

# Prevalences of scabies and pediculosis corporis among homeless people in the Paris region: results from two randomized cross-sectional surveys (HYTPEAC study)

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## Summary

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### Conflicts of interest

None declared.

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**Background** Dermatological infections constitute the most common health problem in the homeless population.

**Objectives** To estimate the prevalences of scabies and pediculosis corporis and to identify associated factors in the homeless population.

**Methods** Two randomized cross-sectional surveys were performed, one on the homeless population sleeping in public places in Paris, and the other on the homeless population in various shelters in the Ile-de-France administrative region. Overall 341 and 667 people, respectively, were interviewed about sociodemographic characteristics, lifestyle and hygiene practices, and were examined by a nurse.

**Results** In individuals sleeping in public places the prevalence of scabies was estimated at 6.5% [95% confidence interval (CI) 0.5–12.5] and for pediculosis corporis at 5.4% (95% CI 1.7–9.1). For those sleeping in shelters these values were 0.4% (95% CI 0.1–1.8) and 0.15% (95% CI 0.0–9.7), respectively ( $P < 0.01$  in both cases). In public places, after multivariate analysis, being a woman, citing squats among the three main types of accommodation and not possessing a sleeping bag were significantly associated with diagnosis of scabies. Likewise, begging, a history of pubic lice, and not taking showers in municipal baths were associated with pediculosis corporis in public places.

**Conclusions** Firstly, this study highlights the real existence of two distinct subpopulations having different sociodemographic characteristics, with specific lifestyles and practices, and with different prevalences of ectoparasitism. Secondly, the results of the multivariate analyses will help the implementation of specific actions targeting the group of people who sleep in public places.

### What's already known about this topic?

- Ectoparasitism is frequent among homeless persons, and is documented mainly in sheltered people.
- Little is known about ectoparasitism and hygiene conditions among homeless people sleeping in public places.

### What does this study add?

- The prevalence of ectoparasitism is higher in homeless people sleeping in public places than in sheltered persons.

- These results encourage further efforts to maintain the low-level prevalence of ectoparasitism in people in shelters and underline the need for the implementation of targeted prevention interventions for people sleeping in public places.

The homeless experience a wide range of medical problems and are susceptible to infections.<sup>1–3</sup> Dermatological infections constitute the most common health problem in the homeless population.<sup>4</sup> Such complications reflect problematic living conditions (close contact with several other people, trauma, nutritional deficiencies, violence, difficult access to healthcare and suboptimal levels of hygiene), which are sometimes exacerbated by alcohol and/or drugs, or by psychiatric problems.<sup>5,6</sup>

Although the incidence of scabies in France was estimated at 330–350 cases and contacts per 100 000 inhabitants per year,<sup>7</sup> the prevalence rates of scabies and pediculosis corporis are unknown in the general population because of the lack of general population surveys. Nevertheless, several surveys of homeless people in France have shown varying prevalence rates for these diseases: 3–56.5% for scabies and 22–68% for pediculosis corporis.<sup>8–10</sup> However, these studies involved specific samples of the homeless population (shelters and individuals were not randomly selected, or the homeless people interviewed during hospital consultations already had skin problems), and did not take into account the diversity of accommodation situations of homeless people (people sleeping in the street, or persons provided shelter according to the following different situations: emergency shelters, stabilization, social rehabilitation, social hostels etc.). Moreover, a survey on skin disease prevalence in a cohort of homeless people housed in a shelter in Boston<sup>11</sup> suggested that the relatively normal results following their examinations reflected the quality of care and services provided in the shelter (showers, laundries, medical care). In this way, the prevalence of ectoparasitism may differ between homeless people sleeping in the street and homeless people provided with shelter. Therefore, investigating only shelters could lead to an underestimation of the prevalence of ectoparasitism and to inadequate decision making regarding the public health strategy to control those diseases better.

The HYTPEAC survey aimed to estimate the prevalences of scabies and pediculosis corporis firstly among homeless people sleeping in Parisian public places and secondly in people sleeping in shelters in the Paris region, and to identify associated factors.

## Materials and methods

### Study type

Two random-sample cross-sectional surveys were conducted successively from October to December 2011, one in Parisian

public places, the other in emergency, stabilization and social reintegration accommodation shelters in the Ile-de-France region. The methodology chosen in the centres was adapted from a methodology previously used for the homeless population.<sup>12,13</sup> The surveys took place during the daytime.

### Study population

The target population of the 'public place' survey included people interviewed in public places who had slept the night before in a place not intended for habitation (public places such as streets and parks, cars, underground passages, underground car parks, cellars, entrance halls, stairwells and railway stations). The survey was carried out in the streets of Paris and two public parks.

The target population of the 'shelters' survey included people interviewed in shelters who had slept the night before in a place not intended for housing or who received free or very low-cost lodging.<sup>13</sup> They were contacted by the support services they frequented. Asylum seekers, female victims of domestic violence and families with children were not included. The facilities provided in shelters in Paris differ according to their type. All were proposed to have beds, showers and laundry (washing machine and clothes dryer). However, old emergency shelters had big dormitories with bunks. New or renovated ones had bedrooms sleeping 1–8 persons. All had community sanitation and distributed wash bags. Finally, single-use nonwoven linens (bed and bath) were given in most emergency shelters where, at the time of the study, the offered stay duration commonly varied from one to seven nights. In other types of centres where the offered stay duration was of several months, blankets and woven linens were supplied. Wash bags were not delivered, and showers and toilets could be private.

### Inclusion criteria

Those surveyed included adult people who spoke French, were able to understand the content and implications of the study and were able to provide their free and informed consent.

### Sample size and sampling

The sample-size calculation was based on the expected prevalence of pediculosis corporis of approximately 19% observed in a previous study.<sup>14</sup> With an absolute accuracy of 3% and a P-value < 5%, the required number of individuals to be interviewed was calculated at 700 people: 500 in shelters and 200 in public places.

A two-stage random-sampling design was used to construct the two samples (Appendix S1; see Supporting Information).

### Data collection

Data collection was performed by teams comprising a sampler and a registered state nurse. In total 12 samplers and nine nurses were recruited and trained accordingly before the field phase. The nurses had received specific theoretical and practical training in dermatological diagnosis, in particular in a hospital department of dermatology intended for impoverished persons. Trainers were dermatologists, parasitologists and nurses familiar with the clinical diagnosis of scabies and pediculosis corporis in homeless people.

The sampler first identified eligible persons and, in the centres, randomly selected participants. In public places, the sampler randomly selected one participant when a group of homeless people was encountered. The nurse then administered a detailed questionnaire on sociodemographic characteristics, living conditions, hygiene practices, possible pathologies and use of healthcare. Next, the nurse performed a dermatological examination, took photos when suspicious lesions were observed for further investigation by a dermatologist, and inspected the clothes of each individual for body lice.

Participants were volunteers and were required to sign a letter of informed consent. The study protocol and all the other documents were approved by the Ile-de-France II National Commission for the Protection of Persons (ID no. A00576-33 RCB 2010, 16/09/2010) and were declared to the National Commission on Informatics and Liberties. Collected data were confidential and questionnaires were completed anonymously.

### Case definition

Case definitions were established prior to the collection of data, according to reported symptoms, results of the dermatological examination by the nurse, and photodiagnosis by the dermatologist.

A case of scabies was defined when one of the following conditions was met: (i) pruritus and observation by the nurse of one or more scabious burrows; (ii) pruritus and observation by the nurse of one or more scabious nodules; (iii) pruritus and a probable diagnosis of scabies by dermatologists from photos; (iv) pruritus and a diagnosis of scabies established by the nurse; (v) night-time pruritus, close contact with someone who scratched themselves and hyperkeratosis on the palms (diagnosis made by nurse or dermatologist from photos); (vi) a self-reported episode of scabies associated with pruritus observed by the nurse; (vii) a self-reported episode of scabies associated with night-time pruritus; (viii) a self-reported episode of scabies associated with scabious nodules, diagnosed by the nurse; (ix) a self-reported episode of scabies associated with probable diagnosis made by the dermatologist from photos and (x) a self-reported episode of scabies associated with observation of scabious burrows by the nurse.

A case of pediculosis corporis was defined when one of the following conditions was met: (i) presence of body lice on skin or clothing; and (ii) presence of scratching lesions on the neck associated with a diagnosis of pediculosis corporis made by the dermatologists using photos or by the nurse.

### Statistical analysis

All analyses were performed with Stata 12 (StataCorp, College Station, TX, U.S.A.) and took into account the sampling design. A sampling weight was associated with each person, calculated as the inverse of the inclusion probability of the person. In order to compare the two subpopulations, the two databases from the two surveys were combined, considering that both samples came from two distinct populations. The sampling frame was therefore redefined by changing the variables representing the stratification and primary units.<sup>15</sup> The percentage of missing data ranged from 0% to 34.3% for those in public places and from 0% to 45.4% for those in shelters. To reduce potential biases and to limit the loss in study power caused by the complete-case analysis, missing data were processed by multiple imputation using chained equations.<sup>16</sup> Elements of the sampling frame were incorporated into the imputation model.<sup>17</sup> Thirty datasets were imputed. Factors associated with scabies and pediculosis corporis were identified using a multivariate Poisson model with robust variance, which was more suited to the cross-sectional design of the survey than logistic regression.<sup>18</sup> Multivariate analysis was performed before and after multiple imputation.<sup>19</sup>

## Results

### Participation rate

Of the 1802 people contacted in public places, 726 were eligible. Of these, only 347 agreed to participate, providing a participation rate of 48.9%. More women and older homeless people refused to participate. We were able to use data from 341 of the 347 questionnaires. In the shelters included in the study, the participation rate was 65%, with 667 of the initial 1043 people contacted being surveyed.

### Study population

One-half (50.1%) of the people approached in public places reported that they had not frequented shelters in the previous 12 months [95% confidence interval (CI) 41.1–59.1], and only 26.9% of those interviewed in shelters declared that they had slept in a place not intended for habitation or in a squat in the 12 months before the interview (95% CI 19.2–34.6). The populations of the public places and shelters were different regarding both their sociodemographic characteristics (Table 1) and their lifestyles (Table 2).

Those sleeping in public places were almost exclusively male, with an estimated sex ratio of 16.9, vs. 1.8 in the shelters. The mean age was 44.1 years for those in public places

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**Table 1** Characteristics of the sheltered homeless population and the street homeless population in the Paris region

	Shelters		Public places		P-value
	n	Estimated proportion (95% CI), %	n	Estimated proportion (95% CI), %	
Sex					
Male	398	64.8 (54.2–75.5)	316	94.4 (91.2–97.6)	< 0.001
Female	269	35.2 (24.5–45.8)	25	5.6 (2.4–8.8)	
Total	667	100	341	100	
Age group (years)					
18–29	113	17.9 (12.6–23.2)	42	12.9 (7.6–18.3)	0.61
30–39	148	22.7 (15.8–29.7)	74	21.6 (15.7–27.4)	
40–49	171	26.7 (21.6–31.7)	116	30.0 (22.8–37.2)	
≥ 50	235	32.7 (27.8–37.9)	109	35.5 (27.8–43.2)	
Total	667	100	341	100	
Place of birth					
France/overseas depts & territories	266	38.9 (33.0–44.8)	212	55.0 (44.8–65.2)	< 0.001
Eastern Europe	26	3.9 (1.0–6.8)	48	18.7 (10.6–26.7)	
North Africa	130	18.1 (14.1–22.1)	35	15.0 (8.3–21.7)	
Sub-Saharan Africa	201	32.0 (25.2–38.9)	18	5.4 (2.3–8.5)	
Other	44	7.1 (4.6–9.5)	28	5.9 (3.0–8.9)	
Total	667	100	341	100	
Educational level					
None or primary	82	8.8 (5.3–12.3)	42	8.3 (4.6–12.0)	0.02
Junior high school	288	43.3 (36.3–50.4)	182	56.6 (48.5–64.6)	
Senior high school	141	23.0 (16.1–30.0)	74	23.3 (16.0–30.6)	
Third-level education	153	24.8 (18.6–31.0)	39	11.8 (6.5–17.2)	
Total	664	100	337	100	
Medical coverage					
No	64	7.1 (3.8–10.3)	114	35.5 (28.0–43.0)	< 0.001
Yes	598	92.9 (89.7–96.1)	220	64.5 (57.0–72.0)	
Total	662	100	334	100	
Work					
No	488	75.6 (69.1–82.0)	307	89.4 (82.7–96.2)	0.02
Yes	179	24.4 (18.0–31.0)	31	10.6 (3.8–17.3)	
Total	667	100	338	100	
Fixed resources					
No	210	30.0 (24.0–36.0)	169	47.1 (38.4–55.8)	< 0.01
Yes	457	70.0 (64.0–76.0)	170	52.9 (44.2–61.6)	
Total	667	100	339	100	
Begging					
No	624	96.6 (94.8–98.4)	137	45.6 (33.9–57.3)	< 0.001
Yes	29	3.4 (1.6–5.2)	191	54.4 (42.7–66.1)	
Total	653	100	328	100	
Time since first episode of homelessness (years)					
< 1	91	13.5 (8.8–18.1)	37	14.4 (5.7–23.0)	< 0.001
1–2	165	27.6 (20.8–34.5)	48	15.6 (9.5–21.8)	
3–9	243	36.2 (30.1–42.4)	88	27.4 (19.1–35.8)	
≥ 10	155	22.7 (17.6–27.8)	159	42.6 (34.5–50.7)	
Total	654	100	332	100	
Duration of current episode of homelessness (years)					
<1	98	14.1 (9.6–18.6)	69	24.2 (14.5–33.9)	< 0.001
1–2	167	29.3 (22.2–36.5)	70	22.2 (14.9–29.6)	
3–9	225	42.4 (35.6–49.2)	82	26.8 (19.5–34.1)	
≥ 10	105	14.2 (10.2–18.2)	91	26.8 (19.1–34.5)	
Total	595	100	312	100	
Primary sleeping place					
PNIFH	30	3.5 (1.8–5.3)	243	85.5 (79.7–91.4)	< 0.001
Squat	4	1.2 (0.3–4.6)	13	4.0 (1.4–6.6)	
Family/acquaintances	28	6.2 (2.2–10.2)	10	3.3 (0.5–6.1)	

(continued)

Table 1 (continued)

	Shelters		Public places		P-value
	n	Estimated proportion (95% CI), %	n	Estimated proportion (95% CI), %	
Shelters	505	80.6 (74.8–86.4)	7	1.1 (0.4–3.1)	
Paid hotels/personal accommodation	36	6.1 (3.2–9.1)	13	3.4 (0.2–6.6)	
Prison/hospital/other <sup>a</sup>	17	2.3 (1.0–3.7)	9	2.7 (0.2–5.2)	
Total	620	100	295	100	
Squats cited among top three sleeping places					
No	639	94.8 (91.2–98.4)	302	87.1 (78.9–95.3)	0.06
Yes	28	5.2 (1.6–8.8)	39	12.9 (4.7–21.1)	
Total	667	100	341	100	
Duration of stay in current sleeping place					
< 5 days	49	6.6 (3.8–9.3)	57	16.7 (10.2–23.1)	< 0.001
5–30 days	74	9.7 (6.0–13.3)	42	13.8 (8.3–19.3)	
1–3 months	70	9.4 (5.7–13.0)	54	17.5 (11.4–23.7)	
3–6 months	66	12.3 (7.4–17.3)	45	14.8 (7.0–22.5)	
6 months to 2 years	211	36.7 (29.4–44.0)	51	13.3 (6.9–29.8)	
≥ 2 years	191	25.3 (18.9–31.7)	84	23.9 (16.5–31.3)	
Total	661	100	333	100	
Number of people in the same sleeping place					
Only the interviewee	216	34.1 (23.8–44.4)	170	50.7 (41.6–59.8)	0.02
2	191	36.1 (27.8–44.4)	61	17.9 (8.9–26.9)	
≥ 3	251	29.8 (19.8–39.8)	103	31.4 (23.1–39.7)	
Total	658	100	334	100	

CI, confidence interval; PNIFH, place not intended for habitation. <sup>a</sup>'Other' includes churches, police stations and centres for asylum seekers.

and 42.8 years for those in shelters ( $P < 0.001$ ). Most people (55.0%) sleeping in public places were born in France, while 38.9% of those interviewed in shelters were born in France and 32.0% in sub-Saharan Africa ( $P < 0.001$ ).

People interviewed in shelters had a higher educational level ( $P = 0.02$ ) than their counterparts sleeping in public places. The latter were significantly less likely than people sleeping in shelters to have social security cover, a job and fixed resources. Those sleeping in public places were significantly more likely to beg. Furthermore, they had been homeless for a significantly longer duration (10.5 years, 95% CI 8.6–12.4 vs. 6.6 years, 95% CI 5.6–7.6;  $P < 0.001$ ), and their current episode of homelessness was longer (6.5 years, 95% CI 5.2–7.7 vs. 5.2 years, 95% CI 4.4–6.1;  $P < 0.001$ ). In comparison with those sleeping in shelters, in the previous 12 months they had slept more often in a place not intended for habitation or in a squat ( $P < 0.001$ ). Moreover, 12.9% of them reported squats as one of the three main accommodation places (vs. 5.2%). They were also more likely to use or to have used drugs (excluding cannabis), and 12.5% still consumed drugs regularly (vs. 0.9%).

No significant difference was observed between the two groups with respect to disability or chronic illness. People in public places were less likely to have seen a doctor in the previous 12 months (68.8% vs. 84.9%), and more often reported a history of scabies (22.3% vs. 7.7%) and pediculosis corporis (27.7% vs. 10.8%). Their hygiene conditions were not the same as their counterparts': they took showers less regularly (more than one a week: 62.8% vs. 97.7%), were less likely to

change clothes more than four times per month (48.9% vs. 89.1% for upper garments, 55.9% vs. 95.2% for undergarments) and were more likely never to wash their clothes in a washing machine (31.1% vs. 7.4%).

### Prevalences of scabies and pediculosis corporis

For people sleeping in public places the prevalence of scabies was estimated at 6.5% (95% CI 0.5–12.5) and at 5.4% (95% CI 1.7–9.1) for pediculosis corporis. Among people sleeping in shelters the prevalences were 0.4% (95% CI 0.1–1.8) and 0.15% (95% CI 0.0–9.7), respectively. These prevalences were significantly different between the street homeless and the sheltered homeless populations ( $P < 0.01$  in both cases).

### Factors associated with ectoparasitosis

Due to the low prevalences of both diseases among homeless people in shelters, multivariate analyses were performed only on data for persons sleeping in public places.

Three factors remained significantly associated with the diagnosis of scabies (Table 3). Among people sleeping in public places, the prevalence of scabies in women was 5.5 times higher than that in men. Similarly, the prevalence of scabies in those citing squats as one of their three main places of habitation in the 12 months preceding the survey was 4.6 times higher than that in those who did not. Finally, the prevalence of scabies in people who did not have a sleeping bag was 4.1 times higher than in those who did have one.

**Table 2** Lifestyles of the sheltered homeless population and the street homeless population in the Paris region

	Shelters		Public places		P-value
	n	Estimated proportion (95% CI), %	n	Estimated proportion (95% CI), %	
Tobacco consumption (cigarettes per day)					
< 10	80	22.9 (16.1–29.6)	45	16.9 (9.9–23.9)	< 0.01
10–19	127	38.4 (30.0–46.9)	77	27.4 (16.3–38.4)	
20–39	123	32.8 (25.4–40.2)	114	32.4 (25.0–39.8)	
≥ 40	20	5.9 (2.5–9.2)	57	23.3 (13.6–33.0)	
Total	350	100	293	100	
Drug consumption (lifetime, excluding cannabis)					
No	645	96.6 (94.6–98.7)	277	83.8 (77.6–89.9)	< 0.001
Yes	22	3.4 (1.3–5.4)	64	16.2 (10.1–22.4)	
Total	667	100	341	100	
Regular consumption of drugs					
No	658	99.1 (98.4–99.8)	294	87.5 (82.0–93.1)	< 0.001
Yes	9	0.9 (0.1–1.6)	47	12.5 (6.9–18.0)	
Total	667	100	341	100	
Regular at-risk consumption of alcohol <sup>a</sup>					
No	562	85.7 (81.4–90.0)	116	32.9 (25.9–40.0)	< 0.001
Yes	101	14.3 (10.0–18.6)	224	67.1 (60.0–74.1)	
Total	663	100	340	100	
History of scabies					
No	606	92.3 (89.7–95.0)	252	77.7 (71.0–84.4)	< 0.001
Yes	53	7.7 (5.0–10.3)	78	22.3 (15.6–29.0)	
Total	659	100	330	100	
History of body lice					
No	600	89.2 (84.9–93.4)	231	72.3 (64.2–80.4)	< 0.001
Yes	64	10.8 (6.6–15.1)	106	27.7 (19.6–35.8)	
Total	664	100	337	100	
History of head lice					
No	629	94.0 (90.6–97.4)	277	85.4 (80.2–90.6)	< 0.01
Yes	34	6.0 (2.6–9.4)	56	14.6 (9.4–19.8)	
Total	663	100	333	100	
History of pubic lice					
No	646	96.7 (94.6–98.7)	301	92.2 (88.7–95.6)	0.03
Yes	19	3.3 (1.3–5.4)	35	7.8 (4.4–11.3)	
Total	665	100	336	100	
Most recent medical consultation < 1 year					
No	83	15.1 (11.0–19.3)	104	31.2 (23.1–39.2)	< 0.001
Yes	569	84.9 (80.7–89.0)	217	68.8 (60.8–76.9)	
Total	652	100	321	100	
Frequency of showers (per week)					
> 1	649	97.7 (96.2–99.2)	237	62.8 (51.5–74.1)	< 0.001
1	11	1.6 (0.3–2.9)	47	21.0 (12.5–29.5)	
< 1	6	0.7 (0.0–1.4)	54	16.2 (9.2–23.1)	
Total	666	100	338	100	
Used Parisian municipal baths/showers					
No	550	87.2 (80.5–93.9)	110	31.3 (23.6–39.1)	< 0.001
Yes	90	12.8 (6.1–19.5)	219	68.7 (60.9–76.4)	
Total	640	100	329	100	
Frequency of changing upper clothing garment (times per month)					
> 4	552	89.1 (82.3–95.9)	142	48.9 (40.1–57.8)	< 0.001
1–4	55	9.8 (3.2–16.4)	87	37.4 (27.6–47.2)	
≤ 1	8	1.1 (0.2–1.9)	42	13.7 (8.7–18.6)	
Total	615	100	271	100	
Frequency of changing underclothing garment (times per month)					
> 4	594	95.2 (93.1–97.5)	174	55.9 (45.6–66.2)	< 0.001
1–4	33	4.2 (2.3–6.1)	71	31.2 (20.1–42.2)	

(continued)

**Table 2** (continued)

	Shelters		Public places		P-value
	n	Estimated proportion (95% CI), %	n	Estimated proportion (95% CI), %	
≤ 1	6	0.6 (0.02–1.1)	39	12.9 (7.9–17.9)	
Total	633	100	284	100	
Use of washing machine					
No	64	7.4 (3.8–11.1)	101	31.1 (23.7–38.5)	< 0.001
Yes	602	92.6 (88.9–96.2)	238	68.9 (61.5–76.3)	
Total	666	100	339	100	

CI, confidence interval. <sup>a</sup>Alcohol Use Disorders Identification Test score ≥ 7 for men and ≥ 6 for women.

**Table 3** Estimated prevalences and factors associated with scabies from multivariate models, in complete cases (CC) and after multiple imputation (MI)

	n	Estimated prevalence (95% CI)	CC analysis (n = 236)		MI analysis (n = 238)	
			Adjusted prevalence ratio (95% CI)	P-value	Adjusted prevalence ratio (95% CI)	P-value
Being a woman						
No	316	5.4 (0.7–10.1)	Reference		Reference	
Yes	25	25.9 (5.7–66.7)	5.3 (1.6–17.3)	0.006	5.5 (1.6–18.2)	0.007
Citing squats among the top three types of sleeping places in the 12 months preceding the survey						
No	302	4.5 (0.6–8.3)	Reference		Reference	
Yes	39	18.5 (1.2–35.9)	4.9 (1.9–12.7)	0.001	4.6 (1.7–12.3)	0.003
Having a sleeping bag						
No	150	9.4 (3.2–24.5)	4.2 (1.1–15.6)	0.033	4.1 (1.1–15.9)	0.043
Yes	188	4.2 (1.5–11.4)	Reference		Reference	

CI, confidence interval.

**Table 4** Estimated prevalences and factors associated with pediculosis corporis from multivariate models, in complete cases (CC) and after multiple imputation (MI)

	n	Estimated prevalence (95% CI)	CC analysis (n = 220)		MI analysis (n = 226)	
			Adjusted prevalence ratio (95% CI)	P-value	Adjusted prevalence ratio (95% CI)	P-value
Begging						
No	137	1.3 (0.3–5.4)	Reference		Reference	
Yes	191	9.1 (3.3–14.9)	5.1 (1.0–24.9)	0.046	5.1 (1.0–25.1)	0.046
History of pubic lice						
No	301	4.5 (0.8–8.2)	Reference		Reference	
Yes	35	15.0 (4.2–41.9)	3.2 (0.8–13.2)	0.106	3.8 (1.0–14.3)	0.044
Using municipal baths/showers						
No	110	11.4 (2.8–19.9)	4.2 (1.3–14.3)	0.021	3.8 (1.1–12.6)	0.032
Yes	219	2.6 (0.8–7.7)	Reference		Reference	

CI, confidence interval.

Likewise, three factors remained associated with having pediculosis corporis at the time of the survey (Table 4). Among people sleeping in public places, the prevalence of pediculosis corporis in those who begged was 5.1 times higher than in those who did not. The prevalence of pediculosis corporis in people with a history of pubic lice was 3.8 times higher than in those with no history of pubic lice. Finally, the prevalence of body lice was 3.8 times higher

among those who did not attend municipal showers than among those who did.

## Discussion

The prevalence of scabies was estimated at 6.5% (95% CI 0.5–12.5) in individuals sleeping in public places, with a prevalence of 5.4% (95% CI 1.7–9.1) for pediculosis corporis. For



those sleeping in shelters these values were 0.4% (95% CI 0.1–1.8) and 0.15% (95% CI 0.0–0.7), respectively. These observed differences are significant and highlight not only the fact that people are not likely to be contaminated in shelters, but also the risk factors associated with scabies and with pediculosis corporis in people sleeping in public places. Indeed one of the original features of the HYTPEAC project is that two successive indirect random-sampling surveys were performed by combining a study in public places with a more classic shelter-based study. We identified two subpopulations that are distinct from one another, with different sociodemographic characteristics and with specific lifestyles and practices. These differences may partly explain the substantial differences in the prevalences of ectoparasitosis observed between the two groups.

The low prevalences of the two diseases in people sleeping in shelters are in line with the conclusions of Stratigos *et al.*<sup>11</sup> They seem to reflect easier access to on-site showers and laundries, and also better access to care and treatment. Indeed, the difference in prevalences in those having a history of ectoparasitosis between the two populations suggests a lower level of contamination among those provided accommodation, suggesting greater control over transmission, which is probably the result of prevention and treatment measures. These results confirm in particular those of Bonilla *et al.*,<sup>20</sup> which showed that people who sleep in public places are at greater risk of body lice.

However, our results in shelters differ from those of Badiaga *et al.*,<sup>14</sup> who investigated some emergency shelters in Marseilles (prevalence of scabies 3.8%, pediculosis corporis 19.1%). We explain this by three factors: the shelters and individuals in Marseilles were not randomly selected but were included on a voluntary basis, encouraging people with skin problems to participate; the people provided shelter had a different migratory history from that seen in Paris; and there might be a different risk of transmission<sup>21</sup> due to the provision of blankets.<sup>8</sup>

In the absence of other studies in public places, it is difficult to make comparisons with our data. Previous surveys that recruited only through support structures<sup>12,13,22</sup> (different kinds of shelters, maternity centres, social hostels, day centres and hot-meal distribution points) mixed those who slept in the street with those provided accommodation. Despite the lack of full coverage in the present study (camps, underground places and subways not included), these results nonetheless show the value of going directly into public places to survey the homeless, as we were able to reach a part of the homeless population that usually eludes statistical surveys.

In public places being a woman remained an independently associated factor for having scabies in the multivariate analysis. This result can be found in the literature, for example in the study by Pannell *et al.* conducted in the general population in England and Wales.<sup>23</sup> That study showed a higher incidence of scabies in women than in men, the difference being significant over almost all age groups. Lassa *et al.* subsequently confirmed this result, highlighting a relative women-to-men risk

ratio of the same order (1.24, 95% CI 1.18–1.33;  $P < 0.001$ ).<sup>24</sup> Scabies is also recognized as a sexually transmitted infection,<sup>25,26</sup> and therefore we can hypothesize that these differences are the result of a degree of sexual promiscuity for women sleeping in public places. Citing squats among the top three sleeping places during the 12 months preceding the survey was also associated with having scabies. After adjustment, those who reported this were 4.6 times more likely to have scabies. This may reflect a community-based lifestyle and inherent promiscuity in squats. Finally, using a sleeping bag protects against the risk of scabies, with people who did not use one being 4.1 times more likely to be infested. Instead, those with a sleeping bag did not share their bed, or at least their bed linen. This reduced the risk of transmission.

With respect to pediculosis corporis, it is likely that those who reported begging, and those who did not go to municipal baths/showers – because they probably did not have the money to buy their own toiletries (towels, washcloth, soap etc.) – are the population who are most excluded. Accordingly they are the population facing the greatest difficulties in terms of regularly taking care of themselves, and consequently are most at risk of pediculosis corporis.

These results demonstrate the value of investigating the homeless directly in public places to estimate better the prevalence of ectoparasitosis and its risk factors. However, such investigations raise real methodological and practical difficulties. In addition to the difficulties on the ground, the problems of identifying homeless people and refusal to participate in the study constituted limitations of our work. Furthermore, restricting the target population to French-speaking individuals excluded two groups: firstly, recent migrants who had not yet learned French, which may have led to an underestimation of prevalence if these migrants were from endemic regions (Eastern Europe, North Africa, sub-Saharan Africa and Asia), and secondly, certain communities living in a group in public places where ectoparasitic transmission is more likely. The exclusion of persons who were not able to provide informed consent, such as individuals with psychotic disorders, those with severe mental impairment, and those risking contamination because of alcohol-related at-risk behaviours, may also have led to an underestimation of the prevalence of ectoparasitosis.

Notwithstanding these limitations, this study demonstrates the importance of investigating public places *in situ* to study health phenomena. These results will help the implementation of specific actions targeting people who sleep in public places, in particular women, and those who sleep in squats. These prevention and awareness actions must focus on the need to have one's own personal sleeping bag. Informing the homeless population about the low risk of transmission of ectoparasitosis in shelters must also be enhanced, in order to reduce the existing fears. Finally, in order to facilitate access to municipal baths/showers, generalized distribution of hygiene kits containing suitable products and packaging – something that some care associations have already implemented – would be very useful.



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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

**Appendix S1.** Sampling methods.