The charade of socioeconomic body-mass index determinants

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One of the greatest current public health issues is the increasing proportion of people with overweight and obesity. A global analysis of body-mass index (BMI) in children, adolescents, and adults showed a practically linear upward trend for both women and men.[1] The trend is not homogeneous across regions, with no increase detectable in some settings, such as eastern Europe, and steep increases in others, such as Latin America and central Asia. This increase in overweight and obesity is clearly linked to an increase in cardiovascular disease[2] and mortality;[3] therefore, understanding its drivers is essential. In their Article on how socioeconomic factors explain variation in BMI, published in *The Lancet Global Health*, Rockli Kim and colleagues[4] start by raising the issue that processes leading to changes in population averages might be different from determinants of individual cases. This is an interesting idea that was previously explored for growth faltering among children.[5] In their study,[5] Roth and colleagues recognised that the changes observed in the height-for-age distribution in the first 3 years of life could not be explained solely by individual determinants (eg, wealth).

Multilevel statistical models, popularised with the ML3 and MLwiN packages by Harvey Goldstein and his team in the 1990s,[6] made the study of contextual determinants and different levels of variability much easier. But, as was learned with a study of day care centre characteristics as determinants of childhood illness,[7] a big problem with contextual determinants is that the number of groups in most studies is very small compared with the number of individuals, hence these studies have low power to assess the associations of interest. Additionally, the variation of the outcome is concentrated at the individual level, so that little variation is left to be explained at the group level. Therefore, it was no surprise that Kim and colleagues found that most of the BMI variation (after or before adjustment for covariates) was at the individual level.[4]

A more interesting finding is that the socioeconomic status variables explain very little of the individual-level variability and much more (in relative terms) of the cluster-level variability. The authors conclude that these determinants are not the main drivers of individual-level differences in BMI. But why would individual characteristics like wealth and education not determine BMI at the individual level and achieve that at the group level? The pattern of the predictor variation might have a role in the explanation. To explore the predictor variation, I calculated the intraclass correlation (ICC) for the continuous wealth score (the percentage of between-cluster variation relative to the total variation) for the 58 countries used in the analysis. The ICC and countries' per-capita gross domestic product were negatively correlated—ie, the poorer the country, the more homogeneous the individuals were within clusters and the more heterogeneous the clusters were between themselves. In many countries, 70% or more of the total variation was between clusters. Next, I calculated the correlation between the proportion of BMI variance explained by socioeconomic status variables at the cluster level (as reported in the Article[4]) and the ICC, and found a correlation of 0·33 (p=0·010). In countries with low wealth ICC (richer countries), the socioeconomic status variables explained less than 20% of between-cluster BMI variance (figure). As the ICC increases, the percentage of between-cluster BMI variability increases, on average—ie, when there is more wealth heterogeneity between clusters, the socioeconomic status variables explain a larger percentage of BMI between-cluster variance. This finding might, in part at least, explain what was observed in Kim and colleagues study.

The pooled analysis presented in the Article requires the assumption that in each country the effect of age and each of the socioeconomic status variables are the same. This assumption is not the case, and it is most visible when the

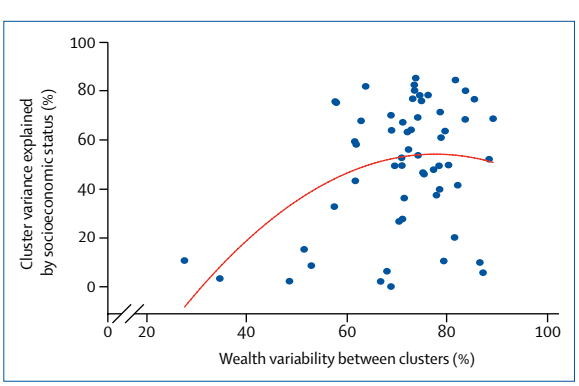

Figure: **Association between body-mass-index cluster-level variance explained by socioeconomic status variables and the proportion of wealth variance due to between-cluster variability**
The red line represents a quadratic fit. Data are from Demographic and Health Surveys and the appendix of Kim and colleagues study.[4]

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direction of the association between BMI and wealth and education is examined. In half of the 26 studies reviewed by Dinsa and colleagues,[8] BMI increased with education, whereas the association was reversed in the other studies. These authors also showed that the direction of the association was related to country income level, with BMI increasing with socioeconomic status in poorer countries, and decreasing with socioeconomic status in richer ones. Therefore, the pooled analysis might present a poor fit for the effect of some socioeconomic status variables. The country-specific analyses are more robust in this sense than the pooled analysis, and thus more interpretable.

However, important lessons are to be learned here. In the study by Kim and colleagues,[4] most of the variability in BMI could not be explained with the socioeconomic status variables. Theoretically, it should have been possible to explain a large part of such variability, since the socioeconomic status variables were distal determinants, and intermediate ones, such as lifestyle, are strongly related to socioeconomic status. Additionally, the range of percentages of variability explained across countries was wide, at both the individual and cluster level. Taken together, these results highlight the difficulties in identifying determinants of BMI amenable to interventions, and the need for solutions that are setting specific.

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I declare no competing interests.

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