RESEARCH REPORT

Influence of socioeconomic status on clinical outcomes and quality of life after percutaneous coronary intervention

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Objectives: To determine whether socioeconomic status (SES) influences clinical outcomes and quality of life after percutaneous coronary intervention (PCI).
Design: Prospective observational study.
Setting: Two interventional cardiac centres.
Participants: 1346 consecutive patients undergoing PCI over a 12-month period.
Outcomes: Self reported health-related quality of life (HRQoL; EuroQol-5 Dimensions (EQ-5D); EuroQol Visual Analogue Scale (EQ-VAS)), repeat angiography, revascularisation, hospital admission, myocardial infarction and death within 12 months, by SES derived using postal address code.
Main results: No significant differences were found between patients with high and low SES in the occurrence of repeat angiography (p = 0.55), repeat revascularisation (PCI, p = 0.81, CAEG, p = 0.27), total cardiac hospitalisation (p = 0.10), myocardial infarction (p = 0.97) or death 12 months after PCI (p = 0.88). Non-procedure-related readmissions were higher in patients with low SES (18.6% *v* 13.7%; p = 0.025). After adjustment for confounding factors, patients with low SES had lower HRQoL scores at baseline (95% CI for difference 0.01 to 0.14; p = 0.003) and at 12 months (95% CI 0.07 to 0.17; p<0.001) compared with those with high SES.
Conclusions: Clinical outcomes were similar for patients in different SES groups. Patients with low SES had considerably more non-procedure-related readmissions and lower quality-of-life scores. Future studies on HRQoL after coronary revascularisation should take account of these important differences related to SES.

Low socioeconomic status (SES) is associated with developing and dying from coronary heart disease (CHD).[1 2] This excess risk, relative to affluent patients, may be due to a combination of more adverse cardiovascular-risk factors,[3] inequalities in access to cardiac investigations,[4–6] longer waiting times for cardiac revascularisation[7] and lower use of secondary prevention drugs.[8 9] SES may also affect outcomes after cardiac procedures. Two previous studies have suggested that SES independently predicts adverse outcome after coronary artery bypass graft (CABG) surgery.[10 11] SES has been reported to influence access and utilisation of angiography and percutaneous coronary intervention (PCI), with some studies showing reduced access[4 5] and others showing no difference.[12] However, there are, to our knowledge, no studies reporting clinical outcomes in relation to SES after PCI, which is an increasingly used catheter-based treatment for obstructed coronary arteries. In addition, although health-related quality of life (HRQoL) has been used as an outcome in several studies on PCI,[13–18] these have generally not taken account of SES.

The Carstair's Deprivation Score[19] has been widely used as a marker of SES in patients with cardiovascular disease.[3 6–8] In this study, we examined the influence of SES (using Carstair's Deprivation Score) on clinical outcomes and quality of life in consecutive unselected patients undergoing PCI.

METHODS

Patient recruitment

Clinical information was collected prospectively on 1346 consecutive patients undergoing their first PCI between February 2001 and February 2002 at two interventional centres using a computerised PCI register. Ethical approval for the study was obtained from the research ethics committees at each of the two participating centres (Western General Hospital, Edinburgh and Glasgow Royal Infirmary, Glasgow).

Clinical outcomes data

Clinical events in the 12 months after PCI were collected via linkage of records in the PCI register with data from the Information and Statistics Division of the Common Services Agency using the Scottish Mortality Record 1 and General Registrar death data. The outcomes analysed included death, repeat angiography, PCI, CABG and a hospital admission with a primary cardiac diagnosis. Readmissions with a cardiac diagnosis were separated into those that resulted in a cardiac procedure (eg, coronary angiography, PCI or CABG) and those that were not to procedure related.

Quality-of-life questionnaires

While in hospital, patients were asked to complete a health and quality-of-life questionnaire before PCI (or within 24 h for urgent or emergency procedures). The questionnaire was posted to patients 11 months after PCI and if necessary a reminder sent 1 month later. The questionnaire included the EuroQol-5 Dimensions (EQ-5D), which consists of five HRQoL items, including mobility, self-care, usual activities, pain or discomfort, and anxiety or depression.[20] A Health Score Index was derived, where a value of 1 represented perfect health and a value of 0 represented death. The questionnaire also asked the respondents to rate their health status on a 20-cm vertical graduated (0–100) EuroQol Visual Analogue Scale (EQ-VAS) with 100 being the best imaginable health and 0 the worst imaginable health. Self-reported cardiac chest pain was documented using the Canadian Cardiovascular Society Score.[21]

Abbreviations: CABG, coronary artery bypass graft; CHD, coronary heart disease; depcat, deprivation category; EQ-5D, EuroQol-5 Dimensions; EQ-VAS, EuroQol Visual Analogue Scale; HRQoL, health-related self-reported quality of life; PCI, percutaneous coronary intervention; SES, socioeconomic status

Patients who completed both baseline and follow-up questionnaires (responders, 52.1%) were different from those who did not (non-responders). Non-responders were more likely to be younger (mean 59.3 (standard deviation (SD) 10.7) *v* 61.6 (SD 9.5) years old; p<0.001) to have had an emergency index procedure (11% *v* 2.8%; p<0.001) to have undergone repeat revascularisation within 12 months (13.6% *v* 9.6%; p = 0.03) and to have lower SES (Carstair's Deprivation Score 1.32 (SD 4.02) *v* 0.39 (SD 3.51); p<0.001) than responders. However, HRQoL score at follow-up was not significantly affected by repeat revascularisation or by having an emergency index procedure, but was strongly influenced by SES. This difference between responders and non-responders is important in the interpretation of the findings of this study.

SES by deprivation category

Carstair's deprivation category (depcat)[19] was calculated from the patients' postal code at the time of their PCI. The seven categories are based on overcrowding, male unemployment, low social class and lack of a car, and have been calculated for each postal code sector (depcat 1, most affluent area; depcat 7 most deprived area). For the purposes of analysis, patients were grouped into those with high (depcat 1–4) or low (depcat 5–7) SES. A sensitivity analysis was carried out to examine the effect of various groupings of depcat (eg, depcat 1–3 *v* 4–7, depcat 1–5 *v* 6–7) on HRQoL scores. The findings were consistent with those presented here (fig 1) which compare depcat groups 1–4 (high SES) with depcat groups 5–7 (low SES).

Statistical methods

Data are presented as mean (SD) and 95% confidence intervals (CI). The χ^2 test was used to compare percentages between groups. Means between groups were compared using analysis of variance and t test. Cox's regression analysis was carried out for age and depcat to assess whether each independently predicted the time to first admission after PCI. Data were also analysed to compare the percentages (logistic regression), means (analysis of variance) and time to event (Cox's regression) between groups adjusting for baseline HRQoL score (EQ-5D), Carstair's depcat, sex, age group, urgency of procedure, multilesion disease, left ventricular ejection fraction, previous myocardial infarction, previous CABG, diabetes, family history of heart disease, hypertension, hyperlipidaemia and smoking status.

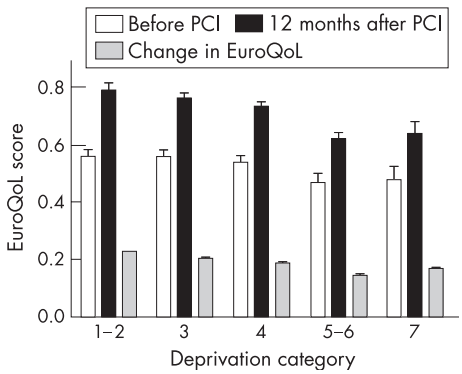

Figure 1 Baseline, 12-month and change in mean HRQoL (EQ-5D) score in patients undergoing percutaneous coronary intervention (PCI) by deprivation category (1–2, most affluent; 7, least affluent; bars are mean with 95% confidence intervals).

RESULTS

Patient characteristics

Compared with the high SES group, the group with low SES was younger, had less hypertension, fewer current or ex-smokers, less multivessel disease, fewer urgent or emergency procedures and lower angina scores (table 1). We found no significant differences between the groups for several other clinical features. Baseline and follow-up questionnaire data were available for 681 of 1308 (52.1%) patients alive at 12 months. Clinical outcome data were available for all 1346 patients.

Univariate analysis of clinical outcomes and quality of life for patients with high and low SES

We found no significant differences between patients with low and with high SES for the clinical end points of repeat angiography, repeat PCI, CABG, myocardial infarction or death (table 2). Similar proportions of high and low SES patients were readmitted to hospital to with cardiac-related problems within 12 months of PCI (28.8% *v* 24.7%, respectively; p = 0.10). Significantly more patients with to low SES were readmitted after PCI and did not require a further cardiac procedure (18.6% *v* 13.7%; p = 0.02; χ^2 test for trend; p = 0.004). These non-procedure-related admissions were mostly due to angina pectoris or chronic ischaemic heart disease (77.2%), but also included heart failure (8.0%), cardiac arrhythmia (8.4%) and acute myocardial infarction (6.4%).

At baseline and 12 months after PCI, patients with low SES had a lower mean HRQoL score than those with high SES, but had a similar improvement in HRQoL (EQ-5D) score (table 2). This association between mean HRQoL score and SES was observed consistently across the range of SES categories (fig 1). Patients who had a non-procedure-related readmission had a significantly lower mean HRQoL score at baseline (EQ-5D, 0.40 (SD 0.35) *v* 0.54 (SD 0.32); 95% CI for difference 0.07 to 0.20; p<0.001) and at follow-up (0.53 (SD 0.34) *v* 0.73 (SD 0.28); 95% CI for difference 0.15 to 0.25;

Table 1 Baseline patient characteristics for patients with high (deprivation categories 1–4) and low (deprivation categories 5–7) socioeconomic status

	High SES (n = 850)	Low SES (n = 441)	p Value*
Male (%)	69	63	0.022
Age (years)†	61.8 (10.1)	59.3 (10.0)	<0.001
Previous MI (%)	38	34	0.124
Previous CABG (%)	12	10	0.254
LVEF (%)†	52.1 (10.5)	51.9 (12.2)	0.913
Hypertension (%)	37	24	<0.001
Diabetes (%)	10	13	0.180
Chronic lung disease (%)	0.6	2.5	0.024
Non-smoker (%)	59	66	<0.001
Current or ex-smoker (%)	41	34	
Coronary disease (%)			
Left main stem	2	2	0.999
Proximal LAD	38	35	0.234
Multivessel disease	30	25	0.051
Procedure status (%)			0.051
Elective	56	62	
Urgent	37	34	
Emergency	7	5	
Angina score (%)			0.004
CCS I–II	45	53	
CCS III–IV	55	47	

CABG, coronary artery bypass graft; CCS, Canadian Cardiac Society; LAD, left anterior descending; LVEF, left ventricular ejection fraction; MI, myocardial infarction; SES, socioeconomic status.
*χ^2 test or Fisher's exact test for comparison of percentages and Mann–Whitney U test for comparing continuous variables.
†Values are mean (SD).

Table 2 12-month outcomes of percutaneous coronary intervention for patients with high (deprivation categories 1–4) and low (deprivation categories 5–7) socioeconomic status

	High SES (n = 876)	Low SES (n = 462)	p Value
Clinical outcomes, % (n)			
Chest pain score			
Worse	11.2 (46)	20.0 (29)	0.012*
Same	26.8 (110)	29.0 (42)	
Better	62.0 (254)	51.0 (74)	
Any hospital admission	24.7 (216)	28.8 (133)	0.10
Non-procedure-related hospital admission	13.7 (120)	18.6 (86)	0.02
Angiography	9.6 (84)	10.6 (49)	0.55
Repeat PCI	9.1 (80)	9.5 (44)	0.81
CABG	3.0 (26)	1.9 (9)	0.27
MI	1.4 (13)	1.5 (7)	0.97
Death	2.7 (24)	2.6 (12)	0.88
HRQoL, mean (SD)			
EQ-5D score			
Baseline	0.55 (0.31)	0.47 (0.35)	0.005
Follow-up	0.75 (0.26)	0.63 (0.30)	<0.001
Change	0.20 (0.35)	0.15 (0.40)	0.11
EQ-VAS score			
Baseline	57.5 (22)	59.5 (20)	0.28
Follow-up	72.3 (19)	64.2 (21)	<0.001
Change	14.9 (24)	4.8 (28)	<0.001

CABG, coronary artery bypass graft; EQ-5D, EuroQol-5 Dimensions; EQ-VAS, EuroQol Visual Analogue Scale; HRQoL, health related quality of life; MI, myocardial infarction; PCI, percutaneous coronary intervention; SES, socioeconomic status.
Eight patients could not be assigned a postal code and so had no Carstairs Score (n = 1338).
*χ^2 test for trend.

p<0.001) than those who did not require such admissions. By contrast, patients readmitted to hospital for another cardiac procedure during the 12 months showed no difference in mean HRQoL score compared with those who were not (EQ-5D, 0.50 (SD 0.35) *v* 0.52 (SD 0.33); 95% CI for difference −0.05 to 0.08; p = 0.61). EQ-VAS showed significantly less improvement in patients with low SES after PCI compared with those with high SES (4.8 (SD 28) *v* 14.9 (SD 24); 95% CI for difference 5.7 to 14.5; p<0.001). Patients with low SES also reported less improvement in symptoms of chest pain 12 months after PCI (table 2).

Multivariate analysis of quality of life and readmissions for patients with high and low SES

After adjustment for confounding factors (HRQoL score, Carstair's depcat, sex, age, urgency of procedure, multilesion disease, left ventricular ejection fraction, previous myocardial infarction, previous CABG, diabetes, family history of heart disease, hypertension, hyperlipidaemia and smoking status), the results of the univariate analysis were mostly maintained. In particular, HRQoL scores were significantly lower at baseline (difference 0.08; 95% CI 0.01 to 0.14; p = 0.003) and at follow-up (difference 0.12; 95% CI 0.07 to 0.17; p<0.001) for patients with low SES. Using the VAS, low SES was associated with a lower mean improvement in self-reported health status after PCI (difference 8.9; 95% CI 3.3 to 14.4; p = 0.002). There continued to be a significant association between a low HRQoL score and a higher chest pain score, both at baseline (p<0.001) and at follow up (p<0.001). Using Cox's regression analysis, SES was found to be an independent predictor of time to non-procedural hospital readmission after PCI (fig 2). After adjustment for confounding factors, the relationship between improvement in chest pain score and SES was no longer significant (p = 0.21).

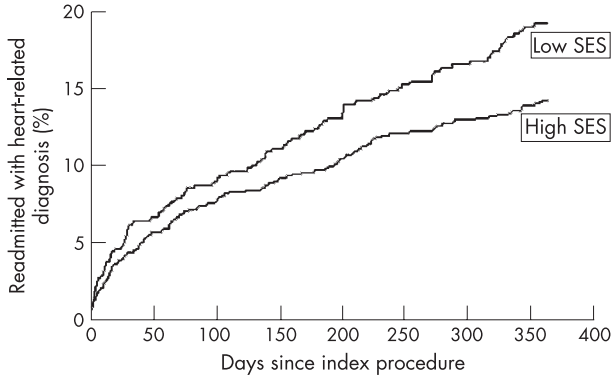

Figure 2 Unadjusted Kaplan–Meier plot showing risk of non-procedure-related readmission after percutaneous coronary intervention (PCI) in patients with high and low socioeconomic status (hazard ratio 1.39; 95% CI 1.05 to 1.83; p = 0.025).

DISCUSSION

In this study of unselected elective and urgent PCI patients, we found no marked differences in the clinical end points of death, myocardial infarction, total cardiac readmissions, angiography or repeat revascularisation between patients with low and high SES in the 12 months after PCI. There was, however, a greater number of non-procedure-related cardiac readmissions in patients with low SES predominantly owing to conditions coded as chronic ischaemic heart disease. The reason for this greater number of admissions is unclear, but it was independently associated with SES after adjustment for several possible confounding factors, including coronary disease severity and baseline risk factor status.

In contrast to our findings regarding PCI, two previous studies on CABG surgery have shown adverse outcomes in patients with low SES. Taylor *et al*[11] examined outcomes in 3578 CABG procedures and found that patients with low SES were more likely to develop myocardial infarction and the combined end point of death and myocardial infarction within 30 days of surgery. Ancona *et al*[10] reported similar findings 30 days after bypass surgery. Our study had a longer duration of follow-up but included a smaller number of patients and may have not been sufficiently powered to observe a small effect of SES on these clinical end points after PCI.

Several previous studies[15–17] have reported favourable changes in HRQoL after PCI, but none have reported this in relation to SES. Lower self-reported HRQoL in people from low SES groups is a feature of the general population.[22] The reasons for this are complex and include factors such as living in an urban environment, low occupational social class and a higher prevalence of depressive illness. Clearly, after adjusting for confounding factors included in our analysis, low SES is independently associated with lower HRQoL score before PCI and this relationship persists at 12 months. Analysing EQ-5D scores, we observed a trend to less improvement in HRQoL score, but EQ-VAS suggested a considerably reduced improvement in HRQoL after PCI, which persisted after adjustment for confounding factors. This was not related to a higher chest pain score in patients from low SES groups, as after adjustment for confounding factors this was similar in both groups. A greater number of readmissions to hospital in patients with low SES may partly explain this finding. However, readmission per se did not seem to influence HRQoL significantly, as patients readmitted for a further cardiac procedure tended to have a higher HRQoL score at follow-up. SES seems to contribute to lower HRQoL and less improvement in ways that are independent of chest pain and hospital readmissions.

What this paper adds

Socioeconomic status is not associated with poorer clinical outcome after percutaneous coronary intervention (PCI). However, deprived patients are more likely to be readmitted with chest pain and have a lower self-reported quality-of-life score after PCI.

Policy implications

Supportive strategies, such as a structured cardiac rehabilitation programme, should be provided for all patients after percutaneous coronary intervention (PCI), but might be more cost effective in patients from lower socioeconomic status (SES) groups who are more likely to be readmitted and have a lower health-related quality of life.

Limitations

The clinical end points in this study were based on all 1346 patients but the number of patients completing both baseline and follow-up HRQoL questionnaires was relatively low (52%). Considerable differences were observed in several variables between responders and non-responders. The markedly lower number of questionnaires returned from patients from low SES groups could have influenced the findings. The observational nature of this study is both a strength and a weakness in that, unlike randomised clinical trials, patients were unselected and are therefore more representative of routine clinical practice. Several statistical tests have been conducted in this study, and some of the associations could have occurred by chance.

CONCLUSIONS

SES does not seem to influence clinical outcomes after PCI but does have a considerable influence on HRQoL. Future studies on HRQoL in patients undergoing coronary revascularisation should take account of differences in SES.

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