Road traffic crime and opioid maintenance treatment

A national cohort study

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Masteroppgave i psykososialt arbeid – selvmord, rus, vold og traumer

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Abstract

Aims This study investigated changes in road traffic crime among patients in opioid maintenance treatment (OMT) over a 9-year period: prior to, during and after treatment.

Design, setting and participants Treatment data on all patients who started OMT in Norway between 1997 and 2003 (n = 3221) were cross-linked with national criminal records. The period of observation was divided into four phases: 3 years prior to application, the waiting list period (the period between application to OMT and the first day of treatment), in-treatment, and out-of-treatment (the time between treatment episodes / after treatment).

Findings During OMT there was more than a 35% reduction in road traffic offenses overall compared to waiting-list levels among the cohort. Men represented the majority of all road traffic offenses, nevertheless experienced less reduction in road traffic offenses during OMT compared to women. The overall crime rate for road traffic offenses for males 3 years prior to application was (incidence rate (IR)) 37.27 and for females (IR) 8.55. During OMT, rates of road traffic convictions for women were reduced to two thirds of the waiting-list level (IR 2.0 versus 6.0), and for men it were reduced by a third (IR 17 versus 25). Patients who remained in continuous treatment had less road traffic offenses during treatment compared to patients who dropped out of treatment. However, these findings were not significant in the adjusted analyses. Patients with pre-treatment road traffic convictions had considerably higher odds of having intoxicated road traffic convictions during treatment (OR = 5.56 [3.56-8.68], p < 0.001), compared to those patients who had no previous pre-treatment convictions. Those who left treatment, permanently or temporarily, relapsed into high levels of convictions outside treatment.

Conclusion Road traffic offenses seem to be reduced in Norway during opioid maintenance treatment. Being a male and having a prior history of road traffic offenses are important risk factors for continued road traffic crime during treatment.

Keywords Buprenorphine, crime, maintenance treatment, methadone, road traffic offenses, retention, opioid, treatment engagement.
Introduction

Since the 1970s, heroin use has been closely associated with public health challenges and social problems worldwide (1-3). Today, heroin remains the drug that accounts for the greatest share of morbidity and mortality associated with drug use in the European Union and Norway (1). Associations between heroin-dependence and crime have been widely reported (4-7). People dependent on heroin are most often associated with drug crime offenses and acquisitive crime (8). Nevertheless, despite the fact that road traffic offenses represent a minor proportion of all crime in this group, road traffic offenses may affect the society as a whole, as it poses a serious risk to both the drivers themselves as well as the broader community (9).

Several studies have examined the relationship between drug use and road traffic accidents in the past. In a recent Norwegian study investigating patients admitted to the emergency department, it was found that 25 % of patients admitted after road traffic accidents had positive findings of psychoactive substances of which about half were for alcohol (10). These findings are in alignment with results from other countries, which have shown a high proportion of patients injured in traffic accidents testing positive of at least one illicit drug (11, 12). Individuals who have used alcohol and/or psychoactive substances, have a significantly higher probability of being involved in fatal road traffic accidents compared with people who are not influenced by such substances (9, 13-18). Research has shown that people who drive while intoxicated are as much as 55 times more likely to be involved in fatal accidents compared to drivers who are not intoxicated (13). In a recent Nordic study, drugs were detected in 4 out of 10 drivers who were killed in road traffic accidents (16).

Opioid maintenance treatment (OMT) is the most widespread treatment for heroin dependence, and has proven to be effective in a number of outcomes, including reduction of heroin use, transmitting infectious diseases and overdose mortality (19-24). Both internationally and nationally, several studies have investigated the associations between OMT and crime, and researchers have generally agreed that OMT reduces criminal activity among heroin dependent persons who are enrolled in OMT-programmes (8, 25, 26). Several factors may affect treatment outcome, and retention in treatment has been found to be important for treatment success. Patients engaged in continuous long-term treatment have been found to have less drug use and less criminal activity (27) during treatment, compared to patients who terminate OMT. Patients who drop out of treatment tend to relapse to more drug use and more criminal activity when they drop out of treatment (26).
Studies investigating driving impairment in apprehended drivers among patients in OMT have found that cases of driving impairment involving methadone alone were very rare, and that impaired driving was most frequently associated with polydrug use (9, 28). In a recent Norwegian study, Bramness and colleagues investigated whether exposure to methadone affected the risk of motor vehicle accidents with personal injury. They found that men exposed to methadone appeared to have an increased risk of being involved in road traffic accidents with personal injuries, while females had no increased risk (29).

Few previous studies have focused primarily on road traffic offenses in relation to heroin-dependent patients enrolled in opioid maintenance programmes, and currently it is not fully known to what extent OMT contributes to reducing road traffic offenses among heroin dependent persons. The present study examines the relationship between road traffic convictions and OMT, in a complete national OMT population over a 9-year period in Norway. The aims of the study were to investigate:

1. Changes in rates of road traffic offenses prior to, during and after OMT.
2. Whether or not there were gender differences in road traffic offenses among patients in OMT.
3. Retention in treatment and the levels of road traffic offenses.
4. The relationship between road traffic offenses prior to OMT with the risk of road traffic offenses during OMT.
2. Methods

2.1. Setting

In a recent international roadside study (DRUID - Driving under the Influence of Alcohol, Drugs and Medicines), where Norway and 12 other countries took part to determine how many drivers who drive with traffic dangerous agents in their blood, where 9236 saliva samples from random motorists in Norway analysed, and 3 % of them tested positive for alcohol or other drugs (30). In practice, this means that approximately one of 30 drivers on Norwegian roads drive with alcohol, illegal drug or narcotic drug in the blood. In 2010 around 9500 drug analyses were made because of suspected affected driving, and The Norwegian Institute of Public Health has shown that in approximately 6300 of these cases (blood tests and breathing tests), the drivers sat behind the wheel under the influence of alcohol (31). This shows that the numbers of drivers detected for driving under the influence in Norway are among the highest in the world (32). It can be discussed whether a possible reason why the Norwegian figures are so high, can be explained by the fact that Norway has a better system to detect people who drive while intoxicated compared to other countries, or perhaps a combination of both best practices and more drivers who drive intoxicated. However, these figures show that driving under the influence of alcohol or other substances is a substantial problem in Norway.

OMT was first implemented in Norway in 1998 as a new treatment option to heroin dependent individuals, who had not been able to benefit from other types of treatment earlier (33). OMT was integrated into the general health and social security system, and patients applied to a regional OMT centres via their general practitioner or social service centres (34). In the initial years of OMT in Norway, which also applies to the observation period of this study, the OMT-guidelines were a bit restrictive with a relatively high threshold. The age limit was 25 years, and patients must have had a significant heroin addiction for several years and tried other types of abstinence-oriented treatments previously without benefitting from it (33). Heroin dependent persons with additional somatic or psychiatric illness were given priority in the initial phase of the program. In 2010 the Norwegian Directorate of Health launched new national guidelines, with less restrictions and no age limit. The only absolute criterion for entering treatment today is opioid dependence, defined according to the ICD-10 or DSM-IV criteria. Over the past decade, OMT in Norway has increased, and in 2010 it passed 6000 patients in treatment (35), which represents about half of the 8,600-12,600
estimated to be problematic opioid users (34). Ninety per cent of these problematic opioid users are estimated to be injecting the heroin (34).

According to the guidelines published by the Norwegian Directorate of Health, patients in OMT may be granted a dispensation for a driving license, provided that certain requirements are met: the treatment is under adequate supervision and control of a named prescribing physician, the dose is set and has been stable for at least 6 months, no use of other sedative or aesthetic agents, and use of illegal drugs has ceased for at least one year (36).

2.2. Design

This is a longitudinal national cohort study, where data is obtained from complete records on all patients who have entered OMT in Norway. Additionally, official data from the Norwegian crime statistics (Statistics Norway) contained detailed information of all registered crime cases including date of crime and offense details. Data from the national OMT-register and the crime statistics were linked using the unique 11-digit identification number, assigned by the Norwegian state to all citizens.

2.3. Study sample and follow-up

The cohort comprised all persons (n=3221) who were admitted to the national OMT programme in Norway between 1997-2003. Participants were included in the study at the time they completed their application for OMT, and crime data for 3 years period prior to the application was also included.

Analyses were conducted for persons who remained in continuous treatment (n=2046) as well as those who dropped out (n=1175). The dropout group included patients who left treatment after one or several treatment episodes.

The study investigated the OMT cohort during 4 different time periods: 3 years prior to application, the waiting list period (the number of days between application to OMT and the first day of treatment), in-treatment, and out-of- treatment (the time between treatment episodes / after treatment). In case of death during or after treatment, the registered date of death was set as the date of last observation.
2.4. Measures

The Norwegian crime statistics provided data on date of crime, penal code and 4 prosecuting decisions: 1) formal charge leading to conviction, 2) formal charge leading to acquittal, 3) fines and 4) other. All convictions represent decisions finding a person guilty of a crime in the court of law. In our study, only formal charges leading to convictions were included in the analyses. Convictions for all types of offenses were recorded.

Three years prior to application for OMT it was 24,634 criminal convictions among the cohort. About 80 % of all convictions were for acquisitive crime and drug offenses. Approximately 11 % of all convictions were related to road traffic offenses, constituting the third largest crime category.

According to The Norwegian Road Traffic Act (37), it is illegal to cause or attempt to drive a motor vehicle if you are affected by alcohol or another intoxicating or aesthetic agent. This study will mainly focus on the two main variables: 1) driving under the influence of alcohol or legal/illegal drugs, 2) general violations of the Road Traffic Act. The most common general violations of the road traffic act is driving without a license, representing approximately 72 % of the category 3 years prior to treatment.

2.5. Statistical analyses

Analyses were performed by using SPSS version 19.0 and STATA version 11.0. Road traffic offense rates were calculated as convictions per 100 person-years by using incidence rates (IR: number of events/total person-years of observation) (38), with 95 % confidence intervals [CI] (39), multiplied with 100. Rates per 100 person-years can be interpreted as a simple % of all person-years in each observation period. To illustrate the effect size of OMT, rate-ratios (RR: rate in exposed/rate in unexposed) (38) with 95 % confidence intervals were calculated. Rates of convictions were stratified according to gender, and whether or not the patients remained in continuous or discontinuous treatment. Three separate multivariate logistic regression models (95 % confidence intervals [CI]) were calculated to determine the effect of age, gender, retention in treatment and pre-treatment convictions on road traffic offenses during treatment.
2.6. Ethics

The study was approved by the Regional Committees for Medical and Health Research Ethics, The Norwegian Social Science Data Services (NSD), the Norwegian Directorate of Health and the Norwegian Police Directorate. Files were merged and made anonymous by Statistics Norway.
3. Results

3.1 Patient characteristics

The cohort (n=3221) included 68 % (n=2176) men and 32 % (n=1045) women. The mean age at start of OMT was 37.7 (SD 6.6) for men and 35.5 (SD 6.6) for women. The total observation time for the cohort was approximately 20 087 person years: which included 9663 person years 3 years prior to application for OMT, 2688 person years in the waiting list period for OMT, 6447 person years during OMT, and 1289 person years between and after treatment episodes. Median years on waiting list were 0.8 (SD 1.0) years for all patients. During the observation period, about two thirds (n=2046) of the cohort remained in continuous treatment, while 36.5 % (785 men and 390 women) dropped out of treatment on at least one occasion.

3.2 Road traffic offenses three years prior to OMT application

During the three-year period prior to OMT application, road traffic offenses accounted for approximately 11 % (n= 2701) of all convictions (n=24 634) in total. Of all road traffic offenses, 27 % (n=734) of the convictions were related to driving under the influence of alcohol or legal/illicit substances, and 73 % (n=1967) convictions were related to general violations of the Road Traffic Act, such as driving without a licence.

In the three-year period prior to application, 757 persons (24 %) within the cohort had at least one conviction for road traffic offenses. Males contributed with the highest rate of road traffic offenses in the study population, and were more likely to have multiple convictions compared to women: 641 men (30 % of the men) had 2433 convictions (mean 3.8, range 1-41), and 116 women (11 % of the women) had 268 convictions (mean 2.3, range 1-11). The overall crime rate for road traffic offenses for males 3 years prior to application was 37.27 [37.23-37.31] and for females 8.55 [8.43-8.67] (Rates per 100 person-years).

3.3 Road traffic offenses before, during and after OMT

Rates of convictions for all crime and road traffic offenses stratified by gender are shown in Table 1. There was a 36 % reduction in road traffic offenses during OMT (Table 1). There were large gender differences in road traffic offenses both before and during treatment;
however, both genders had a significant reduction in road traffic offenses during OMT compared to pre-treatment levels. For men, road traffic offenses were reduced by 30% (RR 0.7) compared to waiting-list levels, and among women road traffic offenses were reduced by 67% (RR 0.33) compared to waiting-list levels (Table 1).

Table 1. Rates of convictions for all crime and road traffic offenses, prior to, during and after OMT, for both females and males

<table>
<thead>
<tr>
<th></th>
<th>3 yrs. prior to application</th>
<th>Waiting list</th>
<th>In treatment</th>
<th>Rate ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IR [95% CI]</td>
<td>IR [95% CI]</td>
<td>IR [95% CI]</td>
<td>RR [95% CI]</td>
</tr>
<tr>
<td>All crime</td>
<td>254.93 [254.92-254.94]</td>
<td>183.39 [183.36-183.42]</td>
<td>72.53 [72.50-72.56]</td>
<td>0.40 [0.38-0.42]</td>
</tr>
<tr>
<td>All crime males</td>
<td>300 [299.99-300.01]</td>
<td>217.45 [217.42-217.48]</td>
<td>88.37 [88.34-88.40]</td>
<td>0.41 [0.39-0.43]</td>
</tr>
<tr>
<td>All crime females</td>
<td>160 [159.97-160.03]</td>
<td>107.01 [106.94-107.08]</td>
<td>41.81 [41.75-41.87]</td>
<td>0.39 [0.36-0.43]</td>
</tr>
<tr>
<td>All road traffic offenses</td>
<td>27.95 [27.91-27.99]</td>
<td>19.05 [18.96-19.14]</td>
<td>12.10 [12.03-12.17]</td>
<td>0.64 [0.57-0.72]</td>
</tr>
<tr>
<td>All road traffic offenses males</td>
<td>37.27 [37.23-37.31]</td>
<td>24.80 [24.71-24.89]</td>
<td>17.28 [17.21-17.35]</td>
<td>0.70 [0.62-0.79]</td>
</tr>
<tr>
<td>All road traffic offenses females</td>
<td>8.55 [8.43-8.67]</td>
<td>6.15 [5.88-6.42]</td>
<td>2.05 [1.76-2.34]</td>
<td>0.33 [0.22-0.49]</td>
</tr>
</tbody>
</table>

a Incidence Rate (IR): number of events/total person years of observation x 100 (Rates per 100 person-years).

b Rate Ratio (RR): rate in treatment/rate in waiting list.

3.4 Driving under the influence and general road traffic offenses before, during and after OMT

During the waiting list period, men had a crime rate of 6.35 [6.17-6.53] for driving under the influence of alcohol or legal/illegal substances, and a crime rate of 18.45 [18.34-18.56] for general road traffic offenses. During treatment, there was nearly a 40% (RR 0.61 [0.53-0.70]) reduction in general convictions for road traffic offenses. However, the reduction was only minor, about 6% (RR 0.94 [0.76-1.17]) for driving intoxicated during treatment.

When stratifying men in the cohort according to whether they were in continuous treatment or not, the pre-treatment rates for general road traffic offenses were found to be higher among those men dropping out of treatment (IR 22.04 [22.19-21.89]), compared to those in continuous treatment (IR 15.83 [15.68-15.98]) (Figure 1). For driving intoxicated, the pre-
treatment rates were similar for both men in continuous (IR 6.42 [6.18-6.66]) and discontinuous (IR 6.24 [5.96-6.52]) treatment (Figure 1).

During treatment, men in continuous treatment had more than a 40 % (RR 0.56 [0.46-0.68]) reduction in general road traffic offenses and almost a 20 % (RR 0.76 [0.57-1.01]) reduction in intoxicated driving (Figure 1). A less marked reduction in general road traffic offenses were found for men in discontinuous treatment (RR 0.77 [0.63-0.94]), and the conviction rate for intoxicated driving actually increased during treatment (RR 1.37 [0.98-1.92]) compared to pre-treatment levels (Figure 1).

Men who dropped out of treatment were found to have a significantly higher rate of general road traffic offenses in the period after treatment (IR 30.66 [30.54-30.78]), while the rate of intoxicated driving remained similar (IR 8.79 [8.57-9.01]) as during treatment (Figure 1).

**Figure 1:** Males (n=2176) - Road traffic offenses prior to, during and after OMT for patients in continuous treatment and dropout. Y-axis: Incidence Rate (IR): number of events/total person years of observation x 100 (Rates per 100 person-years).

During the waiting list period, women had a crime rate of 2.17 [1.71-2.63] for driving under the influence of alcohol or legal/illegals substances, and a crime rate of 3.98 [3.64-4.32] for general road traffic offenses. During treatment, there was nearly a 76 % (RR 0.24 [0.14-0.41])
reduction in general convictions for road traffic offenses, and a 50 % (RR 0.50 [0.27-0.92]) reduction for driving intoxicated.

When stratifying women in the cohort according to whether they were in continuous or discontinuous treatment, the pre-treatment rates of general road traffic offenses for the dropout group (IR 5.21 [4.76-5.66]) was higher than the pre-treatment rates for the continuous group (IR 3.02 [2.50-3.54]). The pre-treatment rates for driving intoxicated for the continuous group (IR 1.94 [1.29-2.59]) was lower compared to those who dropped out of treatment (IR 2.47 [1.82-3.12]) (Figure 2).

During OMT, women in continuous treatment had an 82 % (RR 0.18 [0.08-0.43]) reduction in general road traffic offenses, and a 52 % (RR 0.48 [0.21-1.11]) reduction of intoxicated driving. For the women in discontinuous treatment, it was a 42 % (RR 0.58 [0.24-1.43]) reduction of driving intoxicated, and a 64 % (RR 0.36 [0.18-0.73]) reduction of general road traffic offenses (Figure 2).

The women who dropped out of treatment had a significant increase (IR 4.0 [3.52-4.48]) of general road traffic offenses when they were out of treatment, while the rate of intoxicated driving (IR 1.88 [1.19-2.57]) had a minor increase compared to in-treatment levels (Figure 2).

![Figure 2](image-url)  
**Figure 2:** Females (n=1045) - Road traffic offenses prior to, during and after OMT for patients in continuous treatment and dropout. Y-axis: Incidence Rate (IR): number of events/total person years of observation x 100 (Rates per 100 person-years).
3.5 Factors associated with road traffic offenses during treatment

Some factors were found to be associated with criminal convictions during treatment (Table 2). Women had lower odds of having any road traffic offenses during treatment compared to men when stratified into general and intoxicated road traffic offenses. Age was not significantly associated with general road traffic offenses, but age was significantly related to intoxicated driving: the odds decreased by a factor of OR = 0.98 [0.95-1.0], p < 0.05), for each year holding all other variables constant. Patients who remained in continuous treatment had lower odds of having road traffic offenses compared to patients who dropped out of treatment, but these trends were not significant. Patients with pre-treatment road traffic convictions, had considerably higher odds of having intoxicated road traffic convictions (OR = 5.56 [3.56-8.68], p < 0.001), compared to those patients who had no previous pre-treatment convictions.

Table 2. Odds for road traffic offenses during OMT by gender, age, retention in treatment and pre-treatment criminal convictions

<table>
<thead>
<tr>
<th></th>
<th>Any road traffic offenses</th>
<th>General road traffic offenses</th>
<th>Intoxicated driving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (CI)</td>
<td>P-value</td>
<td>OR (CI)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (reference)</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Women</td>
<td>0.22 [0.14-0.35]</td>
<td>&lt;0.001</td>
<td>0.20 [0.11-0.35]</td>
</tr>
<tr>
<td>Age a</td>
<td>0.98 [0.96-1.00]</td>
<td>0.059</td>
<td>0.98 [0.96-1.01]</td>
</tr>
<tr>
<td>Retention in treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drop out (reference)</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Continuous</td>
<td>0.82 [0.63-1.07]</td>
<td>0.148</td>
<td>0.77 [0.56-1.05]</td>
</tr>
<tr>
<td>Pre-treatment convictions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No convictions (reference)</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Other criminal convictions</td>
<td>1.62 [1.12-2.35]</td>
<td>0.011</td>
<td>1.86 [1.15-3.01]</td>
</tr>
<tr>
<td>Any road traffic convictions</td>
<td>3.73 [2.61-5.33]</td>
<td>&lt;0.001</td>
<td>5.56 [3.56-8.68]</td>
</tr>
</tbody>
</table>

**a** The odds for one unit increase/decrease of change in the explanatory variable given all other held constant in the model.
4. Discussion

Opioid maintenance treatment was found to be associated with significant reductions of criminal convictions in relation to the Road Traffic Act in this national cohort. During treatment, the overall rates of road traffic convictions were reduced by one third of pre-treatment levels. During all periods of follow-up, gender differences were evident; men accounted for the majority of all road traffic offenses compared to women. Patients with pre-treatment road traffic convictions had noteworthy higher odds of having road traffic offenses during treatment.

Three years prior to treatment application, road traffic offenses accounted for about 11% of all crime in this cohort, and about ¼ of these were related to intoxicated driving. In comparison, the mean percentage of intoxicated driving in the normal population in the same time period (1995-1997) was about 3% (40). This shows that the participants of this study are a high-risk group with regards to driving while intoxicated. Reduction of violation of the Road Traffic Act among heroin-dependent individuals is therefore an important benefit in terms of reduced risk of fatal accidents, for both the heroin-dependents themselves as well as society as a whole (9).

The total number of road traffic convictions among women decreased by 67% and for men by 30% while they were in treatment. The results from our study show that OMT has a significant effect in relation to reducing road traffic crime among heroin-dependent people. These findings are similar with findings in previous studies, both nationally (8, 26) and internationally (41), which have found reduced levels of criminal activity among heroin-dependent people after entering OMT.

Prior convictions for road traffic offenses seem to impose a particularly high risk of being convicted for road traffic offenses again during treatment, and the risk was especially high for driving under the influence. In contrast to an Australian study (9), but similar to those of other studies (26, 42), noteworthy gender differences in road traffic convictions were found among our sample of OMT patients. During the three years before treatment, 30% of the men in the cohort had committed a criminal offense in relation to the Road Traffic Act, compared to only 11% of the women. Overall, it was 2701 violations of the Road Traffic Act among the cohort in the three-year period prior to treatment, where men accounted for 90% of the convictions. Those men, who committed road traffic offenses, had on average nearly twice as many convictions compared to the women who committed road traffic offenses during the same
period. These proportions can be seen as corresponding to numbers from the general population, where men have been found to account for 80% of the car accidents involving fatal or serious injuries in Norway (43). This is in alignment with the Australian study which found males and females equally likely to drive, however, they did find that males were more likely to have had a road traffic accident compared to females while they were intoxicated (9).

Retention in treatment is related to improved overall outcomes for substance use, injecting risk behaviour, social functioning, health, mortality, (19) and criminal behaviour (4, 25, 26). However, the results in this study showed somewhat varied results with regard to retention in treatment. In the stratified analyses, the dropout group including both genders had an 18% reduction in road traffic convictions during treatment, and the continuous group for both females and males had a 43% reduction of crime in the same period. This indicates that drug dependence treatment is optimized when patients remain in continuing care (44). Men in discontinuous treatment, however, experienced an increase in the number of convictions for intoxicated driving during treatment. Results from the adjusted regression analyses further showed that there were no significant differences between patients in continuous treatment and non-continuous treatment with regards to road traffic convictions during treatment. However, based on the findings of the regression analyses, it is previous convictions, both general crime and road traffic offenses, which is the largest risk factor in relation to predict future road traffic offenses.

4.1. Limitations

Interpretation of these findings should take into account certain study limitations. First, the official crime statistics records are known to underestimate the actual numbers of criminal activity. Intoxicated driving is a crime that is often more difficult to detect compared with, for example, speeding (45), and according to the Institute of Transport Economics, only one in about 600 thousand trips are detected (46). However, despite the number of convictions being underestimated, we could compare the number of convictions within the four different time phases (3 years prior to application, waiting list period, treatment period and post treatment period), and as a result we were able to assess the changes of observed rates of criminal convictions, which gives us an indication of how the actual crime pattern may change. However, it must be taken into account that road traffic offenses are a minor part of all crime in this cohort, and due to small numbers and the fact that the analyses have additionally been
stratified on several variables, such as gender and retention in treatment, those results must be interpreted carefully.

Second, there was no information available about the patient’s overall health status, but since the OMT guidelines were strict and patients with severe somatic and psychiatric diseases were prioritized during the first years of OMT in Norway (33), it is likely that some of the patients included in this study had psychiatric comorbidity. Another limitation is the lack of information about why some patients dropped out of treatment, and also the absence of information about whether patients in the study population spent some time in prison, hospitals or other institutions, which may have removed or reduced their ability to commit criminal activity during the observation period.

The study has also certain strengths. Firstly, it is a longitudinal cohort study with a complete national cohort, comprising 3221 patients during 20 086 person-years. The study includes patients in both dropout and continuous treatment, which has made it possible to study the effect of patients, who fluctuate between being in care or those who drop in and out of treatment. Another clear strength of this study is the fact that we have used conservative numbers when calculating the effect of treatment, where we used the figures from the waiting list period instead of figures from three years prior to application for OMT, when calculating the rate ratio. Finally, the use of convictions as a measure of crime rather than self-reporting of crime, prevents us from having to deal with the challenges associated with studies that use self-report and hence recall bias.

4.2. Clinical implications

Annually, 200-250 people are killed in road traffic accidents in Norway (15, 47). In two of three fatal accidents where only one car is involved, the driver has ingested alcohol or other drugs shortly before the accident (48). Heroin dependent persons, untreated in terms of OMT, are overrepresented with regard to driving under the influence, and may represent a high-risk group in terms of being involved in fatal car accidents. During OMT, rates of road traffic offenses are reduced in this national cohort of patients. However, the reduction of road traffic offenses is not as pronounced as the reduction of criminal activity in general. This study shows that men are less affected by treatment when using road traffic as an outcome. In other studies where they have looked at gender differences in relation to crime in general among
heroin-dependent people (49), they found a need to adapt the treatment to a greater extent in relation to the different needs of women and men. As this study shows, men are a high-risk group for road traffic offenses. It may therefore be necessary to adapt the treatment in a better way with regards to different needs among the genders, in order to prevent future accidents.

There may be a less than optimal collaboration between the justice sector and the health sector regarding OMT patients who are caught for road traffic offenses. Therefore the introduction of formal contact between the treatment providers and the justice system in these cases may open a window of opportunity for preventive measures among patients. If treatment providers are notified, this could be an opening for counselling about the risks of driving while in OMT.

**Declaration of interest**

None.
References

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