Genes, Pubs, and Drinks: Gene-environment interaction and alcohol licensing policy in the United Kingdom

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Summary

Alcohol plays a significant role in the generation of health inequality, being causally related to more than 60 medical conditions and accounting for a share of the global burden of disease comparable to those of tobacco or hypertension [1]. Our paper shows how genetic propensity to alcohol consumption contributes to these health inequalities in two ways: first by favoring selection into unfavorable environments, and secondly by decreasing susceptibility to more restrictive alcohol licensing policies.

Using the coordinates of all pubs and the branches of all the major retailers in the UK, we construct a fine-grained measure of local alcohol availability for each one of the approximately 500'000 participants in the UK Biobank. Our main measure of genetic propensity is a polygenic risk score for alcohol consumption constructed from a recent genome-wide association study of alcohol use [2].

First, we show that both living in proximity to many alcohol salespoints and a high polygenic propensity for alcohol consumption are related to several measures of alcohol intake. Moreover, we find that individuals with a high polygenic risk self-select into environments with greater alcohol availability, leading to substantial gene-environment correlation where carriers of similar genetic variants tend to cluster in the same area. Similar forms of gene-environment correlations have recently been demonstrated to contribute to inequality in health, socioeconomic status, and education [3,4,5].

Second, we evaluate the effectiveness of alcohol licensing policy. Since the Licensing Act of 2003, responsibility for licensing has been decentralized to 350 local licensing boards. This has led to considerable variation in the restrictiveness or permissiveness of policy, both geographically and over time. Using the data on local licensing activity over the last 10 years, we estimate the causal effect of licensing policy on alcohol consumption for individuals with low and high polygenic risk. We find that a more restrictive licensing policy leads to decreased alcohol intake on average, but individuals with high polygenic risk are less responsive to this policy change.

In the final part, we quantify the effects of licensing policy from a public health perspective, using data on co-morbidity and hospitalizations. As the majority of the public health burden has been shown to be driven by those individuals who develop alcohol dependency [6], we repeat our analysis using a second polygenic risk score for this dependency phenotype [7]. Again, we find that individuals with high genetic risk are less responsive to changes in alcohol availability. Importantly, form a policy perspective, individuals with a high genetic risk to develop alcohol dependency do not necessarily drink more than low-risk individuals, illustrating the value of genetic information in developing targeted interventions to address health-inequality.

Our results demonstrate how genetic information can shed light on the determinants and the dynamics of health inequalities, and how genetic endowments interact with individual choices and public health policy. We show that the effectiveness of supply-focused licensing policy as a tool to mitigate alcohol abuse can clash with individual predispositions and might actually exacerbate genetic inequality, suggesting the need for a more targeted approach.

References:

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