Introduction

Psychoactive substance use among military staff members, although relatively marginal compared with rates observed in the general population, is nevertheless an important public health issue for two reasons. First, military personnel are exposed to operational situations liable to induce stress and psychological disturbances that can lead to drug use. The second reason is that drug use among military personnel involves a significant risk of impairment in operational activities and safety because of certain specific features of military professions (carrying weapons, piloting heavy vehicles or aircraft, etc.). This second reason explains why substance use among military personnel entails a risk of disciplinary sanctions, which are likely to lead to some prevarication among military drug users.

There have been programmes screening for drug use among the military, targeting cannabis in particular. They have most often targeted personnel at enlistment, personnel for whom the impairment of activities by substance use would threaten operational imperatives or randomly sampled sub-populations. Several surveys aiming to estimate drug use prevalence were conducted among the French armed forces from 2005 to 2008. These surveys used both self-reported data and anonymous cannabis urine tests. We were interested in evaluating the prevarication bias in this highly professionalized population.

For this purpose, we first evaluated the internal validity of cannabis use self-report in these surveys. The second aim was to compare self-report in sub-populations according to gender, age, rank and branch of the armed forces to identify subjects that were more liable to prevarication bias.

Methods

Data from three cross-sectional prevalence surveys were used: the first one was conducted in the Navy in 2005, the second in the Army in 2006 and the third in the Air Force in 2008. A two-stage method of randomization was used for each of these surveys. First, a sample of units from the operational units in each branch of armed forces was randomized (35 units in the Navy, 20 in the Army and 10 in the Air Force). Then military personnel were randomized in each unit from the list of personnel present on the day of the survey (from 40 to 80 per unit in the Navy, 50 per unit in the Army and 100 per unit in the Air Force). As the Navy is divided into four different operational divisions, the 35 units in this branch of the armed forces were randomized according to four strata (10 units in the surface fleet, 10 units in submarine forces, 10 in the naval air force and all 5 units of naval fusiliers). Thus, the final sample, constructed to represent all operational French armed forces, included six strata (Army, Air Force and the four Navy strata) and targeted a sample of 3600 personnel (1600 in the Navy, 990 in the Army and 1000 in the Air Force).

The survey procedure was the same in each unit, combining self-administered anonymous questionnaires and blind urine tests for cannabis detection. On the day of survey, the purpose of the survey and the need to perform the urine test were explained to the participants before questionnaire completion. Then the questionnaires, including socio-demographic characteristics and substance
use variables, were completed by the listed personnel in a single session. Finally, urine samples were collected in containers identified with the anonymous code numbers on the questionnaires for each subject. Several methods were used to preserve participant anonymity: questionnaires were pre-identified with anonymous code numbers, the same questionnaire response time was allowed for all subjects (substance users and non-users), envelopes containing the questionnaires were sealed in front of the participants immediately after completion, and participants had the possibility of confidential referral to participate. Participants were also free to refuse the urine test. This protocol was approved by the Ethical Committee of the French Military Service.

According to the maker, the Narcotest THC® (ID Pharma, Paris, France), used to detect cannabis in the urine has 98% sensitivity (Se) and 95% specificity (Sp) for the detection of tetrahydrocannabinol (THC) at the 50 ng/ml threshold. It can be used to detect cannabis consumption in the past 24–36 h after isolated use, in the previous 2 weeks for occasional users and up to 3 weeks for regular users. After taking the sampling weights into account, the estimated detection rate in the French military forces was 3.6% (95% confidence interval: 2.8%–4.5%). The proportion of positive tests was close to the distribution of the armed forces given by the French Defence Social Observatory. The sample included 7.6% (6.5–8.7%) of rank-and-file and 11.0% (9.4–12.6%) of non-commissioned officers (NCO); 11.6% among rank-and-file (9.4–13.8%) and 15.3% among NCO (12.7–18.1%) vs. 11.2% among NCO and 11.0% among officers; 8.0% (6.6–9.5%) of the Army, 10.0% (8.5–11.6%) of the Navy, and 15.0% (13.2–16.7%) of the Air Force (THC) at the 50 ng/ml threshold. It can be used to detect cannabis consumption in the past 24–36 h after isolated use, in the previous 2 weeks for occasional users and up to 3 weeks for regular users.13

Self-report of past-month cannabis use was collected using a dichotomous response format (at least one use vs. no use) and a frequency scale ranging from 0 to 5 (0: no use; 1: 1–2 occasions; 2: 3–9 occasions; 3: 10–19 occasions; 4: 20–29 occasions; 5: every day). The characteristics of the self-reports [Se, Sp, positive predictive value (PPV), negative predictive value (NPV) and global informative value] were computed using the result of the urine tests as a reference. The discriminant power of self-report was evaluated using the receiver operating characteristics (ROC) analysis. Exact 95% confidence intervals were calculated for all estimations, using the ROC curve. To take account of the complex sampling design effect on estimators, all estimations and analyses were performed using the svy procedure of the Stata 9.0. software (StataCorp LP).

### Results

Because of the insufficient number of personnel present at the day of survey in one Navy unit, only 3595 personnel were randomized. The response rate for the survey was 100%, but 102 questionnaires (2.8%) were excluded from analyses because of high proportion of missing data. The exclusion rate was higher in the Navy (5.8%) than in the Army (1.0%) and the Air Force (0.0%) (P < 0.001). The final sample included 3493 observations. Among the retained questionnaires, the proportion of missing data for urine test (subjects who refused the test or did not retrieve their urine) was 1.4% (1.0–1.8). It did not significantly differ according to rank (P = 0.2), but it was higher among men (1.4% vs. 0.4% among women; P = 0.02) and in the Navy (4.3% vs. 2.8% in the Air Force and 0.5 in the Army; P < 0.0001).

After taking the sampling weights into account, the estimated distribution of subjects was 64.6% (62.7–66.4) in the Army, 28.0% (26.3–29.7) in the Air Force and 7.4% (6.8–8.0) in the Navy, which was close to the distribution of the armed forces given by the French Defence Social Observatory. The sample included 7.6% (6.5–8.8) officers, 46.5% (44.3–48.7) non-commissioned officers (NCO) and 49.9% (46.4–53.7) rank-and-file. The Army had more rank-and-file than NCOs (58.7% vs. 35.1%), whereas the opposite trend was observed in the Navy (30.8% rank-and-file vs. 60.9% NCOs) and the Air Force (20.0% vs. 69.1%) (P < 0.0001). The distribution of subjects was 64.6% (62.7–66.4) in the Army, 28.0% (26.3–29.7) in the Air Force and 7.4% (6.8–8.0) in the Navy, which was close to the distribution of the armed forces given by the French Defence Social Observatory. The sample included 7.6% (6.5–8.8) officers, 46.5% (44.3–48.7) non-commissioned officers (NCO) and 49.9% (46.4–53.7) rank-and-file. The Army had more rank-and-file than NCOs (58.7% vs. 35.1%), whereas the opposite trend was observed in the Navy (30.8% rank-and-file vs. 60.9% NCOs) and the Air Force (20.0% vs. 69.1%) (P < 0.0001). The proportion of women [13.0% (11.6–14.5)] was similar with those observed in the French armed forces overall (14.0% for the 2005–08 period), and it was higher in the Air Force (26.0% vs. 10.9% in the Army and 3.0% in the Navy; P < 0.001) and among rank-and-file (15.3% vs. 11.6% among NCO and 11.0% among officers; P = 0.02). The mean age was 31 years (range: 18–56 years). Officers (mean age = 37 years) were significantly older than NCO (mean age = 35 years) and rank-and-file (mean age = 26 years) (P < 0.0001). Personnel were

### Table 1

<table>
<thead>
<tr>
<th>Population*</th>
<th>Gender</th>
<th>Age</th>
<th>Branch of the armed forces</th>
<th>Sample subjects</th>
<th>Prevalence of past-month cannabis use (at least one use vs. no use) compared with the urine test</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Gender</td>
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<td>Percentage of past-month cannabis use (at least one use vs. no use) compared with the urine test</td>
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<td>Se (%)</td>
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<tr>
<td></td>
<td>Men</td>
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<td></td>
<td>17.2 (15.4–19.2)</td>
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<td></td>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td>17.2 (15.4–19.2)</td>
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<td></td>
<td>&lt;20 years</td>
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<td></td>
<td>17.2 (15.4–19.2)</td>
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<td></td>
<td>20–29 years</td>
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<td>30 years</td>
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<td>17.2 (15.4–19.2)</td>
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<td></td>
<td>NCO</td>
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<td>17.2 (15.4–19.2)</td>
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<td></td>
<td>Officers</td>
<td></td>
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<td></td>
<td>17.2 (15.4–19.2)</td>
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<tr>
<td></td>
<td>Navy</td>
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<td>17.2 (15.4–19.2)</td>
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<td></td>
<td>Air Force</td>
<td></td>
<td></td>
<td></td>
<td>17.2 (15.4–19.2)</td>
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<tr>
<td></td>
<td>Whole sample</td>
<td></td>
<td></td>
<td></td>
<td>17.2 (15.4–19.2)</td>
</tr>
</tbody>
</table>

a: Number of subjects presented here are not weighted.

b: Gender.

c: Global informative value: percentage of subjects correctly classified.

d: Population subgroup.

References:
The prevalence of self-reported cannabis use across the sample was 48.2% (46.0–50.4) for long-term cannabis use (at least one use occasion during the whole life), 21.8% (19.9–23.7) for past-year cannabis use and 16.1% (14.4–17.8) for past-month use. As shown in table 1, the proportions of self-reported use were significantly higher ($P<0.01$) in men (17.2% vs. 8.6% in women), in rank-and-file (29.1% vs. 0.9% in officers) and in the Army (20.7% vs. 6.4% in the Air Force). Younger age was strongly associated with greater likelihood of self-reported use (40.4% among subjects aged < 20 years and 27.1% among 20–29 years old vs. 6.6% among subjects aged ≥ 29 years). Among the subjects who reported past-month cannabis use, 45.3% (39.4–51.2) reported using cannabis twice or less, 18.1% (13.5–22.7) on 3–9 occasions, 15.5% (11.1–19.9) on 10–19 occasions and 21.1% (13.7–28.3) on ≥ 20 occasions. The personnel aged < 30 years ($P=0.02$), the lowest ranks ($P=0.02$) and the subjects belonging to the Navy and the Army ($P=0.001$) tended to report more frequent use occasions (table 1). No officer reported more than two occasions of use during the past month. The prevalence of positive urine tests for cannabis across the sample was 13.4% (11.8–15.0). It was higher among men, younger personnel, rank-and-file and in the Army ($P<0.0001$).

The discriminant power of self-report was good, with an area under the ROC curve 0.90 for the dichotomous report of cannabis use and 0.91 for the frequency scale, where the optimal cut-off coincided with that for the dichotomous responses. Smaller areas under the ROC curves were observed among officers [0.75 (0.73–0.75) vs. 0.88 (0.86–0.88) among NCOs and 0.88 (0.86–0.91) in rank-and-file] and subjects aged <20 years [0.75 (0.65–0.82) vs. 0.88 (0.85–0.90) among subjects aged 20–29 years and 0.95 (0.91–0.98) among subjects aged ≥29 years].

As shown in table 1, the global informative value (proportion of subjects correctly classified) of the dichotomous report of past-month cannabis use was good (93.4%). The global positive and negative likelihood ratios were 15.6 and 0.2, respectively. Self-report had good Sp (94.5%) and NPV (97.8%), but lower Se (85.7%) and PPV (70.4%). Se was significantly lower in the Navy [68.7% (66.1–71.2) vs. 87.6% (84.2–90.3) in the Army and 84.5% (78.0–89.1) in the Air Force], among officers and NCOs [49.2% and 79.1%, respectively, vs. 87.3% in rank-and-file]. Although differences were non-significant, Se also tended to be lower among men (85.2% vs. 91.5% among women) and to slightly decrease with younger age. PPV was <75.0% in most of the sub-populations. The global informative value was significantly better among officers (99.1%) and NCOs (96.8%) than among rank-and-file (89.0%) and among older subjects (98.7% among subjects aged ≥ 30 years vs. 88.8% among subjects aged 20–29 years and 74.8% among subjects aged < 20 years).

Finally, the study of variations in positive and negative predictive values (PPV and NPV) for reported past-month cannabis use according to prevalence of positive urine tests showed that the optimal prevalence to obtain the best value for PPV and NPV (~91%) was ~40%, three times greater than the prevalence estimated in our population (figure 1).

**Discussion**

Relatively good agreement was found for recent cannabis use between self-reported data and urine tests, which supports the accuracy of self-report of cannabis use, and is consistent with previous research.14,15 The internal validity of self-report among the military is acceptable considering the prevalence of cannabis use observed in armed forces. The accuracy of self-report among military personnel seems to be comparable with that measured in university students, but better than that measured in adolescents.13,16 The 85.7% Se calculated in our sample is in favour of a relatively low-prevarication level in the French armed forces in self-report of cannabis use. It could be expected that self-report would underestimate use among the military, who risk disciplinary action if detected as illicit substance users, despite the fact that the survey was anonymous. However, considering that participants were informed about the urine test before questionnaire completion, it is possible that the prospect of this test could influence the responses and render self-report more reliable. Finally, the participants were only informed of the urine test just before they were called, which did not give them sufficient time to implement urine tempering methods that would mask positive results.17

Lower Se values were observed among officers, NCOs and in the Navy, which could be interpreted as a greater propensity to concealment concerning recent cannabis use in these sub-populations. It is likely that officers, despite being rare or infrequent users, would tend to hide their use for fear of major sanctions; this category of personnel has greater responsibilities and is expected to show...
exemplary behaviour in the armed forces. Conversely, personnel from rank-and-file, characterized by a lower educational level, are likely to underestimate the disciplinary implications and to have a lesser tendency to conceal the truth about substance use. However, the small number of users observed among officers in our sample (three officers tested positive) leads us to interpret these results with caution for this category of personnel. The lower Se values observed in the Navy compared with other branches of the armed forces could be explained by the existence of many jobs in this branch that require a certain level of qualification and involve great responsibilities, allowing for no tolerance towards drug use. The same phenomenon could have been expected in the Air Force, but it was not evidenced, probably because of the low prevalence of use observed in this branch. The greater proportion of missing data for urine sample observed in these two branches of armed forces (4.3% in the Navy and 2.8% in the Air Force) compared with the Army (0.5%) is in line with this hypothesis.

Although the differences were not significant, lower Se values were observed among younger subjects. Concerning the fact that the users aged <30 years reported higher frequency of use, this result could reflect greater prevarication among frequent users, who could see their use as more reprehensible than occasional users. This phenomenon could be more predominant in the Navy, in which young personnel are mostly NCOs (as Navy personnel include more NCO than rank-and-file, which implies jobs with greater responsibility). On the other side, a good Se value was observed in the Army despite the fact that this branch reported the highest proportion of frequent users. Indeed, young soldiers belong mostly to rank-and-file, which implies lower levels of responsibility.

The low PPV observed in the present study can be interpreted as a limitation of the reference chosen, the urine test, designed to detect recent use. Although urine tests have proved their efficacy in screening long-term users for a period that can exceed 1 month from the last use,18 these tests are not able to detect THC among occasional users for more than a few days after the last use. Thus, the Se of the Narcotest THCs5, reaching 98% for a threshold of 50 ng/ml, decreases to 78% for a threshold of 37.5 ng/ml, a level which could be observed in an occasional user several days after the last use.13,18 However, other studies evaluating self-report also used urine analysis as a reference.8,14,16

Finally, urine testing in the workplace has been adopted widely by some armed forces to identify staff members whose performance could be impaired by their cannabis use, which can be particularly deleterious in military settings. However, the efficacy of cannabis urine testing at the workplace in improving safety has been recently questioned in a review of 20 years of published literature on the question.20 The acute effects of smoking cannabis impair performance for a period of only ~4 h.51 Thus, although long-term heavy use of cannabis can impair cognitive ability, it is not clear whether heavy cannabis users represent a meaningful job safety risk, unless cannabis is used just before starting work or on the job. The authors also mention that although drug testing was related to reductions in the prevalence of positive cannabis tests among employees, urine analyses have not been shown to have a meaningful impact on job accident rates.

It should be noted here that although the French armed forces do have procedures for individual testing, the surveys presented here used anonymous data and only aimed to evaluate the epidemiological scale of drug consumption in the military community, with no possible return to the individual.

In conclusion, despite some limitations because of the urine analysis chosen as a reference, our study is in favour of good accuracy of self-reported data on cannabis use in a global survey, even in a military population. However, it does not make any assumptions on the validity of self-reports collected in individual testing procedures for the purpose of improving job safety. Personnel with the highest job responsibilities seem to be more liable to prevarication, and recent research has questioned the validity of urine analyses in this context. Oral fluid testing, which is considered as a valid non-invasive procedure for cannabis testing for active THC, could be considered here.22

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Key points

- Cannabis use among military constitutes an important public health issue.
- The objective was to compare self-report of recent cannabis use with urine analyses.
- We concluded to good accuracy of self-reported data on cannabis use among the military.
- A greater degree of prevarication was suspected among higher-ranking personnel.

References

Alcohol consumption and social inequality at the individual and country levels—results from an international study

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Background: International comparisons of social inequalities in alcohol use have not been extensively investigated. The purpose of this study was to examine the relationship of country-level characteristics and individual socio-economic status (SES) on individual alcohol consumption in 33 countries. Methods: Data on 101,525 men and women collected by cross-sectional surveys in 33 countries of the GENACIS study were used. Individual SES was measured by highest attained educational level. Alcohol use measures included drinking status and monthly risky single occasion drinking (RSOD). The relationship between individuals’ education and drinking indicators was examined by meta-analysis. In a second step the individual level data and country data were combined and tested in multilevel models. As country level indicators we used the Purchasing Power Parity of the gross national income, the Gini coefficient and the Gender Gap Index. Results: For both genders and all countries higher individual SES was positively associated with drinking status. Also higher country level SES was associated with higher proportions of drinkers. Lower SES was associated with RSOD among men. Women of higher SES in low income countries were more often RSOD drinkers than women of lower SES. The opposite was true in higher income countries. Conclusion: For the most part, findings regarding SES and drinking in higher income countries were as expected. However, women of higher SES in low and middle income countries appear at higher risk of engaging in RSOD. This finding should be kept in mind when developing new policy and prevention initiatives.

Introduction

In high-income countries socio-economic inequalities in health have been investigated extensively.¹ These studies conclude that persons of higher socio-economic status (SES) have lower mortality and morbidity as well as more favourable health behaviours than those of lower status.² When gender is taken into account deviations from this general pattern can be found. In some countries women of higher SES are more likely to report poor self-assessed health (Italy, Portugal, Sweden)³ as well as higher rates of smoking (France, Italy, Spain, Portugal, Lithuania)² and risky single occasion drinking (RSOD) (Mexico, Brazil),⁴ whereas among men, those of lower SES are more likely to report negative outcomes.

Some studies, mainly in Europe, have compared inequalities across-nationally.²⁻⁵ Comparative research enables the investigation of area-level effects which provides information for policy makers regarding (social) environmental factors affecting population health outcomes. The socio-economic position of a region can have an impact on a population’s health beyond individual SES.⁵ For the