Ethnicity and Long-term Prognosis After Myocardial Infarction

A Population-based Cohort Study

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Background: Health disparities are systematic differences in health, favoring members of advantaged over disadvantaged groups in the society. This study examines the contribution of multiple socioeconomic status (SES) measures to ethnic differences in after myocardial infarction (MI) prognosis.

Methods: Patients aged 65 years and younger (n = 1040) belonging to *Ashkenazi* and *Mizrahi* advantaged and disadvantaged ethnic groups discharged from 8 hospitals in central Israel after incident MI in 1992–1993, were followed up through 2005 for all-cause mortality, recurrent MI, heart failure, and ischemic stroke.

Results: Advantaged *Ashkenazi* had higher education, income, employment, and neighborhood SES compared with disadvantaged *Mizrahi*. Cardiovascular risk factors varied among the different ethnic groups. Results showed that the association between ethnic group and all outcomes differed substantially between models that included a single SES measure and those that included multiple measures. For example, the hazard ratio for mortality in disadvantaged *Mizrahi* compared with advantaged *Ashkenazi* was 1.87 [95% confidence interval (CI), 1.40–2.48] in a model adjusting only for demographic variables; 1.58 (95% CI, 1.18–2.12) in a model adjusting also for income; and 1.03 (95% CI, 0.74–2.04) in a model adjusting for all measured SES indicators. Further adjustment for clinical variables did not appreciably change the results.

Conclusions: Findings show that a wide array of modifiable social factors shaped by income, education, and neighborhood socioeconomic conditions can explain ethnic health differences and highlight the importance of using multivariable models of SES.

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Health disparities are defined as unequal health status favoring members of advantaged over disadvantaged groups in the society. Social advantage or disadvantage refers to the relatively favorable or unfavorable social, economic, or political conditions that some groups systematically experience based on their relative position in social hierarchies.[1–4]

Research over the past decade has consistently documented socioeconomic health disparities in which those who are poor and have not graduated high school experience considerably worse health on average than more affluent and educated members of society in many industrialized countries.[3,5,6] For example, in the United States where income and education are the most frequently used socioeconomic measures, the rate of coronary heart disease, the leading cause of death worldwide,[7] is nearly 50% higher among poorest adults (family income <100% of Federal Poverty Level) than among those in the highest income group (family income >400% of Federal Poverty Level).[8] Similarly, although cardiovascular risk factors such as high cholesterol and smoking decreased in the past 3 decades, the decrease was smallest among adults with lower family income.[9]

The social gradient in health has also been observed in countries with national health care systems such as the United Kingdom and Israel.[5,6] For example, in Israel, low individual and neighborhood socioeconomic status (SES) were associated with increased risk of ischemic stroke and long-term survival after myocardial infarction (MI).[10,11]

Studies over the past decade have also documented ethnic differences in health between advantaged and disadvantaged ethnic groups in many western countries.[6,12] For example, in the United States ethnically advantaged groups (whites) have shown lesser rates of coronary heart disease than ethnically disadvantaged groups (eg, African Americans), even when variables such as income, education, geographic location, and insurance status were controlled for.[13] Similar findings were observed in Israel showing a higher cerebrovascular risk among disadvantaged ethnic groups (*Mizrahi*—Jews who immigrated from Asia and North Africa) compared with advantaged ethnic groups (*Ashkenazi*—Jews who immigrated from Europe and America).[14,15] Interestingly, unfavorable risk factor levels did not account for these differences and raised the possible role of other sociocultural factors that were not assessed in the studies.

Socioeconomic and ethnic health inequalities are closely linked. Without adequate socioeconomic information, ethnic health differences may be attributed to genetic or underlying cultural differences that are unlikely to be influenced by policy.[4] The link between socioeconomic and ethnic health disparities is further complicated by modifiable social factors such as wealth, childhood and neighborhood socioeconomic conditions which are usually not measured. In fact, limited research has documented that a wide array of modifiable social factors shaped by income, education, wealth, childhood, and neighborhood socioeconomic conditions, which tend to vary systematically by ethnic groups, can explain ethnic health differences.[16,17] These studies show income gradient within each ethnic group and ethnic differences within levels of income in several health outcomes such as prenatal care and general health status.

Although most health studies examining ethnic differences that consider SES used a single socioeconomic variable measured at a single level, ethnic health risks may significantly vary depending on the definition of SES.[17] Despite the importance of the examination of a multidimensional measure of SES in ethnic health disparities, the role of neighborhood features along with individual-level SES measures in ethnic differences in post-MI prognosis has not been previously considered. In this study, we examined the contribution of multivariable measures of SES (including education, income, employment, and residential neighborhood) in addition to classic risk factors, MI characteristics, and disease severity indexes to ethnic differences in post-MI prognosis. The study was conducted among a geographically defined cohort of patients aged 65 years or less in central Israel. Israel, that has a national health insurance system in which health care is freely available, constitutes a suitable setting to examine the research question under favorable service conditions.

We focus on differences between *Mizrahi* and *Ashkenazi* ethnic groups that continue to be a prominent ethnic distinction among the Jews in Israel. The *Ashkenazi* Jews constitute the dominant social group among Israelis. Although the *Mizrahi* group has made some social and economic gains over the years, the socioeconomic gap has remained. Consistent evidence from the Israel National Bureau of Statistics,[18] public health research, and research in the social sciences[19–21] show that inequality between these groups is still apparent in the levels of education (*Ashkenazi* have 3 additional years of education on average compared with their *Mizrahi* counterparts), average income (*Mizrahi* families earn 85% of the income of their counterparts), and mental health status (prevalence rates of mood and anxiety disorders are twice higher among *Mizrahi*). *Mizrahi*, who typically have darker skin tone than their *Ashkenazi* counterparts tend to experience more prejudice and negative stereotyping albeit in a form that is more implicit rather than explicit and direct.[19,20,22]

We hypothesized that the association between ethnicity and prognosis post-MI will significantly differ in models that include a single SES measure compared with models that include multiple SES measures.

METHODS

Study Setting and Design

Study population was located in a metropolitan area in central Israel. In 1992, approximately 2,000,000 residents lived in this area, 95% of whom were Israeli Jews. An overwhelming majority (95%) of this population lived in the urban areas and about one third were aged between 30 and 64 years. The Israel Study of first acute MI included patients aged 65 years or less who were admitted to one of the 8 medical centers in this area with first acute MI between February 15, 1992 and February 15, 1993, and were followed up through December 31, 2005. This longitudinal, prospective cohort study investigates long-term outcomes, and has previously been described in detail.[10,23] Of the initial 1626 patients who met the study criteria, 81 (5%) died during hospitalization, and 1521 (98%) of the survivors agreed to participate in the study. All aspects of the study were approved by the appropriate Institutional Ethics Committees.

Eligible patients for the current study included 1040 *Mizrahi* and *Ashkenazi* Jewish patients (481 survivors were Israeli born, including 59 Arabs, who were not included in the analyses because of their mixed origin). Eligible patients were further divided into subgroups according to relative social advantage status in the Israeli society[20,24–27] resulting in 4 ethnic groups (see Appendix, Supplemental Digital Content 1, http://links.lww.com/MLR/A351, which presents the distribution by country of origin of the sample): socially advantaged *Ashkenazi* (including Jews who immigrated to Israel from Europe, Americas, Former Soviet Union, and South Africa, n = 353); socially disadvantaged *Ashkenazi* (including Jews who immigrated to Israel from the Balkan, n = 177); socially advantaged *Mizrahi* (including Jews who immigrated to Israel from Iraq, Egypt and Turkey, n = 232); and socially disadvantaged *Mizrahi* (including Jews who immigrated to Israel from other Asian and North African countries, n = 278).

Data Collection

Individual demographic, socioeconomic, and clinical data were collected from medical records and structured interviews conducted approximately 1 week after the index MI.

Socioeconomic Measures

Individual SES data were self-reported at study entry and included the following measures: family income relative to the national average (categorized as below average, average or above average), education (years of schooling), and pre-MI employment status (full-time, part-time, or none). Further information on these measures has been published elsewhere.[23] Neighborhood SES was estimated through an index developed and validated by the Israel Central Bureau of Statistics,[28] which summarizes socioeconomic measures (ie, demographics, education, living standards, employment, unemployment, social welfare benefits) from the 1995 National Census data, allowing the classification of small geographical units (~2000 residents) into SES categories, on a 20-point scale (higher scores denote better SES). Geographic Information System tools were used to assign patients' addresses to the appropriate SES categories at the time of index MI. Study participants resided in 494 distinct geographical units (neighborhoods), all of which are located within an area of approximately 400 square miles.

Clinical Covariates

Inpatient and outpatient medical records and data obtained through structured detailed interviews were used to ascertain cardiovascular disease risk factors, MI characteristics, disease severity indices, and acute management. Measurements recorded at the index hospitalization or at the closest time before or after the index date were considered. Obesity was defined as body mass index $\geq 30\,kg/m^2$. Diabetes, hypertension, and dyslipidemia were classified according to standard criteria based on clinical and laboratory data. Cigarette use was classified into never, former, and current smoking. Comorbidity was assessed by the Charlson index[29] and analyzed categorically (no comorbidity for 0 points, moderate comorbidity for 1–2 points, and severe comorbidity for ≥3 points). MI characteristics and severity indices included infarct type and location, Killip class, and admission to an intensive care unit (ICU). Reperfusion therapy and revascularization included thrombolysis, percutaneous transluminal coronary angioplasty (PTCA), and coronary artery bypass grafting (CABG). Revascularization referred to early procedures performed within 45 days of the index date.

Outcome Measure

Time from baseline to the following events: all-cause death, recurrent MI, heart failure, and ischemic stroke (including transient ischemic attack) were our dependent variables. For the nonfatal outcomes, only those leading to hospitalization were considered for analysis. Follow-up was initiated at the index MI (February 15, 1992–February 15, 1993) and lasted through December 31, 2005 (loss to follow-up <2%). All clinical outcomes were ascertained through various sources of data, including medical records, the Israeli Population Registry, death certificates, hospital charts, family physicians, and family members and verified by a trained physician blind to patients' baseline characteristics.

Statistical Analyses

Analyses were performed using SPSS version 19.0 (SPSS Inc., Chicago, IL) and SAS statistical software version 9.1 (SAS Institute Inc., Cary, NC). Baseline characteristics across ethnic groups were compared by the χ^2 test for categorical variables and analysis of variance for continuous variables.

Cox proportional hazards models were constructed to evaluate the hazard ratios (HRs) and 95% confidence intervals (CIs) for all-cause mortality, recurrent MI, heart failure, and ischemic stroke associated with ethnic groups, with socially advantaged *Ashkenazi* as the reference category. Initial adjustment was made for age and sex. Subsequently, adjustments were made separately for single SES measures (ie, relative income, education, pre-MI employment, and neighborhood SES). Then, all individual and area-level SES measures as well as age and sex were controlled for (model 1). Finally, cardiovascular risk factors, MI characteristics, comorbidity, and cointerventions were added (ie, hypertension, diabetes, dyslipidemia, smoking, obesity, Killip class, ICU, CABG within 45 d, PTCA within 45 d, Charlson index; model 2). As the year of immigration was not a significant prognostic factor and did not substantially modify the relationship between ethnic identity and post-MI outcomes, it was not included in the models. There were no missing values in the covariates used in the regression analyses, except for family income (16%), physical activity (9%), and neighborhood SES (7%), for which imputed values were generated using multiple imputation.[30]

The proportional hazards assumption, as tested with the Schoenfeld residuals, was not met for age and smoking (all-cause mortality model), admission to ICU and PTCA within 45 days (recurrent MI model), and pre-MI employment (heart failure model). These covariates were modeled as stratification variables, where a different baseline survival function was used for each defined stratum. Given the overall average of 2 participants per neighborhood and small intraneighborhood and intrahospital correlations (~0), multilevel models were not applied.

Given a sample size of 177 subjects in the smallest ethnic group and 353 subjects in the referent group, an average probability of event-free survival between 66% and 82% (depending on the outcome), and a significance level of 5%, the estimated statistical power was 55%–77% for detecting an HR ≥ 1.50 and 93%–99% for detecting an HR ≥ 2.00, for the different outcomes.

We assessed the correlations between all pairs of SES variables using Spearman ρ and Cramer *V*, yielding coefficients ranging from 0.06 to 0.42. This suggests that collinearity was not a major concern in these data.

RESULTS

Patient Characteristics

Significant differences were observed in several baseline variables among the ethnic groups (Table 1). Advantaged *Ashkenazi* had higher mean years of education, relative income, and neighborhood SES compared with disadvantaged *Mizrahi*.

Generally, women comprised only 20.6% of this sample, primarily because of age restriction (65 years and younger at study entry) of the parent cohort. On average, women were older than men (58.7 vs. 55.0, $P<0.001$), had fewer years of schooling (9.3 vs. 11.0, $P<0.001$), and lower neighborhood SES (11.9 vs. 12.3, $P=0.17$). In addition, women were more likely to report a lower than average family income (74% vs. 48%, $P<0.001$) and unemployment before MI (68% vs. 17%, $P<0.001$). No significant differences were observed in the proportion of missing values for family income (18% vs. 16%, $P=0.53$) and neighborhood SES (8% vs. 7%, $P=0.60$) between women and men, respectively.

Cardiovascular risk factors varied among the different ethnic groups. Although hypertension was more prevalent

TABLE 1. Patients' Baseline Characteristics by Ethnic Group

	Ethnic Group				
Characteristics	**Advantaged *Ashkenazi* n = 353**	**Disadvantaged *Ashkenazi* n = 177**	**Advantaged *Mizrahi* n = 232**	**Disadvantaged *Mizrahi* n = 278**	***P***
Sociodemographic variables					
Age (y); mean (SD)	56.4 (7.4)	56.8 (7.2)	55.1 (6.6)	54.8 (7.0)	0.003
Male	77	78	83	81	0.29
Year of immigration; median (Q1, Q3)	1954 (1948, 1978)	1949 (1948, 1961)	1951 (1949, 1951)	1952 (1949, 1963)	< 0.001
Education (y); mean (SD)	13.0 (3.7)	11.7 (3.7)	8.9 (3.9)	8.5 (3.9)	< 0.001
Family income relative to national average					< 0.001
Above average	25	35	19	9	
Average	29	27	25	24	
Below average	47	38	56	68	
Pre-MI employment	76	75	75	64	0.004
Neighborhood SES; mean (SD)	13.7 (3.6)	12.9 (3.4)	11.8 (3.3)	10.4 (3.5)	< 0.001
Cardiovascular risk factors					
Hypertension	43	50	34	36	0.004
Diabetes	18	29	26	33	< 0.001
Dyslipidemia	36	42	35	31	0.15
Current smoking	43	44	59	53	0.001
Obesity	18	22	15	15	0.19
MI characteristics and disease severity indexes					
Killip class >1	22	19	22	22	0.91
Intensive care unit	80	73	83	74	0.04
CABG w/in 45 d	7	3	9	5	0.09
PTCA w/in 45 d	19	13	17	13	0.08
Charlson index (points)					0.52
0	60	59	56	59	
1–2	36	35	41	36	
≥ 3	5	6	3	5	

Data are presented as percentages, unless otherwise specified.

Percent of missing data for advantaged *Ashkenazi*, disadvantaged *Ashkenazi*, advantaged *Mizrahi*, and disadvantaged *Mizrahi* were 20%, 16%, 13%, and 15% ($P = 0.20$) for relative income and 9%, 4%, 5%, and 9% for neighborhood SES ($P = 0.09$), respectively.

CABG indicates coronary artery bypass grafting; MI, myocardial infarction; PTCA, percutaneous transluminal coronary angioplasty; SES, socioeconomic status.

among advantaged and disadvantaged *Ashkenazi* patients compared with their *Mizrahi* counterparts, smoking was more prevalent among advantaged and disadvantaged *Mizrahi* patients. Diabetes was significantly less prevalent among advantaged *Ashkenazi* compared with the other ethnic groups. Socially advantaged groups (*Ashkenazi* and *Mizrahi*) had higher rates of acute disease management compared with socially disadvantaged ethnic groups.

Ethnic Groups and Outcome Measures

The association between ethnic groups and post-MI outcomes substantially varied depending on how SES was modeled (Table 2). Overall survival differed among ethnic groups in a model adjusted for age and sex. The HR for all-cause death among disadvantaged *Mizrahi* patients was 1.87 (95% CI, 1.40–2.48) compared with advantaged *Ashkenazi* patients. In models adjusting for single measures of SES the difference was slightly attenuated, yet it remained statistically significant after adjustment for income (HR, 1.58; 95% CI, 1.18–2.12), employment (HR, 1.62; 95% CI, 1.21–2.16), or neighborhood SES (HR, 1.48; 95% CI, 1.09–2.00). However, these differences were not maintained after adjusting for all SES measures, including education, relative income, pre-MI employment, and neighborhood SES (HR, 1.03; 95% CI, 0.74–1.45). Further adjustment for clinical variables did not appreciably change the results (HR, 1.06; 95% CI, 0.76–1.48). A similar picture arose for differences between disadvantaged *Mizrahi* and advantaged *Ashkenazi* with all other outcome measures (Table 2).

Results of sensitivity analysis using a composite outcome that combined all-cause death, recurrent MI, heart failure, and ischemic stroke were also in line with the analysis of the single outcomes. The HR for composite outcome in disadvantaged *Mizrahi* compared with advantaged *Ashkenazi* was 1.54 (95% CI, 1.25–1.90) in a model adjusting only for demographics; 1.41 (95% CI, 1.14–1.75) in a model adjusting also for income; and 1.07 (95% CI, 0.84–1.35) in a model adjusting for multiple SES indicators. Further adjustment for clinical variables did not appreciably change the results (HR, 1.12; 95% CI, 0.89–1.42). In addition, results of the association between different SES measures and the composite outcome stratified by ethnic groups showed that SES-outcome associations did not substantially differ by strata, indicating no substantial interactions between SES and ethnicity in these data (Table 3).

DISCUSSION

The paper presents data on the contribution of multivariable measure of SES to ethnic differences in long-term prognosis post-MI of Israeli patients aged 65 years or less followed up for a median of 13 years. Disadvantaged *Mizrahi* patients showed worse prognosis on a variety of clinical

TABLE 2. Hazard Ratios (95% Confidence Intervals) for Various Cardiovascular Disease Outcomes Postmyocardial Infarction Associated With Ethnic Groups

	Ethnic Groups			
Adjustment	**Advantaged *Ashkenazi* n = 353**	**Disadvantaged *Ashkenazi* n = 177**	**Advantaged *Mizrahi* n = 232**	**Disadvantaged *Mizrahi* n = 278**
All-cause mortality				
No. events (total = 314)	89	59	60	106
Age and sex	1 (reference)	1.35 (0.97–1.88)	1.10 (0.79–1.52)	1.87 (1.40–2.48)
Age, sex, and income	1 (reference)	1.39 (1.00–1.93)	1.00 (0.72–1.40)	1.58 (1.18–2.12)
Age, sex, and education	1 (reference)	1.23 (0.89–1.72)	0.78 (0.55–1.11)	1.28 (0.94–1.76)
Age, sex, and employment	1 (reference)	1.35 (0.97–1.88)	1.02 (0.74–1.43)	1.62 (1.21–2.16)
Age, sex, and neighborhood	1 (reference)	1.27 (0.92–1.77)	0.94 (0.67–1.31)	1.48 (1.09–2.00)
Model 1	1 (reference)	1.25 (0.89–1.74)	0.67 (0.46–0.97)	1.03 (0.74–1.45)
Model 2	1 (reference)	1.13 (0.80–1.60)	0.66 (0.45–0.96)	1.06 (0.76–1.48)
Recurrent myocardial infarction				
No. events (total = 326)	99	49	73	105
Age and sex	1 (reference)	1.02 (0.72–1.43)	1.09 (0.81–1.48)	1.54 (1.17–2.04)
Age, sex, and income	1 (reference)	1.02 (0.73–1.44)	1.08 (0.79–1.46)	1.48 (1.11–1.97)
Age, sex, and education	1 (reference)	0.94 (0.67–1.33)	0.86 (0.62–1.20)	1.22 (0.90–1.64)
Age, sex, and employment	1 (reference)	1.02 (0.72–1.44)	1.08 (0.80–1.46)	1.47 (1.11–1.94)
Age, sex, and neighborhood	1 (reference)	0.99 (0.70–1.39)	1.01 (0.74–1.37)	1.34 (1.00–1.80)
Model 1	1 (reference)	0.92 (0.65–1.31)	0.82 (0.59–1.14)	1.10 (0.80–1.50)
Model 2	1 (reference)	0.92 (0.65–1.31)	0.82 (0.59–1.14)	1.10 (0.80–1.52)
Heart failure				
No. events (total = 253)	66	47	57	83
Age and sex	1 (reference)	1.47 (1.01–2.14)	1.57 (1.10–2.24)	2.16 (1.55–2.99)
Age, sex, and income	1 (reference)	1.57 (1.08–2.29)	1.42 (0.99–2.03)	1.81 (1.29–2.53)
Age, sex, and education	1 (reference)	1.33 (0.91–1.93)	1.05 (0.71–1.54)	1.43 (1.01–2.05)
Age, sex, and employment	1 (reference)	1.46 (1.00–2.13)	1.52 (1.06–2.17)	1.98 (1.42–2.77)
Age, sex, and neighborhood	1 (reference)	1.36 (0.93–1.97)	1.27 (0.88–1.82)	1.59 (1.13–2.25)
Model 1	1 (reference)	1.34 (0.91–1.96)	0.91 (0.61–1.36)	1.13 (0.78–1.64)
Model 2	1 (reference)	1.19 (0.81–1.75)	0.93 (0.62–1.38)	1.17 (0.80–1.69)
Ischemic stroke				
No. events (total = 162)	50	28	28	56
Age and sex	1 (reference)	1.14 (0.72–1.82)	0.93 (0.58–1.48)	1.88 (1.28–2.77)
Age, sex, and income	1 (reference)	1.19 (0.75–1.90)	0.87 (0.54–1.38)	1.64 (1.10–2.44)
Age, sex, and education	1 (reference)	1.10 (0.68–1.75)	0.78 (0.48–1.28)	1.56 (1.02–2.38)
Age, sex, and employment	1 (reference)	1.18 (0.74–1.89)	0.93 (0.58–1.49)	1.85 (1.25–2.74)
Age, sex, and neighborhood	1 (reference)	1.10 (0.69–1.75)	0.84 (0.52–1.36)	1.64 (1.09–2.47)
Model 1	1 (reference)	1.13 (0.70–1.80)	0.74 (0.45–1.23)	1.38 (0.88–2.15)
Model 2	1 (reference)	1.05 (0.65–1.70)	0.73 (0.44–1.23)	1.35 (0.85–2.12)

Model 1: adjusted for age, sex, education, relative income, pre-MI employment, and neighborhood SES.
Model 2: model 1 plus hypertension, diabetes, dyslipidemia, smoking, obesity, Killip class, intensive care unit, CABG within 45 d, PTCA within 45 d, Charlson index.
CABG indicates coronary artery bypass grafting; MI, myocardial infarction; PTCA, percutaneous transluminal coronary angioplasty; SES, socioeconomic status.

outcomes, including mortality, recurrent MI, heart failure, and ischemic stroke compared with advantaged *Ashkenazi* patients. However, the results substantially varied depending on how SES was modeled. Importantly, the observed ethnic differences in health outcomes post-MI remained substantial in models adjusting for single SES indicators, but were virtually removed upon adjustment for multivariable measure of SES.

Research in the past decade has systematically documented disparities in cardiovascular health, recording higher

TABLE 3. Hazard ratios (*P* Values)* for the Composite Cardiovascular Disease Outcome Postmyocardial Infarction Associated With Different Socioeconomic Measures Stratified by Ethnic Groups

		Ethnic Groups			
Socioeconomic Measures	**Overall**	**Advantaged *Ashkenazi***	**Disadvantaged *Ashkenazi***	**Advantaged *Mizrahi***	**Disadvantaged *Mizrahi***
No. events	581	184	98	124	175
Education (1 y)	0.96 (< 0.001)	1.01 (0.59)	0.96 (0.15)	0.93 (0.007)	0.90 (< 0.001)
Low income	1.19 (0.05)	1.22 (0.24)	1.28 (0.28)	1.29 (0.20)	0.99 (0.95)
Unemployment	1.40 (0.001)	1.20 (0.36)	1.67 (0.05)	1.32 (0.22)	1.31 (0.15)
Neighborhood SES (1 U)	0.97 (0.01)	0.97 (0.18)	0.98 (0.49)	0.97 (0.29)	0.95 (0.09)

*Adjusted for age, sex, and all other socioeconomic measures presented in the table.
SES indicates socioeconomic status.

prevalence of risk factors, morbidity, and mortality among disadvantaged ethnic groups such as African Americans in the United States.[13–15] However, these studies have traditionally included limited information on SES while frequently measuring only a single indicator of SES such as income, education, or employment. Thus, for example, several post-MI studies have documented that low SES patients (measured by either income, education or occupational history) are at risk for developing more severe disease as indicated by longer history of cardiovascular disease, higher comorbidity, and more complicated MI.[31,32]

This study, which included a multivariable model of SES, supports the recent call to investigate adequate and rich socioeconomic information in ethnic health disparities research.[3] It is in line with other research showing that a wide array of modifiable social factors shaped by income, education, and neighborhood socioeconomic conditions can explain ethnic health differences.[16,17]

Notably, a higher percentage of advantaged *Ashkenazi* and *Mizrahi* patients were treated in an ICU, had a CABG and PTCA following their incident MI. This may suggest that they received more adequate care compared with the disadvantaged groups. These possible health service disparities (despite the national free health system) may have disproportionately impacted the health outcomes after an MI incident for members of disadvantage ethnic groups.

Our findings raise the issue of overadjustment in health disparities research, where intermediate variables are controlled for and result in biased estimates of the total causal effect towards the null.[33] More specifically, SES, which plays a mediating role in the relationship between ethnicity and health outcomes, may result in cumulative biopsychosocial vulnerabilities throughout the life course.[16,17]

Thus, it is possible that controlling for socioeconomic variables is unjustified and results in underestimation of the role of ethnicity in health outcomes.[34] This is particularly true when accounting for factors that are likely to affect development, such as neighborhood SES. For example, ethnic minorities tend to live in neighborhoods that also have higher crime and poverty rates, a finding that has important implications for both the need for and the availability of resources which are likely to directly impact health throughout development.[35] The social world of disadvantaged ethnic groups is likely to produce both biological and social effects with long-term impact (Lorant and colleagues[36–38]).

The current study has several limitations. First, although they were measured directly and comprehensively, some misclassification may have occurred both in the ethnic origin (which was based solely on country of birth) and individual measures of SES (which were self-reported and sometimes included a limited number of categories). Similarly, although outcome variables were verified by a trained physician, misclassifications may have also occurred in heart failure and ischemic stroke. Second, changes in SES measures after hospital discharge were not accounted for. In addition, potential selection bias may have occurred because of study population that included patients who survived a previous MI, and factors likely to affect the occurrence of MI are also likely to affect post-MI prognosis. Finally, despite the cohort characteristics (ie, a high-risk population of MI survivors) and the long-term clinical follow-up of 13 years, the relatively small sample size may have detracted from the study's power.

Medical practitioners, specialists, or generalists would need to attend to a multivariable set of SES measures—which is likely to affect the health of their patients throughout their life course—when assessing risk post-MI.[39] These measures, which are unlikely to be disentangled from the patients' ethnicity, should be part of the selective preventative measures for post-MI patients.

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REFERENCES

1. Braveman PA. Health disparities and health equity: concepts and measurement. *Annu Rev Public Health*. 2006;27:167–194.
2. Institute of Medicine. *Unequal treatment: Confronting racial and ethnic disparities in health care.* Smedley BD, Stith AY, Nelson AR, eds. Washington, DC: National Academies Press; 2003.
3. Braveman PA, Egerter S, Williams DR. Social determinants of health coming of age. *Annu Rev Public Health*. 2011;32:381–398.
4. Braveman PA, Egerter SA, Mockenhaupt RE. Broadening the focus: the need to address the social determinants of health. *Am J Prev Med*. 2011;40:S4–S18.
5. Epstein L, Horev T. *Inequality in Health and in the Health System [Hebrew]*. Jerusalem: Taub Center for Social Policy Studies in Israel; 2007.
6. Marmot M. Fair society, healthy lives: the Marmot review; strategic review of health inequalities in England post-2010. *The Marmot Review*. 2010. Available at: http://www.local.gov.uk/web/guest/health/-/journal_content/56/10171/3510094/ARTICLE-TEMPLATE Accessed June 7, 2012.
7. World Health OrganizationThe 10 top cause of death. 2008. Available at: http://www.who.int/mediacentre/factsheets/fs310/en/index.html. Accessed April 11, 2011.
8. Braveman PA, Egerter S, An J, et al. Overcoming obstacles to health: report from the Robert Wood Johnson Foundation to the Commission to Build a Healthier America. Robert Wood Johnson Foundation; 2008. Available at: http://www.rwjf.org/files/research/obstaclestohealthhighlight.pdf. Accessed June 7, 2012.

9. Kanjilal S, Gregg EW, Cheng YJ, et al. Socioeconomic status and trends in disparities in 4 major risk factors for cardiovascular disease among US adults, 1971-2002. *Arch Intern Med*. 2006;166:2348–2355.
10. Gerber Y, Benyamini Y, Goldbourt U, et al. Israel study group on first acute myocardial infarction: neighbourhood socioeconomic context and long-term survival after myocardial infarction. *Circulation*. 2010;121: 375–383.
11. Gerber Y, Koton S, Goldbourt U, et al. Poor neighborhood socioeconomic status and risk of ischemic stroke after myocardial infarction. *Epidemiology*. 2011;22:162–169.
12. Williams DR, Mohammed SA. Discrimination and racial disparities in health: evidence and needed research. *J Behav Med*. 2009;32:20–47.
13. Ferdinand KC, Armani A. *Cardiovascular Disease in Racial and Ethnic Minorities (Contemporary Cardiology)*. NJ: Humana Press; 2009.
14. Koren-Morag N, Tanne D, Goldbourt U. Birthplace differences in stroke rates among coronary heart disease patients: is variation explained by recognized risk factors? *Israel Med Assoc J*. 2009;11:586–591.
15. Tanne D, Yaari S, Goldbourt U. Risk profile and prediction of long-term ischemic stroke mortality: a 21-year follow-up in the Israeli Ischemic Heart Disease (IIHD) Project. *Circulation*. 1998;98:1365–1371.
16. Williams DR, Neighbors HW, Jackson JS. Racial/ethnic discrimination and health: findings from community studies. *Am J Public Health*. 2003;93:200–208.
17. Braveman PA, Cubbin C, Egerter S, et al. Socioeconomic status in health research. *JAMA*. 2005;294:2879–2888.
18. Israel Central Bureau of Statistics. Current data on the population in Israel (in Hebrew). 2011. Available at: http://www.cbs.gov.il/reader/?MIval=cw_usr_view_SHTML&ID=629. Accessed April 1, 2012.
19. Saguy T, Dovidio JF, Pratto F. Beyond contact: intergroup contact in the context of power relations. *Pers Soc Psychol B*. 2008;34:432–445.
20. Smooha S. Jewish ethnicity in Israel as a persistent real phenomenon (Hebrew). *Iyunim Bitkumat Israel*. 2003;13:413–425.
21. Nakash O, Gal G, Levav I. Ethnic-based intra- and inter-generational disparities in mental health: results from the Israel-World Mental Health Survey. *Int J Soc Psychiatry*. [May 7 2012 ahead of print]. DOI: 10.1177/0020764012443754.
22. Schwartz S, Link BG, Dohrenwend BP, et al. Separating class and ethnic prejudice: a study of North African and European Jews in Israel. *Soc Psychol Q*. 1991;54:287–298.
23. Gerber Y, Weston SA, Killian JM, et al. Neighborhood income and individual education: effect on survival after myocardial infarction. *Mayo Clin Proc*. 2008;83:663–669.
24. Shenhav Y. *The Arab Jews: Nationality, Religion and Ethnicity*. Tel Aviv: Am Oved; 2003.
25. Ben-Rafael E, Sharot S. *Ethnicity, Religion and Class in Israeli Society*. Cambridge: Cambridge University Press; 2005.
26. Hever H, Shenhav Y, Motzafi-Haller P. *Mizrahim in Israel: A Critical Observation into Israel's Ethnicity [Hebrew]*. Tel Aviv: Van Leer Institute and HaKibbutz HaMeuchad Publishing House; 2003.
27. Shalom-Chetrit S. *Intra-Jewish Conflict in Israel: White Jews, Black Jews*. New York: Routledge; 2010.
28. Israel Central Bureau of Statistics. *Characterization and Classification of Local Authorities by the Socio-Economic Level of the Population*. Jerusalem: Israel Central Bureau of Statistics; 2003.
29. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40:373–383.
30. Rubin D. *Multiple Imputation for Nonresponse in Surveys*. Hoboken, NJ: John Wiley & Sons Inc.; 1987.
31. Alter DA, Chong A, Austin PC, et al. Socioeconomic status and mortality after acute myocardial infarction. *Ann Intern Med*. 2006; 144:82–93.
32. Rasmussen JN, Rasmussen S, Gislason GH, et al. Mortality after acute myocardial infarction according to income and education. *J Epidemiol Community Health*. 2006;60:351–356.
33. Schisterman EF, Cole SR, Platt RW. Overadjustment bias and unnecessary adjustment in epidemiologic studies. *Epidemiology*. 2009; 20:488–495.
34. VanderWeele TJ. Marginal structural models for the estimation of direct and indirect effects. *Epidemiology*. 2009;20:18–26.
35. Massey DS, Eggers ML. The ecology of inequality: minorities and the concentration of poverty, 1970-1980. *Amer J Sociol*. 1990;95: 1153–1188.
36. Lorant V, Bhopal R. Comparing policies to tackle ethnic inequalities in health: Belgium 1 Scotland 4. *Eur J Public Health*. 2010;21:1–6.
37. Myers HF. Ethnicity- and socio-economic status-related stresses in context: an integrative review and conceptual model. *J Behav Med*. 2009;32:9–19.
38. Smith SS. Mobilizing social resources: race, ethnic, and gender differences in social capital and persisting wage inequalities. *Sociol Q*. 2000;41:509–537.
39. Molshatzki N, Drory Y, Myers V, et al. Role of socioeconomic status measures in long-term mortality risk prediction post-myocardial infarction. *Med Care*. 2011;49:673–678.

