Effect of socioeconomic status on patients undergoing elective abdominal aortic aneurysm repair in a publicly funded health care system

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Background: The association between socioeconomic status (SES) and outcomes after abdominal aortic aneurysm (AAA) repair in publicly funded health care systems is poorly described. The purpose of this study was to determine the effect of SES on postoperative outcomes in patients who underwent AAA repair in Nova Scotia, Canada.

Methods: We performed a retrospective analysis of all elective AAA repairs in Nova Scotia between November 2005 and March 2015 using administrative data sources. We compared postoperative 30-day outcomes and long-term survival across socioeconomic quintiles, defined as the Pampalon Material Deprivation Index (MDI) and Social Deprivation Index (SDI). We also compared the relation between baseline characteristics, MDI quintile, SDI quintile and 30-day mortality. We used multivariable logistic regression and survival analysis to calculate adjusted 30-day mortality and long-term survival, respectively.

Results: A total of 1913 patients underwent AAA repair during the study period. The overall 30-day mortality rate was 2.6% (50 patients). Thirty-day outcomes including death (p = 0.8), stroke (p = 0.7), myocardial infarction (p = 0.06), length of stay (p = 0.3) and discharge disposition other than home (p = 0.8) were similar across MDI quintiles. Similarly, there was no statistically significant association between SDI quintile and postoperative outcomes. Multivariable analysis showed that age greater than 70 years (odds ratio [OR] 3.06, 95% confidence interval [CI] 1.55–6.06) and open repair (OR 3.22, 95% CI 1.59–6.52) but not MDI quintile (p = NS) or SDI quintile (p = NS) were associated with increased 30-day mortality. There was no effect of MDI or SDI quintile on long-term survival on univariable or multivariable analysis.

Conclusion: Socioeconomic status does not appear to affect short- or long-term mortality after AAA repair in a publicly funded health care system. Further research is needed to address any existing gaps in screening and referral before repair.

Contexte : Le lien entre le statut socioéconomique (SSÉ) et les issues suivant la réparation d'un anévrisme aortique abdominal (AAA) réalisée dans un système de santé public est mal défini. Cette étude avait pour but de déterminer l'effet du SSÉ sur les issues postopératoires chez les patients ayant subi la réparation d'un AAA en Nouvelle-Écosse, au Canada.

Méthodes : Nous avons mené une analyse rétrospective de toutes les réparations électives d'un AAA réalisées entre novembre 2005 et mars 2015 en Nouvelle-Écosse à partir de bases de données administratives. Nous avons comparé les issues postopératoires sur 30 jours et la survie à long terme pour tous les quintiles socioéconomiques, établis selon l'indice de défavorisation matérielle et sociale de Pampalon (IDMS) et l'indice de défavorisation sociale (IDS). Nous avons aussi comparé les relations entre les caractéristiques de base, les quintiles d'IDMS et d'IDS et la mortalité dans les 30 jours. Nous nous sommes servis d'une régression logistique multivariée et d'analyses de survie pour calculer respectivement la mortalité ajustée dans les 30 jours et la survie à long terme.

Résultats : Au total, 1913 patients ont subi une réparation d'un AAA pendant la période de l'étude. Le taux de mortalité global dans les 30 jours était de 2,6 % (50 patients). Les issues sur 30 jours, soit les décès (p = 0,8), les AVC (p = 0,7), les infarctus du myocarde (p = 0,06), la durée de séjour (p = 0,3) et un état à la sortie autre que le domicile (p = 0,8), étaient similaires pour tous les quintiles d'IDMS. De même, il n'y avait pas d'association statistiquement significative entre le quintile d'IDS et les issues postopératoires. L'analyse multivariée a montré qu'un âge supérieur à 70 ans (rapport de cotes [RC] 3,06, intervalle de confiance [IC] à 95 % 1,55–6,06) et les

réparations ouvertes (RC 3,22, IC à 95 % 1,59–6,52) étaient associés à une mortalité accrue dans les 30 jours, mais ni le quintile d'IDMS (p = NS) ni le quintile d'IDS (p = NS) ne l'étaient. Ces 2 variables n'avaient aucun effet sur l'analyse univariée ou multivariée de la survie à long terme.

Conclusion : Le SSÉ ne semble pas influencer la mortalité à court ni à long terme suivant la réparation d'un AAA réalisée dans un système de santé public. D'autres études seront cependant nécessaires pour examiner la présence de lacunes dans le dépistage et l'orientation du patient avant la réparation.

The incidence of abdominal aortic aneurysms (AAAs) in people older than 65 years in Canada ranges from 1% to 5%.[1,2] Surgical management is the most common form of management, with survival rates in the range of 70% at 5 years.[3–5] One potential predictor of survival after AAA repair is socioeconomic status (SES), which has been identified as a key factor in health inequality both globally and within Canada.[6–9] It is defined as the individual factors relating to social position or economic situation, such as income, occupation level and educational attainment, but may also include area-level factors such as average neighbourhood income and neighbourhood deprivation indices.[10] Notably, SES has been found to be associated with increased mortality after other major elective cardiovascular procedures, including coronary artery bypass grafting.[11]

Long-term mortality after AAA repair has been found to be elevated among people of lower SES.[12–18] Although only 2 studies of this nature have been completed in a publicly funded health care system, both showed low SES to be associated with decreased long-term survival.[14,18] Lower SES has also been associated with increased odds of open repair in such a system.[19]

There is less consensus regarding the impact of SES on perioperative mortality after AAA repair. Some studies suggest the absence of such a relation,[12,20] whereas others support the contrary but do not always differentiate between elective and ruptured AAA repair.[16,18]

Universal health care systems like that in Canada aim to eliminate disparities in health outcomes across socioeconomic strata.[21] Nevertheless, some health disparities remain.[22–25] Identification of the effect of SES on surgical outcomes may help to address such inequities. The objective of the present study was to determine the effect of SES on outcomes after elective AAA in a publicly funded health care system in Nova Scotia, Canada.

Methods

Patients and data sources

We performed a retrospective cohort review of all adults (aged ≥ 18 yr) who underwent elective AAA repair in Nova Scotia between November 2005 and March 2015. The following databases were linked through the Health Data Nova Scotia service: Discharge Abstract Database (DAD), Medical Service Insurance billing codes, Vital Statistics and Canadian Census information. Health Data Nova Scotia is a platform allowing access to multiple administrative health data sources in the province.[26] The DAD is the most comprehensive database for Canadian in-hospital information and contains demographic, administrative and clinical information concerning all inpatient hospital admissions. It contains diagnoses coded as per the *International Statistical Classification of Diseases and Related Health Problems, 10th revision* (ICD-10).[27] Medical Service Insurance provides physician billing information for Nova Scotia. Vital Statistics contains demographic information and underlying cause of death for all fatalities occurring in Canada, coded by ICD-10 codes.[28]

Cases were identified as elective AAA repairs by means of relevant codes through Medical Service Insurance billing, or admission and surgery for AAA in the DAD. Patients younger than 18 years, those without Nova Scotia residency and those with the diagnosis of ruptured AAA were excluded. In addition, the charts of patients coded as having undergone endovascular aneurysm repair (EVAR) were reviewed to correct potential coding errors.

We obtained relevant baseline characteristics including age, sex, history of hypertension, coronary artery disease, peripheral vascular disease or chronic obstructive pulmonary disease, and prior cerebrovascular accident. The relevant ICD-10 codes are given in Appendix 1, Supplemental Table S1 (available at www.canjsurg.ca/lookup/doi/10.1503/cjs.015321/tab-related-content).

Socioeconomic information

We used patient-specific dissemination area based on postal code to derive socioeconomic variables. Dissemination areas are the smallest geographic unit for which Canadian Census-level data are available. They comprise populations of 400–700 people in a neighbourhood.[29] We derived socioeconomic information, including median neighbourhood income and deprivation indices specific to a given patient's dissemination area, from the 2006 Canadian Census. We defined SES using a composite measure based on Canadian Census data, the Pampalon Deprivation Index. The Material Deprivation Index (MDI) is a validated measure of SES based on Canadian

Census data that uses the proportion of people in a dissemination area with less than high school education, average household income, and unemployment rate. The Social Deprivation Index (SDI) is the proportion of people in a dissemination area who live alone; the proportion who are separated, divorced or widowed; and the proportion of single-parent families.[29,30] We classified the Canadian population into quintiles of both material and social deprivation, with quintile 1 being the least deprived and quintile 5 the most deprived.

Outcomes

The primary outcome was short-term mortality, defined as death recorded by Vital Statistics within 30 days of the initial elective repair, or death before discharge from hospital. Secondary outcomes included long-term mortality, defined as death recorded within the 10-year follow-up period. Additional 30-day outcomes of interest included postoperative myocardial infarction, stroke, length of stay and discharge status. The relevant ICD-10 codes are provided in Appendix 1, Supplemental Tables S1 and S2.

Statistical analysis

Continuous variables were reported as means and standard deviations, or as medians and interquartile ranges, as appropriate. Categoric variables were reported as proportions. We compared baseline characteristics across each quintile group using the Fisher exact test, χ^2 test, analysis of variance F test or Kruskal–Wallis test, as appropriate. We used univariable logistic regression to identify predictors of postoperative outcome. Any predictor with an α value less than 0.1 was included in a multivariable logistic regression to identify predictors of 30-day mortality. We calculated Kaplan–Meier survival estimates by MDI quintile and by SDI quintile. We used Cox regression survival analysis to compare long-term mortality across quintiles, adjusting for any factors with a statistical significance value < 0.1 on univariable analysis. All statistical analysis was performed with Stata, version 14 (StataCorp). Approval for this study, with waiver for patient consent, was granted by the Nova Scotia Health Authority Research Ethics Board (no. 1021911).

Results

A total of 2863 patients with an ICD-10 code for AAA in Nova Scotia between November 2005 and March 2015 were identified through the DAD. Of this cohort, 950 patients were excluded: 555 had a ruptured AAA, 308 did not undergo surgery, and 87 had missing SES data. Our final cohort thus consisted of 1913 patients who underwent elective AAA repair. Overall baseline characteristics by MDI quintile are given in Table 1, and baseline characteristics by SDI quintile are presented in Appendix 1, Supplemental Table S3. There were significantly higher rates of coronary artery disease and peripheral vascular disease among patients in higher MDI quintiles than among those in lower MDI quintiles (p = 0.009 and p = 0.008, respectively) (Table 1), and patients in higher SDI quintiles had higher rates of cerebrovascular accident than those in lower SDI quintiles (p = 0.03) (Appendix 1, Supplemental Table S3). In-hospital mortality, 30-day mortality, rates of postoperative complications, discharge to a facility other than home and length of hospital stay did not differ among MDI quintiles (Table 2 and Appendix 1, Supplemental Table S4).

Univariable analysis

The 30-day mortality rate was 2.6%. There was no statistically significant association between MDI quintile and short-term mortality (p = 0.8) (Table 2). Furthermore, there was no statistically significant association between MDI quintile and postoperative stroke, myocardial

Table 1. Baseline characteristics of adults who underwent elective abdominal aortic aneurysm repair in Nova Scotia between November 2005 and March 2015, stratified by Material Deprivation Index quintile

	Material Deprivation Index quintile; no. (%) of patients*						
Characteristic	Overall *n* = 1913	1 *n* = 377	2 *n* = 337	3 *n* = 443	4 *n* = 465	5 *n* = 291	*p* value
Age, mean ± SD, yr	70.1 ± 10.4	71.0 ± 11.6	69.7 ± 10.6	70.7 ± 10.5	69.4 ± 9.9	69.5 ± 8.9	0.1
Female sex	476 (24.9)	94 (24.9)	81 (24.0)	110 (24.8)	107 (23.0)	84 (28.9)	0.6
Hypertension	1441 (75.3)	294 (78.0)	249 (73.9)	326 (73.6)	354 (76.1)	218 (74.9)	0.6
Diabetes	532 (27.8)	98 (26.0)	82 (24.3)	131 (29.6)	140 (30.1)	81 (27.8)	0.3
CAD	534 (27.9)	90 (23.9)	89 (26.4)	114 (25.7)	159 (34.2)	82 (28.2)	0.009
COPD	583 (30.5)	100 (26.5)	105 (31.2)	142 (32.0)	141 (30.3)	95 (32.6)	0.4
PVD	744 (38.9)	118 (31.3)	136 (40.4)	170 (38.4)	192 (41.3)	128 (44.0)	0.008
CVA	184 (9.6)	38 (10.1)	31 (9.2)	40 (9.0)	54 (11.6)	21 (7.2)	0.4
Open repair	1039 (54.3)	200 (53.0)	187 (55.5)	231 (52.1)	263 (56.6)	158 (54.3)	0.7

CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; PVD = peripheral vascular disease; SD = standard deviation.
*Except where noted otherwise.

Table 2. Perioperative outcomes stratified by Material Deprivation Index quintile

Outcome	Overall *n* = 1913	Material Deprivation Index quintile; no. (%) of patients* 1 *n* = 377	2 *n* = 337	3 *n* = 443	4 *n* = 465	5 *n* = 291	*p* value
30-day mortality	50 (2.6)	12 (3.2)	9 (2.7)	13 (2.9)	11 (2.4)	5 (1.7)	0.8
CVA†	10 (0.5)	< 5	< 5	< 5	< 5	< 5	0.7
Myocardial infarction	124 (6.5)	15 (4.0)	22 (6.5)	27 (6.1)	32 (6.9)	28 (9.6)	0.06
Length of stay, median (IQR), d	7 (3–10)	6 (3–10)	7 (4–10)	6 (3–10)	7 (3–10)	7 (4–12)	0.2
Discharge disposition other than home‡	64 (5.1)	14 (5.3)	13 (6.0)	16 (5.7)	14 (4.4)	7 (3.8)	0.8

CVA = cerebrovascular accident; IQR = interquartile range.
*Except where noted otherwise.
†Some numbers suppressed owing to cell sizes less than 5.
‡Proportion of those who survived to discharge.

Table 3. Univariable regression for 30-day mortality by MDI quintile, SDI quintile, baseline characteristics and surgical approach

Variable	OR (95% CI)
MDI quintile	
1	Ref.
2	0.83 (0.35–2.01)
3	0.92 (0.41–2.04)
4	0.74 (0.32–1.69)
5	0.53 (0.19–1.53)
SDI quintile	
1	Ref.
2	0.80 (0.24–2.65)
3	0.97 (0.33–2.89)
4	0.89 (0.31–2.55)
5	1.34 (0.49–3.68)
Age > 70 yr	3.20 (1.63–6.29)
Female sex	1.43 (0.78–2.62)
Hypertension	1.17 (0.59–2.30)
Diabetes	0.41 (0.19–0.93)
CAD	1.47 (0.82–2.64)
COPD	1.29 (0.72–2.32)
PVD	0.73 (0.40–1.34)
CVA	1.55 (0.69–3.50)
Open repair	3.46 (1.72–6.95)

CAD = coronary artery disease; CI = confidence interval; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; MDI = Material Deprivation Index; OR = odds ratio; PVD = peripheral vascular disease; SDI = Social Deprivation Index.

infarction, length of stay or discharge disposition other than home (Table 2). Similarly, there was no statistically significant association between SDI quintile and postoperative outcomes (Appendix 1, Supplemental Table S4). Univariable regression analysis showed age older than 70 years, history of diabetes and open approach to be significantly associated with 30-day mortality (Table 3). Subgroup analysis by operative approach (open v. EVAR) showed no statistically significant association between MDI quintile and short-term mortality, postoperative stroke, myocardial infarction, length of stay and discharge disposition other than home (Appendix 1, Supplemental Table S5).

Table 4. Multivariable logistic regression for 30-day mortality adjusted for MDI quintile, SDI quintile, age greater than 70 years, sex, diabetes and surgical approach

Variable	OR (95% CI)
MDI quintile	
1	Ref.
2	0.89 (0.36–2.16)
3	0.99 (0.40–2.23)
4	0.82 (0.35–1.92)
5	0.55 (0.19–1.60)
SDI quintile	
1	Ref.
2	0.79 (0.23–2.68)
3	0.94 (0.31–2.84)
4	0.91 (0.31–2.68)
5	1.28 (0.46–3.58)
Age > 70 yr	3.06 (1.55–6.06)
Female sex	0.21 (0.65–2.24)
Diabetes	0.45 (0.20–1.02)
Open repair	3.22 (1.59–6.52)

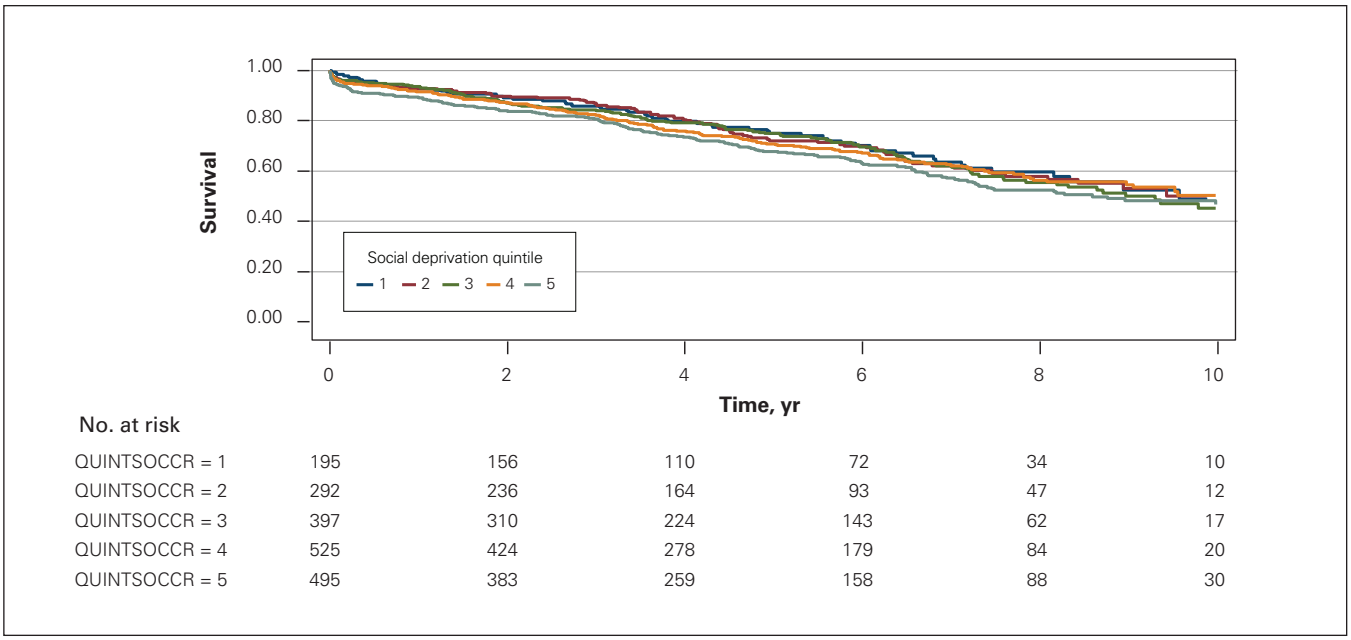
CI = confidence interval; MDI = Material Deprivation Index; OR = odds ratio; SDI = Social Deprivation Index.

Multivariable analysis

After adjustment for confounding variables, the multivariable analysis showed that only age older than 70 years (odds ratio [OR] 3.06, 95% confidence interval [CI] 1.55–6.06) and surgical approach (OR 3.22, 95% CI 1.59–6.52) remained statistically significant predictors of short-term mortality (Table 4). After adjustment for age older than 70 years, female sex, history of diabetes and open repair, neither MDI quintile nor SDI quintile were significantly associated with short-term mortality (Table 4).

Long-term survival

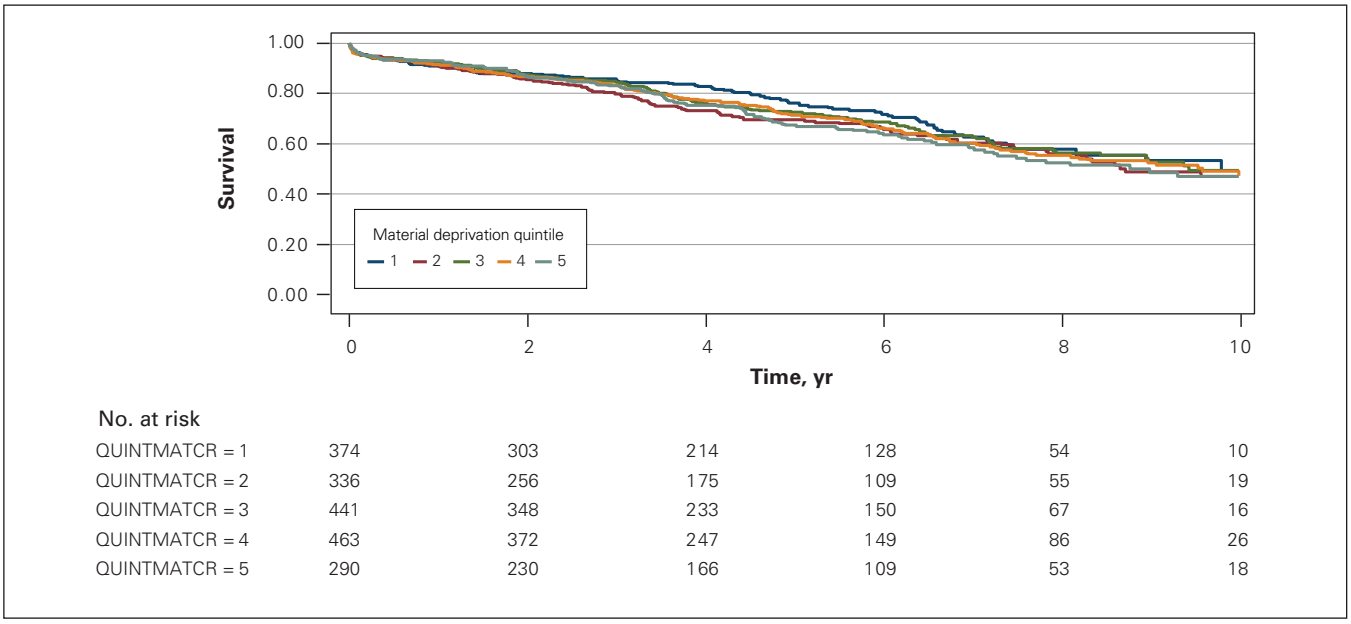
Vital Statistics data were available from Nov. 1, 2005, to Mar. 31, 2015. During that time, 629 patients (32.9%) died during the 8984 patient-years of follow-up (median follow-up duration 4.4 yr). The median survival was 9.5 years.



No. at risk

QUINTSOCCR = 1	195	156	110	72	34	10
QUINTSOCCR = 2	292	236	164	93	47	12
QUINTSOCCR = 3	397	310	224	143	62	17
QUINTSOCCR = 4	525	424	278	179	84	20
QUINTSOCCR = 5	495	383	259	158	88	30

Fig. 1. Kaplan–Meier survival estimates by Social Deprivation Index quintile.



No. at risk

QUINTMATCR = 1	374	303	214	128	54	10
QUINTMATCR = 2	336	256	175	109	55	19
QUINTMATCR = 3	441	348	233	150	67	16
QUINTMATCR = 4	463	372	247	149	86	26
QUINTMATCR = 5	290	230	166	109	53	18

Fig. 2. Kaplan–Meier survival estimates by Material Deprivation Index quintile.

Kaplan–Meier survival estimates were similar among MDI quintiles (Figure 1) and SDI quintiles (Figure 2). Univariable Cox proportional hazards models showed age older than 70 years (hazard ratio [HR] 2.28, 95% CI 1.93–2.70) and history of chronic obstructive pulmonary disease (HR 1.60, 95% CI 1.36–1.88) to be significantly associated with long-term mortality (Table 5). Subgroup analysis by operative approach yielded similar results. On multivariable analysis, only age older than 70 years (HR 2.26, 95% CI 1.90–2.67) and history of chronic obstructive pulmonary disease (HR 1.50, 95% CI 1.28–1.77) remained significantly associated with long-term mortality (Table 6).

Discussion

We identified no statistically significant association between material or social deprivation and short- or long-term mortality after AAA repair. Short- and long-term mortality have been previously explored separately in various health care contexts; however, comparison with previous literature is difficult owing to varying definitions of SES.

In a larger context, Bennett and colleagues[31] found lower SES, defined by median household income of corresponding zip code, to be associated with increased

Table 5. Univariable Cox proportional hazards model for long-term mortality by MDI quintile, SDI quintile, baseline characteristics and surgical approach

Variable	HR (95% CI)
MDI quintile	
1	Ref.
2	1.20 (0.93–1.56)
3	1.08 (0.84–1.39)
4	1.12 (0.87–1.43)
5	1.19 (0.91–1.55)
SDI quintile	
1	Ref.
2	1.01 (0.73–1.41)
3	1.08 (0.80–1.48)
4	1.11 (0.82–1.49)
5	1.28 (0.95–1.71)
Age > 70 yr	2.28 (1.93–2.70)
Female sex	1.07 (0.89–1.28)
Hypertension	1.10 (0.92–1.33)
Diabetes	1.05 (0.88–1.25)
CAD	1.13 (0.96–1.34)
COPD	1.60 (1.36–1.88)
PVD	1.01 (0.86–1.19)
CVA	1.16 (0.90–1.50)
Open repair	1.02 (0.87–1.20)

CAD = coronary artery disease; CI = confidence interval; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; HR = hazard ratio; MDI = Material Deprivation Index; PVD = peripheral vascular disease; SDI = Social Deprivation Index.

Table 6. Multivariable Cox proportional hazards model for long-term mortality adjusting for MDI quintile, SDI quintile, age greater than 70 years, sex and chronic obstructive pulmonary disease

Variable	HR (95% CI)
MDI quintile	
1	Ref
2	1.25 (0.97–1.63)
3	1.06 (0.83–1.37)
4	1.18 (0.92–1.51)
5	1.21 (0.93–1.59)
SDI quintile	
1	Ref
2	1.00 (0.71–1.40)
3	1.05 (0.77–1.43)
4	1.04 (0.77–1.41)
5	1.22 (0.91–1.64)
Age > 70 yr	2.26 (1.90–2.67)
Female sex	1.03 (0.86–1.23)
COPD	1.50 (1.28–1.77)

CI = confidence interval; COPD = chronic obstructive pulmonary disease; HR = hazard ratio; MDI = Material Deprivation Index; SDI = Social Deprivation Index.

postoperative mortality across 13 major surgical procedures spanning several specialties in the United States. In a review of more than 80 articles from numerous countries, Li and colleagues[32] identified SES to have a statistically significant impact on outcomes after orthopedic surgery. In a US population of older patients, Birkmeyer and colleagues[33] also found lower SES (defined on the basis of area-based US census data) to be associated with higher operative mortality across a wide range of surgical procedures. The age range of the population studied closely overlapped that of patients undergoing AAA repair. In the area of vascular surgery, Durham and colleagues[34] found lower income to be associated with inferior limb salvage after femoropopliteal revascularization in the US. In Italy, Agabiti and colleagues[11] reported increased mortality among people of lower income after major elective cardiovascular surgery, including AAA repair.

There exists no consensus on the impact of SES on outcomes after AAA repair. In addition, measures of SES vary across the literature. In several prior studies on the effect of SES on outcomes after AAA, the investigators used payer status[35–39] or household income[11,14,20] to measure SES. The Pampalon index uses Canadian Census data to estimate material and social deprivation and is the most widely used composite measure of SES in Canada.[30,40] Our use of this measure provides a more comprehensive representation of SES than individual proxy measures. In keeping with this, our findings echo most of the literature when examining SES by income or deprivation. In the US, Al Adas and colleagues[12] did not identify any association between socioeconomic deprivation and short-term mortality after elective AAA repair; however, this work was underpowered to detect a difference in 30-day mortality given the low expected death rate. In contrast, studies using payer status as a proxy measure of SES consistently showed increased mortality after AAA repair.[13,35,39] These different measures of SES may be a large contributor to the difference between our study, set in Canada, and studies based in the US.

In Canada, a publicly funded, comprehensive health care system covering necessary physician and hospital visits is well established.[21] In the Canadian context, Faulds and colleagues[19] found socioeconomic deprivation to be associated with increased rates of open repair, whereas our study identified no such relation. However, those authors also found no association with postoperative mortality. The relation between SES and postoperative mortality in similarly publicly funded universal health care systems has been studied in other countries. In the Netherlands, Ultee and colleagues[14] found no association between median gross household income and mortality after AAA repair when income was examined in quintiles. However, they did find lower income to be a significant predictor of postoperative mortality when examined as a continuous variable, with the most marked effect at the lowest levels of income. It is possible that the effect of SES on mortality is seen only within the most deprived quintile, where difficulty accessing care is most prominent, and was thus not captured in our analysis. In Italy, Agabati and colleagues[11]

found no association between income and 30-day mortality after unruptured AAA repair. In New Zealand, increased 30-day mortality was associated with increased deprivation; however, the authors did not distinguish between intact and ruptured AAAs.[18] In Sweden, Zommorodi and colleagues[16] found lower household income to be associated with higher risk of presenting with a ruptured AAA and also with increased 90-day and 1-year mortality. As lower SES has been linked to decreased screening for AAA,[41,42] it is possible that reports of higher mortality seen with lower SES may be related to increased proportions of repair of ruptured AAAs, which were excluded in our study. This may explain our differing results.

Few authors have examined the association between SES and long-term mortality.[12,18] Adas and colleagues[12] found increased long-term mortality after AAA repair in more socioeconomically deprived quintiles. Our study differed from that study in several ways, including the health care contexts in which it was performed. In addition to having a publicly funded health care system, Canada has less income inequality than the US.[43] It is possible that the effects of SES may be visible only at extremes of income inequality and, therefore, were not seen in our study. In New Zealand, Khashram and colleagues[18] found increased long-term mortality with higher deprivation scores; however, this result may have been confounded by the inclusion of ruptured AAAs and differing definitions of deprivation.

Although inequalities in health outcomes based on SES have been reported in Canada,[8] some analyses have shown a decrease in health inequality among older Canadian adults.[44] This is hypothesized to be related to Old Age Security, a guaranteed income for older people.[44] Old Age Security would increase one's means to address health concerns despite living in a deprived area. Therefore, diseases that affect primarily older people are less susceptible to disparities related to income in Canada. This may decrease the effect of SES on health outcomes in Canada compared to other countries with publicly funded health care. Despite the absence of an association with mortality, we did find lower SES to be associated with increased rates of coronary artery disease, peripheral vascular disease and cerebrovascular accident. This reaffirms the presence of health care disparity among patients with increased social and material deprivation.

Our mortality rate after AAA repair was 2.6%, within the range of 1%–4% reported in the Society for Vascular Surgery guidelines.[45] Across MDI quintiles, 65%–74% of patients in our study underwent open AAA repair. There was no significant difference in the frequency of open versus EVAR approach across MDI quintiles. This high proportion of open repair reflects the Canadian experience over the study period: the EVAR approach was selected more often by surgical risk than by anatomy.[46]

Limitations

Our study has several strengths, including the large data set and the comprehensiveness of the data. Re-extraction studies have shown an accuracy rate of the DAD of 92.8%.[47] Furthermore, as reporting of death to Vital Statistics is a legal requirement in Nova Scotia, these data are unlikely to be erroneous.

Given its retrospective nature and collection of data from administrative databases, our study also has limitations. Although administrative data are more accessible than clinical data and allow for access to large data sets, limitations do exist. In particular, the accuracy of individual data elements may be variable. Some potentially confounding variables such as smoking status, race and renal failure were not available in our data set. Smoking contributes to the formation of AAAs and is associated with SES.[48–50] Similarly, race and renal failure have been implicated in mortality differences after ruptured and elective AAA repair.[37,51–53] These unmeasured variables may have confounded our results. Furthermore, we were unable to adjust for aneurysm complexity as well as some unmeasured comorbidities such as renal insufficiency, which may contribute to mortality and may be disproportionately distributed across deprivation quintiles.

Socioeconomic status was not determined from individual patient data but, rather, from population data at the level of dissemination areas and was derived from the 2006 Canadian Census rather than from each individual throughout the study period. People move over time, and socioeconomic situations of certain geographic areas can change within a decade. However, the Pampalon index remains the most widely used and validated way of monitoring social inequalities over time.[54] In addition, because individual income and employment may not apply to older people, area-based socioeconomic indicators may be a more accurate reflection of SES than individual patient data.[55]

We excluded people without a health card number from our cohort, as it was necessary for linking across databases; this may have resulted in the exclusion of people from the most deprived socioeconomic strata. We used material deprivation quintiles as a measure of SES, grouping the most deprived 20% of the population and comparing them to other quintiles. This study did not examine patients living in poverty versus those not living in poverty. It is possible that adverse health outcomes of the 7.7% of Nova Scotians who live in poverty were masked by more favourable outcomes in the remaining 20% of the population of the lowest quintile.[56] Finally, our cohort did not include patients with ruptured AAAs or those who died from aneurysmal disease without seeking medical attention. It is possible that the relation between SES and aneurysmal mortality is mediated through a higher proportion of ruptured AAAs, which would not have been captured in our study.

Conclusion

Socioeconomic status was not associated with short- or long-term mortality after elective AAA repair in a publicly funded health care system. Disparities may still exist in patients presenting with a ruptured AAA. Further research is needed to address any existing gaps in screening and referral before repair.

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