# LETTERS

## IS EDUCATIONAL INEQUALITY PROTECTIVE?

Galea and Ahern[1] 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?

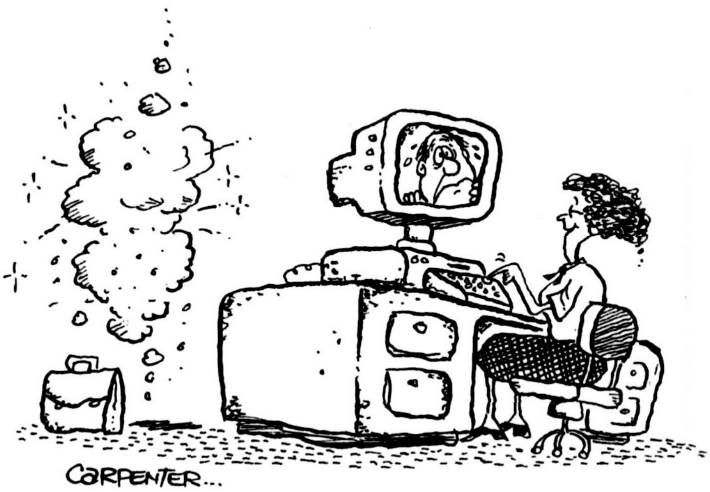
Given the provocative nature of this question, we sought to examine the ecological association of educational inequality and percentage of low-birthweight infants in Montreal. We measured area-level education and calculated the educational Gini coefficient. We found a high degree of collinearity between 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; $P<.01$) 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 β 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 low-birthweight 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

*Letters to the editor referring to a recent Journal article are encouraged up to 3 months after the article's appearance. By submitting a letter to the editor, the author gives permission for its publication in the Journal. Letters should not duplicate material being published or submitted elsewhere. The editors reserve the right to edit and abridge letters and to publish responses.*

*Text is limited to 400 words and 10 references. Submit online at www.ajph.org for immediate Web posting, or at submit.ajph.org for later print publication. Online responses are automatically considered for print publication. Queries should be addressed to the Editor-in-Chief, Mary Northridge, PhD, at men11@columbia.edu.*




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

**Printed with permission of Cartoon Stock. Original Artist Dave Carpenter. *Source.* Available at: http://www.CartoonStock.com.**

neighborhood-level educational inequality is protective of population health. ■

*Spencer Moore, PhD, MPH*
*Mark Daniel, PhD*
*Yan Kestens, PhD*

### About the Authors

*The authors are with the Department of Social and Preventive Medicine, Université de Montréal, Quebec.*

*Requests for reprints should be sent to Spencer Moore, PhD, MPH, Centre de recherche du Centre hospitalier de l'Université de Montréal, 3875 St. Urbain, Bureau 3-02, Montréal, Quebec, Canada H2W 1V1 (e-mail: spencer.moore@umontreal.ca).*

*doi:10.2105/AJPH.2006.101618*

### References

1. Galea S, Ahern J. Distribution of education and population health: an ecological analysis of New York City neighborhoods. *Am J Public Health.* 2005;95:2198–2205.
2. Weinberg C. Toward a clearer definition of confounding. *Am J Epidemiol.* 1993;137:1–8.
3. Greenland S, Morgenstern H. Ecological bias, confounding, and effect modification. *Int J Epidemiol.* 1989;18:269–274.

## GALEA AND AHERN RESPOND

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.

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. ■

*Sandro Galea, MD, DrPH*
*Jennifer Ahern, MPH*

### About the Authors

*Sandro Galea is with the School of Public Health, University of Michigan, Ann Arbor. Jennifer Ahern is with the University of California, Berkeley.*

*Request for reprints should be sent to Sandro Galea, MD, DrPH, Department of Epidemiology, School of Public Health, University of Michigan, 1214 S. University, Ann Arbor, MI 48104-2548 (e-mail: sgalea@umich.edu).*

*doi:10.2105/AJPH.2006.102376*