detected by strain analysis using both echocardiography and CMRI. CMRI is feasible and safe in patients with MitraClips.

This work was supported by research programs of the University of Tuebingen (Fortune 1895-0-0 and Angewandte klinische Forschung 252-0-0) and by the Deutsche Forschungsgemeinschaft (Klinische Forschergruppe KFO 274).

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http://dx.doi.org/10.1016/j.ijcard.2013.07.132

Influence of socioeconomic status on therapy and prognosis after an acute heart failure episode☆

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ARTICLE INFO

Article history:
Received 8 July 2013
Accepted 13 July 2013
Available online 12 August 2013

Keywords:
Heart failure
Prognosis
Equity

The impact of socioeconomic status (SES) on heart failure (HF) treatment, hospitalization and mortality has been previously studied [1]. Several challenges impose on deprived groups once HF is established: healthcare access, transportation costs, affordability of drug regimens [2,3]. Clinicians' perception of these factors may also change their threshold for prescribing therapies.

In Portugal, literacy levels are below the European average; the average income is low with a wide ditch between the top 20% and the bottom 20% of the population. Portugal´s health system is based on the delivery of care by state organizations and intends to be universal and equal.

We investigated if SES influences prognosis after an acute episode of HF and to determine if prognostic-modifying therapy is delivered equitably.

During 21 months of a registry of all patients admitted to our Department due to acute HF, 616 patients were discharged alive. Patients provided informed consent. The study protocol conforms to the ethical principles of the declaration of Helsinki.

Information on socioeconomic data was obtained from the patients or their next-of-kin. A socioeconomic deprivation index (SEDI) was created using the following formula: $SEDI = income + educational\ level + living\ alone$, where income $= 1$ if $<$ minimum wage or 0 if $\geq$ minimum wage; educational level $= 1$ or $= 0$ if ≤ 4 years or >4 years in school, respectively; and living alone $= 1$. The SEDI could thus assume values between 0 and 3, with higher scores indicating lower SES. For prognostic analysis patients were categorized in 2 groups: 0 versus 1 to 3 points in SEDI. Information on socioeconomic variables was obtained in 600 patients. Patients were followed for 6 months.

The endpoints under study were prescription of angiotensin converting enzyme inhibitors (ACEi) or angiotensin II receptor blockers (ARB) and beta blockers (BB) at hospital discharge, and 6-month all-cause mortality and all-cause hospital readmissions.

A multivariate logistic regression analysis was used to determine the influence of socioeconomic variables on the prescription of prognostic-modifying therapy at hospital discharge. Variables expected to influence the prescription - diabetes *mellitus*, arterial hypertension, coronary heart disease, left ventricular systolic dysfunction and age - were included in the model as covariates.

We used Cox regression analysis to quantify the prognostic impact of the SES as determined by the SEDI. An age-, sex- and admission BNP-adjusted analysis was performed.

Patient's characteristics according to educational level and income are summarized in Table 1. Patients with lower income were less often medicated with ACEi and/or ARB at discharge. This association of lower income with less intention to treat with an ACEi and/or ARB was mainly explained by other variables expected to influence its prescription namely arterial hypertension; left ventricular systolic dysfunction and age. The

☆ This study was supported by two grants from "Fundação para a Ciência e a Tecnologia", project PIC/IC/82773/2007 and PTDC/SAU-ESA/107940/2008.
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Table 1
Patient characteristics and comparison according to educational level and income.

	All patients n = 600	Education			Income		
		≤4 years n = 492	>4 years n = 108	p value	Below minimum wage n = 355	Above minimum wage n = 245	p value
Clinical characteristics							
Male sex, n (%)	268 (44.7)	197 (40.0)	71 (65.7)	<**0.001**	132 (37.2)	136 (55.5)	<**0.001**
Age (years), median (IQR)	78 (71–84)	79 (72–84)	76 (64–83)	**0.005**	79 (72–85)	77 (68–84)	**0.02**
Institutionalized, n (%)	27 (4.5)	23 (4.7)	4 (3.7)	0.85	20 (5.6)	7 (2.9)	0.16
Arterial hypertension, n (%)	444 (76.6)	372 (78.3)	72 (68.6)	**0.04**	265 (76.6)	179 (76.5)	1.00
Diabetes *mellitus*, n (%)	241 (43.0)	204 (44.3)	37 (37.0)	0.22	131 (39.8)	110 (47.4)	0.09
Coronary heart disease, n (%)	244 (40.9)	193 (39.5)	51 (47.2)	0.17	134 (37.9)	110 (45.3)	0.08
LVSD, n (%)	324 (55.1)	261 (54.3)	63 (58.9)	0.45	184 (53.5)	140 (57.4)	0.40
Triggered by non-adherence to therapy, n (%)	158 (27.0)	136 (28.4)	22 (20.6)	0.13	102 (29.2)	56 (23.6)	0.16
BMI (Kg/m^2), median (IQR)	25.2 (22.6–27.8)	25.1 (22.6–27.8)	25.4 (22.7–28.0)	0.68	25.1 (22.6–27.9)	25.4 (22.8–27.8)	0.57
Admission laboratory parameters							
Hemoglobin (g/dL), median (IQR)	11.6 (10.4–13.3)	11.6 (10.4–13.2)	11.8 (10.1–13.7)	0.55	11.6 (10.4–13.3)	11.7 (10.4–13.2)	0.88
Creatinine (mg/L), median (IQR)	1.37 (1.10–1.82)	1.35 (1.10–1.84)	1.40–(1.10–1.79)	0.63	1.35 (1.10–1.89)	1.39 (1.12–1.74)	0.58
BNP (pg/mL), median (IQR)	1586.8 (915.0–2785.2)	1581.0 (884.6–2810.9)	1595.1 (1043.4–2589.0)	0.82	1533.3 (903.1–2890.7)	1667.4 (955.3–2710.6)	0.80
Previous medications in use							
Beta-blocker, n (%)	292 (49.1)	240 (49.2)	52 (48.6)	1.00	172 (48.7)	120 (49.6)	0.90
ACEi or ARB, n (%)	371 (62.1)	307 (62.7)	64 (59.8)	0.66	214 (60.5)	157 (64.6)	0.35
Spironolactone, n (%)	81 (13.6)	65 (13.3)	16 (15.0)	0.77	52 (14.7)	29 (12.0)	0.40
Spironolactone, n (%)	81 (13.6)	65 (13.3)	16 (15.0)	0.77	52 (14.7)	29 (12.0)	0.40
Discharge medication							
Beta-blocker, n (%)	453 (75.9)	369 (75.3)	84 (78.5)	0.56	264 (74.6)	189 (77.8)	0.42
ACEi or ARB, n (%)	472 (78.9)	382 (77.8)	90 (84.1)	0.19	269 (75.8)	203 (83.5)	**0.03**
Spironolactone, n (%)	140 (23.5)	108 (22.0)	32 (29.9)	0.11	82 (23.2)	58 (23.9)	0.92
All-cause death, n (%)	122 (20.4)	103 (21.0)	19 (17.6)	0.51	74 (20.8)	48 (19.7)	0.80
All-cause rehospitalization or death, n (%)	277 (46.2)	234 (47.7)	43 (39.8)	0.17	174 (49.0)	103 (42.2)	0.12

ACEi: angiotensin converting enzyme inhibitor, ARB angiotensin II receptor 1 blocker, BMI: body mass index; BNP: brain natriuretic peptide; HF: heart failure, ICD: implantable cardiodefibrillator; IQR: interquartile range, LVSD: left ventricular systolic dysfunction.

adjusted OR for ACEi/ARB prescription was 0.67 (0.43–1.04), p = 0.07. The prescription of BB was not associated with socioeconomic variables (Table 2).

During the 6-month follow-up 122 (20.3%) patients died and 237 (39.5%) were readmitted. Patients' SEDI distribution was as follows: no adverse factor: 69 (11.5%) patients; 1 adverse factor 172 (28.7%), 2 adverse factors 302 (50.3%) and all 3 adverse factors: 57 (9.5%) (Fig. 1).

Patients with at least one adverse factor had a HR of all-cause hospital readmission up to 6-months of 2.01 (95% CI: 1.21–3.34, p value =0.007); the HR of all-cause death was 1.48 (95% CI: 0.77–2.82, p value = 0.24). Patients with SEDI ≥1 had an age-, sex- and admission BNP-adjusted HR of hospital readmission of 1.91 (95% CI: 1.14–3.19; p value = 0.01).

In a large group of consecutive HF patients, we found that deprived patients had higher morbidity but non-different mortality. Patients with socio-economic deprivation had an almost double risk of hospital readmission within 6 months. The vast majority of our patients benefited from the pharmacological therapies known to improve outcome, although patients with low income tended to be less treated with ACEi and/or ARB upon discharge.

Equity in health access is an international priority [4]. Preventable inequalities are unfair and indicate distributional differences of care delivery. There is robust evidence demonstrating outcome improvement with pharmacological treatment in the whole spectrum of HF severity. Only a few studies have examined the prescription of HF prognostic-modifying therapy according to SES. In Scotland, where treatment is charge free, ACEi and BB prescription did not vary according to SES [5]. Similar observations were made in the United States (25). Discrepant results have been reported in Germany where BB prescription was significantly lower in more deprived patients [6]. In our population there was no interference between SES and BB prescription; a trend to lower ACEi/ARB prescription in patients with lower income was observed but still with a high frequency of use of this prognosis modifying medications.

Several studies show that deprived patients hospitalized with HF are at higher risk of readmission. These observations have been reported in different developed countries. Studies from England and USA observed higher hospital readmissions in the most deprived patients [1,2,7].

Table 2
Socio-economic variables and prescription of ACE-i or ARB and beta-blockers at hospital discharge: univariate and multivariate analysis.

	ACEi/ARB		Beta-blocker	
	Crude OR (95% CI), p value	Adjusted* OR (95% CI), p value	Crude OR (95% CI), p value	Adjusted* OR (95% CI), p value
Income < national minimum wage	0.63 (0.42–0.95), 0.03	0.67 (0.43–1.04), 0.07	0.88 (0.60–1.29), 0.51	0.99 (0.65–1.50), 0.96
Education ≤ 4 years	0.65 (0.37–1.14), 0.13	0.69 (0.38–1.24), 0.021	0.84 (0.51–1.39), 0.50	0.90 (0.52–1.56), 0.71
Living alone	2.78 (1.40–5.51), 0.003	2.65 (1.30–5.36), 0.007	1.15 (0.68–1.92), 0.60	1.20 (0.69–2.10), 0.51
SES index ≥1	0.92 (0.72–1.18), 0.52	0.95 (0.73–1.23), 0.68	0.88 (0.48–1.62), 0.69	1.00 (0.52–1.91), 1.00

ACEi: angiotensin converting enzyme inhibitors; ARB: angiotensin II receptor blockers; OR: odds ratio; CI: confidence interval.
* adjusted for left ventricular systolic dysfunction, age, diabetes mellitus, arterial hypertension and coronary artery disease.

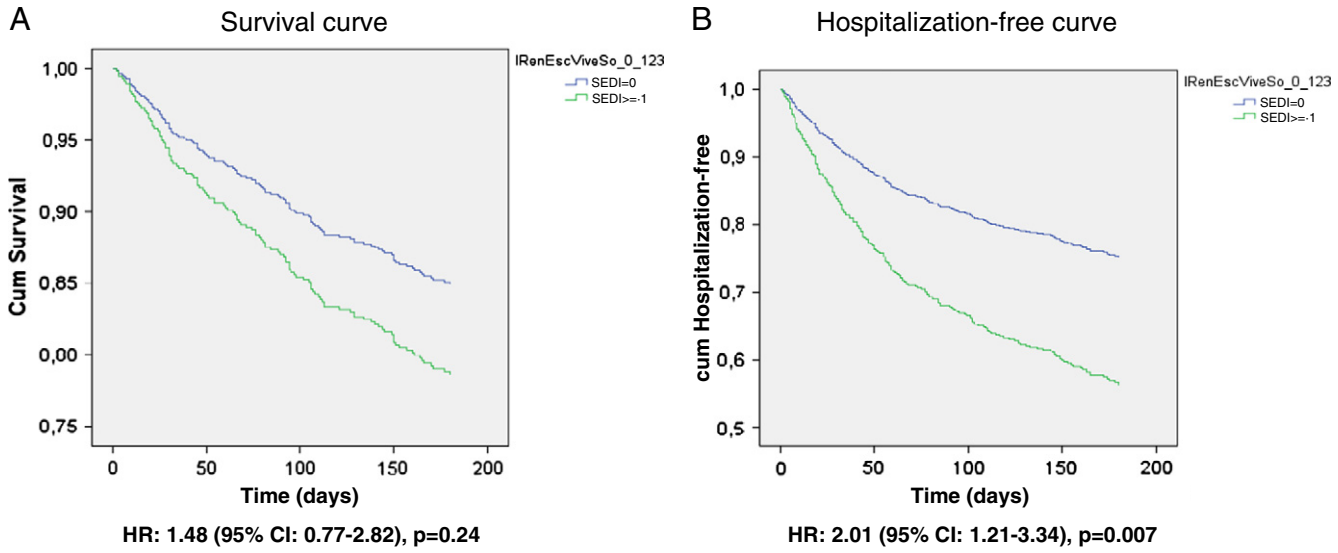

Fig. 1. Survival and hospitalization-free curves according to socioeconomic deprivation (patients with no adverse socioeconomic factor vs those with at least one socioeconomic deprivation factor.A: All cause death and SES index.B: All cause readmission and SES.

Our results extend these observations and show that also in Portugal, a south European nation, the more deprived HF patients are at higher risk of hospital readmissions. These results should help programming political and clinical strategies, aimed to improve the outcome in this frail group of patients in order to attain the national objective of having non-SES dependent outcomes.

In several studies, the relation between SES and mortality paralleled that observed with hospitalization. Some European and US studies have shown that survival was poorer among the most deprived patients. Other observations did not find an association between SES and mortality in HF [8]. Our data extend this observation, suggesting that socio-economic deprivation is currently not a major factor associated with mortality in HF patients.

In our acute HF population deprived patients were at higher risk of hospital readmission, however not in higher risk of mortality. Treatment was independent of SES suggesting that medical therapy is currently being delivered in an equitable fashion in Portugal.

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0167-5273/$ – see front matter
http://dx.doi.org/10.1016/j.ijcard.2013.07.131