


# Diabetes hospitalizations and deaths in a cohort of treatment-seeking illicit drug users

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## Abstract

**Background:** Studies on diabetes among illicit drug users are scarce in Finland. This study aimed to describe hospitalization and death due to diabetes among treatment-seeking illicit drug users.

**Methods:** Information of 4817 treatment-seeking drug users (3365 men and 1452 women) aged 11–65 years (mean 24.5 years) was linked to the Finnish national hospital discharge register and the national death registry to identify those clients who were hospitalized or died from diabetes mellitus during 1997–2013.

**Results:** Fifty-three persons (42 men and 11 women) had primary diagnoses of diabetes, with a total of 146 hospitalizations (121 among men and 25 among women). The total length of stay among men (1183 days) far exceeded those of women (138 days). Overall, type 1 diabetes was the main contributor to hospitalizations (67%,  $n = 98/146$ ). The proportion of Type 1 diabetes with complications was 31% in men ( $n = 37/121$ ) and 44% in women ( $n = 11/25$ ). All cases of deaths due to diabetes ( $n = 7$ ) occurred in men.

**Conclusion:** Diabetes hospitalizations were mainly due to Type 1 diabetes. Longer length of hospital stay was observed in men, and all diabetes deaths occurred among men. Male drug users and drug users in general would require more support to reduce morbidity and mortality due to diabetes.

## Keywords

Diabetes mellitus, hospitalizations, deaths, substance abuse, register linkage, cohort study, epidemiology

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## Introduction

Diabetes and its complications among illicit drug users have been reported in different population samples.<sup>1–3</sup> Hospitalizations due to diabetes ketoacidosis (DKA) and other known diabetes complications have been linked to substance abuse. A recent study carried out in a Spanish population suggested that illicit drug use may have a role in diabetes-related hospitalization.<sup>3</sup> Likewise, a study among Polish adolescents found that cannabis use was associated with a poorer glycemic control among teenagers with Type 1 diabetes.<sup>4</sup> Reports from Umpierrez et al.<sup>5</sup> and Warner et al.<sup>6</sup> showed that cocaine use is related to some of the adult DKA admissions. However, Modzelewski et al.'s study<sup>7</sup> found no association between active cocaine use at the time of hospital admission and development of hyperglycemic crisis. Omission of insulin therapy by people with diabetes is directly associated with acute and increased hospital admissions due to DKA and other diabetes-related hospitalization.<sup>8</sup>

Several factors were examined in a multi-ethnic study which evaluated the precipitating factor for frequency of intentional skipping of insulin injection but illicit drug use was neither investigated nor reported.<sup>9</sup> A US-based study which investigated the causes of insulin therapy cessation among DKA

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patients also did not report on illicit drug use,<sup>10</sup> thus underestimating the contribution of illicit drug use to DKA and DKA-related admissions.

Diabetes-related mortality is also on the increase among this subpopulation of illicit drug users.<sup>11,12</sup> Neglect in taking the history of recreational drug use among people with diabetes, and especially among those with history of frequent hospitalization, has been suspected as a possible explanation for the adverse profile in this subpopulation.<sup>3</sup> A recent study by Jacobsen et al.,<sup>11</sup> which reviewed the terminal hospitalization records of organ donors with Type 1 diabetes, showed that anoxia secondary to illicit drug overdose was the leading cause of death. Furthermore, a case report of a 19-year-old woman with diabetes who used ecstasy and alcohol and was later found dead the following day provided further grounds for concern regarding diabetes mortality in this subpopulation.<sup>12</sup> It is therefore important to focus resources on the management of substance abuse problems. In the general population, age, male gender, education, income, and presence of comorbidity have been associated with non-adherence to oral anti-hyperglycemic agent use among people with Type 2 diabetes.<sup>13</sup> In Type 1 diabetes, diet non-adherence is a more prominent risk factor for insulin omission.<sup>9</sup> However, little is known about the influence of these factors among illicit drug users with diabetes.

In Finland, data on hospitalizations and deaths due to diabetes among illicit drug users are scarce. Some researchers had previously investigated the association between substance use and diabetes, and the focus of their research was the association between alcohol consumption and Type 2 diabetes.<sup>14</sup> However, their study samples (Finnish Twin Cohort) were not drawn from a drug-using population and there was no information about illicit drug users. To the best of our knowledge, we are not aware of any study that has investigated diabetes morbidity and mortality among illicit drug users. We therefore described hospitalization and death due to diabetes among illicit drug users.

## Methods

All Finnish citizens and permanent residents have a unique personal identification number that makes it possible to perform linkage to health and administrative registers at individual level. The study population comprised 3365 men and 1452 women who sought drug abuse treatment at the Helsinki Deaconess Institute (HDI) during 1997–2008. Their primary drugs of abuse reported at initial clinical consultation at HDI included opiates, stimulants, cannabis, medication, alcohol, and other drugs. Detailed descriptions of the study population and data collection method have been provided elsewhere.<sup>15</sup> Clients' information was linked to the national hospital discharge register and the national death registry, and they were followed-up to December 2013 or death, whichever came first, in order to identify hospitalizations and deaths, respectively. In both registers, diagnoses were recorded using the 10th version of the International Classification of Disease (ICD-10) codes. This study considered only a subset of the

clients whose main/primary hospitalization diagnoses and whose underlying causes of death were recorded as ICD-10 codes E10–E14 denoting diabetes mellitus.

Statistical Package for Social Sciences (SPSS) software version 21 for Windows (IBM Corporation, Armonk, NY) was used for all analyses. Data were presented as frequencies, proportions, means, and standard deviation (SD). The research ethics committees of the Kuopio University Hospital and the HDI, the Ministry of Social Affairs and Health of Finland, and appropriate municipal authorities gave approval for the study.

## Results

### Baseline characteristics

Of the 4817 clients, nearly all of them (98%) were Finnish citizens. Seven out of 10 clients (70%) were men and 30% were women. The mean age of the clients was 24.5 years (range: 11–65 years, SD 8.1). Out of the 3784 persons with complete data for marital status, 84% were not married, 8% were married/cohabiting, and 9% were separated/divorced/widowed. Their primary drugs of abuse reported at baseline/initial clinical consultation included opiates (30%) mainly heroin and buprenorphine, stimulants (28%) mainly amphetamines, cannabis (19%), alcohol (21%), prescription medication (2%) mainly benzodiazepines, and other drugs (1%). A more detailed description of the baseline characteristics of the entire cohort can be found elsewhere.<sup>15</sup>

### Diabetes hospitalizations

Individual ICD-10 diagnoses and the observed numbers of hospitalizations are shown in Table 1. Information from the national hospital discharge register revealed that 53 persons had primary diagnosis of diabetes at the end of 2013. Of these, 42 were men and 11 were women. These 53 persons accumulated a total of 146 hospitalizations, 121 among men, and 25 among women. Overall, hospitalizations for Type 1 diabetes were higher than Type 2 diabetes and accounted for 98 out of the 146 hospitalizations (Table 1). Of the overall 98 hospitalizations due to Type 1 diabetes, 48 were with complications and 35 of these complications were DKA. In terms of gender, the number of Type 1 diabetes with complications was higher in men (37 hospitalizations) than in women (11 hospitalizations). However, the proportion of Type 1 diabetes complicated by DKA was higher in women (10 of 11 hospitalizations) than in men (25 out of 37 hospitalizations). The total length of hospital stay in men (1183 days) far exceeded those of women (138 days).

### Diabetes deaths

Deaths in the cohort due to diabetes are presented in Table 2. Information from the national death registry revealed that a total of seven deaths had occurred by the end of 2013. All deaths occurred among men and they were due to

**Table 1.** Observed numbers of hospitalizations due to diabetes and its complications among illicit drug users during 1997–2013.

Main diagnosis	ICD-10 codes	Observed number of hospitalizations		
		All	Males	Females
<b>Type 1 diabetes</b>				
Type 1 diabetes mellitus with coma	E10.0	2	2	0
Type 1 diabetes mellitus with ketoacidosis	E10.1	35	25	10
Type 1 diabetes mellitus with renal complications	E10.2	2	2	0
Type 1 diabetes mellitus with peripheral circulatory complications	E10.5	1	1	0
Type 1 diabetes mellitus with other specified complications	E10.6	1	1	0
Type 1 diabetes mellitus with multiple complications	E10.7	7	6	1
Type 1 diabetes mellitus without complications	E10.9	50	46	4
<b>Type 2 diabetes</b>				
Type 2 diabetes mellitus with coma	E11.0	4	3	1
Type 2 diabetes mellitus with ketoacidosis	E11.1	3	2	1
Type 2 diabetes mellitus with renal complications	E11.2	3	2	1
Type 2 diabetes mellitus with neurological complications	E11.4	2	2	0
Type 2 diabetes mellitus with peripheral circulatory complications	E11.5	1	1	0
Type 2 diabetes mellitus with multiple complications	E11.7	2	1	1
Type 2 diabetes mellitus without complications	E11.9	19	16	3
<b>Others</b>				
Other specified diabetes mellitus with unspecified complications	E13.8	2	2	0
Other specified diabetes mellitus without complications	E13.9	1	1	0
Unspecified diabetes mellitus with ketoacidosis	E14.1	1	1	0
Unspecified diabetes mellitus without complications	E14.9	10	7	3
<b>Total</b>		<b>146</b>	<b>121</b>	<b>25</b>

Fifty-three persons generated a total of 146 hospitalizations.

complications such as coma, ketoacidosis, and multiple complications.

## Discussion

This study described the diabetes and diabetes-related hospitalizations and mortality among 4817 clients who sought drug abuse treatment at HDI. It showed that Type 1 diabetes and its related complications were the main contributors to hospitalization. Men had more primary diagnosis of Type 1 diabetes, higher total number of diabetes-related hospitalizations, and accumulated higher total length of hospital stay than women. Type 2 diabetes contributed one-third of the hospitalizations. All deaths from diabetes occurred in men.

Given the mean age of our cohort, this finding is in keeping with what obtains in the general population in which more cases of Type 1 diabetes are known to occur more among young adults.<sup>16</sup> It is known that non-compliance or omission of insulin therapy is strongly associated with poor glycemic control in Type 1 diabetes and this often leads to acute hospital admission with or without complication.<sup>8</sup> Alcohol and other substances of abuse have been suggested by some authors as the contributing factors to poor insulin therapy compliance.<sup>17,18</sup> Although cannabis, tobacco, and cocaine use were all associated with non-compliance with

insulin therapy in Nyenwe et al.'s study,<sup>19</sup> they found that cocaine use was an independent risk factor for having more DKA-related admissions. In a similar vein, a higher proportion of those with primary diagnosis of diabetes in our study reported stimulants as the primary drug of abuse compared to the other members of the cohort (45.3% vs 27.5%, respectively), followed closely by opiate use (32.1% vs 29.7%, respectively, data not shown). However, Modzelewski et al.'s study<sup>7</sup> found no association between active stimulant/cocaine use at the time of hospital admission and development of hyperglycemic crisis. Apart from insulin omission, there may be other potential mechanisms for hyperglycemic crisis. Drug users tend to have poor health. The presence of infections and other morbidities could trigger secretion of counter-regulatory hormones that promote hyperglycemia. Furthermore, drug such as cocaine by itself can directly impact the secretion of these counter-regulatory hormones.<sup>7</sup>

Two previous studies<sup>1,3</sup> that examined illicit drug use among people with diabetes reported conflicting results. Although information about the hospitalization status of the Chilean participants in Martinez-Aguayo et al.<sup>1</sup> study was not provided, they found a lower lifetime rate of use of illicit drug among adolescents with diabetes when compared to the general population without diabetes. However, a Spanish study by Isidro and Jorge<sup>3</sup> found that the frequency of illicit

**Table 2.** Diabetes deaths among illicit drug users by underlying causes, 1997–2013.

Underlying cause of death	ICD-10 codes	Deaths		
		All	Males	Females
Type 1 diabetes mellitus with coma	E10.0	1	1	0
Type 1 diabetes mellitus with ketoacidosis	E10.1	2	2	0
Type 1 diabetes mellitus with multiple complications	E10.7	1	1	0
Type 2 diabetes mellitus with coma	E11.0	2	2	0
Unspecified diabetes mellitus with ketoacidosis	E14.1	1	1	0
Total		7	7	0

drug use was high among patients with diabetes ketosis and DKA who were screened for history of drug use. They found that over half of the episodes of diabetes ketosis and DKA had a history of illicit drug use. This supports our findings in which most of the hospitalizations due to Type 1 diabetes complications were as a result of DKA.

In our study, we observed that all the deaths from diabetes occurred in men. A previous nationwide Finnish study which assessed the time trend in mortality among patients in the general population with Type 1 diabetes showed higher standardized mortality ratios in women than in men.<sup>20</sup> It is tempting to speculate that the gender disparity in mortality among people living with diabetes is different from that observed among illicit drug users with diabetes. This disparity could be due to the small sample size of our study cohort.

There are documented pathophysiological explanations for hospitalization and/or death due to diabetes among illicit drug users. Authors have suggested an increase in recreational use of drug among young people with Type 1 diabetes in order to handle the emotional burden of this chronic disease condition.<sup>21</sup> Cocaine which is often used for its euphoric effect is an independent risk factor of recurrent admission due to DKA.<sup>6</sup> Many of the illicit drugs are associated with elevated catecholamines, which can inhibit insulin secretion,<sup>22</sup> increase glucagon secretion,<sup>23</sup> and stimulate free fatty acids production,<sup>21,24</sup> thereby promoting oxidative stress in the tissues. These changes lead to increased ketosis, DKA and recurrent hospitalizations, and even death if there is a delay in treatment.

The limitations of this study need to be acknowledged. The small sample of persons with diabetes in this cohort did not allow for sophisticated statistical analysis. There was no information about patients with diabetes at baseline and we could not estimate risks of hospitalization for different subgroups. The cohort consisted of treatment-seeking drug users and our findings may not be generalizable to non-treatment seekers. We do not have information about the clients' active drug use at the time of their hospitalization. It is possible that there might have been some changes in drug use behaviors. This is a descriptive study that reported the proportions of diabetes-related hospitalization and mortality and as such causality cannot be inferred. Despite these limitations, this study provided useful information about hospitalizations due to diabetes

among illicit drug users. This article will create awareness so that physicians involve in the management of diabetic patients will make more effort to explore history of drug use in their patients and counsel or refer them for drug abuse treatment. The paper will also encourage further research in this area possibly using a different study design and more extensive data.

In conclusion, our study showed that Type 1 diabetes contributed more to hospitalizations in this cohort of illicit drug users than Type 2 diabetes. Men as compared to women accumulated longer length of hospital stay, and all the persons who died from diabetes were men. Male drug users were disproportionately affected and this might reflect the fact that male clients far outnumbered females in this cohort. That said, more effort is needed to address drug abuse problems in order to reduce morbidity and mortality due to diabetes. Furthermore, toxicological screening of illicit drug use especially among patients with history of frequent readmissions following diabetes complication could prove useful in early recognition of illicit drug use as a risk factor for diabetes complications and hospitalization; this early recognition with appropriate treatment will help in reducing the diabetes-related morbidity and mortality. In addition, educating patients on the need to adhere to diabetes treatment and on the potential health hazards of substance use in hyperglycemia may also help to reduce diabetes complications and hospitalization. Further studies with larger samples and extensive adjustment for known confounders of diabetes are needed to assess the contributions of each type of illicit drugs to morbidity and mortality due to diabetes among this subpopulation.

### Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Ethical approval

Ethical approvals were obtained from the Research Ethics Committee of the Kuopio University Hospital and the Ethics Committee of Helsinki Deaconess Institute. Permissions were obtained from the Ministry of Social Affairs and Health of Finland and from appropriate municipal authorities of all Greater Helsinki area communities where clients resided.

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## Informed consent

Informed consent was not necessary because Finnish legislation permits the use of medical records (without personal identifiers) for medical and health research with permission from government/institutional authorities.

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