Does socio-economic status of patients have an effect on clinical outcomes after coronary artery bypass grafting surgery

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Abstract

Background: Socioeconomic status (SES) is defined as an individual's social and financial position in comparison with that of other people. Cardiovascular disease is more common in people with low SES. This inverse relation between SES and Cardiovascular disease risk in countries with high-income is associated with some of the behavior and psychology status in people with low SES, such as smoking, malnutrition, and stresses.

Objectives: The purpose of our study was to evaluate the effect of patient's socioeconomic status on clinical outcomes in CABG surgery.

Patients and Methods: Since March 2014 to August 2015, 201 of 412 patients undergoing CABG surgery had operations in private hospitals who were categorized as patients with good socioeconomic status because of their financial position, life situation, and the ability to afford a high price for their operation. And 211 patients who had operation in university hospitals were named low socioeconomic status. Data were compared using Kolmogorov-Smirnov, Chi-square, Student T test and Mann-Whitney U test, regarding structural differences between groups. To determine factors influencing Post-operative outcomes, methods of logistic regression were used.

Results: At the end of the study, The 30-day mortality (p: 0.11), hospital mortality (p: 0.16), dialysis need (p: 0.09), neurologic events (CVA, LOC, Seizure) (p: 0.36), post-operative arrhythmia (AF, PVC, PAC and other) (p: 0.81) of patients with good socioeconomic status were not significantly different from the patients having low socioeconomic status. Hospital stay ($p<0.01$), wound infection (p: 0.004), first day bleeding ($p:<0.0001$), second day bleeding ($p:<0.001$), third day bleeding ($p:<0.001$), Reoperation need (p: 0.02) blood transfusion in first day after surgery ($p < 0.01$), second day after surgery ($p < 0.0001$), and third day after surgery ($p<0.001$) were significantly different in patients having good socioeconomic status and patients with low socioeconomic status.

Conclusions: In our study, socioeconomic status had a significant effect on: Hospital stay, wound infection, first, second and third day bleeding after surgery, Reoperation need, blood transfusion in first, second and third day after surgery. But it had no effect on 30-day mortality and hospital mortality, dialysis need, neurologic events and post-operative arrhythmia.

Key words: CABG surgery, cardiopulmonary bypass, clinical outcomes, socioeconomic status

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Background

Socioeconomic status (SES) refers to various aspects of social stratification and situation, such as income, education, social class and occupation. These aspects are somehow correlated with each other but often used interchangeably [1]. The cardiovascular disease (CVD) risk in both genders is more common in patients with low SES than patients with higher SES. This inverse relation between SES and Cardiovascular disease risk in rich-countries has interrelation with some behaviors and psychology status in people with low SES, such as smoking, malnutrition and stresses. [2] Socioeconomic status (SES) also has an effect on prognosis and survival from disease, because it can provide special conditions for patients. For many years this relationship between social class and getting better in the functional status of the heart, after myocardial infarction has been reported [3]. Various socio-economic factors can effect on dietary status which influences anemia and maybe it is a contributing cause in patients [4]. In patients undergoing surgery, poor nutrition significantly affects outcomes, and patients with poor nutrition have poor outcomes after surgery [5]. Seltzer after assessment of 500 medical-surgical patients found there is a fourfold association between increasing complications and a six fold increasing in mortality in patients who have serum albumin level less than 35 g/L [6]. Immune status and nutritional condition are associated factors that could effect on surgical outcomes in the patients [7]. Nutrition can also affect mortality rate by (50%) in malnourished old patients and (11%) in well-nourished old patients [8]. In patients with stroke, low pre-stroke SES had significant interrelation with post stroke outcomes such as: 3-months mortality, disability and dependence [9].

Objectives

Because of the differences in clinical outcomes in our two groups, socioeconomic status of patients is important. So we designed this study to investigate the role of economy on post-operative outcomes in patients with CABG surgery.

Patients and Methods

In an attempt to clarify effect of socioeconomic status on clinical outcomes in patients with CABG surgery, we retrospectively analyzed the surgical database of three institutions since March 2014 to August 2015. 412 patients who had conditions to include in our study, with a similar surgery team (common surgeon and perfusionist) were divided into two groups. The first 201 patients who had their operation in a private hospital and who had higher socioeconomic status were our first group. The second group were categorized as having low socioeconomic status were 211 other patients who had their operation done in university hospitals. Patients in private hospitals were capable of affording a high charge for their operation and in university hospital there was no charge. For safety of this study local authority's approval was received. Clinical outcomes which we aimed to compare in our two groups were defined as; hospital length of stay, hospital death, wound infection, dialysis need, neurologic events, re -exploration need, bleeding volume in ICU, arrhythmia (AF, PVC, PAC) during hospitalization, blood volumes transfusion during first three day after operation in ICU and 30-day mortality. For ensuring equality in the two groups we excluded patients with: renal insufficiency (Cr>1.5), liver dysfunction (SGPT& SGOT>twofold more than normal), heart insufficiency (EF<30%), patients with previous neurologic events, immune deficiency (WBC<2500), anti-coagulopathy (platelet<100000), preoperative infection (WBC>10000), autoimmune disorders, REDO operations, patients with specific behavior from the study. Pre-operative variables are shown in (Table 1). Significant statistical difference was defined as p values smaller than 0.05. There were several significant statistical differences in pre-operative and intra-operative variables between patients with higher socioeconomic status (private hospital) and patients with low socioeconomic status (university hospitals) when we use the Mann-Whitney estimator to determine group differences (Table 1 and Table 2). Myocardial revascularization by surgeons in all patients was done through median sternotomy. For anticoagulation throughout surgery a heparin dose was administered to keep activated coagulation time greater than 400 s. Protamine dose 1:1 was selected to antagonize heparin effect. In both groups, all patients' (100%) operation was done with on pump surgery and using extracorporeal circulation with mild hypothermia (32° to 34°C). Ascending aorta and venous two-stage cannulation were used for bypassing and tepid crystalloid cardioplegia (22-24°C) in two group was administered to paralyise the heart. Generally, hematocrits below 22 (Hb<7) on extracorporeal circulation and Hb<10 after surgery in ICU was avoided, and aggressively treated by blood transfusion if it occurred. Internal mammary artery use was high in the two groups (83.9% in private hospital and 76% in university hospitals).

Results

Patients having low socioeconomic status, had some risk profile before surgery (Table 1) such as: lesser BSA, height and weight, higher urgent or emergent surgery required and acute myocardial infarction in comparison with higher socioeconomic status patients. Although they were better in some other risk factors before surgery such as: number of grafts, Medical history, DM, HLP and Smoking. Analyzing the pre-operative laboratory data between the two groups showed that patients with higher Socioeconomic status had more kidney and liver problems (SGPT, SGOT, BUN and Cr were higher) and higher hemoglobin levels (patients with low SES (53.4%) tend to be more anemic (p<0.0001) than patients with higher SES (35.3%)), and platelet count was higher too. Hypertension was the most frequent post medical history disease in both groups with no difference in prevalence comparison (p= 0.13) (Table 2). During the CPB and surgery we had some differences between the two groups, such as: use of internal mammary artery (76%) in higher SES group and (83.9%) in low SES group. Also lowest hemoglobin during CPB was lower (p<0.001) in higher SES group patients. Blood transfusion (246.5±228

Table 1. Demographic Data before Surgery

Variable	low socioeconomic status patients	higher socioeconomic status patients	P-Value
Age(y)	61±10.4*	61± 8.8	0.75
Weight(kg)	68.1 ± 12.4	71.3 ± 11.3	0.01
Height(cm)	163.9±9	166.±9.6	0.002
BSA(m^2)	1.73 ± 0.18	1.79 ± 0.18	0.002
EF (%)	50.8±8.8	51.5±8.2	0.50
Number of grafts	3.41 ± .75	4.2± .71	<0.001
Sex (males/females %)	62.6 / 37.4	68.2 / 31.8	0.23
Medical history	90	96	0.01
MI (%)	22.3	0.5	<0.0001
DM (%)	33.2	42.8	0.04
HTN (%)	64.5	57.2	0.13
HLP (%)	46.4	57.2	0.02
COPD (%)	11.4	10.4	0.76
Smoking (%)	23.7	32.8	0.03
Other problems (%)	10.4	33.3	<0.001
Medication (%)	71.6	69.7	0.67
Aspirin (%)	68.7	67.2	0.73
Plavix (%)	14.7	24.4	0.01
Warfarin (%)	.5	.0	0.32
Elective/Emergent (%)	74.9 / 25.1	97 / 3	<0.001

*Mean± Standard Deviation
Abbreviation: BSA, body surface area; EF, ejection fraction; MI, myocardial infarction; DM, diabetes mellitus; HTN, hypertension; HLP, hyper lypidemia; COPD, chronic obstructive pulmonary disease

Table 2. Laboratory Data before Surgery

Variable	low socioeconomic status patients	higher socioeconomic status patients	P-Value
ANEMIA (%)	53.4	35.3	<0.0001
Hemoglobin(g/dl)	12.8±1.9*	13.7±1.7	<0.001
platelet	237189 ± 79446	275044 ± 68929	<0.0001
WBC	7530 ±1724	7281 ± 1602	0.112
Cr	1.07±0.21	1.01 ± 0.18	0.002
BUN	17.15±5.86	20.2±5.8	<0.001
SGPT	26.3± 11.5	30.9±11.9	<0.001
SGOT	25.8±10.2	29.3±9.5	<0.001

*Mean± Standard Deviation
Abbreviation: WBC, white blood cell; BUN, blood urea nitrogen; CR, creatinine; SGPT, serum glutamate-pyruvate transaminase; SGOT, serum glutamic oxaloacetic transaminase.

Table 3: Intra operative information

Variable	low socioeconomic status patients	higher socioeconomic status patients	P-Value
LIMA (%)	83.9	76	0.04
Lowest temperature(Ċ)	33.4± 1*	33.8±0.61	<0.001
Lowest HB(g/d)	7.3±1.3	7.04±1.44	<0.001
Aortic clamp time(min)	32.9±8	30.1±7.25	0.007
Pumping time(min)	56±13.1	53.3±10.5	<0.01
Surgery time(min)	203±29.3	226.3±46.7	<0.001
Urine output(cc)	262.7±212	386±302	<0.0001
Hemofiltration(cc)	2105±616	2460±588.6	<0.001
Blood transfusion(cc)	246.5±228	109.5±151	<0.0001

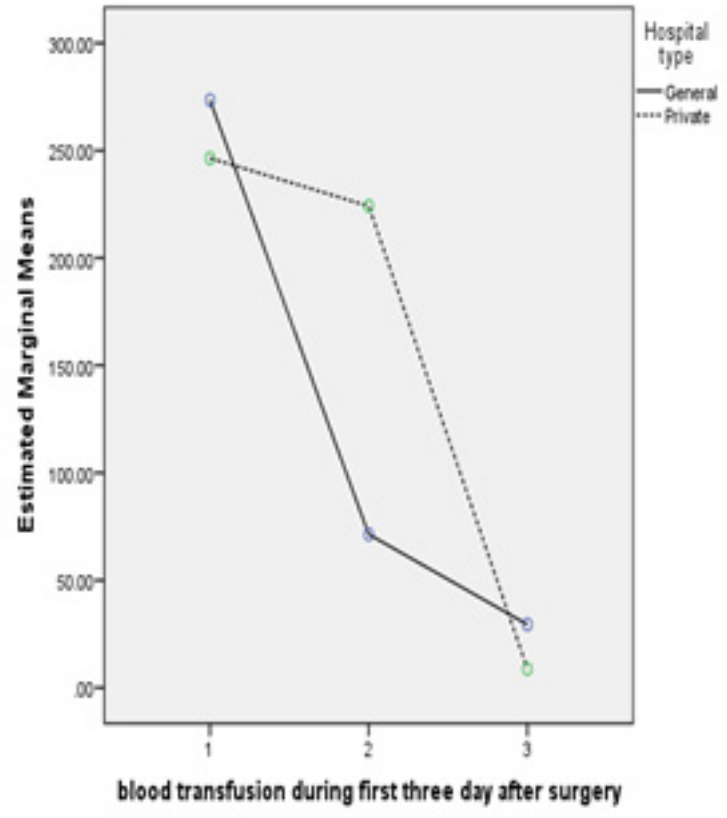
*Mean± Standard Deviation
Abbreviation: LIMA, left internal mammary artery; HB, hemoglobin

Table 4. Post-operative clinical outcomes Analysis in the two groups

Variable	low socioeconomic status patients	higher socioeconomic status patients	P-Value
Hospital stay(day)	5.03 ± 2.7*	4.1 ±0.73	0.01
1st day bleeding(cc)	534.8±396.8	434.8±286.4	<0.0001
2nd day bleeding(cc)	240.6±190	301.2±176.4	<0.001
3rd day bleeding(cc)	41±109.4	10.8±41.8	<0.001
Hospital mortality (%)	2(0.9%)	.0	0.16
Infection (%)	10	3	0.004
Dialysis need (%)	4.3	1.5	0.09
Neurologic events (%)	5.7	8	0.36
CVA (%)	0.9	3	0.13
LOC (%)	3.3	5.5	0.28
Seizure (%)	.5	0	0.32
30-day mortality (%)	2.4	0.5	0.11
Reoperation need (%)	2.4	0	0.02
Arrhythmia (%)	14.2	13.4	0.81
AF (%)	10	5	0.05
PVC (%)	1.9	6	0.03
PAC (%)	3.3	6	0.19
1st day transfusion(cc)	273.5± 263.5	246.5± 173	0.01
2nd day transfusion(cc)	71.4± 146.7	224.2± 189.4	<0.0001
3rd day transfusion(cc)	29.4± 91	8.7± 43.7	<0.001

*Mean± Standard Deviation
Abbreviation: CVA, Cerebra vascular accident; LOC, low of conscious; AF, atrial fibrillation; PVC, premature ventricular contraction; PAC, premature atrial contraction

Figure 1: blood transfusion volume during the first three days after surgery



vs. 109.5±151 and p<0.0001), Aortic clamp time (p<0.007) and pumping time (p<0.01) were lower in the higher SES group in comparison with the low SES group. But surgery time (p<0.001), lowest temperature (p<0.001), urine output (p<0.0001) and hemofiltration (p<0.001) were higher in the higher SES group (Table 3). Analyzing the post-operative clinical outcomes between the two groups showed that: Hospital mortality (p: 0.16), Dialysis need (p: 0.09), Neurologic events (p: 0.36), CVA (p: 0.13), LOC (p: 0.28), Seizure (p: 0.32), 30-day mortality (p: 0.11), total Arrhythmias (p: 0.81) and post-operative PAC (p: 0.19) were not significantly different in the higher SES and low SES groups. But Hospital stay (4.1 ±0.73 vs. 5.03 ± 2.7, p<0.01), wound infection (p<0.004), first-day bleeding after surgery (p<0.0001), third-day bleeding (p<0.001), first-day blood transfusion (p<0.01), third-day blood transfusion (p<0.001), Reoperation need (p: 0.02), post-operative AF (p: 0.05) and PVC (p: 0.03), were significantly lower in the higher SES group patients in comparison with the low SES group. But bleeding volume (p<0.001) and blood transfusion volume (p<0.0001) during second day after surgery were significantly higher in the higher SES group patients (Table 4). Figure 1 shows blood transfusion volume during the third day after surgery.

Discussion

The effect of patients' socio-economic status (SES) on nutrition and health is important. SES is interrelated with the health base on lifestyles which is the circumstances of cardiovascular disease. It means that low SES is associated with some risky behaviors like smoking or less physical activity and poor dietary adaption in patients which makes them feel hopeless and depressed [11]. Yu, Zhijie, et al found the reverse relationship between SES and cardiovascular disease risk factor [12]. Lynch, et al. showed the developmental, behavioral and psychological effect of SES in the childhood period in that it was reinforced and maintained during the life time[13]. Because we didn't have similar research in this area, there was an uncertain gap between our knowledge and this influence on outcomes. For this study we used survey data in two university hospitals and one private hospital to examine the degree of patient socio-economic status effect on post-operative result in patients undergoing coronary artery bypass grafting surgery. Clinical outcomes were defined as: hospital stay, hospital mortality, dialysis need, wound infection, blood transfusion, bleeding, 30 day mortality, re-exploration need, neurologic events and arrhythmia that was gathered from a cluster of the patients and phone calls to the patients or their visitors and compared with each other to clarify this effect. Our result showed that preoperative socio-economic status of the patients who had CABG surgery affected clinical outcomes in many aspects. Similar to our result, some studies have concluded that socioeconomic status and operative status has been associated with outcomes [14-16]. Yu, Tsung-Hsien et al, reached the result that poorer quality of services were associated with worse outcomes in patients with low-income who had CABG surgery. In fact there was less tendency in individuals with low income toward high-quality healthcare despite Health Insurance programs an this was the cause of worse clinical outcome after surgery [17]. But in some other aspects there were no differences. Some studies had been done on a few aspects of our study. Results in our study did not show any significant

1. Some patients don't like to be infused by other people's blood in any situation because of their religions.

difference between hospital mortality and 30-day mortality after surgery between low SES and higher SES patients (p>0.05). Unlike our study Dzayee, et al showed in their cohort study that Mortality Rate after CABG surgery in patients with lower socioeconomic position was higher during their study period[18]. Also Yong, et al. found that with increase in patients' income, mortality rate was decreased slightly (10.8% mortality in patients with lowest income versus 9.4% in highest-income patients). Re-admission after thirty days in higher socioeconomic status patients were higher (9.9% in lower-income patients versus 10.4% in higher-income) [19]. And Abbasi, et al's result showed that Hospital mortality in patients with low socioeconomic status was higher in comparison with high socioeconomic status patients due to the acute coronary syndrome [20]. But similar to our study Shi, William Y, et al. found that patients from remote areas undergoing CABG surgery experienced poorer long-term survival. But thirty-day mortality was not different in the different groups (1.6% vs. 1.6%, p>0.99) [21].

We found that Hospital length of stay has been affected by patients SES ((4.1 ±0.73 vs. 5.03 ± 2.7, p<0.01). As in our conclusion Poole, et al. showed in their study that Hospital Length of stay after CABG in patients with depression had a relationship with socioeconomic status [22]. SES also has an important role in access to cardiac care services and significant effects on one-year mortality after MI [23]. We concluded that patients SES had a significant role in choosing hospital type (private hospital or university hospitals), and pre-operative health status such as: BSA, Weight and height, acute MI, emergency operation, hemoglobin level (anemia), platelet count, and Cr level and also had significant effect on need for blood products during surgery, length of hospital stay, wound infection, re-exploration need for bleeding, bleeding volume and blood transfusion volume after surgery in patients who had CABG surgery. But it had no effect on hospital and 30-day mortality, dialysis need, neurologic events and arrhythmia.

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