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Estimating the number of drug users with mortality data when drug-related deaths are underreported, a case study

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Context

The multiplier method is a common way to indirectly estimate the number of drug users [1, 2]. Its mathematical simplicity ensures its spreading. Multiplier based on drug related deaths (DRD) is a likely alternative. However, some concerns arise when the number of DRD is thought to be under-estimated [3].

In France, all deceases are centralized and recorded by the general mortality registry, in charge of elucidating the causes of death. The suspected DRD are temporary labelled as "ill-defined or unknown causes of death", awaiting the official toxicological results to be published. In some cases, laboratories invoke medical secrecy to keep from transmitting the results to the general mortality registry. In others, analysis are delayed or even cancelled for budget constraints. The temporary code becomes permanent and some DRD are officially classified as unknown causes of death. Both the number of DRD and the consequent estimates of the number of drug users will thus be underestimated. A correction needs be applied.

Method

Data come from the general mortality registry, applying the 10th version of the International Classification of Diseases. The dataset is updated on a yearly basis and consists in Total number of deaths (T), composed of Known causes of deaths (K) in which are located the official DRD (D) and Ill-defined causes of death (I).

DRD (D) include all deaths induced by the use of illicit substances (cannabis excluded), opiates substitution treatments (both methadone and buprenorphine) and misuse of morphine painkillers.

DRD are assumed to either be labelled as such (D) or as "ill-defined, unknown causes of death" (D_i), whose number is to be estimated. Therefore, the real number of DRD (D^*) is:

$$D^*=D+D_i$$

In order to define D_i, we assume that the set of ill-defined causes of deaths is a random subset of the deaths whose causes are known. In that perspective, the proportion of unobserved DRD coded as ill-defined causes is then similar to the number of DRD reported to the number of deaths whose causes are known. This yields:

$$\frac{D_i}{I} \equiv \frac{D}{K}$$

Substituting, we get:

$$D^* = D + D_i = D + \left[I \times \frac{D}{K} \right]$$

And then $D^*=DT/K$. An alternative proof, using a maximum likelihood estimation from a binomial perspective (the encoding is a failure or a success), yields the same result. This estimate can be broken down into sub-categories, i.e. gender or age groups.

Conclusion

- The number of drug users experienced a sharp increase between 2000 and 2011.
- One user out of three is female. This proportion remains quite stable over the period.

Some limitations arise:

- This method can be applied in a specific context, i.e. within the institutional decision to encode DRD as ill-defined causes. It cannot be generalized or must be adapted to local specificities.
- It also assumes that DRD, and all other known causes of death, are correctly defined.
- The high prevalence of F19 codes (unknown or polysubstances) prevent any attempt of breaking down by substances.

Table 1. Estimated number of drug users in France in 2000-2011 using a modified multiplier method.

Year	Estimated number of DU	Females				Males			
		N*	IC 95%	Prevalence	IC 95%	N*	IC 95%	Prevalence	IC 95%
2000	140 600	47 300	[41 400-53 800]	2.9	[2.5-3.3]	93 300	[81 600-106 000]	5.7	[5.0-6.5]
2001	153 700	47 300	[41 200-53 700]	2.9	[2.5-3.2]	106 400	[92 600-120 800]	6.5	[5.6-7.3]
2002	137 100	44 800	[39 000-50 300]	2.7	[2.4-3.0]	92 300	[80 300-103 600]	5.6	[4.9-6.3]
2003	135 400	39 000	[33 600-43 800]	2.3	[2.0-2.6]	96 400	[82 900-108 200]	5.9	[5.0-6.6]
2004	166 400	49 200	[43 500-55 100]	3.0	[2.6-3.3]	117 300	[103 700-131 400]	7.1	[6.3-8.0]
2005	180 900	54 100	[47 700-60 600]	3.3	[2.9-3.6]	126 800	[111 700-142 000]	7.7	[6.8-8.6]
2006	201 100	55 700	[49 400-61 900]	3.3	[3.0-3.7]	145 400	[128 900-161 600]	8.9	[7.9-9.8]
2007	208 500	54 400	[48 200-60 800]	3.3	[2.9-3.7]	154 100	[136 700-172 400]	9.4	[8.3-10.5]
2008	242 300	67 900	[60 300-74 900]	4.1	[3.6-4.5]	174 400	[155 000-192 600]	10.6	[9.5-11.8]
2009	256 500	67 200	[60 400-73 800]	4.1	[3.7-4.5]	189 300	[170 100-208 000]	11.6	[10.4-12.7]
2010	257 500	72 400	[64 400-79 500]	4.4	[3.9-4.8]	185 200	[164 700-203 400]	11.4	[10.1-12.5]
2011	242 400	77 800	[68 800-86 400]	4.7	[4.2-5.3]	164 600	[145 500-182 900]	10.1	[8.9-11.2]
Δ 2000-11	+72%	+64%				+76%			

Prevalence in ‰ of 15-54 year-olds. Source: General mortality registry, author's calculation.

References

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