Repeat self-harm: application of hurdle models

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Summary
Among those who present to the emergency department for self-harm, many will repeat. Self-harm repetition is an outcome of interest in both observational and intervention studies. However, few such studies analyse the number of repeat self-harm presentations. Here, hurdle models are introduced as a potentially useful statistical method for these analyses. Emergency department data from the Province of Ontario, Canada, are used to illustrate an example of implementing hurdle models and interpreting their results.

Declaration of interest
None.

Method
This is a population-based retrospective cohort study of 12- to 17-year-olds presenting to the emergency department for self-harm in Ontario, Canada. Data are from the National Ambulatory Care Reporting System (NACRS), covering a 7-year period (1 April 2002 to 31 March 2009). The data capture every emergency department visit; all legal residents are insured for acute and primary healthcare services and every hospital submitted NACRS emergency department data. The 2006 Ontario population of 12- to 17-year-olds was about 1 million. Ethical approval was obtained from St Michael’s Hospital.

Results
The cohort included 10,937 individuals (8012 (73.3%) girls and 2925 (26.7%) boys), of whom 3546 (32.4%) were admitted at their index episode. Overall, 1325 (12.1%) made at least one repeat self-harm presentation within 1 year of their index episode (classified as repeaters), and this proportion was almost identical in the two exposure groups (12.2% and 12.1% among admitted and non-admitted respectively).

The binary models, logistic regression and survival analysis found no statistically significant association between admission and repetition (odds ratio (OR) 1.01, $P=0.8309$; hazard ratio 1.01, $P=0.8614$). The count models' AIC and BIC (Table 1) suggest substantial improvement in model fit from selecting the negative binomial, Poisson hurdle and negative binomial hurdle models over the Poisson model. Both fit indices favour the negative binomial hurdle model, demonstrating their flexibility in accounting for overdispersion from excess zeroes as well as other sources. Interpreting the negative binomial hurdle model, similar to the binary analyses, the logit portion shows admission subsequent to the index episode was not associated with repetition (OR = 1.02, $P=0.7269$). However, the negative binomial portion shows that, among repeaters, the estimated number of repeat presentations is lower among those admitted ($P=0.0179$).
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Discussion

These results highlight the importance of considering the number of repeat presentations when studying self-harm. Others have already acknowledged the tendency for self-harm repetition studies to ignore multiple presentation and proposed alternative analyses, including recurrent event survival analysis and multinomial logistic regression. Here, we have shown that hurdle models are also an appropriate and useful statistical method. They are more informative than binary analyses because the investigator models are also an appropriate and useful statistical method. They are independent from the funding sources. No endorsement is intended or should be inferred.

Table 1  Count model results for the association between in-patient admission and repeat self-harm presentation(s) within 1 year for 12- to 17-year-olds in Ontario, Canada

<table>
<thead>
<tr>
<th>Count models</th>
<th>Coefficient (standard error)</th>
<th>P</th>
<th>AIC</th>
<th>BIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poisson</td>
<td>−0.0537 (0.0495)</td>
<td>0.2791</td>
<td>12317</td>
<td>12327</td>
</tr>
<tr>
<td>Negative binomial</td>
<td>−0.0606 (0.0697)</td>
<td>0.3854</td>
<td>10610</td>
<td>10613</td>
</tr>
</tbody>
</table>

Poisson hurdle

Logit

Poisson

−0.2527 (0.0832)

0.0223 (0.0637)

−0.2854 (0.1194)

AIC, Akaike information criterion; BIC, Bayesian information criterion.

References


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