

A deep dive into the relationship between trauma admissions and lockdown measures during the COVID-19 pandemic in South Africa.

A HIGH LEVEL OVERVIEW

Statistical Analysis completed by:

Prof. Mike Murray, Associate Professor in the School of Mathematics, Statistics and Computer Science, University of KwaZulu-Natal

Ian McGorian, Silverfox Consulting

Peer reviewed by:

Prof. Graham Barr, Emeritus Professor in Statistical Science, University of Cape Town

Trauma Admissions in 5 Western Cape Hospitals

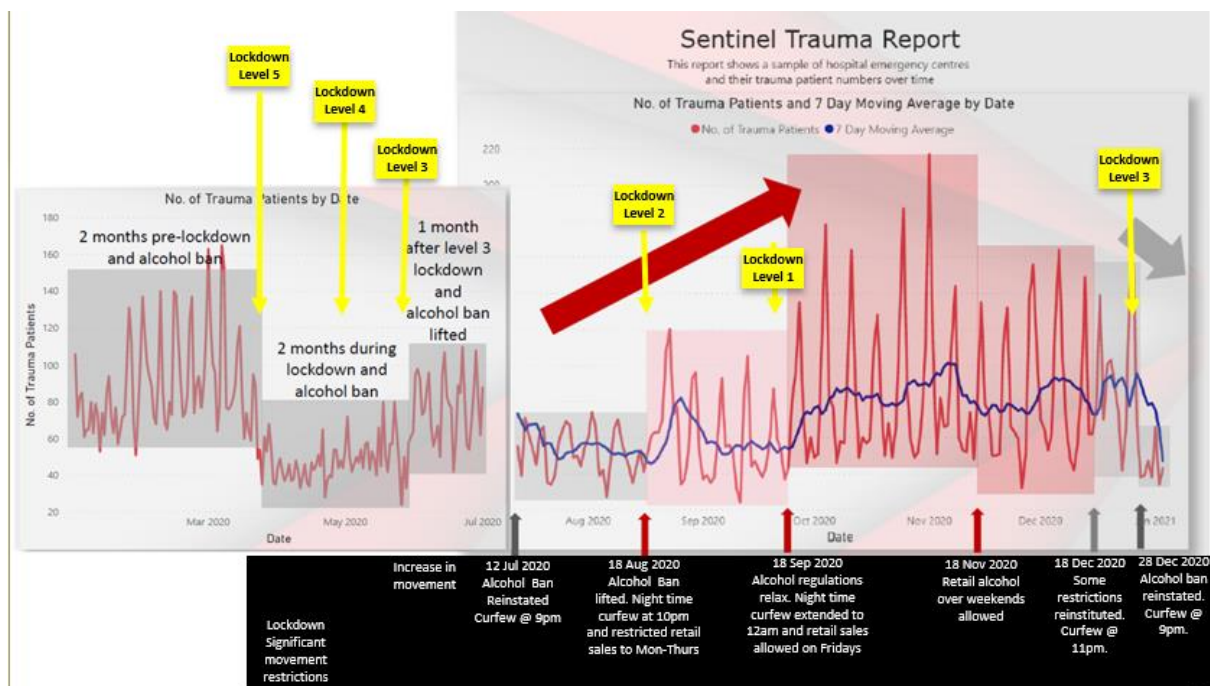
It has become the norm to present a graph of the admissions to A&E (attendances and emergency) at 5 Western Cape hospitals over the period of the CoVid-19 pandemic overlaid with a graph of the various levels of the Alcohol Ban which has been imposed over the same period. The fact that one can see an association between these two time series has then been used to attest to the efficacy of these bans in reducing trauma admissions at these hospitals. The assertion that Alcohol Bans and/or Alcohol restrictions are causal in the reduction of trauma admissions is now firmly entrenched and repeated regularly by senior members of Government. That Government speaks of an urgent need to alter existing and implement new legislation with regard to the sale, marketing and consumption of alcohol demands that we establish with certainty whether there actually does exist a clear causal link between Alcohol Bans and trauma admissions.

A specific causal link from one variable, D , to another, Y , cannot simply be assumed when we observe a statistically significant association between these two variables. The reason for this is that at least part of the observed association between two variables may arise by reverse causation (the effect of Y on D) or by the confounding effect of a third variable, X , on both D and Y . In this paper we set out to interrogate the claim that a clear causal link between Alcohol Bans and trauma admissions exists, and indicate that the simultaneous imposition of various levels of Lockdown / Curfew along with Alcohol restrictions will confound any attempt to come to a causal conclusion. In fact, the measured association between alcohol restrictions and trauma admissions in the year 2020 becomes statistically insignificant when an adjustment for the simultaneously imposed Curfew is made.

In order to establish that an Alcohol Ban definitively causes the number of trauma admissions to decrease in South Africa would require the almost impossible task of setting up a properly randomised and repeatable experiment, where various levels of the alcohol ban are randomly assigned to individuals (and communities) in South Africa. Only if different levels of Alcohol Bans applied to these groups consistently gave rise to different trauma admissions for the different groups, could one conclude that alcohol restrictions are causally linked to trauma admissions. What we are observing here, however, is an observational study over time where one has no control over the key determinants of trauma, and where, in fact, a blanket Alcohol Ban has been assigned to everyone in South Africa. Hence no direct causal inference from the Alcohol Ban to the reduction in trauma admissions can be drawn from this data set.

Moreover, the fact that trauma admissions have decreased in countries with no alcohol bans during lockdown, clearly infers that other lockdown measures, apart from alcohol restrictions, are instrumental in causing trauma admissions to decrease. Such counterfactuals further weaken the government's case that it has been alcohol restrictions that have been the main driver in decreasing trauma admissions.

In presentations to Government the graph that is being referenced below has become the centrepiece for an argument supporting an Alcohol Ban. In every instance, the assertion is strongly made that variances in trauma admissions can be causally linked to the different levels of alcohol restrictions. The evidence may appear compelling at first blush, but fails to address an effect no less important, namely that the alcohol restrictions coincided with other restrictions that may also have had an impact on trauma admissions. Not the least of these being the level of lockdown as highlighted by the yellow markers:



Consequently, what we are observing in the above graph is (at best) a possible association (not a causal effect) between a particular level of alcohol restriction (being measured by D) and an associated trauma admission figure (being measured by Y). Note, however, that this association could just as easily be attributed to the level of Lockdown / Curfew (call this variable X) that was being simultaneously imposed on the economy. In statistical parlance, we refer to the relationship between variables D and Y as being confounded by variable X . In the context of this paper, can the reduction in trauma cases that we are observing be attributed solely to the Alcohol Ban, or does it arise because of social pressures and other factors such as reduced mobility that flow from the level of lockdown that is being imposed on the country? Or, most likely, does it arise from a combination of the lockdown factors in conjunction with the Alcohol Ban that is being imposed on the country?

Results

We constructed a simple linear Regression model with trauma admissions as the dependent variable and Alcohol Restriction and Curfew levels as potential explanatory variables, and with a one period autocorrelation adjustment. The estimates are computed using weekly data, for the period 7th Feb, 2020 to 17th January, 2021. When we first use Alcohol Restriction (only) as an explanatory variable. The parameter estimate we obtained for the coefficient of the Alcohol Restriction variable in this model is highly significant (p -value < 0.01). Consequently, with this simple, one-variable model of trauma admissions, raising the level of the Alcohol Ban appears to be associated (in a statistically significant way) with a reduction in trauma cases. This is the result that is being used to promote an Alcohol Ban in the country –with this association being claimed to also be *causal*- but it should be noted that such an interpretation must assume that the model used is correctly specified, and that no other variables could be confounding any relationship between alcohol and trauma admissions.

Note, however, that when we now estimate a model with the level of Curfew as the sole explanatory variable, over the same period, the parameter estimate that we obtain for the coefficient of the level of Curfew is also highly significant (p -value < 0.01). In this case it appears that raising the level of the lockdown also appears to be significantly associated with a reduction in trauma cases. One can only conclude that both these variables, at the very least, need to be included in a model of trauma

admissions, whereas the governmental focus remains on Alcohol Restrictions being the sole driver of trauma admissions.

Crucially, when we then include both variables as explanatory variables, namely the Alcohol Restriction factor and the Curfew level, in the model of trauma admissions, the estimation results indicate that only the coefficient for the level of curfew is statistically significant and the statistical significance of the Alcohol Restriction factor falls away ($p=0.456$). So, from a Statistical perspective, the Curfew Level factor dominates the Alcohol Restriction factor when it comes to explaining trauma admissions. Referring back to Figure 1, what this means is that any association we perceive in the graph between trauma admissions and the level of Alcohol is dominated by a stronger association between the levels of Curfew and trauma admissions. Possible explanations for trauma cases dropping when lockdown is made more severe include a reluctance among people to present at trauma for fear of isolation or contracting the virus, restrictions on transport, reduced social interaction, restrictive admission procedures and loss of income; all of which arise as unintended and intended consequences of a more severe form of lockdown.

Weekend-binge drinking and its purported effect on trauma admissions

There is sufficient historical data to establish what is referred to as the trauma admissions “weekend effect”, a term used to describe elevated admissions to A&E commencing on Friday night and ending on Sunday. In addition, there are observed effects on trauma admissions for Pay Days and Public Holidays. Presentations made to Government have noted this effect and attributed differences solely to the Alcohol Ban, implying that alcohol is the sole driver of the weekend effect.

As a starting point for this discussion, the trauma admission figures that are being presented to government are not separated into those that are alcohol related and those that are not alcohol related. Therefore, if we want to specifically attribute an increase in trauma cases to an alcohol related ‘binge-drinking cause’, then some distinction between alcohol-related trauma cases and trauma cases not related to alcohol needs to be made.

Given the quality of the data that has been made available and since excessive alcohol consumption and particularly binge-drinking naturally occurs over weekends, we can try and tease out this weekend binge drinking effect by considering (for each week) the *average* number of trauma cases that we observe during the week (Mon, Tues, Wed, Thurs) and subtract that from that the *average* number of trauma cases that we observe over the weekend (Friday, Saturday and Sunday). What we are trying, in effect, to create is a week versus weekend differential that can be attributed to weekend binge drinking; we label this variable traumadiff.

A similar set of regression estimations to those computed above is now performed, except we now use the variable traumadiff as the dependent variable rather than the variable trauma admissions. In a parallel way to the results above, when only one explanatory variable is considered in the model, the Alcohol Restriction variable has a significant coefficient ($p<0.05$) as does the Curfew level explanatory variable, although at a higher level of significance ($p<0.01$). But, when *both* variables are included in the regression, the statistical significance of the Alcohol Restriction variable falls away but the Curfew level coefficient remains significant ($p<0.02$). The statistical analysis thus indicates that the Curfew level is the key determinant of the weekend-trauma admission peak (as measured by traumadiff) and although Alcohol may have some effect, it is statistically insignificant when Curfew levels are included in the model specification. In no shape or form are these results suggesting that no binge drinking is actually taking place over the weekend or that the amount of alcohol that is being consumed is not having an effect on trauma admissions. Rather, the model estimation results indicate that limiting the amount of alcohol that is being consumed (through an

Alcohol Ban) is helping to reduce traumadiff, but that when both alcohol restrictions and a curfew are operative the consequences flowing from a curfew – namely, limited mobility, social interaction, etc that are more strongly associated with a reduction in the number of trauma cases than the Alcohol Ban itself.

Mobility and the “Weekend effect”

Google has released mobility data for the Western Cape for the duration of the pandemic; this data describes changes from a baseline for Transit, Retail and Recreation, Grocery and Pharmacy and Parks with a more negative value indicating a higher level of restriction. Consequently, this mobility data provides another view of the effect of Government regulations, effectively describing actual societal response to regulations that are being imposed. We substituted the Google mobility (labelled G-mobility) in place of the curfew level variable in our model of traumadiff. The regression results suggest as before that if one includes a factor describing mobility restriction (in this case G-Mobility rather than Curfew) along with Alcohol Restrictions as explanatory variables, the G-mobility variable is significant ($p < 0.05$) but the effect of the Alcohol Restriction variable on the “Weekend effect” becomes insignificant.

This finding strengthens the contentions already made in the paper; namely that there are strong associations between restrictions on movement for both overall admissions as well as “weekend effects”. This does not suggest that mobility (as proxied by the variable G-mobility) is responsible (or causal) for determining trauma admissions; Rather, it indicates that the narrative that only Alcohol restrictions are a determinant of trauma admissions (and, indeed, a *causal* determinant), is subject to criticism, when *other* variables, like G-mobility, clearly also have an important role to play in determining trauma admissions.

Counterfactuals

A common technique employed in statistical modelling is the creation of a counterfactual. This method is used to describe what would have happened in the absence of an intervention. This concept is fundamental for testing the efficacy of drugs etc. Without a control group taking a placebo drug, in a suitably randomised trial, statements regarding the efficacy of the drug are weakened considerably. In the case of the pandemic and the responses (regulations) employed by Government, a counterfactual is not readily apparent. In all instances, regulations were universal across the country and implemented at the same time. However, South Africa is not the only country to have imposed Lockdown regulations; most countries across the world imposed regulations in one form or another. However, South Africa distinguishes itself as being one of the few countries that imposed an outright Alcohol Ban simultaneously with Lockdown.

This coincidence of events presents the opportunity to consider other countries as counterfactual proxies, even though this was not by design. A sharp reduction in trauma admissions during periods of lockdowns have been observed in numerous countries in the absence of an alcohol ban or restriction. The negative effect on trauma admissions has been observed in countries heavily affected by the pandemic like Italy (-57%) and the United Kingdom (-57%), as well as countries with relatively light experience of the virus like New Zealand (-43%) and Ireland (-62%). In any particular country, under conditions of lockdown, there are clearly multiple factors at play which contribute to a reduction of trauma admissions, with strong associations to the set of Lockdown regulations specific to the country in question.

One cannot simply ignore the counterfactual that countries that did not impose alcohol bans also experienced a significant reduction in trauma admissions post lockdown implementation.

Conclusion

The assertion that alcohol bans directly caused the reduction of trauma admissions is refuted because of the concurrent existence of various confounding variables. When viewed in isolation, a weak case can be made that raising the level of the alcohol ban is associated with a decrease in trauma admissions. However, when an extended model is estimated which also includes the Curfew level, or a measure of mobility (G-mobility) as an explanatory variable, the Alcohol Restriction variable is rendered insignificant. This is because the Curfew level (or G-mobility) variable has a strongly significant negative association with trauma admissions, implying that an increase in curfew restrictions results in a reduction of trauma admissions or “weekend effects”. The results presented above indicate that imposing an additional alcohol ban will have limited effect on reducing trauma admissions over and above those already resulting from the curfew. Although seemingly beneficial in the short run, the use of a curfew should be tempered with reference to the rights enshrined in the constitution - curfews can never be considered as long run policies.