IS EDUCATIONAL INEQUALITY PROTECTIVE?/GALEA AND AHERN RESPOND

Spencer Moore; Mark Daniel; Yan Kestens; Sandro Galea; Jennifer Ahern *American Journal of Public Health*; Jan 2007; 97, 1; ABI/INFORM Global pg. 8

LETTERS

IS EDUCATIONAL INEQUALITY PROTECTIVE?

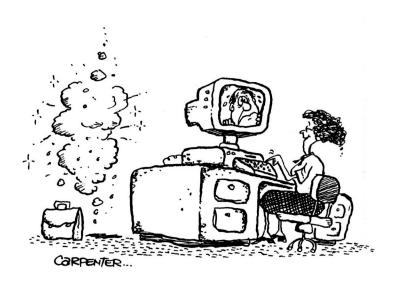
Galea and Ahern¹ examined the ecological association between educational distribution and a range of population health outcomes. In one of their findings, Galea and Ahern reported that higher levels of educational inequality within New York City neighborhoods were associated with lower percentages of low birthweight. The finding contradicts the more frequently found association between higher levels of income-related inequality and unfavorable population health outcomes. Is neighborhood educational inequality protective of population health?

Given the provocative nature of this question, we sought to examine the ecological association of educational inequality and percentage of low-birthweight infants in Montreal. We measured area-level education and calculated the educational Gini coefficient. We found a high degree of collinearity between measures of mean education and educational Gini coefficient (-0.89; *P*<.001). This collinearity yielded models susceptible to unstable coefficient estimation.

Galea and Ahern reported a similarly high degree of correlation between mean education and education Gini measures (-0.84;

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THERE, MR. JASON. YOU ARE NOW ENTERED INTO OUR COMPUTER."

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P<.01) in their analyses. Areas with higher average education tend to have lower levels of educational inequality. Considerable collinearity between mean education and educational Gini coefficient may account for the change in the direction of the B coefficient for the education Gini coefficient, as reported by Galea and Ahern when they introduced their mean education variable to the previous bivariate regression of the percentage of lowbirthweight infants on the education Gini coefficient. Variance inflation factor values increased from 1.0 to 5.2 when we added mean education to our bivariate model; we observed a more modest increase from 1.0 to 1.5 when we used alternative measures of education (percentage of adults with at least a college degree) and educational distribution (standard deviation in schooling). Correlated factors that may act as confounders or effect modifiers should potentially be omitted from analysis because biased estimates may result, particularly in ecological regression.^{2,3} An ostensibly positive relation between educational

inequality and favorable health outcomes may constitute no more than a statistical artifact. The potential political consequences of accepting the conclusion that a form of social inequality might be beneficial for health requires attention to assumptions underpinning statistical conclusion validity.

A number of differences between our investigation and that of Galea and Ahern should be mentioned. First, Canadian census data do not allow the same level of discrimination in educational attainment that Galea and Ahern achieved. Second, we examined the ecological association at a smaller area of analysis (census tract) than Galea and Ahern (district level). Whether these differences have corresponding implications on the hypothesized association between educational inequality and population health remains a topic for further research. As few such studies have been published, we suggest that the considerable collinearity found between mean education and educational Gini coefficient precludes general acceptance of the conclusion that

neighborhood-level educational inequality is protective of population health.

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As a second concern, strong collinearity also raises the issue of residual confounding. With only 59 data points, we could not adjust for mean education nonparametrically and thus we cannot be certain that we have completely adjusted for the influence of mean education in our examination of the education Gini coefficient. Allowing nonlinearity in the effect of mean education with squared terms and restricting the analysis to the range of mean education, which removed all potential outlying values of education Gini coefficients, did not change the results for any of the final models. However, further research on this topic, ideally with more observations, will have to explore the potential role of residual confounding as an explanation for the associations we have documented.

As a final note, this study was one study, in one unique city, with one conceptualization of neighborhood. It was our goal to engender further inquiry into the potential role of neighborhood education distribution in different

contexts. The work reported by Moore et al. in their letter is a good step toward that goal. We look forward to further work in this area, whether it supports or contradicts the findings we reported. Our results suggest a nuanced role of absolute levels and distributions of the fundamental determinants of population health. We hope that our work stimulates research that improves our understanding of the complex (and not necessarily intuitive or anticipated) role that different contextual factors play in shaping the health of populations.

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Moore et al. raise a concern about collinearity in our study, a concern that we shared when conducting this analysis. There are 2 distinct issues that merit discussion in relation to collinearity. First, when independent variables are strongly correlated, standard errors may be inflated and one of the independent variables may wash out the effect of the other. To examine whether these were problems in our analysis we calculated the bootstrap confidence intervals for the final models and found only minimal inflation of the confidence intervals and no change in inference for any of the models. Both mean education and the education Gini coefficient remained significantly negatively associated with the population health indicators we reported in our research. In addition, the variance inflation factor was 3.5, suggesting that the standard errors were inflated by a factor of 1.9 ($\sqrt{3.5}$). Typically the variance inflation factor is considered a problem when it is 10 or greater. Although there is clearly some collinearity between our independent variables, as we reported in our research, variance inflation and instability of estimates are not plausible explanations for our findings.

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