Examining the geographical variation of discrete and aggregate drowning events using Ambulance Victoria attended cases

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Background

Drowning has a major impact on public health, and as such is investigated using various analytical and/or environment specific approaches. Spatial analysis approaches offer an opportunity to investigate drowning with emphasis on 'place'.

As drowning can be geographically represented as individual points or as event counts or summaries, there is a need to demonstrate how different spatial data types can be used to visualise how drowning relative risk vary geographically.

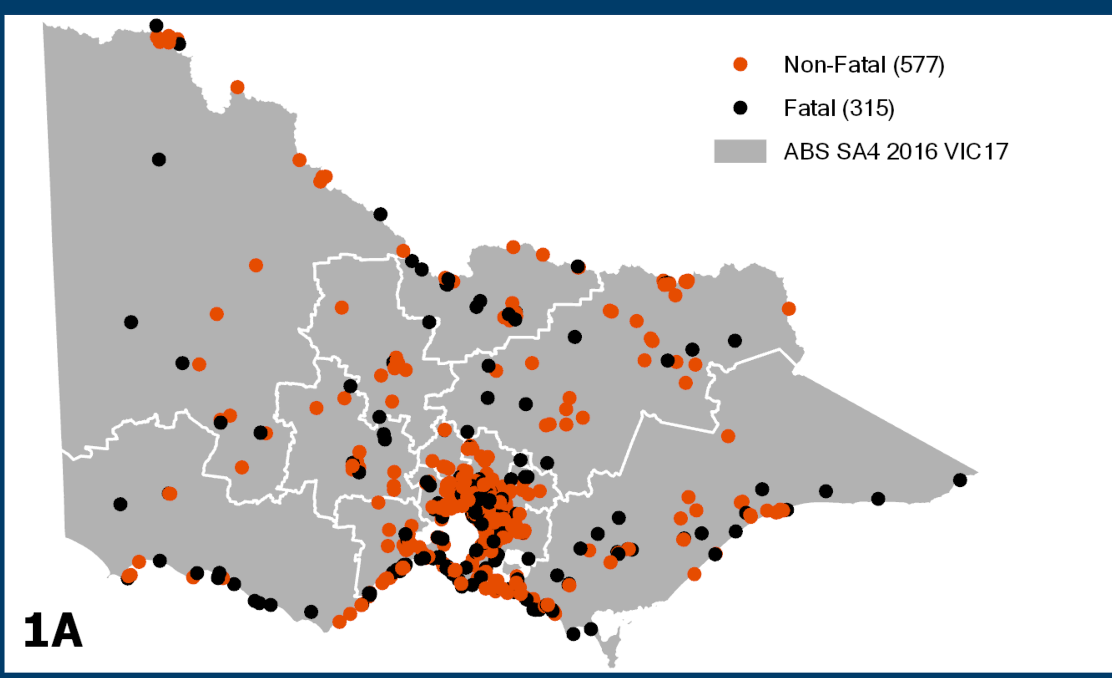
Methods

The study used 10 years of individually georeferenced Ambulance Victoria (AV) attended cases (January 1st 2007 to 31st December 2016), in the Australian state of Victoria. Being recorded as individual drowning events, they were first used to construct whole area continuous relative risk maps. By assigning the individual events to areal units and counting the events, relative risk maps were also devised for discrete areal unit maps.

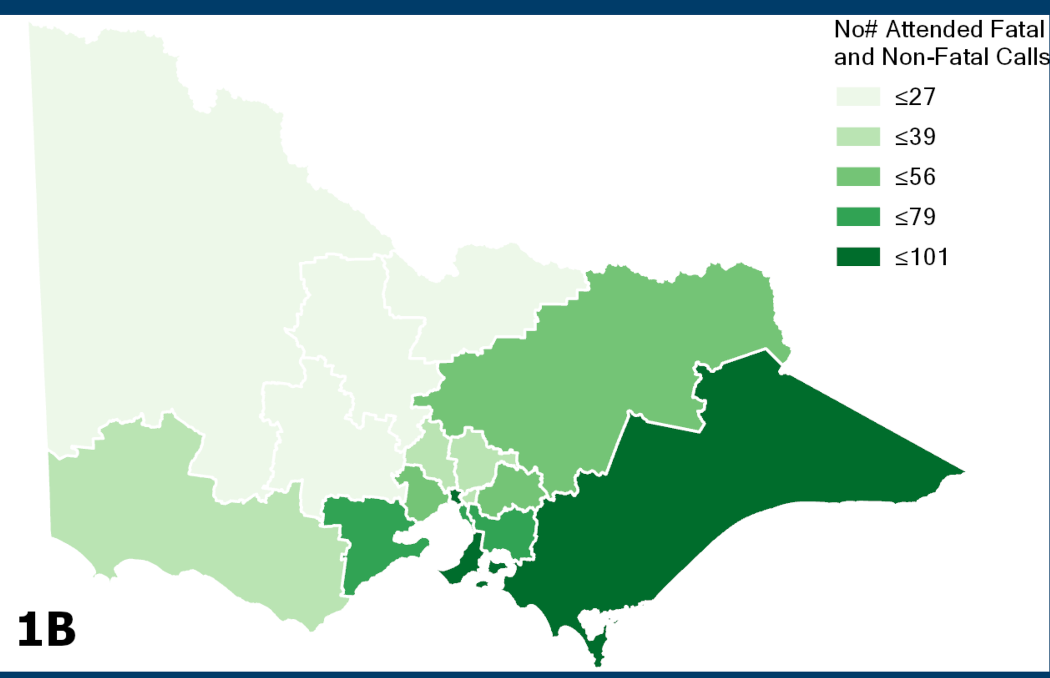
Additionally, as event cases were attributed a fatal and/or non-fatal descriptor, analysis was extended to examine geographical differences of the relative risk of each drowning type for both continuous and discrete areal unit maps. The geographical units used were Statistical Areas Level 4 (SA4) as defined by the Australian Bureau of Statistics (ABS, 2016). Various geographical representations of drowning events are visualised below.

Figure 1A - Point representation of Ambulance Victoria attended calls (2007-2016). Each point represents one fatal or non-fatal drowning event across Victoria, Australia. The ratio of non-fatal (577) to fatal (315) events across Victoria is 1.83 (83% higher for non-fatal events).

Figure 1B - Aggregated AV attended calls (fatal or non-fatal) based on SA4. Call response counts are mapped using a quintile classification scheme. Historically epidemiological event data were generally only available in aggregate form due primarily to data recording limitations. Data is still often only provided in aggregate form for confidentiality reasons.



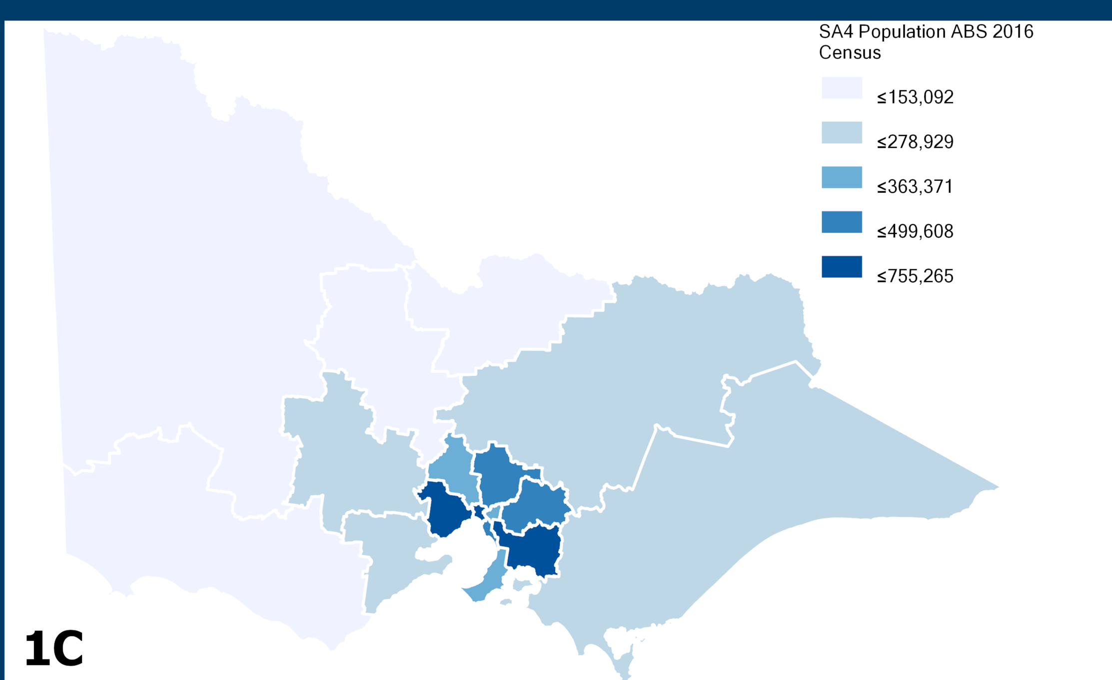
1A



1B

Figure 1C - Victorian population based on SA4 regions. The map uses a quintile classification scheme similar to Figure 1B to allow easy comparison. This figure shows that higher population densities are present in the centre areas of the map corresponding with metropolitan areas (Melbourne).

Figure 1D - Choropleth map of Standard Mortality Ratios (SMR's) using AV attended call counts (fatal and non-fatal) within each SA4 along with areal unit census counts. The mapped SMR's show how each unit's local event to population ratio compares to the overall Victorian event to population ratio. As such, unit ratios are considered relative risk ratios. Here, there is a higher relative risk of a fatal or non-fatal event being attended by AV in regional areas compared to the more densely populated metropolitan areas.



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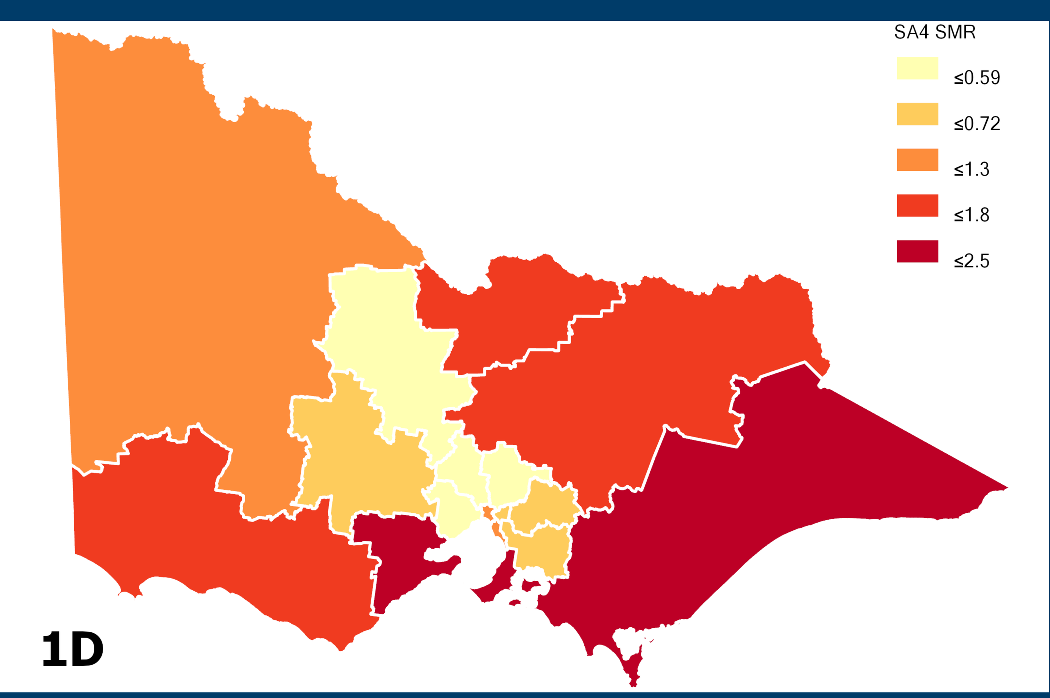
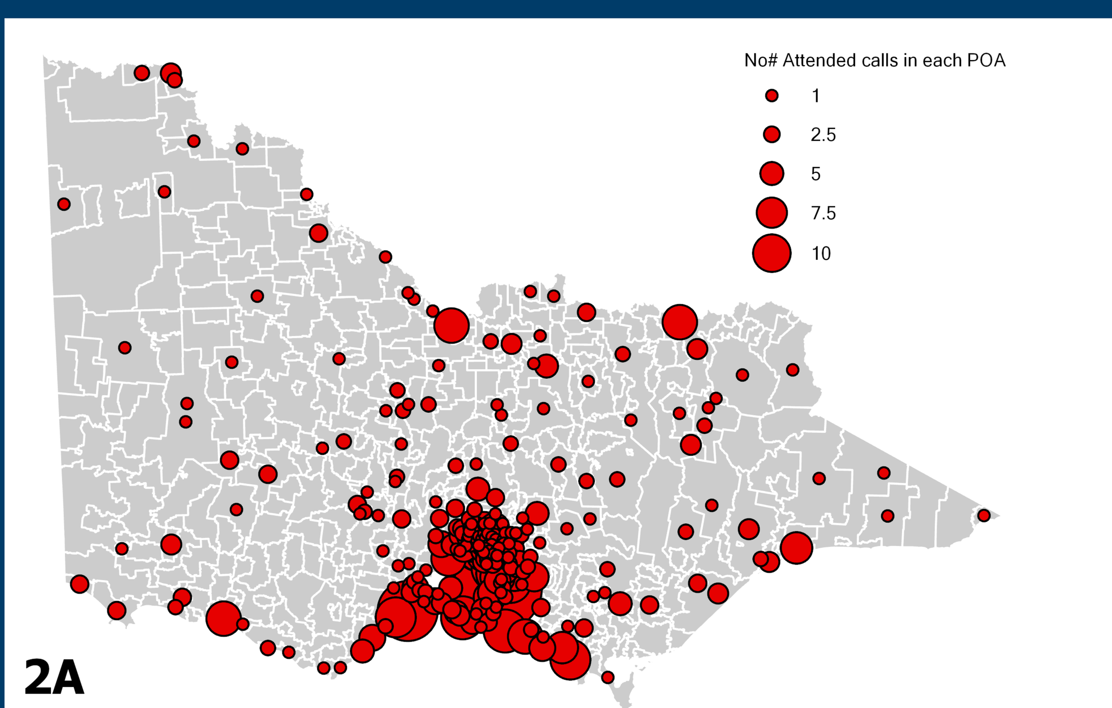


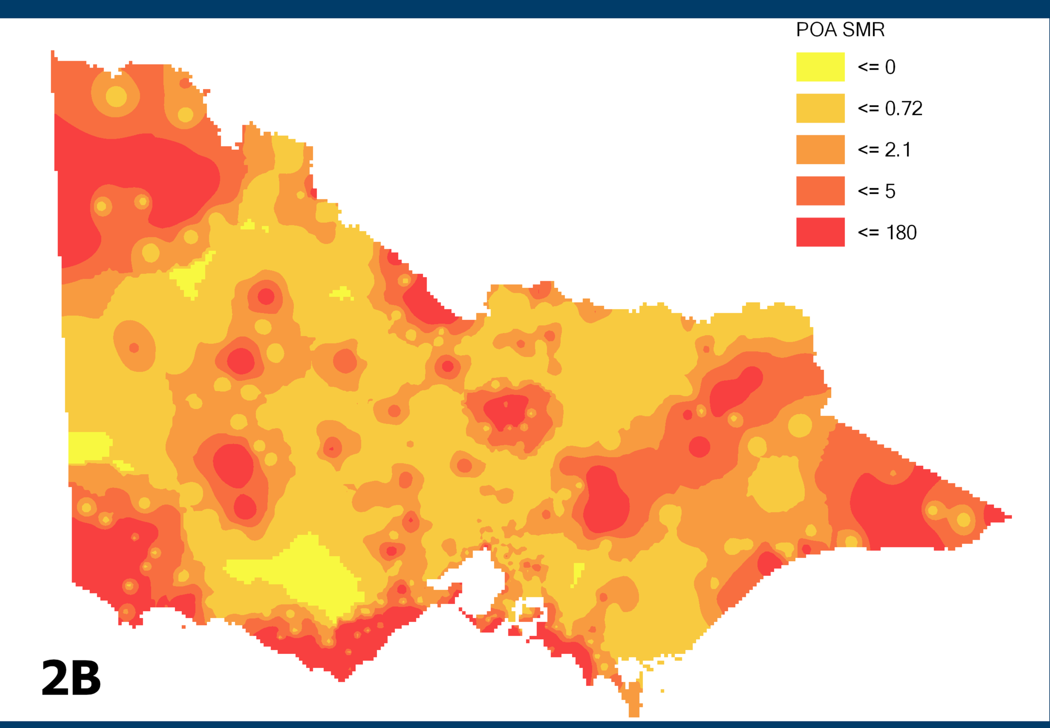
1D

Figure 2A - Combines aggregate mapping approaches with more intuitive point pattern representations. Here, the points symbolise combined fatal and non-fatal drowning counts based on postcode location. The point symbols are proportional, with postcode areas with more event counts having larger points. Figure 2A illustrates a limitation to this approach when several areal units overlap, such as in the densely populated Melbourne metropolitan area.

Figure 2B - Combines the aggregate event points from Figure 2A and postcode census counts, and calculates individual postcode SMR values. These values are then smoothed across the map creating a continuous relative risk layer. Darker orange and red colours indicate areas where AV attended fatal and non-fatal drowning calls are at a higher rate than expected given the local resident population.



2A



2B

Findings

Using the same underlying data source to construct both continuous and discrete form maps allows comparison of the mapped outputs. Although some inherent methodological differences are associated with each data type, they enable comparison of not only the relative risk of drowning but a comparison of fatal and non-fatal drowning events and how they vary geographically.

In this example, many regional areas have higher relative risk ratios compared to Melbourne metropolitan areas. Although regional areas area more susceptible to extreme SMR values because of low population counts, these relative risk visualisation approaches allow researchers to ask important exploratory questions of these map representations.

Conclusion

Visualising the relative risk of drowning is an insightful preliminary step in articulating the geographical distribution of drowning events. This enables drowning prevention experts to focus attention on understanding significant geographical variation of rates and possible etiological factors. However, caution must be exercised in utilising the most appropriate method with benefits and limitations of the different outputs.

Reference

Australian Bureau of Statistics. (2016). *1270.0.55.001 - Australian Statistical Geography Standard (ASGS): Volume 1 - Main Structure and Greater Capital City Statistical Areas, July 2016*. Australian Bureau of Statistics: Canberra.