a higher risk of hospitalisation than patients with a high SES. Moreover, low SES patients had more often a higher

triage level, had more diagnostics test and longer ED-LOS compared to other SES groups. However, in-hospital mortality and the number of ED-return visits were not different between the three SES groups.

We hypothesized that patients with low SES would be less healthy than those with a higher SES, which indirectly would result in higher admission rates and in-hospital mortality after presentation at the ED. Our data allowed us to determine important confounders, such as comorbidity, organisational factors and the severity of illness at the ED, which makes it possible to contribute important information to already existing evidence on the topic of SES, where some studies did not adjust for potential and important confounders (7,25). Our study indeed observed a higher chance of hospitalisation (OR 1.3 CI 1.1-1.7) for community-dwelling patients with a low SES than for patients with intermediate/high SES. This finding is in line with other studies (9,26,27). It may be possible that part of the community-dwelling frail patients were admitted for care problems, which is not a reason for admission for institutionalized patients as extra care is available for these patients. Future studies should elaborate the living arrangements and social network of older adults to investigate the influence of these matters on ED usage.

In-hospital mortality and ED-revisits within 30 days were not associated with SES. This contrasts with other studies that found a higher risk of in-hospital mortality and readmissions in older adult patients with a low SES (8,16,17), but is in line with other studies that did not found an association (11,12,18). The association of low SES and adverse outcomes was found in studies that included patients with a specific diagnosis (e.g. pneumonia or heart failure) (18,28) or that analysed the number of ED visits per SES category (4,6,9,29), whereas our study focused on an undifferentiated, and therefore, more generalizable, older adult ED population. Another reason not finding an association between low SES and outcomes might be that most studies did not account for differences in living situation (17,30,31). We found that care and nursing homes were mostly situated in low SES areas, while their inhabitants will probably belong to all three SES (32). Additionally, institutionalized patients may influence revisit rates, because they are treated by their own doctor in the nursing home. It may be useful to take the living situation into account when using SES based on zip code, because care facilities structures at home influence ED outcomes.

The fact that we did not find an association between SES and in-hospital mortality and revisits may be due to the organisation of the health care system in the Netherlands and may underscore/reflect that our health care is indeed accessible to all patients, regardless of their SES. In the Netherlands, the health care system consists of a well organised GP-network, with 24-hours a day access for acute care patients, which is

equally accessible for every inhabitant (29). In the Netherlands, care provided by the general practitioner is fully covered by the basic obligatory health insurance (33). Therefore this system provides equal access to health care by the general practitioner to every resident, independent of their SES (5,34-36). In addition, this care selects the most severely ill patients for referral to the ED. The acute health care system differs over the countries, and in some countries, for instance the United States, the ED is used as a safety-net for underserved and uninsured patients (37). Also, evenly important, the financial health care structure is different worldwide In short, specifically regarding acute care, differences in organization and financial coverage of acute care make comparisons between countries difficult (38).

In the Netherlands, older adults are, in general, financially well-covered (39), as only 3.5% of them are poor (39). Concerning other studies on older adults and SES, the methods of determining SES differed substantially, and some included education, income and occupancy, but none of the methods have proved to be comprehensive enough (40). One study in Canada among older adults that determined factors of ED usage matched postal codes with several indicators, such as income, employment and living alone (10). In a Mediterranean study, SES was defined on years of education and the mean annual income of the family (41). In conclusion, the comparison of studies on SES is complicated by different levels of SES in the general population and of the way SES is defined.

Apart from the above mentioned, the following study limitations should be mentioned. Firstly, our results are not generalizable to cardiology and gynaecology patients as we excluded these patients. For these cardiology patients, it is known that low SES may have a stronger association with adverse outcomes (42), and excluding these from our study may explain that we did not find associations between SES and outcome (except for hospitalisation in community dwelling patients). Secondly, we retrieved SES on basis of zip codes, which may be imprecise and yield smaller associations of SES with adverse outcomes (43). However, one zip code in the database of Statistics Netherlands covers only 17 households and therefore, we consider this way of retrieving SES rather reliable (44,45). Thirdly, retrieving SES of patients living in a nursing home or other care home facilities on basis of zip code is probably not reliable. Therefore, we made subgroup analysis of community dwelling patients and institutionalized patients, which is a strong point of our study. Lastly, coding for the living situation may not be precise, but we think that this does not lead to an underestimation since the percentage of institutionalized patients (9.1%) is almost similar as percentages given in another study (9.0%) (46).

In this study, we provided important information in terms of health outcomes on the SES in the acute health care setting in the vulnerable older adult population. We investigated a large unselected group of older adult ED patients stratified to living situation, which provides additional knowledge on the care and problems of older adult patients in the ED. Our study shows that in a country with assumed equal health care access only minor outcome differences were observed between different SES groups. Therefore, physicians should be aware of the potential differences between SES groups given the higher chance of hospitalisation. Improvement in adequately diagnosing and treating older adult patients is important, but the additional value of SES in the emergency care should be evaluated further to develop effective interventions to ensure high quality of care. Future studies should elaborate the living arrangements and social network of older adults, because these probably influences access to the ED and the number of (re-)admissions.

In conclusion, low SES community-dwelling older adults were more often hospitalised than high SES community-dwelling patients, but no differences in in-hospital mortality and ED-revisits between the SES groups.

Contributorship statement

JW and SB conceived the study and designed the protocol. SL contributed to the design for the overall older adults project. JW, PS and ID analyzed and interpreted the data. HH supervised the conduct of the study and data collection. JW, PS and ID drafted the manuscript. MA helped with the statistical analyses. JW designed the database. JW, ID, PS, SB, MA, SL and HH contributed substantially to its revision and approved the final manuscript.

Data sharing statement

Data of the study is available from the data governance board of Maxima Medical Centre Institutional Data Access / Ethics Committee for researchers who meet the criteria for access to confidential data. Data are from the non-specific complaints study when contacting the data governance board (Jolanda.Luime@mmc.nl).

References

(1) Hoogendijk EO, van Hout HP, Heymans MW, van der Horst HE, Frijters DH, Broese van Groenou MI, et al. Explaining the association between educational level and frailty in older adults: results from a 13-year longitudinal study in the Netherlands. Ann Epidemiol 2014 Jul;24(7):538-44.e2.

(2) Lowthian JA, Curtis AJ, Cameron PA, Stoelwinder JU, Cooke MW, McNeil JJ. Systematic review of trends in emergency department attendances: an Australian perspective. Emerg Med J 2011 May;28(5):373-377.

(3) Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008 Jun 5;358(23):2468-2481.

(4) Droomers M, Westert GP. Do lower socioeconomic groups use more health services, because they suffer from more illnesses? Eur J Public Health 2004 Sep;14(3):311-313.

(5) van Doorslaer E, Wagstaff A, van der Burg H, Christiansen T, De Graeve D, Duchesne I, et al. Equity in the delivery of health care in Europe and the US. J Health Econ 2000 Sep;19(5):553-583.

(6) Khan Y, Glazier RH, Moineddin R, Schull MJ. A population-based study of the association between socioeconomic status and emergency department utilization in Ontario, Canada. Acad Emerg Med 2011 Aug;18(8):836-843.

(7) Tozer AP, Belanger P, Moore K, Caudle J. Socioeconomic status of emergency department users in Ontario, 2003 to 2009. CJEM 2014 May;16(3):220-225.

(8) Begley C, Basu R, Lairson D, Reynolds T, Dubinsky S, Newmark M, et al. Socioeconomic status, health care use, and outcomes: persistence of disparities over time. Epilepsia 2011 May;52(5):957-964.

(9) Filc D, Davidovich N, Novack L, Balicer RD. Is socioeconomic status associated with utilization of health care services in a single-payer universal health care system? Int J Equity Health 2014 Nov 28;13:115-014-0115-1.

(10) Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur AM, Roberge D, Larouche D, et al. Continuity of primary care and emergency department utilization among elderly people. CMAJ 2007 Nov 20;177(11):1362-1368.

(11) Ho KM, Dobb GJ, Knuiman M, Finn J, Webb SA. The effect of socioeconomic status on outcomes for seriously ill patients: a linked data cohort study. Med J Aust 2008 Jul 7;189(1):26-30.

(12) Alter DA, Chong A, Austin PC, Mustard C, Iron K, Williams JI, et al. Socioeconomic status and mortality after acute myocardial infarction. Ann Intern Med 2006 Jan 17;144(2):82-93.

(13) Samaras N, Chevalley T, Samaras D, Gold G. Older patients in the emergency department: a review. Ann Emerg Med 2010 Sep;56(3):261-269.

(14) Ramos M. Impact of socioeconomic status on Brazilian elderly health. Rev Saude Publica 2007 Aug;41(4):616-624.

(15) Cournane S, Conway R, Byrne D, O'Riordan D, Coveney S, Silke B. Social deprivation and the rate of emergency medical admission for older persons. QJM 2016 Oct;109(10):645-651.

(16) Hutchings A, Raine R, Brady A, Wildman M, Rowan K. Socioeconomic status and outcome from intensive care in England and Wales. Med Care 2004 Oct;42(10):943-951.

(17) Rathore SS, Masoudi FA, Wang Y, Curtis JP, Foody JM, Havranek EP, et al. Socioeconomic status, treatment, and outcomes among elderly patients hospitalized with heart failure: findings from the National Heart Failure Project. Am Heart J 2006 Aug;152(2):371-378.

(18) Izquierdo C, Oviedo M, Ruiz L, Sintes X, Vera I, Nebot M, et al. Influence of socioeconomic status on community-acquired pneumonia outcomes in elderly patients requiring hospitalization: a multicenter observational study. BMC Public Health 2010 Jul 15;10:421-2458-10-421.

(19) Brouns SHA, Dortmans MKJ, Jonkers FS, Lambooij SLE, Kuijper A, Haak HR. Hyponatraemia in Elderly Emergency Department Patients: A Marker of Frailty. Neth J Med 2014;72(6):311-317.

(20) Centraal bureau voor de statistiek. Inhoud kerncijfers postcodegebieden 2008-2010. 2012.

(21) Kunst A.E. Bos V. Mackenback J.P. Monitoring socioeconomic inequalities in health in the european union: guidelines and illustrations. EU Working Group on Socio-economic Inequalities in Health 2011.

(22) Needham DM, Scales DC, Laupacis A, Pronovost PJ. A systematic review of the Charlson comorbidity index using Canadian administrative databases: a perspective on risk adjustment in critical care research. J Crit Care 2005 Mar;20(1):12-19.

(23) Zachariasse JM, Seiger N, Rood PP, Alves CF, Freitas P, Smit FJ, et al. Validity of the Manchester Triage System in emergency care: A prospective observational study. PLoS One 2017 Feb 2;12(2):e0170811.

(24) Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care 2005 Nov;43(11):1130-1139.

(25) Bagher A, Andersson L, Wingren CJ, Ottosson A, Wangefjord S, Acosta S. Socio-economic status and major trauma in a Scandinavian urban city: A population-based case-control study. 2016;44:217-223.

(26) Robert S. Stern M, Joel S. Weissman P, Arnold M. Epstein, MD, MA. The emergency department as a pathway to admission for poor and high cost patients. JAMA 1991;266(16):2238-2243.

(27) Raffaeke Antonelli-Incalzi, Carla Ancona, Francesco Forastiere, Valeria Belleudi, Andrea Corsonello, Carlo A Perucci. Socioeconomic status and hospitalization in the very old: a retrospective study. BMC Public Health 2007;7(227).

(28) Bhayana R, Vermeulen MJ, Li Q, Hellings CR, Berdahl C, Schull MJ. Socioeconomic status and the use of computed tomography in the emergency department. CJEM 2014 Jul;16(4):288-295.

(29) van der Meer JB, van den Bos J, Mackenbach JP. Socioeconomic differences in the utilization of health services in a Dutch population: the contribution of health status. Health Policy 1996 Jul;37(1):1-18.

(30) Cressman AM, Macdonald EM, Yao Z, Austin PC, Gomes T, Paterson JM, et al. Socioeconomic status and risk of hemorrhage during warfarin therapy for atrial fibrillation: A population-based study. Am Heart J 2015 Jul;170(1):133-40, 140.e1-3.

(31) Govindarajan P, Gonzales R, Maselli JH, Johnston SC, Fahimi J, Poisson S, et al. Regional differences in emergency medical services use for patients with acute stroke (findings from the National Hospital Ambulatory Medical Care Survey Emergency Department Data File). J Stroke Cerebrovasc Dis 2013 Nov;22(8):e257-63.

(32) Arendts G, Howard K. The interface between residential aged care and the emergency department: a systematic review. Age Ageing 2010 May;39(3):306-312.

(33) van der Linden MC, Lindeboom R, de Haan R, van der Linden N, de Deckere ER, Lucas C, et al. Unscheduled return visits to a Dutch inner-city emergency department. Int J Emerg Med 2014 Jul 5;7:23-014-0023-6. eCollection 2014.

(34) Pines JM, Hilton JA, Weber EJ, Alkemade AJ, Al Shabanah H, Anderson PD, et al. International perspectives on emergency department crowding. Acad Emerg Med 2011;18(12):1358-1370.

(35) van der Linden MC, Lindeboom R, van der Linden N, van den Brand CL, Lam RC, Lucas C, et al. Self-referring patients at the emergency department: appropriateness of ED use and motives for self-referral. Int J Emerg Med 2014 Jul 16;7:28-014-0028-1. eCollection 2014.

(36) Holmes JL. Emergency medicine in the Netherlands. Emergency Medicine Australasia 2010;22(1):75-81.

(37) Di Somma S, Paladino L, Vaughan L, Lalle I, Magrini L, Magnanti M. Overcrowding in emergency department: an international issue. Intern Emerg Med 2015 Mar;10(2):171-175.

(38) Grundy E, Holt G. The socioeconomic status of older adults: how should we measure it in studies of health inequalities? J Epidemiol Community Health 2001 Dec;55(12):895-904.

(39) Smits CH, van den Beld HK, Aartsen MJ, Schroots JJ. Aging in the Netherlands: state of the art and science. Gerontologist 2014 Jun;54(3):335-343.

(40) Martelin T. Mortality by indicators of socioeconomic status among the Finnish elderly. Soc Sci Med 1994 May;38(9):1257-1278.

(41) Katsarou A, Tyrovolas S, Psaltopoulou T, Zeimbekis A, Tsakountakis N, Bountziouka V, et al. Socio-economic status, place of residence and dietary habits among the elderly: the Mediterranean islands study. Public Health Nutr 2010 Oct;13(10):1614-1621.

(42) Carlsson AC, Li X, Holzmann MJ, Wandell P, Gasevic D, Sundquist J, et al. Neighbourhood socioeconomic status and coronary heart disease in individuals between 40 and 50 years. Heart 2016 May 15;102(10):775-782.

(43) Aarts MJ, van der Aa MA, Coebergh JW, Louwman WJ. Reduction of socioeconomic inequality in cancer incidence in the South of the Netherlands during 1996-2008. Eur J Cancer 2010 Sep;46(14):2633-2646.

(44) Bos, V. Kunst, A.E., Mackenback, J. in verslag aan de Programmacommissie Sociaal-economische gezondheidsverschillen II [In Dutch]. Instituut Maatschappelijke Gezondheidszorg, Erasmus Universiteit, Rotterdam 2000.

(45) Smits, J. Keij, I. Mackenbach, J.P. in Sociaal-economische gezondheidsverschillen: Van verklaren naar verkleinen [In Dutch]. Zon/MW, Den Haag 2001.

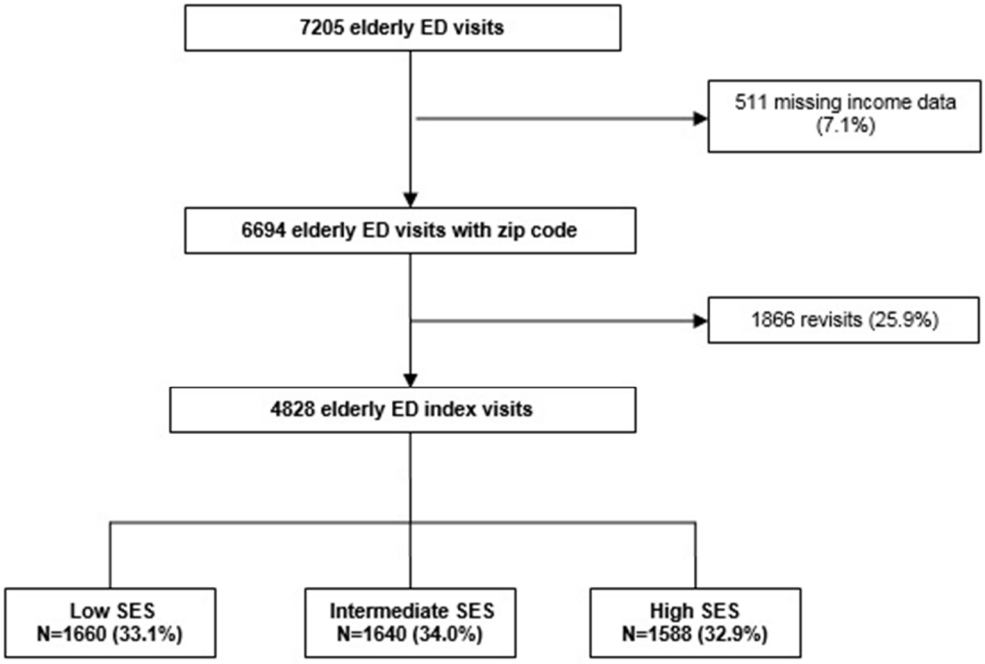
(46) Ribbe MW, Ljunggren G, Steel K, Topinkova E, Hawes C, Ikegami N, et al. Nursing homes in 10 nations: a comparison between countries and settings. Age Ageing 1997 Sep;26 Suppl 2:3-12.

Figures

Figure 1. The Flow chart of older adult patients divided into three SES groups.

ED = Emergency department. SES = Socioeconomic Status

1
2
3
4
5
6
7
8



45x31mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5-6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-12
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations			12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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

BMJ Open

Older adult community-dwelling patients with low socioeconomic status are hospitalised more often after visiting the emergency department

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019318.R2
Article Type:	Research
Date Submitted by the Author:	13-Nov-2017
Complete List of Authors:	Wachelder, Joyce; Maxima Medisch Centrum, Internal Medicine van Drunen, Isabelle ; Maxima Medisch Centrum, Internal Medicine Stassen, Patricia; Maastricht University CAPHRI School for Public Health and Primary Care; Maastricht Universitair Medisch Centrum+ Interne Geneeskunde, Internal Medicine Brouns , Steffie ; Maxima Medisch Centrum, Internal Medicine Lambooij, Suze ; Maxima Medisch Centrum, Internal Medicine Aarts, Mieke ; Netherlands Comprehensive Cancer Organisation Haak , Harm; Maxima Medisch Centrum, Eindhoven ; Maastricht University CAPHRI School for Public Health and Primary Care
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Geriatric medicine
Keywords:	Socioeconomic Status, Elderly, Emergency Department

Older adult community-dwelling patients with low socioeconomic status are hospitalised more often after visiting the emergency department

J.J.H. Wachelder[12], I.S. van Drunen[1#], P.M.Stassen[24#], S.H.A Brouns[12], S.L.E. Lambooij[1], M.J. Aarts[3], H.R. Haak[124]

1. Department of Internal Medicine, Máxima Medical Centre, 5631 BM Eindhoven/Veldhoven, the Netherlands.

2. Maastricht University, Department of Health Services Research, and CAPHRI School for Public Health and Primary Care, 6229 ER Maastricht, the Netherlands.

3. Netherlands Comprehensive Cancer Organisation, PO Box 19097, 3501DB Utrecht, the Netherlands.

4. Dept. of Internal Medicine, division of general medicine, section acute medicine, Maastricht University Medical Centre, 6229 HX Maastricht, the Netherlands.

# Authors contributed equally.

Correspondence should be addressed to: Joyce Wachelder, Department of Internal Medicine, Máxima Medical Centre, PO Box 90052, 5600 PD Eindhoven, The Netherlands; telephone number: +31408886300, fax number +31402450385, Email: joyce.wachelder@mmc.nl

Disclosure: There are no conflicts of interest. No funding was received.

Word count: 4072 (including tables)

Word count abstract: 250

Number of Tables: 3. Number of Figures: 1.

References: 46

Keywords: Socioeconomic Status; Older adult; Emergency Department

Abstract

Objectives: Older adults frequently visit the Emergency Department (ED). Socioeconomic State (SES) has an important impact on health and ED utilization, however, the association between SES and ED utilization in elderly remains unclear. The aim of this study was to investigate the association between SES in older adult patients visiting the ED on outcomes.

Design: A retrospective study.

Participants: Older adults (≥65 years) visiting the ED, in the Netherlands. SES was stratified into tertiles based on average household income at zip code level; low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month).

Primary outcomes: hospitalisation, in-hospital mortality and 30-day ED-return visits. Effect of SES on outcomes for all groups were assessed by logistic regression and adjusted for confounders.

Results: In total, 4828 older adults visited the ED during the study period. Low SES was associated with a higher risk of hospitalisation among community-dwelling patients compared with high SES (adjusted OR1.3 95%CI 1.1-1.7). This association was not present for intermediate SES (adjusted OR1.1 95%CI 0.95-1.4). In-hospital mortality was comparable between the low and high SES-group, even after adjustment for age, comorbidity and triage level (low OR 1.4 95%CI 0.8-2.6, intermediate OR 1.3 95%CI 0.8-2.2). Thirty-day ED-revisits among community-dwelling patients were also equal between the SES groups (low: adjusted OR 1.0 95%CI 0.7-1.4 and intermediate: adjusted OR 0.8 95%CI 0.6-1.1).

Conclusion: In older adult ED patients, low SES was associated with a higher risk of hospitalisation than high SES. However, SES had no impact on in-hospital mortality and 30-day ED-revisits after adjustment for confounders.

Strengths and limitations of this study

- This is one of the only studies to provide detailed insight into the impact of different socioeconomic status groups of older adults in the emergency care.
- Additionally, this study the living situation was used to differentiate between community-dwelling patients and institutionalized patients to observe differences in outcomes.
- This study used a retrospective cohort study and linked patient zip code with income data based on a well-defined database by Statistics Netherlands.
- A strength of our study is that we investigated a large undifferentiated group of older adult emergency care patients.
- Limitations were that we were not able to extract the data of cardiology and gynaecology patients and that we used zip code to define the socioeconomic status.

Introduction

The burden on the Emergency Department (ED) capacity has been increasing over the past decades, which is mostly due to a substantially increasing number of older adults (≥65 years old) (1). Given the extent and complexity of the problems in these patients, it is essential to identify determinants that lead to the ED visits in order to maintain high quality of care of older adult ED patients (2).

Low socioeconomic status (SES) has already been identified as an important determinant of health status and is strongly associated with poor adverse health outcomes (3). Patients with a low SES visit the general practitioner more and the specialist less often than patients with a high SES (4,5). Moreover, patients with a low a SES use the ED more frequently and are admitted to the hospital more often than those with a high SES (4,6-10). However, most studies focused on the influence of SES on the quantity of ED utilization, rather than on the reasons for and outcomes of these ED visits in general (8,10-12) .

It is well-known that older adults are vulnerable and prone to adverse health outcomes, such as ED visits, ED return visits, hospitalisation and mortality (13). However, research on the effect of SES on ED visits and adverse health outcomes in these older adults is scarce (10,14,15). Some of these studies demonstrated conflicting results as where low SES patients showed higher risk of adverse health outcomes (8,16,17), while other studies did not find such an increased risk (11,12,18). Moreover, most studies focused on patients with a specific diagnosis (e.g. heart failure, pneumonia or injury) and other studies merely studied ED utilization (10,14,18).

To understand the ED utilization patterns of older adults, it can be important to take their SES into account. Understanding the characteristics of older adult ED patients, including their SES, may be the first step to maintain or improve high quality of acute care. We hypothesize that low SES influences the risk of adverse health outcomes in the ED setting in a negative way and adds to the vulnerability of older adult ED patients even in a country in which health care access is organized for every inhabitant, regardless of SES.

The aim of this study was to determine differences between different SES groups among older adults s and additionally and most importantly we investigated the association of SES with hospitalisation, in-hospital mortality and ED-revisits.

Method

Study design, setting and population

A retrospective cohort study was performed in the Maxima Medical Centre, a 550-bed teaching hospital in the Netherlands. Yearly, approximately 30,000 patients visit the ED (19), of whom 30% are older adults (≥65 years). In the Netherlands, patients are usually referred to the ED by a general practitioner. The general practitioners provide acute care all days of the week and every hour of the day, including out of office hours.

Older adults who visited the ED for all medical (including oncology) and surgical specialities in one year (between 1st of September 2011 and 31st of August 2012), were included. Data from the acute cardiac care unit and gynaecology unit were not available in the database, because these patients do not visit the ED .

Data of the ED visits were automatically extracted from the electronic patient records (Chipsoft-EZIS, version 5.2). Categorization of the data was done according a fixed data extraction form by one researcher (JW). A random sample of all variables was checked by another researcher (ID). The patients' zip code (on average 17 households per zip code) was used to determine the SES at a neighbourhood level by combining the median household income per month and mean value of the houses. Data on income were provided by Statistics Netherlands (20). This dataset excluded zip codes with less than 10 households to guarantee anonymity. The median income data derived from zip codes in the database from Statistics Netherlands were linked to our database and subsequently divided into tertiles (21): low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month). It was impossible to retrieve SES data for patients with unknown zip code or patients living abroad (Belgium), and therefore, these patients were excluded (N=511, 6.9%).

To investigate the effect of the living situation in the three SES groups, we conducted a subgroup analysis for the outcomes of community-dwelling patients and for patients who were institutionalized. Living situation was determined on basis of zip codes, including those of the nursing and care home patients. The first ED visit in the study period was considered the index visit, other visits after the index visit were excluded to avoid duplicate analysis of the patients' characteristics and outcomes. The Institutional Review Board of Máxima Medical Centre approved this study and confirmed that the Medical Research Involving Human Subject Act (WMO) was not applicable.

Data collection & definitions

The following data were retrieved from the electronic patient record: age, gender, zip code, comorbidity, number of used medications. The Charlson comorbidity index (CCI) was used to quantify comorbidity (22). All electronic patient (both ED and hospital) records were assessed to retrieve comorbidity. For a random sample

of 50% of the patients per SES group, comorbidity was manually retrieved. It was not feasible to do this for all patients. The patients' living situation was categorized into community-dwelling patients (living independently or with home care) and institutionalized patients (care home and nursing home).

To assess the severity of illness at presentation, the Manchester Triage Level (MTS) (23), vital parameters (systolic blood pressure, heart rate), laboratory tests (CRP and leukocytes) and the ED diagnoses were retrieved. The triage level based on the five-level MTS was categorised into 3 groups: urgent (red and orange), moderate (yellow), and low (green). In our ED the triage colour blue is not used, because these patients almost never visit our ED. Classification of ED diagnoses was done according the International Classification of Disease-10 (ICD-10)" (24). The group 'other', consisted out of diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.

Organizational factors retrieved were time of arrival, mode of referral (self-referral, GP, ambulance, specialist and other), specialty, number of diagnostic tests (sum of radiological tests, electrocardiogram, arterial blood gas analysis, laboratory tests, urine analysis, urine and blood culture), number of specialist consultations in the ED, ED-Length-of-Stay (LOS) and hospital-LOS. Time of presentation was classified into 3 shifts: day (8am-6pm), evening (6pm-12pm) and night (12pm-8am). The following specialties were considered surgical: (general) surgery, plastic surgery, urology, and orthopaedics. Pulmonology, neurology, internal medicine and gastroenterology were considered medical specialities. Hospital LOS was defined as the number of days between hospital admission and hospital discharge. Dates of death during hospital stay and of the ED-return visit were retrieved. The data were extracted by one trained medical abstractor who was blinded for the study hypothesis.

Statistical analyses

All statistical analyses were performed using SPSS 22.0 (Armonk, New York, 2015). Comparisons between two SES groups (low vs. intermediate, low vs. high and intermediate vs. high) were conducted using ANOVA (post-hoc Tukey test) for continuous data and the Chi square test for categorical data. For continuous variables that were not normally distributed, the Wilcoxon-Mann-Whitney-Test was used. Missing data were categorised as "unknown" and included in the analyses of categorical parameters, to explore the influence of missing values. To investigate the independent effect of SES on hospitalisation, in-hospital mortality, and 30-day ED-return

visits, logistic regression analyses was performed. Multivariable analysis was performed to calculate the adjusted Odds Ratio (OR) and in order to estimate the effect of confounders of age, gender, triage level and CCI. Age, CCI and medications were included as a linear variable in this analysis. For day of the week, a weekday was reference, and for sex, female was reference. Triage level was categorized as follows: urgent, intermediate and low (reference). Sensitivity analysis was performed to evaluate the effect of ED-revisits on mortality. For this analysis, those who died during hospitalisation were excluded (N=199). To estimate the effect of the living situation on the SES and their outcomes, patients were divided into community-dwelling patients and institutionalized patients. OR and corresponding 95% Confidence Intervals (CI) were calculated for each of the outcomes. A p-value was considered significant when <0.05.

Results

During the study period, 7205 ED visits by older adult patients were registered in our ED. In total, 511 patients (7.1%) were excluded because income data were missing and 1866 visits (25.9%) because the visit was a revisit. In total, 4828 index visits were included. Of these 1660 visits (33.1%) were classified as having a low SES, 1640 (34.0%) as intermediate and 1588 (32.9%) as having a high SES (Figure 1).

Patient characteristics

The mean age of the study population was 77±7.7 years, and slightly less patients were male (44.5%) (Table 1). In total, 4381 (90.7%) were community-dwelling patients and 9.2% lived institutionalized. Patients were mostly referred by a GP (58.5%) and were triaged as having moderate urgency (43.8%). More than half (56.5%) of the patients were hospitalised, and their median hospital-LOS was 5 days. In-hospital mortality was 4.1%.

Table 1. Patient characteristics and SES of older adult patients visiting the ED

Characteristics	Total population N = 4828	Socioeconomic Status			P-value
		Low N = 1660 (33.1%)	Intermediate N = 1640 (34.0%)	High N = 1588 (32.9%)	
Age, years					
Mean (SD)	77 (7.7)	80 (7.6)	76 (7.6)	75 (7.4)	<0.001#
Median (IQR)*	77 (12)	80 (11)	76 (12)	74 (12)	
Gender (%)*					<0.001
Male	2149 (44.5%)	618 (38.6%)	759 (46.3%)	772 (48.6%)	
Female	2679 (55.5%)	982 (61.4%)	881 (53.7%)	816 (51.4%)	
CCI, median (IQR)	1.2 (1.6)	1.0 (0-8)	1.0 (0-10)	1.0 (0-11)	0.09
Unknown		45 (5.3%)	49 (5.3%)	54 (6.2%)	
No. of medications, mean (SD)*	2.5 (4.3)	3.3 (4.7)	2.4 (4.2)	1.9 (3.9)	<0.001@
Mode of referral*					
General Practitioner	2680 (55.5%)	937 (61.8%)	905 (57.8%)	838 (56.0%)	0.03
Self-referral	852 (17.6%)	215 (13.4%)	292 (17.8%)	345 (21.7%)	<0.001
Ambulance	664 (13.8%)	244 (15.3%)	237 (14.5%)	183 (11.5%)	0.01
Specialist	632 (13.1%)	204 (9.6%)	206 (9.9%)	222 (10.8%)	0.75
Living situation*					<0.001
Community-dwelling	4381 (90.7%)	1266 (79.1%)	1556 (94.9%)	1559 (98.2%)	
Institutionalized	443 (9.2%)	330 (20.6%)	84 (5.1%)	29 (1.8%)	
Missing	4 (100%)	4 (100%)	0	0	

SES = Socioeconomic status. SD = Standard deviation. CCI = Charlson comorbidity index. ED = Emergency Department. P-values P-values low, intermediate and high SES: using the Chi-square test, ANOVA (post-hoc Tukey) and Mann-Whitney-U-test.

= p-value low vs. intermediate <0.001, low vs. high <0.001, intermediate vs. high 0.001.

@ = p-value low vs. intermediate 0.001, low vs. high <0.001, intermediate vs. high 0.042.

* = p<0.05.

Patient characteristics and Socioeconomic status

Patients with a low or intermediate SES were older than patients with a high SES (80 vs. 76 and 75 years resp., p<0.001) (Table 1). Male patients less frequently had a low SES than intermediate and high SES patients (38.6% vs. 46.3% and 48.6% resp., p<0.001). The GP had referred patients in the low SES-group more often than in the intermediate and high SES-group (61.8% vs. 57.8% and 56.0% resp., p=0.03). Patients in the low SES-group used more medications than the high SES-group (3.3 vs. 1.9, p<0.001).

Organizational and clinical parameters in the ED and SES

There were no differences in the specialties (surgical vs. medical) that treated the patients nor in time of presentation between the three SES groups (Table 2). In addition, the vital parameters at presentation were comparable between the three groups. Patients with a low SES more often had a higher urgent triage level than the high SES-group, however, this difference was not significant (15.4% vs. 12.1%, p=0.02). In the low and the intermediate SES-group, more diagnostics tests were performed than in the high SES-group (mean 2.3 vs. 2.1 vs. 2.0, resp., p<0.001). Patients with low SES had a longer ED-LOS than patients with intermediate and high SES (140 min vs. 133 vs. 133, resp. p=0.01). Diagnoses differed between the three groups: endocrine diseases were more common in the low SES group (3.1%) than the intermediate or high SES group (1.7% and 1.6%, p=0.03), and the same was observed for infectious diseases. (Table 2).

Table 2. Organisational and clinical parameters of older adult ED patients within the different SES groups.

	Socioeconomic Status			
	Low N = 1660 (33.1%)	**Intermediate N = 1640 (34.0%)**	**High N = 1588 (32.9%)**	**P-value**
Specialism				0.16
Medical	879 (54.9%)	858 (52.3%)	822 (51.8%)	
Surgical	721 (45.1%)	782 (47.7%)	766 (48.2%)	
Shift				0.15

Morning	1130 (70.9%)	1148 (70.2%)	1169 (73.7%)	
Evening	240 (21.3%)	354 (21.7%)	318 (20.0%)	
Night	124 (7.8%)	133 (8.1%)	100 (6.3%)	
Level of triage				
Low*	628 (39.8%)	640 (39.7%)	687 (44.0%)	0.02
Moderate	702 (44.5%)	730 (35.3%)	683 (43.7%)	0.69
Urgent	246 (15.4%)	242 (14.8%)	192 (12.1%)	0.02
No triage	24 (1.5%)	28 (1.7%)	26 (1.6%)	0.98
No. of extra consultations at ED				0.80
None	1376 (86.0%)	1407 (85.6%)	1365 (86.0%)	
1	200 (12.5%)	215 (13.1%)	199 (12.5%)	
≥2	24 (0.5%)	18 (1.1%)	24 (1.4%)	
Vital parameters				
Systolic blood pressure (mmHg), mean (SD)	152 (31.7)	153 (31.3)	152 (30.8)	0.94
Missing	428 (26.9%)	530 (32.4%)	545 (35.5%)	
Heart rate (min), mean (SD)	81.5 (17.0)	82.5 (18.1)	82.1 (17.7)	0.32
Missing	734 (45.9%)	806 (49.1%)	819 (51.6%)	
Medical procedures at ED				
No. of diagnostic tests, mean (SD)	2.3 (1.8)	2.1 (1.8)	2.0 (1.7)	<0.001#
Laboratory test (%)*	1081 (67.9%)	1046 (64.1%)	974 (61.7%)	<0.001
CRP (mg/L), median (IQR)	16 (60)	14 (55)	15 (66)	0.47
Leukocytes (x10^9/L), median (IQR)	9.2 (6)	9.3 (5)	8.8 (5)	0.91
Diagnosis at ED				
Injury	487 (30.6%)	504 (30.8%)	508 (32.2%)	0.56
Otherwise	280 (17.6%)	286 (17.5%)	289 (18.3%)	0.79
Circulatory / Respiratory	232 (14.6%)	257 (15.7%)	201 (12.7%)	0.06
Other	202 (12.7%)	217 (13.3%)	218 (18.3%)	0.64
Digestive	163 (10.2%)	175 (10.8%)	169 (10.7%)	0.88

Genito-urinary	68 (4.3%)	73 (4.5%)	58 (3.7%)	0.51
Infectious	65 (4.1%)	52 (3.2%)	45 (2.8%)	0.14
Endocrine / Metabolic	50 (3.1%)	28 (1.7%)	25 (1.6%)	0.03
Neoplasm / haematology	47 (2.9%)	52 (3.2%)	70 (4.4%)	0.05
Missing	6 (0.4%)	3 (0.2%)	9 (0.6%)	
ED-LOS in minutes, median (IQR)*	140 (83)	133 (90)	133 (87)	0.01@

SES = Socioeconomic Status. SD = Standard deviation. ED = Emergency department. CRP = C-reactive protein.
ED-Diagnosis 'other' (ICD-10 classification) = diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.
P-values low, intermediate and high SES: using the Chi-square test, ANOVA (post-hoc Tukey) and Mann-Whitney-U-test.
* = p <0.05.
# = p-value low vs intermediate <0.001, low vs high <0.001, intermediate vs. high <0.01.
@ = p-value low vs intermediate 0.01, low vs high 0.004, intermediate vs. high 0.93.

Patient outcomes and SES

Patients with a low SES were more frequently hospitalised than the intermediate and high SES-group (62.3% vs. 55.4% vs. 52.3%, resp., p<0.001, Table 3). In addition, patients with a low SES had a longer hospital-LOS than patients with a high SES (6.0 vs. 5.0 days, p<0.001). However, the hospital-LOS did not differ between intermediate SES and high SES patients (5 days in both groups, p=0.45). The finding that low SES patients were more often hospitalised than the high SES group turned out not to be independent of age and comorbidity (adjusted OR 1.3 95% CI 0.9–1.4, Table 3). When stratified according to living situation, low SES community-dwelling patients had a higher risk of hospitalisation with an OR of 1.3 (95% CI 1.1-1.7) compared with patients with a high SES. In contrast, institutionalized low SES patients had a lower risk of hospitalisation with an OR of 0.2 (95% CI:0.1-0.7). Intermediate SES patients did not have a higher odd for hospitalisation (OR 1.0 95% CI 0.95-1.4) than high SES patients.

Table 3. Multivariable analysis of the effect on SES on ED outcomes and within different living situations.

	Socioeconomic Status	Number (%)	All patients N = 4828 (OR 95%CI)	Community-dwelling patients N = 4381 (OR 95%CI)	Institutionalized patients N = 443 (OR 95%CI)
Hospitalisation[1]	Low	996/1660 (62.3%)	1.1 (0.9-1.4)	**1.3 (1.1-1.7)**	**0.2 (0.1–0.7)**
	Intermediate	909/1640 (55.4%)	1.1 (0.9-1.4)	1.1 (0.95-1.4)	0.4 (0.1-1.2)
	High	830/1588 (52.3%)	1.0	1.0	1.0
In-hospital mortality[2]	Low	86/996 (5.4%)	1.2 (0.7-2.0)	1.4 (0.8-2.6)	0.8 (0.1-6.8)
	Intermediate	58/909 (3.5%)	1.1 (0.6-1.9)	1.3 (0.8-2.2)	0.4 (0.1-4.0)
	High	55/830 (3.5%)	1.0	1.0	1.0
30-day ED-revisits[3#]	Low	184/1514 (11.5%)	1.0 (0.8-1.4)	1.0 (0.7-1.4)	1.0 (0.2-4.7)
	Intermediate	220/1582 (13.5%)	0.9 (0.7-1.1)	0.8 (0.6-1.1)	0.8 (0.2-4.6)
	High	196/1533 (12.3%)	1.0	1.0	1.0

ED = Emergency Department. OR = Odds Ratio. CI = confidence Interval.
1 = adjusted variable include age and Charlson comorbidity index.
2 = adjusted for age, Charlson comorbidity index, and triage level.
3 = adjusted for age, Charlson comorbidity index and gender. # = without patients who died during hospitalisation.

In-hospital mortality was higher for the low SES group (5.4%) compared with the intermediate (3.5%) and the high SES group (3.5%, p=0.01, unadjusted $OR_{low\_vs\_high}$:0.6 95% CI 0.4-0.9). The difference in in-hospital mortality between low and high SES patients was no longer significant when adjusted for age, comorbidity and triage level (adjusted OR 1.2 95% CI 0.7–2.0).

There was no difference in 30-day ED-revisit rate between the low, intermediate and high SES group (21.3%, 20.4% vs. 20.8%, resp., p=0.88). Neither was the 30-day ED-revisit rate different after correcting for age, comorbidity and gender (adjusted OR 1.0, 95% CI 0.8–1.4). Moreover, adjusting for the living situation did not alter the results significantly (Table 3).

Discussion

Our study was a large population-based study that investigated the association of SES with ED visits of older adult (≥65 years) patients. We found that older adult community-dwelling ED patients with a low SES have a higher risk of hospitalisation than patients with a high SES. Moreover, low SES patients had more often a higher

triage level, had more diagnostics test and longer ED-LOS compared to other SES groups. However, in-hospital mortality and the number of ED-return visits were not different between the three SES groups.

We hypothesized that patients with low SES would be less healthy than those with a higher SES, which indirectly would result in higher admission rates and in-hospital mortality after presentation at the ED. Our data allowed us to determine important confounders, such as comorbidity, organisational factors and the severity of illness at the ED, which makes it possible to contribute important information to already existing evidence on the topic of SES, where some studies did not adjust for potential and important confounders (7,25). Our study indeed observed a higher chance of hospitalisation (OR 1.3 CI 1.1-1.7) for community-dwelling patients with a low SES than for patients with intermediate/high SES. This finding is in line with other studies (9,26,27). It may be possible that part of the community-dwelling frail patients were admitted for care problems, which is not a reason for admission for institutionalized patients as extra care is available for these patients. Future studies should elaborate the living arrangements and social network of older adults to investigate the influence of these matters on ED usage.

In-hospital mortality and ED-revisits within 30 days were not associated with SES. This contrasts with other studies that found a higher risk of in-hospital mortality and readmissions in older adult patients with a low SES (8,16,17), but is in line with other studies that did not found an association (11,12,18). The association of low SES and adverse outcomes was found in studies that included patients with a specific diagnosis (e.g. pneumonia or heart failure) (18,28) or that analysed the number of ED visits per SES category (4,6,9,29), whereas our study focused on an undifferentiated, and therefore, more generalizable, older adult ED population. Another reason not finding an association between low SES and outcomes might be that most studies did not account for differences in living situation (17,30,31). We found that care and nursing homes were mostly situated in low SES areas, while their inhabitants will probably belong to all three SES (32). Additionally, institutionalized patients may influence revisit rates, because they are treated by their own doctor in the nursing home. It may be useful to take the living situation into account when using SES based on zip code, because care facilities structures at home influence ED outcomes.

The fact that we did not find an association between SES and in-hospital mortality and revisits may be due to the organisation of the health care system in the Netherlands and may underscore/reflect that our health care is indeed accessible to all patients, regardless of their SES. In the Netherlands, the health care system consists of a well organised GP-network, with 24-hours a day access for acute care patients, which is

equally accessible for every inhabitant (29). In the Netherlands, care provided by the general practitioner is fully covered by the basic obligatory health insurance (33). Therefore this system provides equal access to health care by the general practitioner to every resident, independent of their SES (5,34-36). In addition, this care selects the most severely ill patients for referral to the ED. The acute health care system differs over the countries, and in some countries, for instance the United States, the ED is used as a safety-net for underserved and uninsured patients (37). Also, evenly important, the financial health care structure is different worldwide In short, specifically regarding acute care, differences in organization and financial coverage of acute care make comparisons between countries difficult (38).

In the Netherlands, older adults are, in general, financially well-covered (39), as only 3.5% of them are poor (39). Concerning other studies on older adults and SES, the methods of determining SES differed substantially, and some included education, income and occupancy, but none of the methods have proved to be comprehensive enough (40). One study in Canada among older adults that determined factors of ED usage matched postal codes with several indicators, such as income, employment and living alone (10). In a Mediterranean study, SES was defined on years of education and the mean annual income of the family (41). In conclusion, the comparison of studies on SES is complicated by different levels of SES in the general population and of the way SES is defined.

Apart from the above mentioned, the following study limitations should be mentioned. Firstly, our results are not generalizable to cardiology and gynaecology patients as we excluded these patients. For these cardiology patients, it is known that low SES may have a stronger association with adverse outcomes (42), and excluding these from our study may explain that we did not find associations between SES and outcome (except for hospitalisation in community dwelling patients). Secondly, we retrieved SES on basis of zip codes, which may be imprecise and yield smaller associations of SES with adverse outcomes (43). However, one zip code in the database of Statistics Netherlands covers only 17 households and therefore, we consider this way of retrieving SES rather reliable (44,45). Thirdly, retrieving SES of patients living in a nursing home or other care home facilities on basis of zip code is probably not reliable. Therefore, we made subgroup analysis of community dwelling patients and institutionalized patients, which is a strong point of our study. Lastly, coding for the living situation may not be precise, but we think that this does not lead to an underestimation since the percentage of institutionalized patients (9.1%) is almost similar as percentages given in another study (9.0%) (46).

In this study, we provided important information in terms of health outcomes on the SES in the acute health care setting in the vulnerable older adult population. We investigated a large unselected group of older adult ED patients stratified to living situation, which provides additional knowledge on the care and problems of older adult patients in the ED. Our study shows that in a country with assumed equal health care access only minor outcome differences were observed between different SES groups. Therefore, physicians should be aware of the potential differences between SES groups given the higher chance of hospitalisation. Improvement in adequately diagnosing and treating older adult patients is important, but the additional value of SES in the emergency care should be evaluated further to develop effective interventions to ensure high quality of care. Future studies should elaborate the living arrangements and social network of older adults, because these probably influences access to the ED and the number of (re-)admissions.

In conclusion, low SES community-dwelling older adults were more often hospitalised than high SES community-dwelling patients, but no differences in in-hospital mortality and ED-revisits between the SES groups.

Contributorship statement

JW and SB conceived the study and designed the protocol. SL contributed to the design for the overall older adults project. JW, PS and ID analyzed and interpreted the data. HH supervised the conduct of the study and data collection. JW, PS and ID drafted the manuscript. MA helped with the statistical analyses. JW designed the database. JW, ID, PS, SB, MA, SL and HH contributed substantially to its revision and approved the final manuscript.

Data sharing statement

Data of the study is available from the data governance board of Maxima Medical Centre Institutional Data Access / Ethics Committee for researchers who meet the criteria for access to confidential data. Data are from the non-specific complaints study when contacting the data governance board (Jolanda.Luime@mmc.nl).

References

(1) Hoogendijk EO, van Hout HP, Heymans MW, van der Horst HE, Frijters DH, Broese van Groenou MI, et al. Explaining the association between educational level and frailty in older adults: results from a 13-year longitudinal study in the Netherlands. Ann Epidemiol 2014 Jul;24(7):538-44.e2.

(2) Lowthian JA, Curtis AJ, Cameron PA, Stoelwinder JU, Cooke MW, McNeil JJ. Systematic review of trends in emergency department attendances: an Australian perspective. Emerg Med J 2011 May;28(5):373-377.

(3) Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008 Jun 5;358(23):2468-2481.

(4) Droomers M, Westert GP. Do lower socioeconomic groups use more health services, because they suffer from more illnesses? Eur J Public Health 2004 Sep;14(3):311-313.

(5) van Doorslaer E, Wagstaff A, van der Burg H, Christiansen T, De Graeve D, Duchesne I, et al. Equity in the delivery of health care in Europe and the US. J Health Econ 2000 Sep;19(5):553-583.

(6) Khan Y, Glazier RH, Moineddin R, Schull MJ. A population-based study of the association between socioeconomic status and emergency department utilization in Ontario, Canada. Acad Emerg Med 2011 Aug;18(8):836-843.

(7) Tozer AP, Belanger P, Moore K, Caudle J. Socioeconomic status of emergency department users in Ontario, 2003 to 2009. CJEM 2014 May;16(3):220-225.

(8) Begley C, Basu R, Lairson D, Reynolds T, Dubinsky S, Newmark M, et al. Socioeconomic status, health care use, and outcomes: persistence of disparities over time. Epilepsia 2011 May;52(5):957-964.

(9) Filc D, Davidovich N, Novack L, Balicer RD. Is socioeconomic status associated with utilization of health care services in a single-payer universal health care system? Int J Equity Health 2014 Nov 28;13:115-014-0115-1.

(10) Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur AM, Roberge D, Larouche D, et al. Continuity of primary care and emergency department utilization among elderly people. CMAJ 2007 Nov 20;177(11):1362-1368.

(11) Ho KM, Dobb GJ, Knuiman M, Finn J, Webb SA. The effect of socioeconomic status on outcomes for seriously ill patients: a linked data cohort study. Med J Aust 2008 Jul 7;189(1):26-30.

(12) Alter DA, Chong A, Austin PC, Mustard C, Iron K, Williams JI, et al. Socioeconomic status and mortality after acute myocardial infarction. Ann Intern Med 2006 Jan 17;144(2):82-93.

(13) Samaras N, Chevalley T, Samaras D, Gold G. Older patients in the emergency department: a review. Ann Emerg Med 2010 Sep;56(3):261-269.

(14) Ramos M. Impact of socioeconomic status on Brazilian elderly health. Rev Saude Publica 2007 Aug;41(4):616-624.

(15) Cournane S, Conway R, Byrne D, O'Riordan D, Coveney S, Silke B. Social deprivation and the rate of emergency medical admission for older persons. QJM 2016 Oct;109(10):645-651.

(16) Hutchings A, Raine R, Brady A, Wildman M, Rowan K. Socioeconomic status and outcome from intensive care in England and Wales. Med Care 2004 Oct;42(10):943-951.

(17) Rathore SS, Masoudi FA, Wang Y, Curtis JP, Foody JM, Havranek EP, et al. Socioeconomic status, treatment, and outcomes among elderly patients hospitalized with heart failure: findings from the National Heart Failure Project. Am Heart J 2006 Aug;152(2):371-378.

(18) Izquierdo C, Oviedo M, Ruiz L, Sintes X, Vera I, Nebot M, et al. Influence of socioeconomic status on community-acquired pneumonia outcomes in elderly patients requiring hospitalization: a multicenter observational study. BMC Public Health 2010 Jul 15;10:421-2458-10-421.

(19) Brouns SHA, Dortmans MKJ, Jonkers FS, Lambooij SLE, Kuijper A, Haak HR. Hyponatraemia in Elderly Emergency Department Patients: A Marker of Frailty. Neth J Med 2014;72(6):311-317.

(20) Centraal bureau voor de statistiek. Inhoud kerncijfers postcodegebieden 2008-2010. 2012.

(21) Kunst A.E. Bos V. Mackenback J.P. Monitoring socioeconomic inequalities in health in the european union: guidelines and illustrations. EU Working Group on Socio-economic Inequalities in Health 2011.

(22) Needham DM, Scales DC, Laupacis A, Pronovost PJ. A systematic review of the Charlson comorbidity index using Canadian administrative databases: a perspective on risk adjustment in critical care research. J Crit Care 2005 Mar;20(1):12-19.

(23) Zachariasse JM, Seiger N, Rood PP, Alves CF, Freitas P, Smit FJ, et al. Validity of the Manchester Triage System in emergency care: A prospective observational study. PLoS One 2017 Feb 2;12(2):e0170811.

(24) Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care 2005 Nov;43(11):1130-1139.

(25) Bagher A, Andersson L, Wingren CJ, Ottosson A, Wangefjord S, Acosta S. Socio-economic status and major trauma in a Scandinavian urban city: A population-based case-control study. 2016;44:217-223.

(26) Robert S. Stern M, Joel S. Weissman P, Arnold M. Epstein, MD, MA. The emergency department as a pathway to admission for poor and high cost patients. JAMA 1991;266(16):2238-2243.

(27) Raffaeke Antonelli-Incalzi, Carla Ancona, Francesco Forastiere, Valeria Belleudi, Andrea Corsonello, Carlo A Perucci. Socioeconomic status and hospitalization in the very old: a retrospective study. BMC Public Health 2007;7(227).

(28) Bhayana R, Vermeulen MJ, Li Q, Hellings CR, Berdahl C, Schull MJ. Socioeconomic status and the use of computed tomography in the emergency department. CJEM 2014 Jul;16(4):288-295.

(29) van der Meer JB, van den Bos J, Mackenbach JP. Socioeconomic differences in the utilization of health services in a Dutch population: the contribution of health status. Health Policy 1996 Jul;37(1):1-18.

(30) Cressman AM, Macdonald EM, Yao Z, Austin PC, Gomes T, Paterson JM, et al. Socioeconomic status and risk of hemorrhage during warfarin therapy for atrial fibrillation: A population-based study. Am Heart J 2015 Jul;170(1):133-40, 140.e1-3.

(31) Govindarajan P, Gonzales R, Maselli JH, Johnston SC, Fahimi J, Poisson S, et al. Regional differences in emergency medical services use for patients with acute stroke (findings from the National Hospital Ambulatory Medical Care Survey Emergency Department Data File). J Stroke Cerebrovasc Dis 2013 Nov;22(8):e257-63.

(32) Arendts G, Howard K. The interface between residential aged care and the emergency department: a systematic review. Age Ageing 2010 May;39(3):306-312.

(33) van der Linden MC, Lindeboom R, de Haan R, van der Linden N, de Deckere ER, Lucas C, et al. Unscheduled return visits to a Dutch inner-city emergency department. Int J Emerg Med 2014 Jul 5;7:23-014-0023-6. eCollection 2014.

(34) Pines JM, Hilton JA, Weber EJ, Alkemade AJ, Al Shabanah H, Anderson PD, et al. International perspectives on emergency department crowding. Acad Emerg Med 2011;18(12):1358-1370.

(35) van der Linden MC, Lindeboom R, van der Linden N, van den Brand CL, Lam RC, Lucas C, et al. Self-referring patients at the emergency department: appropriateness of ED use and motives for self-referral. Int J Emerg Med 2014 Jul 16;7:28-014-0028-1. eCollection 2014.

(36) Holmes JL. Emergency medicine in the Netherlands. Emergency Medicine Australasia 2010;22(1):75-81.

(37) Di Somma S, Paladino L, Vaughan L, Lalle I, Magrini L, Magnanti M. Overcrowding in emergency department: an international issue. Intern Emerg Med 2015 Mar;10(2):171-175.

(38) Grundy E, Holt G. The socioeconomic status of older adults: how should we measure it in studies of health inequalities? J Epidemiol Community Health 2001 Dec;55(12):895-904.

(39) Smits CH, van den Beld HK, Aartsen MJ, Schroots JJ. Aging in the Netherlands: state of the art and science. Gerontologist 2014 Jun;54(3):335-343.

(40) Martelin T. Mortality by indicators of socioeconomic status among the Finnish elderly. Soc Sci Med 1994 May;38(9):1257-1278.

(41) Katsarou A, Tyrovolas S, Psaltopoulou T, Zeimbekis A, Tsakountakis N, Bountziouka V, et al. Socio-economic status, place of residence and dietary habits among the elderly: the Mediterranean islands study. Public Health Nutr 2010 Oct;13(10):1614-1621.

(42) Carlsson AC, Li X, Holzmann MJ, Wandell P, Gasevic D, Sundquist J, et al. Neighbourhood socioeconomic status and coronary heart disease in individuals between 40 and 50 years. Heart 2016 May 15;102(10):775-782.

(43) Aarts MJ, van der Aa MA, Coebergh JW, Louwman WJ. Reduction of socioeconomic inequality in cancer incidence in the South of the Netherlands during 1996-2008. Eur J Cancer 2010 Sep;46(14):2633-2646.

(44) Bos, V. Kunst, A.E., Mackenback, J. in verslag aan de Programmacommissie Sociaal-economische gezondheidsverschillen II [In Dutch]. Instituut Maatschappelijke Gezondheidszorg, Erasmus Universiteit, Rotterdam 2000.

(45) Smits, J. Keij, I. Mackenbach, J.P. in Sociaal-economische gezondheidsverschillen: Van verklaren naar verkleinen [In Dutch]. Zon/MW, Den Haag 2001.

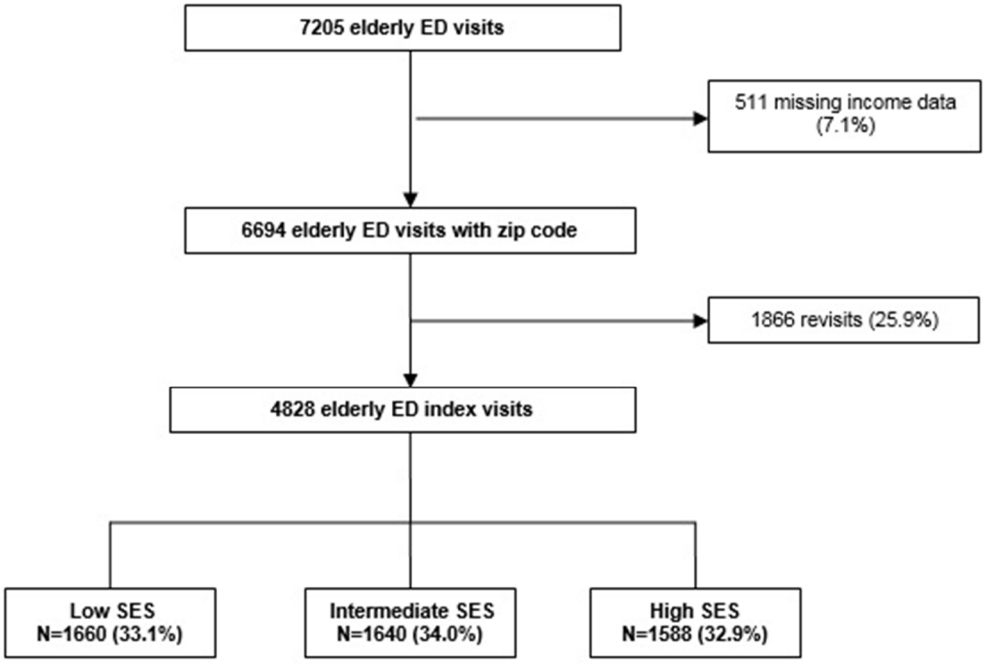
(46) Ribbe MW, Ljunggren G, Steel K, Topinkova E, Hawes C, Ikegami N, et al. Nursing homes in 10 nations: a comparison between countries and settings. Age Ageing 1997 Sep;26 Suppl 2:3-12.

Figures

Figure 1. The Flow chart of older adult patients divided into three SES groups.

ED = Emergency department. SES = Socioeconomic Status

1
2
3 1
4
5 2
6 3
7
8 4
9
10 5
11
12 6
13
14 7
15
16
17 8
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



45x31mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5-6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-12
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations			12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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

BMJ Open

Association of socioeconomic status on outcomes in older adult community-dwelling patients after visiting the emergency department: a retrospective cohort study.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019318.R3
Article Type:	Research
Date Submitted by the Author:	16-Nov-2017
Complete List of Authors:	Wachelder, Joyce; Maxima Medisch Centrum, Internal Medicine van Drunen, Isabelle ; Maxima Medisch Centrum, Internal Medicine Stassen, Patricia; Maastricht University CAPHRI School for Public Health and Primary Care; Maastricht Universitair Medisch Centrum+ Interne Geneeskunde, Internal Medicine Brouns , Steffie ; Maxima Medisch Centrum, Internal Medicine Lambooij, Suze ; Maxima Medisch Centrum, Internal Medicine Aarts, Mieke ; Netherlands Comprehensive Cancer Organisation Haak , Harm; Maxima Medisch Centrum, Eindhoven ; Maastricht University CAPHRI School for Public Health and Primary Care
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Geriatric medicine
Keywords:	Socioeconomic Status, Elderly, Emergency Department

Association of socioeconomic status on outcomes in older adult community-dwelling patients after visiting the emergency department: a retrospective cohort study

J.J.H. Wachelder[12], I.S. van Drunen[1#], P.M.Stassen[24#], S.H.A Brouns[12], S.L.E. Lambooij[1], M.J. Aarts[3], H.R. Haak[124]

1. Department of Internal Medicine, Máxima Medical Centre, 5631 BM Eindhoven/Veldhoven, the Netherlands.

2. Maastricht University, Department of Health Services Research, and CAPHRI School for Public Health and Primary Care, 6229 ER Maastricht, the Netherlands.

3. Netherlands Comprehensive Cancer Organisation, PO Box 19097, 3501DB Utrecht, the Netherlands.

4. Dept. of Internal Medicine, division of general medicine, section acute medicine, Maastricht University Medical Centre, 6229 HX Maastricht, the Netherlands.

# Authors contributed equally.

Correspondence should be addressed to: Joyce Wachelder, Department of Internal Medicine, Máxima Medical Centre, PO Box 90052, 5600 PD Eindhoven, The Netherlands; telephone number: +31408886300, fax number +31402450385, Email: joyce.wachelder@mmc.nl

Disclosure: There are no conflicts of interest. No funding was received.

Word count: 4072 (including tables)

Word count abstract: 250

Number of Tables: 3. Number of Figures: 1.

References: 46

Keywords: Socioeconomic Status; Older adult; Emergency Department

Abstract

Objectives: Older adults frequently visit the Emergency Department (ED). Socioeconomic State (SES) has an important impact on health and ED utilization, however, the association between SES and ED utilization in elderly remains unclear. The aim of this study was to investigate the association between SES in older adult patients visiting the ED on outcomes.

Design: A retrospective study.

Participants: Older adults (≥65 years) visiting the ED, in the Netherlands. SES was stratified into tertiles based on average household income at zip code level; low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month).

Primary outcomes: hospitalisation, in-hospital mortality and 30-day ED-return visits. Effect of SES on outcomes for all groups were assessed by logistic regression and adjusted for confounders.

Results: In total, 4828 older adults visited the ED during the study period. Low SES was associated with a higher risk of hospitalisation among community-dwelling patients compared with high SES (adjusted OR1.3 95%CI 1.1-1.7). This association was not present for intermediate SES (adjusted OR1.1 95%CI 0.95-1.4). In-hospital mortality was comparable between the low and high SES-group, even after adjustment for age, comorbidity and triage level (low OR 1.4 95%CI 0.8-2.6, intermediate OR 1.3 95%CI 0.8-2.2). Thirty-day ED-revisits among community-dwelling patients were also equal between the SES groups (low: adjusted OR 1.0 95%CI 0.7-1.4 and intermediate: adjusted OR 0.8 95%CI 0.6-1.1).

Conclusion: In older adult ED patients, low SES was associated with a higher risk of hospitalisation than high SES. However, SES had no impact on in-hospital mortality and 30-day ED-revisits after adjustment for confounders.

Strengths and limitations of this study

- This is one of the only studies to provide detailed insight into the impact of different socioeconomic status groups of older adults in the emergency care.
- Additionally, this study the living situation was used to differentiate between community-dwelling patients and institutionalized patients to observe differences in outcomes.
- This study used a retrospective cohort study and linked patient zip code with income data based on a well-defined database by Statistics Netherlands.
- A strength of our study is that we investigated a large undifferentiated group of older adult emergency care patients.
- Limitations were that we were not able to extract the data of cardiology and gynaecology patients and that we used zip code to define the socioeconomic status.

Introduction

The burden on the Emergency Department (ED) capacity has been increasing over the past decades, which is mostly due to a substantially increasing number of older adults (≥65 years old) (1). Given the extent and complexity of the problems in these patients, it is essential to identify determinants that lead to the ED visits in order to maintain high quality of care of older adult ED patients (2).

Low socioeconomic status (SES) has already been identified as an important determinant of health status and is strongly associated with poor adverse health outcomes (3). Patients with a low SES visit the general practitioner more and the specialist less often than patients with a high SES (4,5). Moreover, patients with a low a SES use the ED more frequently and are admitted to the hospital more often than those with a high SES (4,6-10). However, most studies focused on the influence of SES on the quantity of ED utilization, rather than on the reasons for and outcomes of these ED visits in general (8,10-12) .

It is well-known that older adults are vulnerable and prone to adverse health outcomes, such as ED visits, ED return visits, hospitalisation and mortality (13). However, research on the effect of SES on ED visits and adverse health outcomes in these older adults is scarce (10,14,15). Some of these studies demonstrated conflicting results as where low SES patients showed higher risk of adverse health outcomes (8,16,17), while other studies did not find such an increased risk (11,12,18). Moreover, most studies focused on patients with a specific diagnosis (e.g. heart failure, pneumonia or injury) and other studies merely studied ED utilization (10,14,18).

To understand the ED utilization patterns of older adults, it can be important to take their SES into account. Understanding the characteristics of older adult ED patients, including their SES, may be the first step to maintain or improve high quality of acute care. We hypothesize that low SES influences the risk of adverse health outcomes in the ED setting in a negative way and adds to the vulnerability of older adult ED patients even in a country in which health care access is organized for every inhabitant, regardless of SES.

The aim of this study was to determine differences between different SES groups among older adults s and additionally and most importantly we investigated the association of SES with hospitalisation, in-hospital mortality and ED-revisits.

Method

Study design, setting and population

A retrospective cohort study was performed in the Maxima Medical Centre, a 550-bed teaching hospital in the Netherlands. Yearly, approximately 30,000 patients visit the ED (19), of whom 30% are older adults (≥65 years). In the Netherlands, patients are usually referred to the ED by a general practitioner. The general practitioners provide acute care all days of the week and every hour of the day, including out of office hours.

Older adults who visited the ED for all medical (including oncology) and surgical specialities in one year (between 1st of September 2011 and 31st of August 2012), were included. Data from the acute cardiac care unit and gynaecology unit were not available in the database, because these patients do not visit the ED .

Data of the ED visits were automatically extracted from the electronic patient records (Chipsoft-EZIS, version 5.2). Categorization of the data was done according a fixed data extraction form by one researcher (JW). A random sample of all variables was checked by another researcher (ID). The patients' zip code (on average 17 households per zip code) was used to determine the SES at a neighbourhood level by combining the median household income per month and mean value of the houses. Data on income were provided by Statistics Netherlands (20). This dataset excluded zip codes with less than 10 households to guarantee anonymity. The median income data derived from zip codes in the database from Statistics Netherlands were linked to our database and subsequently divided into tertiles (21): low (<€1800/month), intermediate (€1800-€2300/month) and high (>€2300/month). It was impossible to retrieve SES data for patients with unknown zip code or patients living abroad (Belgium), and therefore, these patients were excluded (N=511, 6.9%).

To investigate the effect of the living situation in the three SES groups, we conducted a subgroup analysis for the outcomes of community-dwelling patients and for patients who were institutionalized. Living situation was determined on basis of zip codes, including those of the nursing and care home patients. The first ED visit in the study period was considered the index visit, other visits after the index visit were excluded to avoid duplicate analysis of the patients' characteristics and outcomes. The Institutional Review Board of Máxima Medical Centre approved this study and confirmed that the Medical Research Involving Human Subject Act (WMO) was not applicable.

Data collection & definitions

The following data were retrieved from the electronic patient record: age, gender, zip code, comorbidity, number of used medications. The Charlson comorbidity index (CCI) was used to quantify comorbidity (22). All electronic patient (both ED and hospital) records were assessed to retrieve comorbidity. For a random sample

of 50% of the patients per SES group, comorbidity was manually retrieved. It was not feasible to do this for all patients. The patients' living situation was categorized into community-dwelling patients (living independently or with home care) and institutionalized patients (care home and nursing home).

To assess the severity of illness at presentation, the Manchester Triage Level (MTS) (23), vital parameters (systolic blood pressure, heart rate), laboratory tests (CRP and leukocytes) and the ED diagnoses were retrieved. The triage level based on the five-level MTS was categorised into 3 groups: urgent (red and orange), moderate (yellow), and low (green). In our ED the triage colour blue is not used, because these patients almost never visit our ED. Classification of ED diagnoses was done according the International Classification of Disease-10 (ICD-10)" (24). The group 'other', consisted out of diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.

Organizational factors retrieved were time of arrival, mode of referral (self-referral, GP, ambulance, specialist and other), specialty, number of diagnostic tests (sum of radiological tests, electrocardiogram, arterial blood gas analysis, laboratory tests, urine analysis, urine and blood culture), number of specialist consultations in the ED, ED-Length-of-Stay (LOS) and hospital-LOS. Time of presentation was classified into 3 shifts: day (8am-6pm), evening (6pm-12pm) and night (12pm-8am). The following specialties were considered surgical: (general) surgery, plastic surgery, urology, and orthopaedics. Pulmonology, neurology, internal medicine and gastroenterology were considered medical specialities. Hospital LOS was defined as the number of days between hospital admission and hospital discharge. Dates of death during hospital stay and of the ED-return visit were retrieved. The data were extracted by one trained medical abstractor who was blinded for the study hypothesis.

Statistical analyses

All statistical analyses were performed using SPSS 22.0 (Armonk, New York, 2015). Comparisons between two SES groups (low vs. intermediate, low vs. high and intermediate vs. high) were conducted using ANOVA (post-hoc Tukey test) for continuous data and the Chi square test for categorical data. For continuous variables that were not normally distributed, the Wilcoxon-Mann-Whitney-Test was used. Missing data were categorised as "unknown" and included in the analyses of categorical parameters, to explore the influence of missing values. To investigate the independent effect of SES on hospitalisation, in-hospital mortality, and 30-day ED-return

visits, logistic regression analyses was performed. Multivariable analysis was performed to calculate the adjusted Odds Ratio (OR) and in order to estimate the effect of confounders of age, gender, triage level and CCI. Age, CCI and medications were included as a linear variable in this analysis. For day of the week, a weekday was reference, and for sex, female was reference. Triage level was categorized as follows: urgent, intermediate and low (reference). Sensitivity analysis was performed to evaluate the effect of ED-revisits on mortality. For this analysis, those who died during hospitalisation were excluded (N=199). To estimate the effect of the living situation on the SES and their outcomes, patients were divided into community-dwelling patients and institutionalized patients. OR and corresponding 95% Confidence Intervals (CI) were calculated for each of the outcomes. A p-value was considered significant when <0.05.

Results

During the study period, 7205 ED visits by older adult patients were registered in our ED. In total, 511 patients (7.1%) were excluded because income data were missing and 1866 visits (25.9%) because the visit was a revisit. In total, 4828 index visits were included. Of these 1660 visits (33.1%) were classified as having a low SES, 1640 (34.0%) as intermediate and 1588 (32.9%) as having a high SES (Figure 1).

Patient characteristics

The mean age of the study population was 77±7.7 years, and slightly less patients were male (44.5%) (Table 1). In total, 4381 (90.7%) were community-dwelling patients and 9.2% lived institutionalized. Patients were mostly referred by a GP (58.5%) and were triaged as having moderate urgency (43.8%). More than half (56.5%) of the patients were hospitalised, and their median hospital-LOS was 5 days. In-hospital mortality was 4.1%.

Table 1. Patient characteristics and SES of older adult patients visiting the ED

Characteristics	Total population N = 4828	Socioeconomic Status			P-value
		Low N = 1660 (33.1%)	Intermediate N = 1640 (34.0%)	High N = 1588 (32.9%)	
Age, years					
Mean (SD)	77 (7.7)	80 (7.6)	76 (7.6)	75 (7.4)	<0.001#
Median (IQR)*	77 (12)	80 (11)	76 (12)	74 (12)	
Gender (%)*					<0.001
Male	2149 (44.5%)	618 (38.6%)	759 (46.3%)	772 (48.6%)	
Female	2679 (55.5%)	982 (61.4%)	881 (53.7%)	816 (51.4%)	
CCI, median (IQR)	1.2 (1.6)	1.0 (0-8)	1.0 (0-10)	1.0 (0-11)	0.09
Unknown		45 (5.3%)	49 (5.3%)	54 (6.2%)	
No. of medications, mean (SD)*	2.5 (4.3)	3.3 (4.7)	2.4 (4.2)	1.9 (3.9)	<0.001@
Mode of referral*					
General Practitioner	2680 (55.5%)	937 (61.8%)	905 (57.8%)	838 (56.0%)	0.03
Self-referral	852 (17.6%)	215 (13.4%)	292 (17.8%)	345 (21.7%)	<0.001
Ambulance	664 (13.8%)	244 (15.3%)	237 (14.5%)	183 (11.5%)	0.01
Specialist	632 (13.1%)	204 (9.6%)	206 (9.9%)	222 (10.8%)	0.75
Living situation*					<0.001
Community-dwelling	4381 (90.7%)	1266 (79.1%)	1556 (94.9%)	1559 (98.2%)	
Institutionalized	443 (9.2%)	330 (20.6%)	84 (5.1%)	29 (1.8%)	
Missing	4 (100%)	4 (100%)	0	0	

SES = Socioeconomic status. SD = Standard deviation. CCI = Charlson comorbidity index. ED = Emergency Department. P-values P-values low, intermediate and high SES: using the Chi-square test, ANOVA (post-hoc Tukey) and Mann-Whitney-U-test.

= p-value low vs. intermediate <0.001, low vs. high <0.001, intermediate vs. high 0.001.

@ = p-value low vs. intermediate 0.001, low vs. high <0.001, intermediate vs. high 0.042.

* = p<0.05.

Patient characteristics and Socioeconomic status

Patients with a low or intermediate SES were older than patients with a high SES (80 vs. 76 and 75 years resp., p<0.001) (Table 1). Male patients less frequently had a low SES than intermediate and high SES patients (38.6% vs. 46.3% and 48.6% resp., p<0.001). The GP had referred patients in the low SES-group more often than in the intermediate and high SES-group (61.8% vs. 57.8% and 56.0% resp., p=0.03). Patients in the low SES-group used more medications than the high SES-group (3.3 vs. 1.9, p<0.001).

Organizational and clinical parameters in the ED and SES

There were no differences in the specialties (surgical vs. medical) that treated the patients nor in time of presentation between the three SES groups (Table 2). In addition, the vital parameters at presentation were comparable between the three groups. Patients with a low SES more often had a higher urgent triage level than the high SES-group, however, this difference was not significant (15.4% vs. 12.1%, p=0.02). In the low and the intermediate SES-group, more diagnostics tests were performed than in the high SES-group (mean 2.3 vs. 2.1 vs. 2.0, resp., p<0.001). Patients with low SES had a longer ED-LOS than patients with intermediate and high SES (140 min vs. 133 vs. 133, resp. p=0.01). Diagnoses differed between the three groups: endocrine diseases were more common in the low SES group (3.1%) than the intermediate or high SES group (1.7% and 1.6%, p=0.03), and the same was observed for infectious diseases. (Table 2).

Table 2. Organisational and clinical parameters of older adult ED patients within the different SES groups.

	Socioeconomic Status			
	Low N = 1660 (33.1%)	**Intermediate N = 1640 (34.0%)**	**High N = 1588 (32.9%)**	**P-value**
Specialism				0.16
Medical	879 (54.9%)	858 (52.3%)	822 (51.8%)	
Surgical	721 (45.1%)	782 (47.7%)	766 (48.2%)	
Shift				0.15

Morning	1130 (70.9%)	1148 (70.2%)	1169 (73.7%)	
Evening	240 (21.3%)	354 (21.7%)	318 (20.0%)	
Night	124 (7.8%)	133 (8.1%)	100 (6.3%)	
Level of triage				
Low*	628 (39.8%)	640 (39.7%)	687 (44.0%)	0.02
Moderate	702 (44.5%)	730 (35.3%)	683 (43.7%)	0.69
Urgent	246 (15.4%)	242 (14.8%)	192 (12.1%)	0.02
No triage	24 (1.5%)	28 (1.7%)	26 (1.6%)	0.98
No. of extra consultations at ED				0.80
None	1376 (86.0%)	1407 (85.6%)	1365 (86.0%)	
1	200 (12.5%)	215 (13.1%)	199 (12.5%)	
≥2	24 (0.5%)	18 (1.1%)	24 (1.4%)	
Vital parameters				
Systolic blood pressure (mmHg), mean (SD)	152 (31.7)	153 (31.3)	152 (30.8)	0.94
Missing	428 (26.9%)	530 (32.4%)	545 (35.5%)	
Heart rate (min), mean (SD)	81.5 (17.0)	82.5 (18.1)	82.1 (17.7)	0.32
Missing	734 (45.9%)	806 (49.1%)	819 (51.6%)	
Medical procedures at ED				
No. of diagnostic tests, mean (SD)	2.3 (1.8)	2.1 (1.8)	2.0 (1.7)	<0.001#
Laboratory test (%)*	1081 (67.9%)	1046 (64.1%)	974 (61.7%)	<0.001
CRP (mg/L), median (IQR)	16 (60)	14 (55)	15 (66)	0.47
Leukocytes (x10^9/L), median (IQR)	9.2 (6)	9.3 (5)	8.8 (5)	0.91
Diagnosis at ED				
Injury	487 (30.6%)	504 (30.8%)	508 (32.2%)	0.56
Otherwise	280 (17.6%)	286 (17.5%)	289 (18.3%)	0.79
Circulatory / Respiratory	232 (14.6%)	257 (15.7%)	201 (12.7%)	0.06
Other	202 (12.7%)	217 (13.3%)	218 (18.3%)	0.64
Digestive	163 (10.2%)	175 (10.8%)	169 (10.7%)	0.88

Genito-urinary	68 (4.3%)	73 (4.5%)	58 (3.7%)	0.51
Infectious	65 (4.1%)	52 (3.2%)	45 (2.8%)	0.14
Endocrine / Metabolic	50 (3.1%)	28 (1.7%)	25 (1.6%)	0.03
Neoplasm / haematology	47 (2.9%)	52 (3.2%)	70 (4.4%)	0.05
Missing	6 (0.4%)	3 (0.2%)	9 (0.6%)	
ED-LOS in minutes, median (IQR)*	140 (83)	133 (90)	133 (87)	0.01@

SES = Socioeconomic Status. SD = Standard deviation. ED = Emergency department. CRP = C-reactive protein.
ED-Diagnosis 'other' (ICD-10 classification) = diseases of the nervous system, musculoskeletal and connective tissue, skin and subcutaneous tissue, eye and adnexa, ear and mastoid and mental.
P-values low, intermediate and high SES: using the Chi-square test, ANOVA (post-hoc Tukey) and Mann-Whitney-U-test.
* = p <0.05.
# = p-value low vs intermediate <0.001, low vs high <0.001, intermediate vs. high <0.01.
@ = p-value low vs intermediate 0.01, low vs high 0.004, intermediate vs. high 0.93.

Patient outcomes and SES

Patients with a low SES were more frequently hospitalised than the intermediate and high SES-group (62.3% vs. 55.4% vs. 52.3%, resp., p<0.001, Table 3). In addition, patients with a low SES had a longer hospital-LOS than patients with a high SES (6.0 vs. 5.0 days, p<0.001). However, the hospital-LOS did not differ between intermediate SES and high SES patients (5 days in both groups, p=0.45). The finding that low SES patients were more often hospitalised than the high SES group turned out not to be independent of age and comorbidity (adjusted OR 1.3 95% CI 0.9–1.4, Table 3). When stratified according to living situation, low SES community-dwelling patients had a higher risk of hospitalisation with an OR of 1.3 (95% CI 1.1-1.7) compared with patients with a high SES. In contrast, institutionalized low SES patients had a lower risk of hospitalisation with an OR of 0.2 (95% CI:0.1-0.7). Intermediate SES patients did not have a higher odd for hospitalisation (OR 1.0 95% CI 0.95-1.4) than high SES patients.

Table 3. Multivariable analysis of the effect on SES on ED outcomes and within different living situations.

	Socioeconomic Status	Number (%)	All patients N = 4828 (OR 95%CI)	Community-dwelling patients N = 4381 (OR 95%CI)	Institutionalized patients N = 443 (OR 95%CI)
Hospitalisation[1]	Low	996/1660 (62.3%)	1.1 (0.9-1.4)	**1.3 (1.1-1.7)**	**0.2 (0.1–0.7)**
	Intermediate	909/1640 (55.4%)	1.1 (0.9-1.4)	1.1 (0.95-1.4)	0.4 (0.1-1.2)
	High	830/1588 (52.3%)	1.0	1.0	1.0
In-hospital mortality[2]	Low	86/996 (5.4%)	1.2 (0.7-2.0)	1.4 (0.8-2.6)	0.8 (0.1-6.8)
	Intermediate	58/909 (3.5%)	1.1 (0.6-1.9)	1.3 (0.8-2.2)	0.4 (0.1-4.0)
	High	55/830 (3.5%)	1.0	1.0	1.0
30-day ED-revisits[3#]	Low	184/1514 (11.5%)	1.0 (0.8-1.4)	1.0 (0.7-1.4)	1.0 (0.2-4.7)
	Intermediate	220/1582 (13.5%)	0.9 (0.7-1.1)	0.8 (0.6-1.1)	0.8 (0.2-4.6)
	High	196/1533 (12.3%)	1.0	1.0	1.0

ED = Emergency Department. OR = Odds Ratio. CI = confidence Interval.
1 = adjusted variable include age and Charlson comorbidity index.
2 = adjusted for age, Charlson comorbidity index, and triage level.
3 = adjusted for age, Charlson comorbidity index and gender. # = without patients who died during hospitalisation.

In-hospital mortality was higher for the low SES group (5.4%) compared with the intermediate (3.5%) and the high SES group (3.5%, p=0.01, unadjusted $OR_{low\_vs\_high}$:0.6 95% CI 0.4-0.9). The difference in in-hospital mortality between low and high SES patients was no longer significant when adjusted for age, comorbidity and triage level (adjusted OR 1.2 95% CI 0.7–2.0).

There was no difference in 30-day ED-revisit rate between the low, intermediate and high SES group (21.3%, 20.4% vs. 20.8%, resp., p=0.88). Neither was the 30-day ED-revisit rate different after correcting for age, comorbidity and gender (adjusted OR 1.0, 95% CI 0.8–1.4). Moreover, adjusting for the living situation did not alter the results significantly (Table 3).

Discussion

Our study was a large population-based study that investigated the association of SES with ED visits of older adult (≥65 years) patients. We found that older adult community-dwelling ED patients with a low SES have a higher risk of hospitalisation than patients with a high SES. Moreover, low SES patients had more often a higher

triage level, had more diagnostics test and longer ED-LOS compared to other SES groups. However, in-hospital mortality and the number of ED-return visits were not different between the three SES groups.

We hypothesized that patients with low SES would be less healthy than those with a higher SES, which indirectly would result in higher admission rates and in-hospital mortality after presentation at the ED. Our data allowed us to determine important confounders, such as comorbidity, organisational factors and the severity of illness at the ED, which makes it possible to contribute important information to already existing evidence on the topic of SES, where some studies did not adjust for potential and important confounders (7,25). Our study indeed observed a higher chance of hospitalisation (OR 1.3 CI 1.1-1.7) for community-dwelling patients with a low SES than for patients with intermediate/high SES. This finding is in line with other studies (9,26,27). It may be possible that part of the community-dwelling frail patients were admitted for care problems, which is not a reason for admission for institutionalized patients as extra care is available for these patients. Future studies should elaborate the living arrangements and social network of older adults to investigate the influence of these matters on ED usage.

In-hospital mortality and ED-revisits within 30 days were not associated with SES. This contrasts with other studies that found a higher risk of in-hospital mortality and readmissions in older adult patients with a low SES (8,16,17), but is in line with other studies that did not found an association (11,12,18). The association of low SES and adverse outcomes was found in studies that included patients with a specific diagnosis (e.g. pneumonia or heart failure) (18,28) or that analysed the number of ED visits per SES category (4,6,9,29), whereas our study focused on an undifferentiated, and therefore, more generalizable, older adult ED population. Another reason not finding an association between low SES and outcomes might be that most studies did not account for differences in living situation (17,30,31). We found that care and nursing homes were mostly situated in low SES areas, while their inhabitants will probably belong to all three SES (32). Additionally, institutionalized patients may influence revisit rates, because they are treated by their own doctor in the nursing home. It may be useful to take the living situation into account when using SES based on zip code, because care facilities structures at home influence ED outcomes.

The fact that we did not find an association between SES and in-hospital mortality and revisits may be due to the organisation of the health care system in the Netherlands and may underscore/reflect that our health care is indeed accessible to all patients, regardless of their SES. In the Netherlands, the health care system consists of a well organised GP-network, with 24-hours a day access for acute care patients, which is

equally accessible for every inhabitant (29). In the Netherlands, care provided by the general practitioner is fully covered by the basic obligatory health insurance (33). Therefore this system provides equal access to health care by the general practitioner to every resident, independent of their SES (5,34-36). In addition, this care selects the most severely ill patients for referral to the ED. The acute health care system differs over the countries, and in some countries, for instance the United States, the ED is used as a safety-net for underserved and uninsured patients (37). Also, evenly important, the financial health care structure is different worldwide In short, specifically regarding acute care, differences in organization and financial coverage of acute care make comparisons between countries difficult (38).

In the Netherlands, older adults are, in general, financially well-covered (39), as only 3.5% of them are poor (39). Concerning other studies on older adults and SES, the methods of determining SES differed substantially, and some included education, income and occupancy, but none of the methods have proved to be comprehensive enough (40). One study in Canada among older adults that determined factors of ED usage matched postal codes with several indicators, such as income, employment and living alone (10). In a Mediterranean study, SES was defined on years of education and the mean annual income of the family (41). In conclusion, the comparison of studies on SES is complicated by different levels of SES in the general population and of the way SES is defined.

Apart from the above mentioned, the following study limitations should be mentioned. Firstly, our results are not generalizable to cardiology and gynaecology patients as we excluded these patients. For these cardiology patients, it is known that low SES may have a stronger association with adverse outcomes (42), and excluding these from our study may explain that we did not find associations between SES and outcome (except for hospitalisation in community dwelling patients). Secondly, we retrieved SES on basis of zip codes, which may be imprecise and yield smaller associations of SES with adverse outcomes (43). However, one zip code in the database of Statistics Netherlands covers only 17 households and therefore, we consider this way of retrieving SES rather reliable (44,45). Thirdly, retrieving SES of patients living in a nursing home or other care home facilities on basis of zip code is probably not reliable. Therefore, we made subgroup analysis of community dwelling patients and institutionalized patients, which is a strong point of our study. Lastly, coding for the living situation may not be precise, but we think that this does not lead to an underestimation since the percentage of institutionalized patients (9.1%) is almost similar as percentages given in another study (9.0%) (46).

In this study, we provided important information in terms of health outcomes on the SES in the acute health care setting in the vulnerable older adult population. We investigated a large unselected group of older adult ED patients stratified to living situation, which provides additional knowledge on the care and problems of older adult patients in the ED. Our study shows that in a country with assumed equal health care access only minor outcome differences were observed between different SES groups. Therefore, physicians should be aware of the potential differences between SES groups given the higher chance of hospitalisation. Improvement in adequately diagnosing and treating older adult patients is important, but the additional value of SES in the emergency care should be evaluated further to develop effective interventions to ensure high quality of care. Future studies should elaborate the living arrangements and social network of older adults, because these probably influences access to the ED and the number of (re-)admissions.

In conclusion, low SES community-dwelling older adults were more often hospitalised than high SES community-dwelling patients, but no differences in in-hospital mortality and ED-revisits between the SES groups.

Contributorship statement

JW and SB conceived the study and designed the protocol. SL contributed to the design for the overall older adults project. JW, PS and ID analyzed and interpreted the data. HH supervised the conduct of the study and data collection. JW, PS and ID drafted the manuscript. MA helped with the statistical analyses. JW designed the database. JW, ID, PS, SB, MA, SL and HH contributed substantially to its revision and approved the final manuscript.

Data sharing statement

Data of the study is available from the data governance board of Maxima Medical Centre Institutional Data Access / Ethics Committee for researchers who meet the criteria for access to confidential data. Data are from the non-specific complaints study when contacting the data governance board (Jolanda.Luime@mmc.nl).

References

(1) Hoogendijk EO, van Hout HP, Heymans MW, van der Horst HE, Frijters DH, Broese van Groenou MI, et al. Explaining the association between educational level and frailty in older adults: results from a 13-year longitudinal study in the Netherlands. Ann Epidemiol 2014 Jul;24(7):538-44.e2.

(2) Lowthian JA, Curtis AJ, Cameron PA, Stoelwinder JU, Cooke MW, McNeil JJ. Systematic review of trends in emergency department attendances: an Australian perspective. Emerg Med J 2011 May;28(5):373-377.

(3) Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008 Jun 5;358(23):2468-2481.

(4) Droomers M, Westert GP. Do lower socioeconomic groups use more health services, because they suffer from more illnesses? Eur J Public Health 2004 Sep;14(3):311-313.

(5) van Doorslaer E, Wagstaff A, van der Burg H, Christiansen T, De Graeve D, Duchesne I, et al. Equity in the delivery of health care in Europe and the US. J Health Econ 2000 Sep;19(5):553-583.

(6) Khan Y, Glazier RH, Moineddin R, Schull MJ. A population-based study of the association between socioeconomic status and emergency department utilization in Ontario, Canada. Acad Emerg Med 2011 Aug;18(8):836-843.

(7) Tozer AP, Belanger P, Moore K, Caudle J. Socioeconomic status of emergency department users in Ontario, 2003 to 2009. CJEM 2014 May;16(3):220-225.

(8) Begley C, Basu R, Lairson D, Reynolds T, Dubinsky S, Newmark M, et al. Socioeconomic status, health care use, and outcomes: persistence of disparities over time. Epilepsia 2011 May;52(5):957-964.

(9) Filc D, Davidovich N, Novack L, Balicer RD. Is socioeconomic status associated with utilization of health care services in a single-payer universal health care system? Int J Equity Health 2014 Nov 28;13:115-014-0115-1.

(10) Ionescu-Ittu R, McCusker J, Ciampi A, Vadeboncoeur AM, Roberge D, Larouche D, et al. Continuity of primary care and emergency department utilization among elderly people. CMAJ 2007 Nov 20;177(11):1362-1368.

(11) Ho KM, Dobb GJ, Knuiman M, Finn J, Webb SA. The effect of socioeconomic status on outcomes for seriously ill patients: a linked data cohort study. Med J Aust 2008 Jul 7;189(1):26-30.

(12) Alter DA, Chong A, Austin PC, Mustard C, Iron K, Williams JI, et al. Socioeconomic status and mortality after acute myocardial infarction. Ann Intern Med 2006 Jan 17;144(2):82-93.

(13) Samaras N, Chevalley T, Samaras D, Gold G. Older patients in the emergency department: a review. Ann Emerg Med 2010 Sep;56(3):261-269.

(14) Ramos M. Impact of socioeconomic status on Brazilian elderly health. Rev Saude Publica 2007 Aug;41(4):616-624.

(15) Cournane S, Conway R, Byrne D, O'Riordan D, Coveney S, Silke B. Social deprivation and the rate of emergency medical admission for older persons. QJM 2016 Oct;109(10):645-651.

(16) Hutchings A, Raine R, Brady A, Wildman M, Rowan K. Socioeconomic status and outcome from intensive care in England and Wales. Med Care 2004 Oct;42(10):943-951.

(17) Rathore SS, Masoudi FA, Wang Y, Curtis JP, Foody JM, Havranek EP, et al. Socioeconomic status, treatment, and outcomes among elderly patients hospitalized with heart failure: findings from the National Heart Failure Project. Am Heart J 2006 Aug;152(2):371-378.

(18) Izquierdo C, Oviedo M, Ruiz L, Sintes X, Vera I, Nebot M, et al. Influence of socioeconomic status on community-acquired pneumonia outcomes in elderly patients requiring hospitalization: a multicenter observational study. BMC Public Health 2010 Jul 15;10:421-2458-10-421.

(19) Brouns SHA, Dortmans MKJ, Jonkers FS, Lambooij SLE, Kuijper A, Haak HR. Hyponatraemia in Elderly Emergency Department Patients: A Marker of Frailty. Neth J Med 2014;72(6):311-317.

(20) Centraal bureau voor de statistiek. Inhoud kerncijfers postcodegebieden 2008-2010. 2012.

(21) Kunst A.E. Bos V. Mackenback J.P. Monitoring socioeconomic inequalities in health in the european union: guidelines and illustrations. EU Working Group on Socio-economic Inequalities in Health 2011.

(22) Needham DM, Scales DC, Laupacis A, Pronovost PJ. A systematic review of the Charlson comorbidity index using Canadian administrative databases: a perspective on risk adjustment in critical care research. J Crit Care 2005 Mar;20(1):12-19.

(23) Zachariasse JM, Seiger N, Rood PP, Alves CF, Freitas P, Smit FJ, et al. Validity of the Manchester Triage System in emergency care: A prospective observational study. PLoS One 2017 Feb 2;12(2):e0170811.

(24) Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care 2005 Nov;43(11):1130-1139.

(25) Bagher A, Andersson L, Wingren CJ, Ottosson A, Wangefjord S, Acosta S. Socio-economic status and major trauma in a Scandinavian urban city: A population-based case-control study. 2016;44:217-223.

(26) Robert S. Stern M, Joel S. Weissman P, Arnold M. Epstein, MD, MA. The emergency department as a pathway to admission for poor and high cost patients. JAMA 1991;266(16):2238-2243.

(27) Raffaeke Antonelli-Incalzi, Carla Ancona, Francesco Forastiere, Valeria Belleudi, Andrea Corsonello, Carlo A Perucci. Socioeconomic status and hospitalization in the very old: a retrospective study. BMC Public Health 2007;7(227).

(28) Bhayana R, Vermeulen MJ, Li Q, Hellings CR, Berdahl C, Schull MJ. Socioeconomic status and the use of computed tomography in the emergency department. CJEM 2014 Jul;16(4):288-295.

(29) van der Meer JB, van den Bos J, Mackenbach JP. Socioeconomic differences in the utilization of health services in a Dutch population: the contribution of health status. Health Policy 1996 Jul;37(1):1-18.

(30) Cressman AM, Macdonald EM, Yao Z, Austin PC, Gomes T, Paterson JM, et al. Socioeconomic status and risk of hemorrhage during warfarin therapy for atrial fibrillation: A population-based study. Am Heart J 2015 Jul;170(1):133-40, 140.e1-3.

(31) Govindarajan P, Gonzales R, Maselli JH, Johnston SC, Fahimi J, Poisson S, et al. Regional differences in emergency medical services use for patients with acute stroke (findings from the National Hospital Ambulatory Medical Care Survey Emergency Department Data File). J Stroke Cerebrovasc Dis 2013 Nov;22(8):e257-63.

(32) Arendts G, Howard K. The interface between residential aged care and the emergency department: a systematic review. Age Ageing 2010 May;39(3):306-312.

(33) van der Linden MC, Lindeboom R, de Haan R, van der Linden N, de Deckere ER, Lucas C, et al. Unscheduled return visits to a Dutch inner-city emergency department. Int J Emerg Med 2014 Jul 5;7:23-014-0023-6. eCollection 2014.

(34) Pines JM, Hilton JA, Weber EJ, Alkemade AJ, Al Shabanah H, Anderson PD, et al. International perspectives on emergency department crowding. Acad Emerg Med 2011;18(12):1358-1370.

(35) van der Linden MC, Lindeboom R, van der Linden N, van den Brand CL, Lam RC, Lucas C, et al. Self-referring patients at the emergency department: appropriateness of ED use and motives for self-referral. Int J Emerg Med 2014 Jul 16;7:28-014-0028-1. eCollection 2014.

(36) Holmes JL. Emergency medicine in the Netherlands. Emergency Medicine Australasia 2010;22(1):75-81.

(37) Di Somma S, Paladino L, Vaughan L, Lalle I, Magrini L, Magnanti M. Overcrowding in emergency department: an international issue. Intern Emerg Med 2015 Mar;10(2):171-175.

(38) Grundy E, Holt G. The socioeconomic status of older adults: how should we measure it in studies of health inequalities? J Epidemiol Community Health 2001 Dec;55(12):895-904.

(39) Smits CH, van den Beld HK, Aartsen MJ, Schroots JJ. Aging in the Netherlands: state of the art and science. Gerontologist 2014 Jun;54(3):335-343.

(40) Martelin T. Mortality by indicators of socioeconomic status among the Finnish elderly. Soc Sci Med 1994 May;38(9):1257-1278.

(41) Katsarou A, Tyrovolas S, Psaltopoulou T, Zeimbekis A, Tsakountakis N, Bountziouka V, et al. Socio-economic status, place of residence and dietary habits among the elderly: the Mediterranean islands study. Public Health Nutr 2010 Oct;13(10):1614-1621.

(42) Carlsson AC, Li X, Holzmann MJ, Wandell P, Gasevic D, Sundquist J, et al. Neighbourhood socioeconomic status and coronary heart disease in individuals between 40 and 50 years. Heart 2016 May 15;102(10):775-782.

(43) Aarts MJ, van der Aa MA, Coebergh JW, Louwman WJ. Reduction of socioeconomic inequality in cancer incidence in the South of the Netherlands during 1996-2008. Eur J Cancer 2010 Sep;46(14):2633-2646.

(44) Bos, V. Kunst, A.E., Mackenback, J. in verslag aan de Programmacommissie Sociaal-economische gezondheidsverschillen II [In Dutch]. Instituut Maatschappelijke Gezondheidszorg, Erasmus Universiteit, Rotterdam 2000.

(45) Smits, J. Keij, I. Mackenbach, J.P. in Sociaal-economische gezondheidsverschillen: Van verklaren naar verkleinen [In Dutch]. Zon/MW, Den Haag 2001.

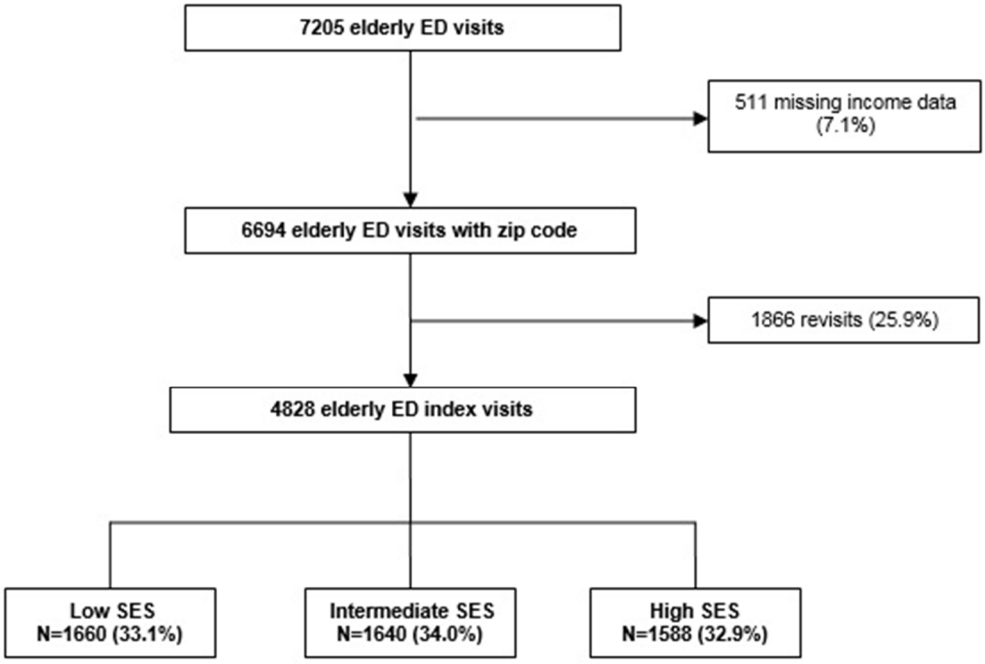
(46) Ribbe MW, Ljunggren G, Steel K, Topinkova E, Hawes C, Ikegami N, et al. Nursing homes in 10 nations: a comparison between countries and settings. Age Ageing 1997 Sep;26 Suppl 2:3-12.

Figures

Figure 1. The Flow chart of older adult patients divided into three SES groups.

ED = Emergency department. SES = Socioeconomic Status

1
2
3
4
5
6
7
8



45x31mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5-6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	7-12
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	11-12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations			12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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