Potential population impact of changes in heroin treatment and smoking prevalence rates: using Population Impact Measures

Perihan Torun¹, Richard F. Heller², Arpana Verma¹

Background: The drug misuse and asthma are major health problems in urban settings. There are effective interventions to reduce cigarette smoking and also to treat heroin use; in the context of European System of Urban Health Indicators Project (EURO-URHIS), we explored the use of Population Impact Measures (PIMs) to describe the potential for increase in methadone use and reduction in cigarette smoking to reduce deaths—from heroin use—and asthma events in examples of urban populations. Methods: The two PIMs calculated here are the Number of Events Prevented in your Population (NEPP) and the Population Impact Number of Eliminating (or reducing the prevalence of) a Risk Factor (PIN-ER-t). Results: Increasing methadone treatment uptake from its current levels to 90% would prevent 21 (95% CI: 11–34) deaths in Manchester City, 218 (95% CI: 114–339) in Greater London and overall 1 243 (95% CI: 641–1953) in England in 1 year. In males 2 (95% CI: −22 to 28), 27 (95% CI: −296 to 363) and 170 (95% CI: −1757 to 2186) and in females 36 (95% CI: 6–70), 0 and 2312 (95% CI: 934–3783) fewer asthma cases per year would have been expected in Manchester City, Greater London and overall in England respectively, if the smoking prevalence is reduced from current levels to 20% in both sexes. Conclusions: PIMs provide estimates of absolute risk and benefit to a total population, of potential use to policy-makers since current practice and intervention goals are taken into account.

Keywords: asthma, impact of interventions, population impact measures, substance use.

Introduction

Misuse of alcohol, tobacco and drugs is common and causes major health and other problems in society. There are, however, effective interventions for the prevention and treatment of various substance misuses, including cigarette smoking and heroin use.

There are an estimated 281,320 people in England who use opiates (8.53 per 1000 population aged from 15 to 64), including heroin.¹ The most common drug problem amongst those who contacted treatment services in England has been found to be the long-term opiate (usually heroin) dependence.² Opiate misuse prevalence both in London and Yorkshire and the Humber was around 11 per 1000 and in the North West and West Midlands around 10 per 1000; the lowest prevalence was found in the South East and East of England with around 5 per 1000 population.¹

Oral methadone is the most common maintenance prescription for heroin in the UK.³ Methadone maintenance therapy reduces mortality, compared with no therapy;⁴,⁵ patients in methadone treatment were four times less likely to die than those not in treatment or discharged from treatment.⁶

The results from previous—mainly cross-sectional—studies, had shown contradictory results for the link between cigarette smoking and bronchial asthma in adult population.²⁻⁶ However, in a recent case-control study with improved design—in terms of definition of asthma and inclusion of only incident cases—it was found that the risk of developing asthma was significantly higher among current smokers.¹⁷

Asthma is one of the most common chronic diseases in adults; in England and Wales prevalence is 331 and 388 per 10,000 males and females, respectively.¹⁸ Smoking is also very common: around one in four people in England reported that they smoke cigarette; the prevalence varies between 22% and 29% in the Regions of England.¹⁹

Both drug misuse and asthma have been thought to be major health problems in urban settings,¹⁰,¹¹ and this paper attempts to quantify the effect of possible interventions to reduce the impact on urban populations. This is performed in the context of urban health for EURO-URHIS Project, which aims to develop a European system of urban health indicators, in order to support policy-making, identify and prioritise urban health problems on the basis of evidence and enable monitoring of the effects of actions taken to address them.²² Population Impact Measures (PIMs) have the advantage of providing estimates of absolute risk and benefit to a total population, of potential use to policy-makers since current practice and intervention goals are taken into account.²³⁻³⁰

In this paper, we explore the use of PIMs to describe the potential for increase in methadone use and reduction in cigarette smoking to reduce deaths—from heroin use—and asthma events in examples of urban populations.

Methods

The two PIMs calculated here are the Number of Events Prevented in your Population (NEPP) and the Population Impact Number of Eliminating (or reducing the prevalence of) Risk Factor (PIN-ER-t); these measures have been described previously.²³,²⁵

The NEPP brings the information on the prevalence of a condition in local populations, current treatment uptake rates, treatment effectiveness and mortality (or any other outcome) from the condition together to produce a single figure, which is the number of deaths (or events) which could be prevented by the intervention in our population. The PIN-ER-t produces a measure of absolute risk rather than relative risk by taking
Population Attributable Fraction (PAF) one step further, and relates this to a particular population denominator, by incorporating a population denominator and baseline incidence of the health outcome—therefore, it shares the assumptions PAF relies on. It equals the population size multiplied by the risk of an event in the next $t$ years, multiplied by the PAF.$^{25}$

Firstly, we wanted to determine the number of deaths prevented in 1 year by methadone maintenance treatment, i.e. NEPP, in the 15–64 age group, if treatment uptake is increased from its estimated current level of 30% in Manchester, 18% in London and 22% overall in England to 90% (based on an aspirational goal that might be achieved). In order to calculate the figure we required the following local information: population size, prevalence of heroin use, proportion of those eligible for methadone treatment (see table 1 for the calculation of population eligible for treatment); relative risk reduction for overall mortality with methadone treatment and mortality risk without treatment were also required from the literature.

Current methadone treatment rates were not readily available, hence have been estimated from the number of heroin users in any treatment. This rate has also been used to estimate the prevalence of heroin use from the opiate use prevalence rates. Baseline risk of death (i.e. mortality risk in the untreated heroin user) has been taken from the overall mortality rate of a cohort of heroin users in London; it may underestimate the true mortality rate as some users will be in treatment, although a significant proportion is assumed to not receive the treatment long enough.$^{31}$ The reduction in the risk of death in those who are treated with methadone compared to those who are not receiving treatment has been obtained from a systematic review and meta-analysis.$^{6}$

PIN-ER-t has been calculated for the reduction in the number of asthma episodes in the 20–64 age group in 1 year, if smoking prevalence is reduced to the lowest level found in England, i.e. 20% in females in London, from its current level, and also for a theoretical elimination of smoking in the population. This calculation required the population size, the proportion of smokers and annual incidence of asthma in Manchester, Greater London and England and also risk of asthma in smokers compared to non-smokers; the ex-smoker’s risk of developing asthma was assumed to be equal to that of non-smoker.

The prevalence of smoking presented here has been obtained from the General Household Survey for Great Britain.$^{19}$ Asthma incidence for England was not available from the literature and routinely collected data. We calculated asthma incidence for the 20–64 age group in the way it was calculated previously as the sum of first ever (F) and new (N) episodes reported from GP weekly returns data, and applied this rate to each of our areas of interest.$^{18,32,33}$

Confidence intervals for both measures are constructed using an online PIM calculator, which uses computer-based simulation and examines the spread of PIN-ER-t and NEPP after calculating it many times while varying outcome incidence, risk factor prevalence and relative risk at random.$^{34,35}$

### Results

**Methadone treatment**

Increasing methadone treatment uptake from its current levels to 90% would prevent 21 (95% CI: 11–34) deaths in Manchester, 218 (95% CI: 114–339) in Greater London and overall 1243 (95% CI: 641–1953) in England in one year (see Appendix for formula and terms in Supplementary data). The calculation does not take into account the impact of less common treatments methods in use on heroin user mortality.

All figures used in the calculation are presented in table 1. The baseline risk of death is assumed to be similar across the country. The proportion eligible for treatment is the product of treatment adherence rate$^{36}$ which is also assumed to be similar across the country, and the proposed increase in treatment uptake rates.

**Smoking cessation**

We have explored the reduction in the incidence of asthma in a year, which could be achieved from reducing prevalence of smoking from its current level to 20%—i.e. to the lowest level found in England in both sexes; table 2 displays the data used for the calculation of PIN-ER-t. In males 2 (95% CI: –22

### Table 1 Data collected to calculate NEPP for heroin-user mortality

<table>
<thead>
<tr>
<th>Formula</th>
<th>Manchester</th>
<th>Greater London</th>
<th>England</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>322552</td>
<td>5268628</td>
<td>32670524</td>
</tr>
<tr>
<td>$P_d$</td>
<td>0.0147</td>
<td>0.0077</td>
<td>0.0073</td>
</tr>
<tr>
<td>$c_d$</td>
<td>0.0161</td>
<td>0.0161</td>
<td>0.0161</td>
</tr>
<tr>
<td>$RRR$</td>
<td>0.75 (0.67–0.81)</td>
<td>0.75 (0.67–0.81)</td>
<td>0.75 (0.67–0.81)</td>
</tr>
<tr>
<td>$P_n$</td>
<td>0.37</td>
<td>0.45</td>
<td>0.42</td>
</tr>
</tbody>
</table>

$a$: [(proportion to be treated) – (proportion already treated)] × treatment adherence rate$^{36}$

### Table 2 Data collected to calculate PIN-ER-t for asthma where $t = 1$ year

<table>
<thead>
<tr>
<th>Formula</th>
<th>Manchester</th>
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<th>England</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>288513</td>
<td>4827371</td>
<td>30336106</td>
</tr>
<tr>
<td>$P_s$</td>
<td>0.26 (M)</td>
<td>0.25 (M)</td>
<td>0.25 (M)</td>
</tr>
<tr>
<td>$c_s$</td>
<td>0.23 (F)</td>
<td>0.20 (F)</td>
<td>0.22 (F)</td>
</tr>
<tr>
<td>$RR$</td>
<td>1.04 (M) (0.66–1.65)</td>
<td>1.04 (M) (0.66–1.65)</td>
<td>1.04 (M) (0.66–1.65)</td>
</tr>
<tr>
<td>$l_i$</td>
<td>0.006 (M)</td>
<td>0.006 (M)</td>
<td>0.006 (M)</td>
</tr>
</tbody>
</table>

$a$: RR estimation from OR$^{38}$ based on baseline risk of asthma in Swedish population$^{16}$
Population impact of reducing smoking

Greater London smoking prevalence for females is already 20% as it is for Manchester and overall for England. However, in on asthma incidence would be expected to be higher in females Therefore, the impact of reduction in the smoking prevalence asthma incidences are also higher in women than in men. found to be more likely to develop asthma compared to males; London. The strength of the relationship between smoking and already at the target rate of 20% among women in Greater regions of England but are higher in men than in women— the Number Needed to Treat, which would indicate result in disproportionate population impacts in the Greater London, and other figures are assumed to be similar. from one city to another—are quite similar in Manchester and current levels in Manchester, Greater London and in England. The prevalence rates for smoking are quite similar between—although vary from one city to another—are quite similar in Manchester and Greater London, and other figures are assumed to be similar. Therefore only the difference in treatment rates could have resulted in disproportionate population impacts in the different areas. The advantage of using the PIM NEPP here is to bring the information on the frequency of heroin use in local populations, methadone treatment effectiveness and mortality from heroin use together to produce a single figure, which is the number of heroin user deaths, which could be prevented by methadone use in our population. It takes into account the current treatment rates, and offers a population dimension beyond the Number Needed to Treat, which would indicate here how many people should be treated to prevent one heroin-user death. The prevalence rates for smoking are quite similar between the regions of England but are higher in men than in women—and already at the target rate of 20% among women in Greater London. The strength of the relationship between smoking and asthma were quantified in various publications. Females were found to be more likely to develop asthma compared to males; asthma incidences are also higher in women than in men. Therefore, the impact of reduction in the smoking prevalence on asthma incidence would be expected to be higher in females as it is for Manchester and overall for England. However, in Greater London smoking prevalence for females is already 20% and as a result a reduction in the number of female asthma cases would not be expected.

Limitations

The PIMs are simple and useful and give us extra information at local level if local data are available; otherwise they have to rely on imputation from national figures to the local level. As NEPP and PIN-ER-t are based on estimates of prevalence rates, they may over or underestimate the overall impact in the location of interest. However, the local relevance and precision of PIMs can be improved by using local surveys of risk factors. PIN-ER-t statistic is derived from PAF, and so it shares some of the limitations of PAF. Firstly, it estimates attributable outcome and not necessarily preventable outcome numbers, as it may not be possible to remove the risk factor from the population altogether. Hence the numbers may overestimate achievable impact and are therefore measures of potential impact. On the other hand, the population impact of an individual risk factor may be underestimated due to interactions between risk factors, or impacts on other disease outcomes. PIN-ER-t - and PAF- vary with differences in relative risk. Moreover, it may be argued that the local data and publications required to populate the PIM formulas may not be readily available. However, if these simple measures are found to be useful for widespread use in policy making, the future contents of public health data systems and future research agendas will be influenced and consequently the data will readily be available; there is a requirement for updating PIMs as local figures and figures from publications change.

Conclusions

The ultimate aim of public health research and local/national public health information systems is to ensure that evidence-based public health practice is happening; this can be assisted through the calculation of PIMs, which bring two types of information, i.e. local data and research findings, together.

Supplementary Data

Supplementary data are available at EURPUB online.

Acknowledgement

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Conflict of interest: None declared.
Key points

- The population impacts of smoking and smoking cessation on burden of heart disease have been explored previously.
- This paper extends the use of PIMs to drug misuse area: heroin use prevalence, treatment and all-cause mortality rates are combined with the estimated reduction in the overall mortality with methadone treatment to calculate the population impact of increased methadone treatment uptake. The population impact of smoking on asthma incidence has also been investigated as a step further to the calculation of commonly used PAF measure.
- The results indicate that increasing methadone treatment uptake to 90% would prevent 1243 deaths in England in 1 year; in males 170 and in females 2312 fewer asthma cases per year would have been expected in England, if the smoking prevalence is reduced to 20% in both sexes.
- PIMs can be useful in drawing the attention of policymakers to the impact of certain risk factors and interventions.

References

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