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Towards the demise of the urban – rural contrast: a research design inadequate to understand urban influences on human biology

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A familiar study design in human biology is the urban – rural contrast. This design actually predates modern human biology considerably. Social philosophers of the 17th century contrasted urban and rural populations to discern a basic human nature that was uninfluenced by culture (Schell and Ulijaszek, 1999). In that era urban life was considered the epitome of culture and that view is not uncommon today. By the middle of the twentieth century human biologists had applied the urban-rural contrast often. At the same time the United Nations began collecting and compiling data by urban and rural places. Innumerable papers have been published in human biology journals using this research design although the frequency has begun to decline.

Whether it is the UN or modern human biologists using the urban - rural contrast, the basic form is the same. It classifies people or samples into either one of those two exposure groups for the urban - rural comparison. Inherent in classification are the assumptions of homogeneity of individuals' exposure within each group and heterogeneity of exposure between the groups. These assumptions are weak and can lead to false conclusions of difference or similarity. Further, in studies that summarise and compare urban - rural differences across studies, heterogeneity among the urban groups and among the rural groups undermines summarization. Each of these weaknesses is described in more detail.

Defining the problem.

The urban - rural contrast is a form of typology and like biological typologies (e.g., racial typology) it has similar weaknesses. It makes the assumption of homogeneity in the categories, i.e., that each member of the group, for example each urban resident, has the same degree of exposure to urbanism as others in the same category. However, today more than ever, the homogeneity of exposure in each group is doubtful. Urban places are characterized by social stratification. This in turn has consequences for urban residents' exposure by place, occupation and resources. The strongest example of within urban heterogeneity is the presence of urban slums and urban wealth in the same conurbation. Rural residents today also display heterogeneity hidden by the simple dichotomy. Prior to the mid-20th century residents of many rural, agrarian places may have experienced more similar exposures due perhaps to less social stratification, more similarity in activities and less unequal accumulation of resources. Today however, rural places may include financial, industrial and agrarian activities that create heterogeneity of exposures among rural

residents. In short, the homogeneity of “exposure” within each category is doubtful at best. While there may be some places in the world where all rural residents lead the same lives, those places must be few, and the number of urban places with homogeneous lives and exposures is probably zero.

The urban - rural contrast is especially vulnerable to the weaknesses of typology because it is a dichotomy. Typologies can differ in granularity with some typologies involving a dozen or more types. With more granularity there is more opportunity for homogeneity within each type and less opportunity for misclassification of exposures. The urban - rural contrast, as a dichotomous typology, makes the greatest and the weakest assumption of homogeneity within each type, rural or urban.

A consequence of misclassification due to heterogeneity within an exposure category is often a decrease in absolute differences between means of outcome variables with an increased variance in the outcome measures. With increased variances, absolute differences between means are more difficult to detect statistically. Thus, within a single study using the urban – rural contrast, the multitude of exposures and the heterogeneity of exposures among residents, makes the statistical test of difference rather meaningless.

Another problem with the urban - rural contrast design is the variation in definitions of urban (Dahly and Adair, 2007). Definitions vary across nations, agencies and investigators undermining cross-study comparisons and summarizations of rural urban differences.

In addition, the urban and rural environments have changed over time and many of these changes have led to a reduction of differences in the environments. Urban and rural places are not different in the ways they once were or might have been. For example, information isolation is no longer characteristic of rural places. Given the improvements in communication during the second half of the 20th century and the revolution in information access in the 21st, residents of rural areas may have the same exposure to information about health, finances, government etc. as urban residents have, and the same opportunities for communication with others as well. The defining characteristics of each place have changed, and those same features overlap between urban and rural places. Manufacturing used to be a defining characteristic of urban places but today urban residents work more in commerce or finance and information. Meanwhile manufacturers have located plants in rural areas giving needed employment to rural residents. Further, with the revolution in communications, rural residents can join the information industry remotely and participate in financial transactions with distant effects. Finally, farming itself has changed; it has become more industrialised, conducted on a larger scale, and more often farms are not owned by those people performing the tasks of farming. When considering the smaller farm, the work is now mechanized, noisy, and involves the handling of numerous chemicals as fertilizers and pesticides and even antibiotics. While differences remain in areas such as access to health care, it is becoming much less clear just what an urban - rural contrast is actually contrasting. When Philippine communities were scored for urbanicity, there was considerable overlap in scores between “rural” and “urban” ones (McDade and Adair, 2001). The difference between the dichotomous categories is not as it might have been 100 years ago.

Given the numerous possibilities for activities in urban and in rural places, no two urban places are identical nor are any two rural ones. This limits or invalidates generalization across studies about urban - rural differences. It is indeed difficult or impossible to generalize today about the effects of urbanism on, for example, the growth of children because urban places vary so much in terms activity patterns, employment, exposure to pollutants and psychosocial stress, family size, health care, population size and density, diets and nutritional status. Replication of results, a hallmark of science, is impossible when the identities being compared change. Without the ability to compare findings across studies, to test replication of findings, and to generalise, it is difficult to consider the research activity truly scientific.

Finally, an important reason to abandon the urban - rural comparison is the existence of diverse and offsetting influences. Some features of the urban environment may promote greater growth or decrease morbidity while there may be other features with the opposing effects. For example, urban environments may be more stress-inducing to urban populations yet the health care access of these populations may balance the biological effects of the more intense stressors. When comparing the urban and rural samples for the stress-related disease there may be no difference in the rate of that disease. The opposing forces have balanced each other producing a net effect of zero. This does not mean that stress is innocuous and does not contribute to disease.

Why do “we” persist with the urban - rural contrast?

Why do some human biologists continue to use this research design, embracing typology of the environment when they have rejected biological typology long ago? While human biologists are trained in the study of human variation, and they appreciate and measure biological variation along multiple dimensions, they are not trained in assessing environmental characteristics. Generalities (urban vs. rural) are a comfortable substitute for the work of measuring environmental features and resulting in likely misclassification of individuals. The US National Resources Counsel examined the variety of measures of environmental and biological exposures and prioritised them for scientific research (Table 1). At the highest level were measures made on the individual (biomarkers), such as blood lead, or testosterone level, or height. Lower were classifications based on measures of surrogates of exposure or distance from a source of exposure; and lower still were measurements made in the environment defined along municipal boundaries and extended to all residents of that environment, such as measures of noise or air pollution for a postal code, county, or census tract. Most human biologists lack the training to measure environmental features precisely such as air quality, noise levels, materials in water, pesticide exposures and household and population density. As a result these potential influences are absent in many studies by human biologists even though they can influence growth, reproduction, morbidity and mortality. While we measure biological characteristics of the individuals in our studies with precise measurements, we do not characterise the environmental characteristics of those individuals with nearly the same accuracy. This is a classic example of unbalanced precision.

How to fix the problem.

If we are to understand what it is about modern environments that is affecting human biology we can use the very diversity that is ignored by the typological approach. Instead of lumping all the diverse influences within an urban or rural environment into one category, by measuring individual dimensions in each environment we can understand the specific roles played by specific environmental features. For example, human biologists might study populations along a continuum of population density to understand the role of that specific urban feature. The same could be done with any pollutant, or with access to food sources, and or access to health care. This measurement-based approach is more likely to lead to replication and generalisation.

As human biologists are not trained in environmental science and health methods, engaging collaborators who are so trained is a logical solution. If that is not possible, human biologists could carefully consider the salient dimensions of the urban-rural continuum hypothesised to affect their biological outcome of interest and incorporate those into their study.

The measurement approach was illustrated in papers comprising two symposia sponsored by the SSHB and the resulting volumes (Schell et al. 1992; Schell and Ulijaszek 1999) as well as several review papers on the human biology of urban populations (Schell 2005; Schell and Denham 2003). Relevant features of the urban environment are measured at the individual level and become part of each individual's characterisation along with their biological and social data. These individual level measures can be used individually or if numerous and interrelated may be aggregated using statistical techniques. Adair and colleagues utilised a factor analytic approach to reduce the complexity of measured variables and separate as factors different sets of influences on the populations studied across an urban-rural spectrum (McDade and Adair, 2001; Dahly and Adair, 2007). The extracted factors were more powerful predictors than the component variables, indicating the value of the approach.

If the measurement approach is not possible, human biologists using an urban-rural contrast could describe the places they compare in far more detail than some have in the past. A report of an urban –rural comparison that does not contain information about the urban and rural places is not very informative and cannot be incorporated into summaries and contribute to generalisations about urban influences on human biology.

Summary

Measurement and replication are hallmarks of science. Measuring features of the environment and including those variables in our analyses will produce more precise specifications of influences on outcomes of interest to human biologists. Making these measurements will require either more diverse training or more collaborations with scientists from complementary disciplines. Through work with more balanced precision we will be able to test generalisations through replicated analyses and create more concrete and valid summarisations across studies concerning the role of the environment in human biology.

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Table 1.

Hierarchy of Exposure measurements. National Research Council, 1991.

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1. Quantified personal measurements
 2. Quantified measurements of the environment near the residence or other locations of activities
 3. Quantified surrogates of exposure
 4. Distance from a point source and duration of residence
 5. Distance OR duration of residence
 6. Residence or employment in area reasonably close to location where exposure is assumed
 7. Residence or employment in defined geographical area (e.g., a postal code) of the location
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