

Changing Demographics and Prevalence of Body Lice among Homeless Persons, Marseille, France

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The prevalence of body lice among 2,288 sheltered homeless persons in the city of Marseille during 2000–2017 was 12.2% and significantly decreased over time. We report a positive association between body lice infestations and older age, duration of stays in France for migrants, frequent consumption of alcohol, and tobacco smoking.

Homeless persons are predisposed to infections because of their poor physical state and lack of hygiene; therefore, outbreaks of contagious diseases are more prevalent among them (1,2). Body lice infestation prevalence in homeless populations has been shown to be 19.0%–68.0% (3–7). However, despite the capacity of these ectoparasites to be vectors of several diseases, study of infestation has been minimal among the homeless. To identify potential risk factors for body lice infestation, we analyzed the demographics and chronic medical conditions of the homeless population from Marseille and their variations during 18 years.

The Study

The protocol for this study was reviewed and approved by the Institutional Review Board and Ethics Committee of Assistance Publique Hôpitaux de Marseille (2010-A01406–33). We conducted cross-sectional, 1-day surveys during 2000–2017 in 2 Marseille shelters (A and B) housing a limit of 300 homeless persons each with a high turnover. Most persons in shelters A and B stay for nights only with no time limitation, but shelter A has a special day/night unit with a 35-bed capacity, dedicated to high-risk sedentary homeless persons whose characteristics include a high level of poverty, poor hygiene, alcoholism, and mental illness. We informed participants of our ongoing study of infectious diseases and that they could receive a complete medical examination free of charge and treatment when needed. Participants volunteered and signed informed consent documents. A medical team

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interviewed participants by using a standardized questionnaire and physically examined them for the presence of ectoparasites (online Technical Appendix, <https://wwwnc.cdc.gov/EID/article/23/11/17-0516-Techapp1.pdf>). Several delousing measures were administered over time at the 2 shelters (online Technical Appendix).

We recruited 2,288 persons, 57% of whom were enrolled in shelter A (Table 1). Most participants were middle-aged men, most of whom were originally from North Africa and settled in France >12 years before the survey was done. A total of 334 (33.2%) migrants reported recurrent travel to their country of origin. Homelessness lasting >1 year accounted for 44.1% of cases.

The proportion of France- and Eastern Europe-born homeless persons decreased significantly over time ($R^2 = 0.68$ and 0.55 , respectively) and the proportion from North Africa increased ($R^2 = 0.64$) (online Technical Appendix Figure 1). The mean duration of stays in France for migrants and the mean duration of homelessness decreased significantly over time ($R^2 = 0.71$ and 0.53 , respectively; online Technical Appendix Figure 2).

Among participants, 75% reported smoking tobacco, 60% consuming alcohol, and 20% consuming cannabis (online Technical Appendix Figure 2). In addition, 25% of participants had an elevated body mass index; 5.8% were underweight. Tobacco smoking and frequent alcohol consumption decreased significantly during the study period ($R^2 = 0.61$ and 0.94 , respectively; online Technical Appendix Figure 3).

We recorded a high prevalence of pruritus (548 persons [26.9%]), associated with scratch lesions in 306 (17.4%) persons. Overall, 382 (23.3%) participants had lice. The prevalence of differing types of lice was body lice, 12.2% ($n = 242$); head lice, 4.5% ($n = 87$); crab lice, 3.2% ($n = 53$); and scabies, 2.8% ($n = 50$). The prevalence of body lice decreased significantly during the study period ($R^2 = 0.58$) (online Technical Appendix Figure 3).

Body lice prevalence was higher in shelter A than in shelter B, increased with age and duration of homelessness, and was higher among persons born in France compared with others (Table 1). Body lice were less common in persons born in North Africa than in those born elsewhere. Body lice prevalence in migrants increased with duration

Table 1. Demographics and results of univariate and multivariate analysis of risk factors for body lice infestation among homeless persons, Marseille, France, 2000–2017*

| Demographics | Total | Body lice prevalence | Odds ratio (95% CI), p value | |
|---|--------------|----------------------|------------------------------|--------------------------|
| | | | Univariate analysis | Multivariate analysis |
| Shelter used | | | | |
| A† | 1,305 (57.0) | 90 (10.5) | 1.33 (1.01–1.76), 0.041 | 3.45 (1.37–8.66), 0.008 |
| B | 983 (43.0) | 152 (13.5) | | |
| Sex | | | | |
| M | 2,161 (95.4) | 236 (12.6) | | |
| F | 105 (4.6) | 5 (5.7) | | |
| Age, y | | | | |
| Mean (SD) | 43.1 (15.0) | NA | | |
| Range | 18–86 | NA | | |
| <25 | 221 (10.0) | 4 (2.1) | | |
| 25–50 | 1,291 (58.5) | 105 (9.5) | | |
| >50 | 694 (31.5) | 121 (19.8) | 2.70 (2.04–3.57), <0.0001 | 2.47 (1.14–5.34), 0.022 |
| Birthplace | | | | |
| France mainland | 597 (26.4) | 95 (19.2) | 2.18 (1.64–2.89), <0.0001 | |
| France overseas territories | 23 (1.0) | 6 (30.0) | | |
| North Africa | 1,109 (49.0) | 95 (9.6) | 0.62 (0.47–0.81), <0.0001 | |
| Sub-Saharan Africa | 123 (5.4) | 14 (13.0) | | |
| Eastern Europe | 270 (11.9) | 16 (7.0) | | |
| Western Europe | 77 (3.4) | 10 (14.3) | | |
| Asia | 51 (2.3) | 3 (6.7) | | |
| Other | 11 (0.5) | 0 | | |
| Duration of residence in France, y | | | | |
| Mean (SD) | 12.2 (16.8) | NA | | |
| Range | 0–75 | NA | | |
| <1 | 390 (38.8) | 8 (2.3) | | |
| 1–5 | 176 (17.5) | 4 (2.6) | | |
| >5‡ | 438 (43.6) | 41 (11.6) | 5.46 (2.83–10.55), <0.0001 | 4.28 (1.79–10.23), 0.001 |
| Visited country of origin since immigration | 334 (33.2) | 20 (7.4) | | |
| Total no. visits to country of origin since immigration | 672 (66.8) | 27 (4.8) | | |
| Duration of homelessness, y | | | | |
| Mean | 3.8 | NA | | |
| Range | 0–57 | NA | | |
| <1 | 1,218 (55.9) | 66 (6.3) | | |
| 1–5 | 443 (20.3) | 52 (13.4) | | |
| >5 | 518 (23.8) | 112 (24.7) | 3.67 (2.77–4.88), <0.0001 | |

*Values are no. (%) persons except as indicated. Blank cells indicate statistically insignificant results; variables with a prevalence <5.0% were not included in the univariate model. NA, not applicable.

†Includes high-risk homeless special unit (33 of the 300 beds in the shelter).

‡North African migrants only: body lice prevalence was 1.6% in persons living in France for <5 y vs. 9.3% in those living in France for >5 y (OR 6.39, 95% CI 2.41–16.95; $p < 0.0001$).

of stay in France. Consuming alcohol frequently, smoking tobacco, and being underweight were associated with an increased risk for body lice (Table 2). In multivariate analyses, only housing in shelter A, older age, duration of stay in France for migrants, frequent consumption of alcohol, and smoking tobacco remained associated with an increased prevalence of body lice. Smoking, alcohol consumption, and underweight prevalence varied according to place of birth (online Technical Appendix).

Conclusions

In this survey, we observed significant changes over time in the demographic characteristics of the homeless population in Marseille. Overall, France-born, long-term homeless persons were progressively replaced by migrants of North Africa origin, who had a shorter duration of

homelessness. Concurrently, the prevalence of frequent alcohol consumption and tobacco smoking decreased over time. France-born homeless persons were more prone to alcoholism and smoking habits, and those originating from North Africa were less likely to be frequent consumers of alcohol.

The decrease over time in overall body lice prevalence could be attributed to the changes in the characteristics of the population and also to the effects of delousing interventions conducted in the shelters. We identified several independent risk factors for body lice, including older age, residence duration in France of migrants, frequent alcohol consumption, and tobacco smoking. The latter 2 factors are likely correlative because they are markers of poor self-care, which may be associated with risk of body lice infestation.

Table 2. Results of univariate and multivariate analysis of risk factors for body lice infestation among homeless persons, Marseille, France, 2000–2017*

| Risk factor | Total | Body lice prevalence | Odds ratio (95% CI), p value | |
|----------------------------|--------------|----------------------|------------------------------|---------------------------|
| | | | Univariate analysis | Multivariate analysis |
| Substance use | | | | |
| Alcohol | | | | |
| Never | 892 (39.8) | 29 (3.7) | | |
| Sometimes | 623 (27.8) | 55 (9.8) | | |
| Frequently | 729 (32.5) | 155 (25.1) | 5.01 (3.77–6.68), <0.0001 | 3.93 (1.85–8.36), <0.0001 |
| Tobacco | | | | |
| Never | 576 (25.5) | 20 (4.0) | | |
| Yes | 1680 (74.5) | 218 (14.9) | 4.16 (2.60–6.65), <0.0001 | 2.46 (1.04–5.79), 0.04 |
| Cannabis (never) | 921 (82.1) | 70 (8.1) | | |
| Cannabis | 201 (17.9) | 23 (11.9) | | |
| Injected substances | 19 (1.1) | 5 (27.8) | | |
| Nasally inhaled substances | 40 (3.0) | 7 (24.1) | | |
| Drug substitutes | 25 (1.5) | 5 (21.7) | | |
| Medical conditions | | | | |
| COPD | 38 (9.9) | 11 (5.6) | | |
| Asthma | 63 (6.1) | 3 (6.5) | | |
| Bronchitis | 44 (4.3) | 4 (12.1) | | |
| Cancer | 6 (0.9) | 0 | | |
| Diabetes | 47 (5.8) | 1 (2.2) | | |
| Hepatitis | 22 (2.8) | 7 (33.3) | | |
| History of pulmonary TB | 55 (4.2) | 3 (7.1) | | |
| Weight | | | | |
| Mean BMI (SD) | 23.8 (4.2) | | | |
| BMI range | 13.5–65.0 | | | |
| Underweight | 97 (5.8) | 14 (17.9) | 2.998 (1.53–5.90), 0.001 | |
| Normal weight | 1,009 (60.3) | 93 (10.8) | | |
| Overweight | 439 (26.2) | 23 (6.0) | | |
| Obesity | 129 (7.7) | 11 (9.6) | | |

*Only statistically significant results are reported; blank cells indicate statistically insignificant results. Variables with a prevalence <5.0% were not included in the univariate model.

These results correlate with the observation of very high prevalence of body lice found in a specific survey by our team of 33 high-risk homeless persons from shelter A in which an 84.9% prevalence was found, compared to an estimated 22.0% prevalence in the overall population of shelter A over the same period of time (8). Those results corroborate our observation of a higher overall prevalence of body lice in shelter A than in shelter B. The subpopulation of the homeless persons with an elevated level of high-risk behaviors, housed in the special sector of shelter A, may have acted as a source of reinfestation for the other persons in this shelter. Unfortunately, being housed in shelter A's special unit was not documented on a regular basis in our surveys.

We found no other published study addressing risk factor analysis for body lice among sheltered homeless persons. In a Paris survey, A. Arnaud et al. conducted a risk factor analysis among homeless persons sleeping in public areas only, and body lice prevalence was associated with a history of pubic lice, begging, and not attending municipal showers (9). In a survey of homeless persons in San Francisco who were consulting for possible lice infestation, male gender, African American ethnicity, and sleeping outdoors were significantly associated with having body lice (7).

Our observation that the strongest determinant of body lice in the homeless was alcoholism correlates with

previous observations that trench fever is associated with a history of alcoholism (10–13). Because body lice are known vectors of trench fever, which was the most frequently reported vectorborne infection identified in homeless persons in Europe and the US during 1990–2014, targeted removal of lice should specifically reduce its incidence in this population (14,15).

Our survey has several limitations. The homeless persons were not randomly selected, so those who had skin disease symptoms might have been more prone to enroll in the survey because a free medical examination was offered. Our results represent only homeless persons provided with shelter and cannot be extrapolated to those sleeping outside, where a higher prevalence of body lice has been reported (9).

Notwithstanding these limitations, these results demonstrate the value of investigating the homeless in shelters directly to estimate the prevalence of body lice and its risk factors. Our survey indicates that demographic factors, addictions, and being underweight are factors associated with body lice risk, which may be used to better target populations for delousing measures.

Dr. Ly is a medical doctor and a PhD student at Aix-Marseille University. His main research interest is epidemiology of diseases in mobile populations.

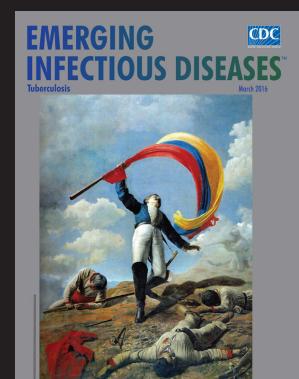
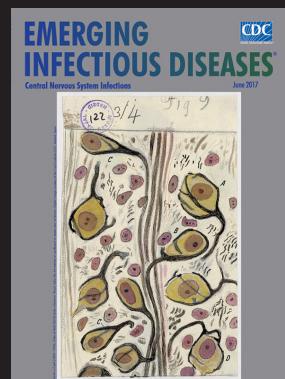
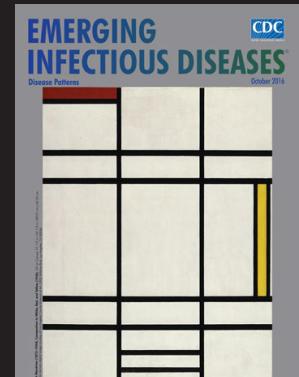
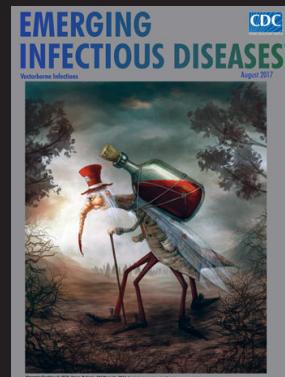
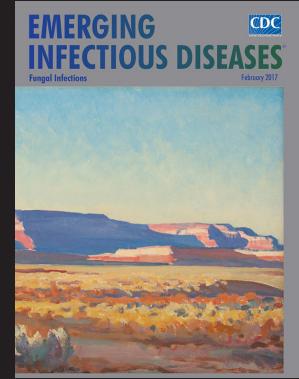
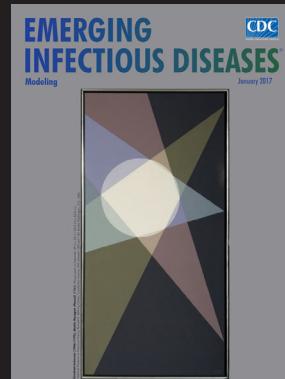
References

1. Fazel S, Geddes JR, Kushel M. The health of homeless people in high-income countries: descriptive epidemiology, health consequences, and clinical and policy recommendations. *Lancet*. 2014;384:1529–40. [http://dx.doi.org/10.1016/S0140-6736\(14\)61132-6](http://dx.doi.org/10.1016/S0140-6736(14)61132-6)
2. Raoult D, Foucault C, Brouqui P. Infections in the homeless. *Lancet Infect Dis*. 2001;1:77–84. [http://dx.doi.org/10.1016/S1473-3099\(01\)00062-7](http://dx.doi.org/10.1016/S1473-3099(01)00062-7)
3. Arfi C, Dehen L, Bénassaïa E, Faure P, Farge D, Morel P, et al. Dermatologic consultation in a precarious situation: a prospective medical and social study at the Hôpital Saint-Louis in Paris [in French]. *Ann Dermatol Venereol*. 1999;126:682–6.
4. Guibal F, de La Salmonière P, Rybojad M, Hadjrabia S, Dehen L, Arlet G. High seroprevalence to *Bartonella quintana* in homeless patients with cutaneous parasitic infestations in downtown Paris. *J Am Acad Dermatol*. 2001;44:219–23. <http://dx.doi.org/10.1067/mjd.2001.110062>
5. Rydkina EB, Roux V, Gagua EM, Predtechenski AB, Tarasevich IV, Raoult D. *Bartonella quintana* in body lice collected from homeless persons in Russia. *Emerg Infect Dis*. 1999;5:176–8. <http://dx.doi.org/10.3201/eid0501.990126>
6. Bonilla DL, Kabeya H, Henn J, Kramer VL, Kosoy MY. *Bartonella quintana* in body lice and head lice from homeless persons, San Francisco, California, USA. *Emerg Infect Dis*. 2009;15:912–5. <http://dx.doi.org/10.3201/eid1506.090054>
7. Bonilla DL, Cole-Porse C, Kjemtrup A, Osikowicz L, Kosoy M. Risk factors for human lice and bartonellosis among the homeless, San Francisco, California, USA. *Emerg Infect Dis*. 2014;20:1645–51. <http://dx.doi.org/10.3201/eid2010.131655>
8. Foucault C, Ranque S, Badiaga S, Rovey C, Raoult D, Brouqui P. Oral ivermectin in the treatment of body lice. *J Infect Dis*. 2006;193:474–6. <http://dx.doi.org/10.1086/499279>
9. Arnaud A, Chosidow O, Détéz MA, Bitar D, Huber F, Foulet F, et al. Prevalences of scabies and pediculosis corporis among homeless people in the Paris region: results from two randomized cross-sectional surveys (HYTPEAC study). *Br J Dermatol*. 2016;174:104–12. <http://dx.doi.org/10.1111/bjd.14226>
10. Brouqui P, Houpiqian P, Dupont HT, Toubiana P, Obadia Y, Lafay V, et al. Survey of the seroprevalence of *Bartonella quintana* in homeless people. *Clin Infect Dis*. 1996;23:756–9. <http://dx.doi.org/10.1093/clinids/23.4.756>
11. Brouqui P, Lascola B, Roux V, Raoult D. Chronic *Bartonella quintana* bacteremia in homeless patients. *N Engl J Med*. 1999;340:184–9. <http://dx.doi.org/10.1056/NEJM199901213400303>
12. Pons I, Sanfeliu I, Noguera MM, Sala M, Cervantes M, Amengual MJ, et al. Seroprevalence of *Bartonella* spp. infection in HIV patients in Catalonia, Spain. *BMC Infect Dis*. 2008;8:58. <http://dx.doi.org/10.1186/1471-2334-8-58>
13. Chaloner GL, Harrison TG, Birtles RJ. *Bartonella* species as a cause of infective endocarditis in the UK. *Epidemiol Infect*. 2013;141:841–6. <http://dx.doi.org/10.1017/S0950268812001185>
14. Badiaga S, Brouqui P. Human louse-transmitted infectious diseases. *Clin Microbiol Infect*. 2012;18:332–7. <http://dx.doi.org/10.1111/j.1469-0691.2012.03778.x>
15. Leibler JH, Zakhour CM, Gadhoke P, Gaeta JM. Zoonotic and vector-borne infections among urban homeless and marginalized people in the United States and Europe, 1990–2014. *Vector Borne Zoonotic Dis*. 2016;16:435–44. <http://dx.doi.org/10.1089/vbz.2015.1863>

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Technical Appendix

Case Definition for Ectoparasite Infestation

Medical doctors conducted clinical examination of hair, body, and clothing. Lice in the clothing or on the body below the neck were considered a positive indication of body lice infestation. Any lice found on the head with the presence of nits were considered to be head lice. Finding lice on pubic hairs was considered a positive indication for crab lice infestation. Lice were collected from all persons using forceps and identified at the species level (*Pediculus* or *Phtirius*) by a medical entomologist based on morphological criteria. Distinction between *P. humanus humanus* (body lice) and *P. humanus capitis* (head lice) was based on recovery sites (clothing and body versus scalp and nape).

A case of scabies was defined on clinical criteria by trained physicians. Individuals were considered affected by scabies when presenting with itchy papular rash with or without vesicles and/or itchy skin-colored scabious burrows in at least two of the following parts of the body: finger webs, flexor surface of the wrist, elbows, armpit, buttocks and genitalia, and breasts.

Statistical Analysis

Statistical analysis was conducted using SPSS (version 22.0). We hypothesized that several factors may influence the outcome of body lice prevalence, including demographics and chronic medical conditions. The Pearson's Chi-square test and Fisher exact test, when appropriate, were applied to analyze the categorical variables. P values of ≥ 0.05 were considered significant. Variation over time was assessed statistically as the proportion of variance explained by year and considered adequately fitted if the coefficient of determination [R^2 statistic] was $>50\%$.

Chronology of Delousing Measures Conducted at Marseille Shelters

A general practitioner is available for medical care 2 or 3 times per week and a registered nurse is available daily in each shelter to provide medical care. Since 2001, individuals presenting with lice have been provided showers, new clothes, and laundry. Given that lice were recovered not only from the homeless' clothes but also from the bedding, blankets were either treated with permethrin or boiled regularly (1). These measures, however, have failed to control body-lice infestation in these shelters. In addition, from 2004 to 2005, 3 doses of oral ivermectin (12 mg each), administered at 7-day intervals were provided to patients having lice, resulting in a dramatic reduction of lice at day 14 (from 84.5% infestation rate at day 0 to 18.5% at day 14), but was followed by a recrudescence of lice infestation at day 45 (60.7%) (2). Since 2006, a single dose regimen of 24 mg ivermectin has been used and proved effective at day 14, reducing the prevalence of pruritus (from 92.7% at day 0 to 68.6% at day 14) (3). This effect was however not sustained at day 28 (79.2% pruritus), very likely because of reinfestation from other untreated subjects in the shelters (3). In 2011, body lice-infested homeless persons were randomly assigned to receive 0.4% permethrin-impregnated underwear or an identical-appearing placebo for 45 days. Permethrin-impregnated underwear was more efficient than placebo at eliminating body louse infestations by day 14 (from 100% infestation rates at day 0 to 72% at day 14 in the permethrin group, compared to 91% in the placebo group). However, this difference was not sustained on day 45 with the prevalence of permethrin-resistant lice significantly more frequent in the permethrin group than in the placebo group. This strategy was discontinued in 2012 (4). The shelter's staff was informed of the results of the studies every year following each cross-sectional survey or delousing trials and became aware of recommendations for delousing. The current strategy applied in the two shelters is to offer systematic empirical 24 mg single dose ivermectin to treat pruritus in individuals seeking help in association with washing and changes of clothing and linens and treatment of blankets with insecticides. Since the effect of ivermectin is transient in this context, repeated use is recommended, given that the drug is remarkably safe (4).

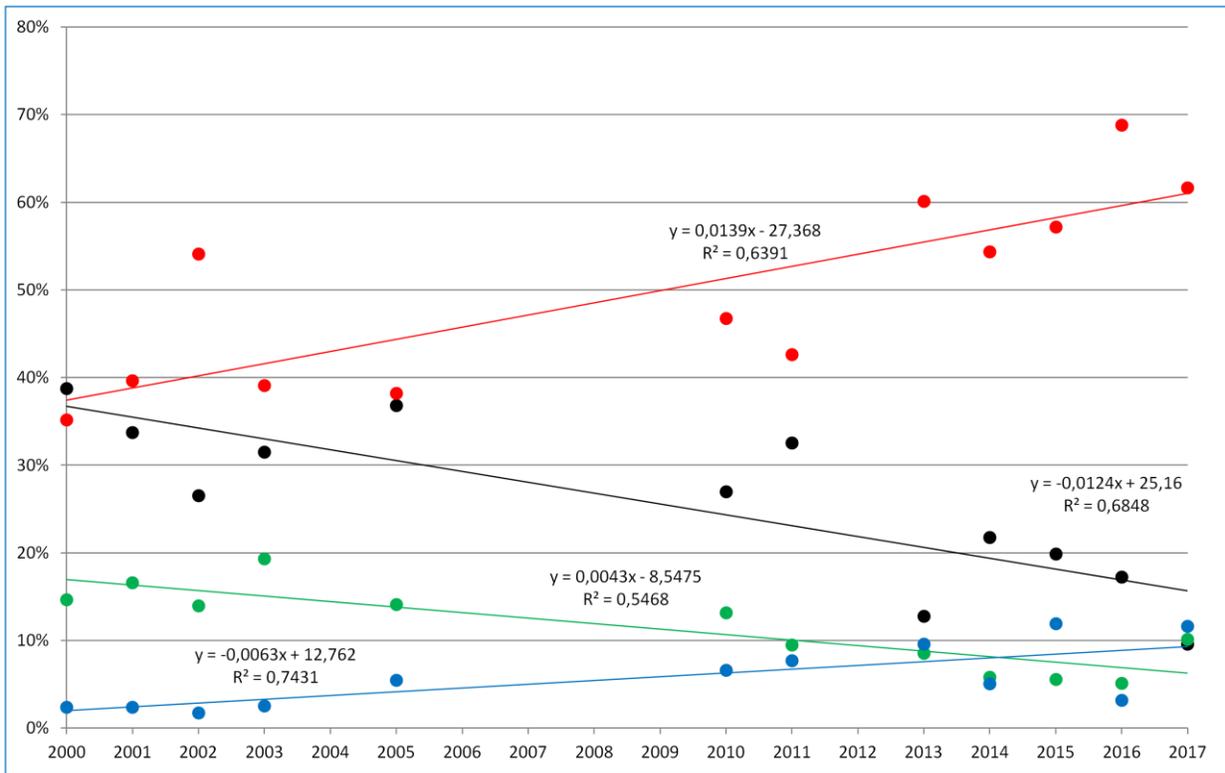
Effect of Place of Birth on Smoking, Alcohol Consumption, and Underweight Prevalence

Frequent consumption of alcohol prevalence was of 47.5% in individuals born in France, compared to 27.1% in others (Odds ratio = 2.43 [2.00–2.95], $p < 0.0001$) and 23.2% in those born in North Africa compared to 41.6% in others (Odds ratio = 0.42 [0.35–0.50], $p < 0.0001$). Smoking prevalence was of 84.5% in French-born individuals compared to 70.8% in others (Odds ratio = 2.24 [1.75–2.86], $p = 0.0001$) and 70.4% in those born in North Africa compared to 78.4% in others (Odds

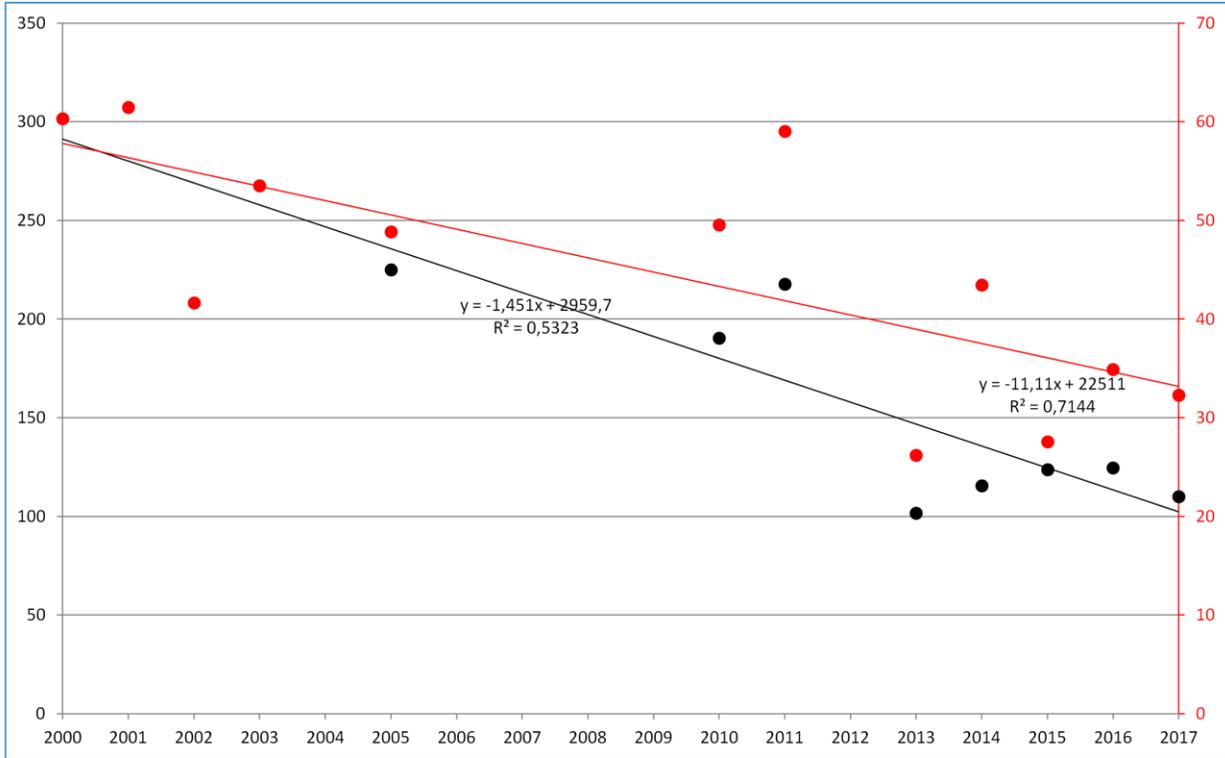
ratio = 0.65 [0.54–0.79], $p < 0.0001$). 9.3% of French-born individuals were underweight compared to 4.7% of others (Odds ratio = 2.08 [1.36–3.19], $p = 0.001$) and 5.1% of individuals originating from North Africa were underweight compared to 6.6% of others (Odds ratio = 0.76 [0.50–1.14], $p = 0.18$).

References

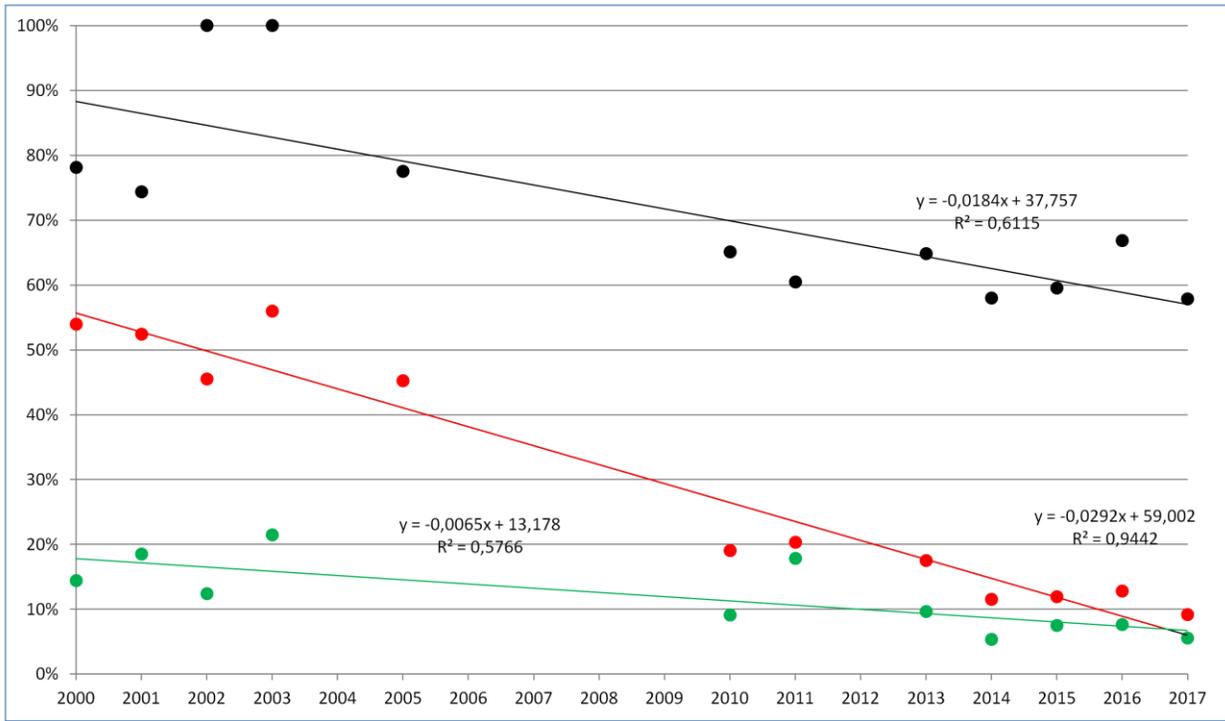
1. Brouqui P, Stein A, Dupont HT, Gallian P, Badiaga S, Rolain JM, et al. Ectoparasitism and vector-borne diseases in 930 homeless people from Marseilles. *Medicine (Baltimore)*. 2005;84:61–8. [PubMed](http://dx.doi.org/10.1097/01.md.0000152373.07500.6e) <http://dx.doi.org/10.1097/01.md.0000152373.07500.6e>
2. Foucault C, Ranque S, Badiaga S, Rovey C, Raoult D, Brouqui P. Oral ivermectin in the treatment of body lice. *J Infect Dis*. 2006;193:474–6. [PubMed](http://dx.doi.org/10.1086/499279) <http://dx.doi.org/10.1086/499279>
3. Badiaga S, Foucault C, Rogier C, Doudier B, Rovey C, Dupont HT, et al. The effect of a single dose of oral ivermectin on pruritus in the homeless. *J Antimicrob Chemother*. 2008;62:404–9. [PubMed](http://dx.doi.org/10.1093/jac/dkn161) <http://dx.doi.org/10.1093/jac/dkn161>
4. Benkouiten S, Drali R, Badiaga S, Veracx A, Giorgi R, Raoult D, et al. Effect of permethrin-impregnated underwear on body lice in sheltered homeless persons: a randomized controlled trial. *JAMA Dermatol*. 2014;150:273–9. [PubMed](http://dx.doi.org/10.1001/jamadermatol.2013.6398) <http://dx.doi.org/10.1001/jamadermatol.2013.6398>



Technical Appendix Figure 1. Birthplace (%) according to year in study of risk factors for body lice infestation among homeless persons in Marseille, France, 2000–2017. Black dots: France; red dots: North Africa; green dots: Eastern Europe; blue dots: sub-Saharan Africa.



Technical Appendix Figure 2. Mean duration of residence in France, in months, for migrants (black dots); and mean duration of homelessness in months (red dots) according to year in study of risk factors for body lice infestation among homeless persons in Marseille, France, 2000–2017.



Technical Appendix Figure 3. Prevalence (%) of smoking habits (black dots), frequent alcohol consumption (red dots) and body lice infestation (green dots) according to year in study of risk factors for body lice infestation among homeless persons in Marseille, France, 2000–2017.