Epidemiological foundations for the Insurance Hypothesis: Methodological considerations

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Epidemiological foundations for the Insurance Hypothesis: Methodological considerations

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Abstract

Nettle et al evaluate evidence for the Insurance Hypothesis, which links obesity with the perception of food scarcity. Epidemiological findings in this area have generally been weak and inconsistent. The present commentary examines three key methodological issues arising from the literature on the association between obesity and the perception of food scarcity in humans, with suggestions for future epidemiological research.

The target article by Nettle et al evaluates the evidence for the Insurance Hypothesis, which posits that obesity in humans is linked to food insecurity, such that the presence of environmental cues that signal food shortage lead to an increase in fat storage. In environments where the presence of food shortage signals is chronic, this process may lead to increased levels of obesity in the population.

To examine this hypothesis, the authors present a review and meta-analysis of the epidemiological evidence of the linkage between food insecurity and obesity in humans. The analysis reveals a robust positive association, but one that is limited to females in high-income nations. The authors make some general comments concerning the limitations of the epidemiological research, but in order to fully evaluate the Insurance Hypothesis, it is critical to examine in detail these limitations of the meta-analysis, and in turn to present an epidemiological approach that would be well-equipped to examine this hypothesis.

The first critical limitation is that most of the studies conducted in this area have employed a cross-sectional design, rather than a longitudinal design. While cross-sectional designs allow for the ascertainment of associations and the development of hypotheses concerning the possible causal relationships between food insecurity and obesity, it is not possible to establish causality using studies of this nature. It should be noted that cross-sectional designs may be useful in determining the extent to which any associations between food insecurity and obesity generalize across populations, but these considerations are secondary in comparison to studies designed in a manner to test adequately a causal hypothesis.

A second critical limitation in the literature is that few of these studies have been able to adequately control for possible sources of confounding in the association between food insecurity and obesity. Nettle et al reported that their meta-analysis did not detect a difference between estimates of associ-

ation that were adjusted for confounding (socio-economic status) and those that were not, suggesting that the existing studies may have failed to sufficiently control for confounding. Yet, controlling for confounding is a key factor in the ascertainment of causality; without adequate control for confounding, it is impossible to evaluate whether food insecurity plays a causal role in increasing obesity. The use of longitudinal designs, with repeated measures of both the perception of food insecurity and obesity, would allow the fitting of *conditional fixed effects models* (Allison, 2009; Hamerle & Ronning, 1995), which account for all sources of non-observed fixed confounding that influence both food insecurity perception and obesity, and which can be augmented by observed time-dynamic covariate factors during the period of observation. Given the availability of repeated measures data, fixed effects modelling provides a robust indication of possible causality. Nettle et al noted (p. X) that they were able to find only one study that had repeated measures of both food insecurity and obesity (Whitaker & Sarin, 2007).

In addition, while the opposite causal pathway (obesity causing food insecurity) seems implausible, it may be plausible to suggest that individuals who are obese have different *perceptions* of food availability than individuals who are not, and are perhaps more likely to perceive food sources as insecure, rather than secure. In order to ascertain the direction of causality, and rule out the possibility that obesity could be driving an increase in the perception of food insecurity, repeated measures data could also be used to test the likely direction of causality using structural equation modelling procedures (Fergusson, Boden, & Horwood, 2007; Fergusson et al., 2015) that compare the fit of models that represent: a) a causal pathway from perceptions of food insecurity to obesity; b) a causal pathway from obesity to perceptions of food insecurity; and c) a reciprocal causal pathway in which each plays a causal role in the other.

It is clear from the paper by Nettle et al that an understanding of group differences will play an important role in our understanding of the role of food insecurity in the risk of obesity. However, a

third critical limitation is that the studies reviewed have been unable to adequately test important group differences in the association between food insecurity and obesity. Nettle et al reported that their meta-analysis revealed evidence of gender differences, such that the association applied for females but not for males, but was unable to detect any differences related to age or other major group difference (such as ethnicity). While it may be difficult to design a single study that can adequately test all plausible group differences in the association between food insecurity and obesity, the use of nested designs or multi-group analyses (Boden, Sanders, Munford, & Liebenberg, 2016; Boden, Sanders, Munford, Liebenberg, & McLeod, 2015; Fergusson, Boden, & Horwood, 2008; Muthén & Muthén, 1998-2012) allow the fitting of models across groups, and permit tests of the equivalence of model fit across these groups, using only a single model. Multiple tests of groups differences may be applied to a single model as well. The signal advantage of this modelling procedure is that it proves possible to directly compare parameter estimates across groups with the model without increasing standard error, thereby reducing model imprecision, and increasing the sensitivity of the model to detect effects. A nested or multiple-group model approach can also be combined with the conditional fixed-effects and structural equation modelling approaches detailed above in order to provide a comprehensive approach to testing the robustness of the association to confounding, the direction of causality in the association, and the ascertainment of critical group differences in the association between the perception of food insecurity and obesity.

Nettle et al provide a thorough review and analysis of the epidemiological literature concerning food insecurity and obesity. It is clear that, on the basis of this review, there are considerable methodological weaknesses that compromise the robustness of the observed associations. The application of a series of design improvements and modelling procedures would allow a much better understanding of the nature of these associations, and provide further evidence to evaluate the Insurance Hypothesis.

References

Allison, P. D. (2009). *Fixed Effects Regression Models*. Newbury Park, CA: Sage.

Boden, J. M., Sanders, J., Munford, R., & Liebenberg, L. (2016). The Same But Different? Applicability of a General Resilience Model to Understand a Population of Vulnerable Youth. *Child Indicators Research,* 1-18. doi: 10.1007/s12187-016-9422-y

Boden, J. M., Sanders, J., Munford, R., Liebenberg, L., & McLeod, G. F. H. (2015). Paths to Positive Development: a Model of Outcomes in the New Zealand Youth Transitions Study. *Child Indicators Research*, 1-23. doi: 10.1007/s12187-015-9341-3

Fergusson, D. M., Boden, J. M., & Horwood, L. J. (2007). Unemployment and suicidal behaviour in a New Zealand birth cohort: A fixed effects regression analysis. *Crisis, 28*(2), 95-101.

Fergusson, D. M., Boden, J. M., & Horwood, L. J. (2008). Developmental antecedents of interpartner violence in a New Zealand birth cohort. *Journal of Family Violence, 23*, 737-753.

Fergusson, D. M., McLeod, G. F. H., Horwood, L. J., Swain, N. R., Chapple, S., & Poulton, R. (2015). Life satisfaction and mental health problems (18 to 35). *Psychological Medicine, 45*(11), 2427-2436. doi: 10.1017/S0033291715000422

Hamerle, A., & Ronning, G. (1995). Panel analysis for qualitative variables. In C. C. a. S. M. Arminger G (Ed.), *Handbook of Statistical Modeling for the Social and Behavioral Sciences* (pp. 401–451). New York: Plenum Press.

Muthén, L. K., & Muthén, B. O. (1998-2012). *Mplus Users Guide. Seventh Edition*. Los Angeles, CA: Muthén & Muthén.

Whitaker, R. C., & Sarin, A. (2007). Change in food security status and change in weight are not associated in urban women with preschool children. *The Journal of nutrition, 137*(9), 2134-2139.