Prevalence of hepatitis C in drug users in Flanders: determinants and geographic differences

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SUMMARY

The prevalence of hepatitis C and related risk factors in drug users were compared in two geographic regions in Belgium, the city of Antwerp and the mixed urban–rural area of Limburg. All 310 participants were surveyed and screened for hepatitis B, hepatitis C and HIV. Prevalence rates of anti-HCV, anti-HBc and anti-HIV were 71, 62 and 4% in Antwerp and 46, 21 and 0% in Limburg respectively. Injecting drug use, duration of injecting drug use, work as a commercial sex-worker, originating from Turkey or Northern Africa, marginalization and anti-HBc positivity were identified as independent predictors for hepatitis C infection. In this study an important difference in HCV seroprevalence among drug users in a methadone maintenance programme across two geographic regions in Belgium was demonstrated. This was explained not only by variations in drug-related risk behaviour, but also by differences in sexual risk behaviour and socio-economic status.

INTRODUCTION

Hepatitis C virus (HCV) was first identified in 1989 as a major causative agent of post transfusion non-A, non-B hepatitis. According to WHO estimates, in 1997, approximately 3% of the world population, or about 170 million people may be infected with hepatitis C [1].

In Flanders, Belgium HCV antibody is found in 0·9% of the general population [2]. One of the main routes of transmission was exposure to infected blood. Since the introduction of systematic screening of blood and blood-derived products, the main risk factor for acquiring hepatitis C in industrialized countries is injecting drug use. In this population transmission of hepatitis C occurs primarily through sharing contaminated injecting materials, primarily needles and syringes, but evidence is growing that other materials like filters, spoons and rinse water may be responsible for a proportion of HCV infections among injecting drug users (IDU) [3–7].

The impact on the total epidemic burden of HCV of other routes of transmission such as sexual or household exposure to an infected person is not clear. The prevalence of hepatitis C antibody in non-IDU is also considerably higher than in the general population. It has been suggested that in this population transmission could occur via sharing snorting materials, via high risk sexual behaviour, or via household contacts with IDU [8].

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A systematic review revealed a considerable variability of the prevalence of HCV in IDU within Western Europe with rates varying between 37 and 98 % [9].

No conclusive explanation could be given for this geographic variability. Therefore, an epidemiological study was undertaken to compare the prevalence of hepatitis C and related risk factors in two centres situated in distinct geographic areas in the same country, more specifically an urban and a mixed urban–rural area.

MATERIALS AND METHODS

Study population

Patients were recruited in two outpatient centres in Flanders, Belgium. These medico-social centres were established in 1997 through out Belgium by the Belgian Ministry of Health to provide medical and psychosocial care to problematic illegal drug users. These centres share the composition of their therapeutic team, their target group, being the most problematic drug users in their region and their working methods according to the principles of harm reduction. The latter comprises a set of practical strategies that reduce negative consequences of drug use, incorporating a spectrum of strategies from safer use, to managed use, and finally, abstinence. At the time of the study, needle exchange did not exist in Belgium.

Both centres are located in northern Belgium (Flanders). One is in downtown Antwerp, a port town with approximately 450 000 inhabitants. The other centre covers most of the province of Limburg, a mixed urban–rural population where even the largest cities have no more than 60 000 inhabitants.

For reasons of comparability, only patients engaged in a methadone maintenance programme were included. All patients seen in a methadone programme during an 18-month period in 1999–2000, were eligible for the study except those who had been previously treated for hepatitis C. This study was approved by the Ethical Committee of The Catholic University of Leuven. Before inclusion, patients were informed about the study and asked to sign a written consent form.

Data collection and laboratory methods

All participants were interviewed by means of a standardized interview for information on their socio-demographic status, mental health, drug use history, drug use related-risk behaviour and sexual risk behaviour, by a member of the therapeutic team.

With respect to socio-demographic status, we included questions on recent migration, strength of social network and degree of marginalization for which we expected to find differences when comparing an urban with a more rural area.

During analysis some answers were placed in a so-called summary variable. One of these summary variables is an indicator for the degree of marginalization, summing up the negative replies to the questions on having an identity card (compulsory in Belgium), having health insurance and having housing. Three is the highest possible score, concordant with a high level of marginalization. Similarly, the answers to the questions concerning contact with their father, mother or both parents during the past 3 months and living alone were summarized into one variable and the resulting score was used as an indicator for the strength of the patient's social network. Three is the highest possible score correlating with an estimated poor social network. The Zung depression score was used as a depression screening tool, with a maximum score of 100. In clinical settings a score of 60 is used as a cut-off point for depression [10].

Blood specimens were collected and immediately sent to the laboratory for hepatitis B, hepatitis C and HIV screening.

Samples were screened for hepatitis C antibody using a third generation immunoassay (AxSYM HCV 3.0, Abbott Laboratories, Abbott Park, IL, USA). Confirmation testing by an immunoblot assay (RIBA HCV 3.0, Chiron Corp, Emeryville, CA, USA) was undertaken where the immunoassay gave a weakly positive result. HCV RNA was tested where the immunoblot assay gave an indeterminate result.

Samples were screened for hepatitis B surface antigen (HBsAg), hepatitis B core antibody (HBc-Ab), hepatitis B surface antibody and HIV antibody also using an immunoassay (AxSYM HBsAg, AxSYM CORE, AxSYM AUSAB and AxSYM HIV-1/2 gO; Abbott Laboratories).

Statistical methods

Analysis was performed using SPSS 10 for windows (SPSS Inc., Chicago, IL, USA). The level of statistical significance was set at 0·05.

Proportions were compared using the Pearson χ^2 test and when appropriate Fischer's exact test. Means were compared using the t test.

Multiple logistic regression was performed to identify factors independently associated with positive HCV antibody status. Forwards stepwise modelling, starting with all variables shown in Table 1 and using 0·05 and 0·10 as the cut-off point for entry and removal respectively, was used. The fit of the model was analysed using the Hosmer and Lemeshow goodness-of-fit test and by calculating the accuracy between the predicted and observed values.

RESULTS

During the 18-month inclusion period, 182 heroin users were admitted to the methadone programme in Limburg of whom 105 (60·4%) participated in the study. Of those who were not included in the study 21 persons refused to participate. Others stopped the methadone programme, for reasons like detainment, admission in a residential centre or relapse of drug use, before they could be invited to participate. In Antwerp, 297 patients were counted in the methadone programme during the inclusion period. A total of 205 (69%) of these patients were included in the study. Fourteen refused to participate, 76 stopped the programme before they could be invited to participate, and two were excluded because they had been treated for hepatitis C. In both centres participants and non-participants were comparable with respect to gender distribution, age distribution, proportion of intravenous drug users and duration of intravenous drug use.

Baseline characteristics

Socio-demographic characteristics, data regarding drug use, mental health, sexual behaviour and antibody status for the participants are summarized in Table 1.

Drug users in Limburg were in general more likely to have a foreign nationality, a better socioeconomic situation and a lower risk profile with respect to sexual behaviour and drug use when compared with the population in Antwerp.

Screening for HCV antibody was performed according to the decision tree described in the methodology section. In 6·3% of the cases the third-generation immunoassay gave an indeterminate result and an immunoblot assay was done. The latter resulted in a negative result in 17% of the cases. HCV RNA testing was needed in one case and the result was negative.

The prevalence of HCV antibody was statistically significantly higher among Antwerp drug users than among Limburg drug users (71% *vs.* 46% respectively). In IDU the prevalence rates were 84·4 and 66·2%, respectively. Among non-injectors the prevalence rates, 24·5% in Antwerp and 12·5% in Limburg, did not differ significantly.

A total of 62% of the drug users in Antwerp tested positive for anti-HBc compared to 21% in Limburg. Differentiating for injecting status, the same significant differences were found with anti-HBc prevalence rates of 71·3 and 29·5 in injectors and 29·5 and 7·5% in non-injectors, in Antwerp and Limburg respectively. Hepatitis B vaccination coverage in both populations was very low. Only 11 persons in the total population were positive for anti-HBs alone as an estimation for vaccination.

Four percent of the drug users in Antwerp and none in Limburg were HIV-positive.

Univariate associations with hepatitis C serology

Univariate predictors of HCV seropositivity are summarized in Table 2. Among the variables related to the socioeconomic situation, a low level of education, meaning only primary school, being unemployed at the time of interview and scores above 0 for degree of marginalization and social network strength all appeared significantly associated with hepatitis C infection. The mean Zung depression score was significantly higher in drug users with positive hepatitis C serology compared to non-infected drug users, 60·9 ($\pm$12·1) and 54·4 ($\pm$12·5) respectively. With respect to sexual behaviour, a significant association was found between positive HCV serology, a history of sexually transmitted infection (STI), and whether they had ever worked as a commercial sex-worker. With regard to drug use, a lifetime experience with more than three different illegal drugs, having ever injected, and sharing needles as well as other injection materials were all significantly related to positive HCV serology. Furthermore, the mean age of start of injecting was significantly lower and the duration of injecting drug use significantly longer amongst IDU positive for HCV antibody compared to IDU with negative HCV serology.

Table 1. *Characteristics of the two populations and univariate associations with hepatitis C serology*

Variable	Total no.	Limburg No.	%	Antwerp No.	%	P value	Anti-HCV positive No.	%	Anti-HCV negative No.	%	P value
Gender	310										
Male	206	72	68·6	134	65·4	n.s.	135	69·6	71	61·2	n.s.
Female	104	33	31·4	71	34·6		59	30·4	45	38·8	
Mean age	310										
		33·0 (±5·9)		34·5 (±6·5)		n.s.	34·5 (±6·3)		33·1 (±6·4)		n.s.
Nationality	309										
Western Europe	219	61	58·7	158	77·1	<0·0001	137	70·6	82	71·3	n.s.
Southern Europe	41	28	26·9	13	6·3		25	12·9	16	13·9	
Northern Africa	26	9	8·7	17	8·3		17	8·8	9	7·8	
Turkey	15	6	5·8	9	4·4		10	5·2	5	4·3	
Other	8	0		8	3·9		5	2·6	3	2·6	
Duration stay in Belgium	109										
>10 yr or born in Belgium	90	45	99	45	91·2	<0·0001	57	82·6	33	82·5	n.s.
10 yr or less	19	1	1	18	8·8		12	17·4	7	17·5	
Level of education	302										
Only primary school	162	51	51	111	55	n.s.	112	58·6	50	45	0·022
Higher certificate	140	49	49	91	45		79	41·4	61	55	
Employment	310										
Yes	71	30	28·6	41	20	n.s.	36	50·7	35	49·3	0·019
No	239	75	71·4	164	80		158	66·1	81	33·9	
Contact police/justice past 3 months	310										
Yes	136	55	52·4	119	58	n.s.	90	46·4	46	39·7	n.s.
No	174	50	47·6	86	42		104	53·6	70	60·3	
Degree of marginalization	310										
Score 0	260	98	93·3	162	79	0·001	154	79·4	106	91·4	0·005
Score 1–3	50	7	6·7	43	21		40	20·6	10	8·6	
Strength of social network	296										
Score 0	110	52	53·1	58	29·3	<0·0001	62	33	48	44·4	0·049
Score 1–3	186	46	46·9	140	70·7		126	67	60	55·6	
Ever taken antidepressives	310										
Yes	128	37	35·2	91	44·4	n.s.	88	45·4	40	34·5	n.s.
No	182	68	64·8	114	55·6		106	54·6	76	65·5	
Ever taken antipsychotics	310										0·054
Yes	51	16	15·2	35	17·1	n.s.	38	19·6	13	11·2	
No	259	89	84·8	170	82·9		156	80·4	103	88·8	
Zung depression score	253										
		56·7 (±13·2)		59·5 (±12·2)		n.s.	60·9 (±12·1)		54·4 (±12·5)		<0·0001
Setting	310										
Limburg	105						48	45·7	59	54·3	<0·0001
Antwerp	205						146	71·2	59	28·9	
Number of sexual partners last year	310										
0	43	15	14·6	28	14	n.s.	30	15·8	13	11·5	n.s.
1	147	57	55·3	90	45		85	44·7	62	54·9	
2–5	78	23	22·3	55	27·5		51	26·8	27	23·9	
6–10	11	1	1	10	5		9	4·7	2	1·8	
11–20	7	4	3·9	3	1·5		3	1·6	4	3·5	
>20	17	3	2·9	14	7		12	6·3	5	4·4	

Table 1 (*cont.*)

Variable	Total no.	Limburg No.	Limburg %	Antwerp No.	Antwerp %	P value	Anti-HCV positive No.	Anti-HCV positive %	Anti-HCV negative No.	Anti-HCV negative %	P value
Always use condom with regular partner	305										
Yes or not applicable	44	21	20·6	23	1·3	n.s.	24	12·4	20	17·9	0·021
No	261	81	79·4	180	88·7		169	87·6	92	82·1	
Always use condom with occasional partner	305										
Yes or not applicable	218	78	76·5	140	69	0·03	136	70·5	82	73·2	n.s.
No	87	24	23·5	63	31		57	29·5	30	26·8	
Always use condom with clients	304										
Yes or not applicable	281	94	93·1	187	92·1	n.s.	174	90·6	107	95·5	n.s.
No	23	7	6·9	16	7·9		18	9·4	5	4·5	
Ever worked as commercial sex-worker	310										
Yes	67	15	14·3	52	25·4	0·025	50	25·8	17	14·7	0·021
No	243	90	85·7	153	74·6		144	74·2	99	85·3	
Ever had sexually transmitted infection	310										
Yes	77	15	14·3	62	30·2	0·002	60	30·9	17	14·7	0·001
No	233	90	85·7	143	69·8		134	69·1	99	85·3	
Piercing(s)	310										
Yes	67	28	26·7	39	19	n.s.	122	62·9	60	51·7	0·053
No	243	77	73·3	166	81		72	37·1	56	48·3	
Tattoo(s)	310										
Yes	182	63	60	119	58	n.s.	43	22·2	24	20·7	n.s.
No	128	42	40	86	42		151	77·8	92	79·3	
Different illegal drugs taken ever taken	310										
3 or less	92	43	41	49	23·9	0·002	43	22·2	49	42·2	<0·0001
4 or more	218	62	59	156	76·1		151	77·8	68	57·8	
Cocaine use past 3 months	307										
Yes	128	27	26	101	49·8	<0·0001	108	56	71	62·3	n.s.
No	179	77	74	102	50·2		85	44	43	37·7	
Heroin use past 3 months	307										
Yes	186	76	73·1	110	54·2	0·001	110	57	76	66·7	n.s.
No	121	28	26·9	93	45·8		83	43	38	33·3	
Ever injected	310										
Yes	225	65	61·9	160	78	0·003	178	91·8	47	40·5	<0·0001
No	85	40	38·1	45	22		16	8·2	69	59·5	
Mean age first injection	225	23·19 (±6·1)		21·5 (±6·7)		n.s.	21·21 (±6·2)		24·0 (±7·3)		0·002
Duration IDU (years)	223										
≤1	44	14	21·9	30	18·9	n.s.	28	15·9	16	34·8	0·002
1–2	18	7	10·9	11	6·9		13	7·4	5	10·9	
3–5	45	17	26·6	28	17·6		32	18·2	13	28·3	
6–10	46	11	17·2	35	22		39	22·2	7	15·2	
>10	70	15	23·4	55	34·6		64	36·4	5	10·9	
IDU past 3 months	199										
Yes	116	25	46·3	91	62·8	0·036	97	61·4	19	46·3	n.s.
No	83	29	53·7	54	37·2		61	38·6	22	53·7	
Sharing needles/syringes	225										
Yes	161	37	56·9	124	77·5	0·002	136	76·4	25	53·2	0·002
No	64	28	43·1	36	22·5		42	23·6	22	46·8	

[*continued overleaf*]

Table 1 (*cont.*)

Variable	Total no.	Limburg		Antwerp		P value	Anti-HCV positive		Anti-HCV negative		P value
		No.	%	No.	%		No.	%	No.	%	
Sharing other materials	225										
Yes	187	47	72·3	140	87·5	0·006	155	87·1	32	68·1	0·002
No	38	18	27·7	20	12·5		23	60·5	12·9	31·9	
Anti-HCV	310										
Yes	194	48	45·7	146	71·2	<0·0001					
No	116	57	54·3	59	28·8						
HBs-Ag	308										
Yes	15	2	1·9	13	6·3	n.s.	12	6·3	3	2·6	<0·0001
No	293	101	98·1	192	93·7		180	93·8	113	97·4	
Anti-HBc	305										
Yes	148	21	20·8	127	62·3	<0·0001	123	64·7	25	21·7	n.s.
No	157	80	79·2	77	37·7		67	35·3	90	78·3	
Anti-HIV	307										
Yes	9	0		9	4·4	0·032	8	4·2	1	0·9	n.s.
No	298	102	100	196	95·6		183	95·8	115	99·1	

n.s., Not statistically significant.

Finally, the presence of anti-HBc antibodies was associated with a higher risk for HCV infection.

Multivariate analysis

Results are summarized in Table 3. Binary logistic regression was performed with HCV antibody as the dependent variable and 31 risk factors from Table 1 as independent variables. Only HBsAg serology was not included because it was thought to add no supplementary information to anti-HBc. Nationality was entered in the model as a categorical variable, grouped as in Table 1. Originating from Turkey, originating from Northern Africa, marginalization, ever having worked as a commercial sex-worker, ever injected, sharing of injection materials other than needles/syringes, and duration of injecting drug use emerged as statistically significant independent risk factors for HCV infection. When only the IDU were considered, unemployment, lifetime use of three different illicit drugs or more, duration of injecting, sharing of injection materials other than needles/syringes and the presence of anti-HBc (OR 3·1, 95% CI 1·5–6·4) came out as statistically significant independent predictors for positive HCV serology.

The Hosmer and Lemeshow test resulted in P values of 0·154 and 0·650 suggesting a good fit of both models. The accuracy was 81·1 and 80·2% respectively.

DISCUSSION

In this study, comparing two populations of drug users in different regions revealed important similarities and differences with respect to characteristics, behaviour and serology. Some of the differences were not surprising, considering that a more rural population was compared to an urban population. Phenomena like immigration, commercial sex work, problems of isolation and marginalization were expected to be more prevalent in a city. However, it was remarkable that these differences were still obvious within this subpopulation of problematic drug users. Drug-related behaviour was also found to be significantly more problematical in Antwerp compared to Limburg with injecting and sharing of injecting materials more often reported in Antwerp. The prevalence rates of hepatitis B and hepatitis C were significantly elevated amongst Antwerp drug users, being 62 and 71% respectively compared to 21 and 46% respectively amongst Limburg drug users. Within the group of IDU, these differences remained and for hepatitis B became even more pronounced. In the group of non-injectors, we found relatively high rates of HCV prevalence: 24·5% in Antwerp and 12·5% in Limburg. Other studies targeting populations of non-IDU have reported prevalence rates widely varying between 2 and 25% [4, 11–21].

Many of the identified risk factors for hepatitis C infection in this study are similar to those previously

Table 2. *Univariate predictors of HCV seropositivity among drug users*

Variable	Anti-HCV positive		Anti-HCV negative		P value
	No.	%	No.	%	
Level of education					
Only primary school	112	58·6	50	45	0·022
Higher certificate	79	41·4	61	55	
Employment					
Yes	36	50·7	35	49·3	0·019
No	158	66·1	81	33·9	
Degree of marginalization					
Score 0	154	79·4	106	91·4	0·005
Score 1–3	40	20·6	10	8·6	
Strength of social network					
Score 0	62	33	48	44·4	0·049
Score 1–3	126	67	60	55·6	
Zung depression score					
	60·9 ($\pm$12·1)		54·4 ($\pm$12·5)		<0·0001
Setting					
Limburg	48	45·7	59	54·3	<0·0001
Antwerp	146	71·2	59	28·9	
Ever worked as commercial sex-worker					
Yes	50	25·8	17	14·7	0·021
No	144	74·2	99	85·3	
Ever sexually transmitted infection					
Yes	60	30·9	17	14·7	0·001
No	134	69·1	99	85·3	
Different illegal drugs taken ever taken					
3 or less	43	22·2	49	42·2	<0·0001
4 or more	151	77·8	68	57·8	
Ever injected					
Yes	178	91·8	47	40·5	<0·0001
No	16	8·2	69	59·5	
Mean age first injection (years)					
	21·21 ($\pm$6·2)		24·0 ($\pm$7·3)		0·002
Duration IDU (years)					
$\leqslant$1	28	15·9	16	34·8	0·002
1–2	13	7·4	5	10·9	
3–5	32	18·2	13	28·3	
6–10	39	22·2	7	15·2	
>10	64	36·4	5	10·9	
Sharing needles/syringes					
Yes	136	76·4	25	53·2	0·002
No	42	23·6	22	46·8	
Sharing other materials					
Yes	155	87·1	32	68·1	0·002
No	23	60·5	12·9	31·9	
Anti-HBc					
Yes	123	64·7	25	21·7	<0·0001
No	67	35·3	90	78·3	

Table 3. *Adjusted odds ratios (OR) for the effect of predictor variables on testing positive for HCV infection*

Predictors	Total population		Intravenous drug users	
	OR (95% CI)	P value	OR (95% CI)	P value
Ever injected	3·6 (1·1–12·1)	0·037	—	—
Duration IDU (years)	1·6 (1·2–2·0)	<0·0001	1·5 (1·1–1·9)	0·006
Sharing of injection material*	3·0 (1·2–7·4)	0·015	3·6 (1·4–9·3)	0·007
Lifetime number of drugs taken less than 3	—	—	0·6 (0·4–0·9)	0·005
Unemployment	—	—	2·7 (1·1–6·7)	0·028
Level of marginalization	3·8 (1·4–10·8)	0·011	—	—
Nationality			—	—
Western Europe	1	—	—	—
Southern Europe	1·8 (0·7–4·9)	n.s.	—	—
Northern Africa	8·7 (2·4–31·1)	0·001	—	—
Turkey	12·0 (2·3–61·1)	0·003	—	—
Other	2·0 (0·2–16·2)	n.s.		
Ever worked as sex-worker	3·0 (1·2–7·2)	0·016	—	—
Anti-HBc	—	—	3·1 (1·5–6·4)	0·002

* Other than needles/syringes.
n.s., Not statistically significant.

reported with duration of injection most often cited [5, 6, 15, 19, 22–25]. Other often cited risk factors crudely confirmed in our study include sharing needles/syringes and other injection paraphernalia. In the multivariate analysis only sharing injection paraphernalia other than needles/syringes was retained in the final model as an independent predictor for hepatitis C infection.

In studies concerning the prevalence of hepatitis C in IDU, often a number of sexual risk factors have been crudely associated with hepatitis C prevalence, but these associations tended to disappear when drug-related practices were accounted for in multivariate analysis. In this study a history of a STI and having worked as a commercial sex-worker were crudely associated with hepatitis C infection. In the multivariate analysis only the practice of commercial sex-work was retained as an independent predictor for hepatitis C seroconversion. However, the latter relationship disappeared when only injectors were included in the multivariate analysis. It seems that the significance of sexual transmission in the population of injectors is probably very limited, since hepatitis C is far more effectively transmitted by the parenteral route. However, in non-injectors the sexual transmission of hepatitis C might contribute to the higher prevalence rates of hepatitis C when compared to the general population. Since non-injectors often have (ex-)injecting sexual partners of whom most are infected with hepatitis C, exposure

to hepatitis C in this group is evidently much more frequent than in the general population where the background prevalence varies around 1%. The results of some studies investigating the prevalence of hepatitis C in non-injecting drug using populations are consistent with this hypothesis. Goldberg et al. [13] documented a HCV prevalence of 15% among non-IDU women with an injecting sexual partner. The prevalence rates of hepatitis C observed by Orduna et al. [16] and Pineda et al. [18] in Spanish non-injecting drug-using prostitutes amounted to 8·8 and 5·8% respectively. In another study the seroprevalence of hepatitis C among 1257 consecutive non-intravenous drug-using patients attending Baltimore sexually transmitted diseases clinics was found to be 9·7% [19]. It should be noted, however, that one cannot exclude transmission of hepatitis C via household contacts in the case of sexual relationships.

A significant finding in this study included the relationship between socioeconomic factors and positive hepatitis C serology. Crudely, a low level of education, unemployment, marginalization and a loose social network were found to be associated with hepatitis C infection. In multivariate analysis only marginalization was retained as an independent predictor for hepatitis C infection and unemployment when only the IDU were considered. These findings confirm the results of a population-based study by Alter et al. [3]. In their analysis it was demonstrated that among subjects of 17–59 years of age

independent associations with HCV infection included poverty, having had 12 or fewer years of education, and having been divorced or separated. The impact of socioeconomic status on the prevalence of disease has been extensively investigated, though not specifically for hepatitis C. In a review by Seeman et al. [26] evidence was presented linking three broad aspects of the social environment to health, the network of personal social relationships within which most of us live, individual socioeconomic status, and community-level social characteristics. Obviously, the impact of social environment has to be considered when investigating the epidemiology of hepatitis C. However, as Seeman stated: 'Much remains to be elucidated, however, concerning the actual mechanisms through which something as complex and multifaceted as SES [socioeconomic status] "gets under the skin".'

Among IDU the presence of anti-HBc was an independent risk factor for hepatitis C infection. This finding reflects that this population is at risk of developing both infectious diseases and that both diseases are probably subject to similar transmission dynamics.

It is customary to include in multivariate analysis only those variables for which a significant relationship with the dependent variable has been demonstrated in univariate analysis. However, confounding can result both in an apparently significant effect and in hiding a significant effect. Therefore, it was decided to include all variables from the univariate analysis in the multiple regression analysis. This approach revealed having Northern African or Turkish nationality as a strong independent predictor for hepatitis C infection, while this relation was not observed in univariate analysis. Further exploration of the data revealed that injecting drug use was less frequently reported in these ethnic groups: 50 and 53% respectively compared to 72% in the total population. However, the hepatitis C prevalence among the non-injectors of these two ethnic groups was 46% among the Northern African and 43% in Turkish drug users, well above the prevalence of 10% observed in the European population of non-injectors. It might be expected that drug injection is more stigmatized amongst these ethnic groups and they may, therefore, be more likely to deny the practice of intravenous drug use. Behavioural data in this study were self-reported and could, therefore, be subject to biases associated with differences in the accuracy and completeness of reporting of past behaviours. However, Darke et al. [27] concluded that the literature showed respectable reliability and validity of self-reported behaviours when compared to biomarkers, criminal records, and collateral interviews and thus, that self-reports of drug users are sufficiently reliable and valid to provide descriptions of drug use, drug-related problems, and the natural history of drug use. Another hypothesis considers a higher background prevalence of hepatitis C within people originating from Northern Africa or Turkey, resulting in higher hepatitis C prevalence rates before starting drug use. However, the prevalence rates in Morocco and Turkey, where most of the Northern African and Turkish drug users originated, vary according to WHO estimates between 1 and 2·4% and therefore, do not support this theory [1].

A significant difference in hepatitis C prevalence was found between the two regions. When characteristics and behaviours were accounted for in multivariable analysis, the relationship between positive hepatitis C serology and place of recruitment disappeared. It seems that the difference of hepatitis C prevalence between the two regions can entirely be explained by differences in behaviour and characteristics. In this study, however, it was shown that not only variations in drug-related risk factors, but also variations of sexual risk behaviour and varying socioeconomic status need to be taken into account when trying to understand geographic variations of HCV prevalence in drug users.

Our findings, therefore, suggest that prevention efforts should be targeted not only to IDU but also to non-IDU. Moreover, prevention measures should not only be directed towards ceasing high-risk drug-related behaviour but should also include measures to decrease sexual high-risk behaviour, certainly in populations where intravenous drug use is less common. Efforts should be made to gain a better understanding of how different social conditions influence variation of hepatitis C prevalence in drug users.

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