Thirteen years of drug testing at the department of military forensic medicine in Rome: analytical results

Tredici anni di Drug Test presso il DMML di Roma: risultati analitici

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Abstract - The drug phenomenon has bio-psycho-social connotations that must always be borne in mind when assessing the health status of a military community as part of the wider population in which it operates. This retrospective epidemiological study, conducted at the DMML – Dipartimento Militare di Medicina Legale) (Department of Military Forensic Medicine) in Rome, described over 13 years of EMIT tests on substances of abuse (drug tests) and benzodiazepines (BZDs), carried out for screening purposes on both military and civilian personnel and for medico-legal screening purposes on personnel of the Armed Forces and of State Corps referring to the DMML (central/southern Italy). An analytical study was also carried out on frozen samples stored at this Department, to assess any decay in the concentration of metabolites previously found positive and confirmed by the 2nd level test in previous years.
A positivity of 10.75% for BZDs emerged out of a total of about 4,700 samples and 1.10% for drug tests.
There were no drastic decreases in concentration in the tested substances after storage at different temperatures, even though storage at freezer temperature (-20°C and without excessive temperature fluctuations) is optimal compared to that in the refrigerator. There were also few changes between storage at refrigerator temperature and room temperature.
The extrapolated data from the years considered revealed a consistent level of abuse within the Armed Forces, as well as an increasing trend, primarily affecting the State and Police Corps. Notably, the latter are not subject to random checks. The high number of positive tests for BZDs is a factor deserving attention that opens an employment and occupational scenario on the motivations that drive State Corps and Police personnel to use/abuse such substances.

Riassunto - Il fenomeno della droga ha dei connotati bio-psico-sociali che devono essere sempre tenuti presenti quando si valuta lo stato di salute di una collettività militare che si inserisce nella più ampia popolazione in cui opera. Questo studio epidemiologico retrospettivo, condotto presso il DMML di Roma, ha descritto oltre 13 anni di test EMIT su sostanze d'abuso (drug test) e benzodiazepine (BZD), in ambito sia di screening per Esercito e Civili, che medico-legale in sede di accertamento d'idoneità per il personale di tutte le FF.AA e Corpi dello Stato afferenti al bacino d'utenza di questo DMML (Italia centrale/Sud); è stato altresì effettuato uno studio analitico in campioni congelati e conservati presso questo Dipartimento, onde valutare un eventuale decadimento in concentrazione dei metaboliti precedentemente riscontrati positivi ed anche confermati al test di 2° livello negli anni addietro.
È emersa una positività del 10.75% per le BZD su un totale di circa 4.700 campioni e del 1.10% per i drug test.
Non sono emersi drastici decrementi di concentrazione nelle sostanze esaminate dopo conservazioni a temperature diverse, pur in costanza del fatto che la conservazione a temperatura di congelatore (-20°C e senza eccessivi sbalzi termici) è ottimale rispetto a quella del frigorifero, e poco cambia tra quest'ultima e la temperatura ambiente.
I dati estrapolati dagli anni presi in considerazione hanno portato ad evidenziare un costante livello del fenomeno degli abusi in ambito FFAA ma anche un tendenziale incremento che riguarda soprattutto i Corpi dello Stato e di Polizia; personale, quest'ultimo, che non viene sottoposto a controlli randomici. Fattore che merita attenzione è l'elevato numero di positività alle BZD che apre uno scenario lavorativo ed occupazionale sulle motivazioni che spingerebbe il personale dei Corpi dello Stato e di Polizia all'uso/abuso di tali sostanze.

Keywords: drug test, BZB, army, EMIT method.

Key messages:

- The drug phenomenon has bio-psycho-social connotations that must always be kept in mind when assessing the health status of a military community.
- The abuse of cocaine and BZB in the analysed sample reflects the national trend.

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Introduction

The drug phenomenon has bio-psycho-social connotations that must always be kept in mind when assessing the health status of a military community that is part of the wider population in which it operates. At the laboratory of the Department of Forensic Medicine in Rome, a retrospective epidemiological study was carried out over a 13-year period (2012-2024) to assess the prevalence of drug addiction in our working environment based on data extrapolated from the Laboratory Information System (LIS). To this end, data was processed according to various criteria, bearing in mind that this specific environment is part of a broader one, not only within the Armed Forces and equivalent Corps, but also within the entire society of which they are part. Lastly, it was decided to submit 25 residual urine samples, which had already been subjected to Level 2 testing as positive, and which are now being disposed of due to the expiry of deadlines for possible counter-analysis by the interested parties. They were used for the re-determination of the substance(s) to which they were found positive at three different times and under different conditions. Data was compared in order to identify a pattern of concentration decay or, in any case, to ascertain the effects of long storage (more than two years) at the temperature required by law and, in some cases, of thermal stress due to the need to thaw the sample for the confirmation test and then re-storage it at -20°C for possible 'counter-analysis' for at least another three months as required by law. The period considered is quite long and there are various connotations of the variables that have occurred during this time frame. It follows that the results cannot be suggestive, *tout-court*, of a clear increase/decrease of the drug phenomenon in the Armed Forces/State Corps compared to the rest of the population. However, it can be food for thought for a probabilistic reasoning to put in place appropriate measures in Preventive Medicine, especially in Primary Prevention.

Materials and Methods

In the relevant period, approximately 16,800 urine samples were screened for a total of approximately 100,000 determinations for the detection of urinary catabolites of drugs of abuse and benzodiazepines (BZD) by means of the EMIT (*Enzyme Multiplied Immunoassay Technique*) method using the *Abbott Architect c4000*® instrument at first and the *Abbott Alinity C*® instrument that allows quantitative determinations. In the report, the semi-quantitative determination emerges in relation to the automatic comparison, carried out between the instrument's computer and that of the LIS, between the stored result and the statutory cut-off, as programmed in advance. If the concentration is below the cut-off, the word '*Negative*' will be printed in the interfacing programme (and then in the report), otherwise '*Positive (waiting for confirmation test)*'. In the latter case, in addition to the repetition with method TLC (*Thin Layer Chromatography*) using the kit Alere® Multi-Drug Screen Cup with DxLINK Technology, the sample is stored at -20°C with the aliquot to be sent to the 2nd Level Laboratory. Tab.1 shows the legally required cut-offs of some substances of abuse and the average residence time in urine.

For the purposes of this study, data covering 13 years of activity, from 2012 (nine years) to 2024 were extracted from the LIS and, by means of MS-Excel® and MS-Access®, unique records were obtained by person/date of execution with personal information, entity and service of affiliation and 1st and 2nd level results. Queries were then extracted in which grouping, 'filtering' and pivot tables were carried out, obtaining new tables on which to base graphs and tables. Where possible, statistical inference calculations were carried out, such as the Chi-square (χ^2) indicated for evaluating frequency distributions. With regard to the data concerning the year 2011 and the first three months of 2012, the statistics sent at the time were re-elaborated, while for data concerning the relapse for substance use in the year 2023, the statistics were extrapolated from the computer system in use at the Medical Commissions through the platform «Knowadge». The 4 quarterly tables were extrapolated, in Excel format® by merging them into a single table and then, through the «filter» function, the diagnoses inherent to the use of substances including alcohol were identified. Records were also filtered based on other data such as the service/State Corps, age (which can be obtained from the date of birth) and other. In comparing data with environments larger than the one considered, some meta-analyses of data extrapolated from relevant publications [1-3] were carried out. However, meta-analyses do not cancel out possible methodological biases. For example, population studies report relatively large samples but are often based on voluntary adhesion and adhesion rates that are affected by the varied distribution of healthcare facilities in the territory, with possible underestimates of the phenomenon.

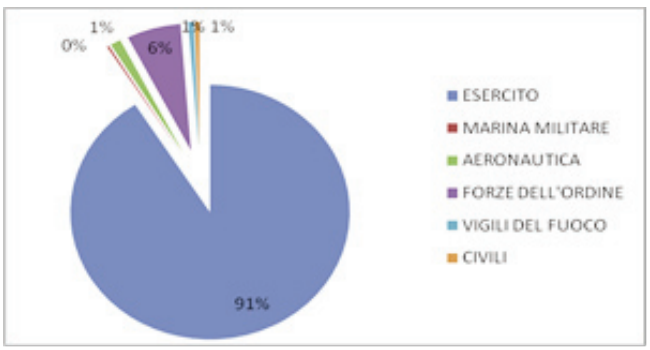
With regard to the analytical re-determi-

nation of the 25 urine samples to be disposed of after the expiry of the legal storage periods and that were confirmed positive in many cases, the analytical determination was carried out on three successive dates, i.e. after de-freezing, the next day after approximately 24 hours of storage at refrigerator temperature (between 4 and 8°C) and the following day again after 24 hours of storage at room temperature. This was done to test the extent to which thermal stresses and storage time could affect the concentration of the substance. For obvious reasons of feasibility, only the first-level test was chosen. Finally, in order to obviate the possibility that results may have been affected by the blocking of the action of any urinary hydrolases, which may have been denatured by freezing, and thus inactivated, 1 sample that had been found positive was determined in duplicate the following day, dividing it into two aliquots: one stored at room temperature and the other at refrigerator temperature.

Tab. 1 - Average urine residence time of certain substances and statutory cut-offs.

Metabolites	Average time in urine	Cut-Off 1st level*	Cut-off 2nd level**
Opiates	2-3 days	300 ng/ml	100 ng/ml
Cocaine	1-2 days	300 ng/ml	100 ng/ml
Cannabinoids	7 days if occasional use; 40 days if continuous use	50 ng/ml	15 ng/ml
Amphetamine	2-4 days	500 ng/ml	250 ng/ml
MDMA	1-5 days	500 ng/ml	250 ng/ml

* Annex A and, respectively, ** Annex B of the Regulation[22].



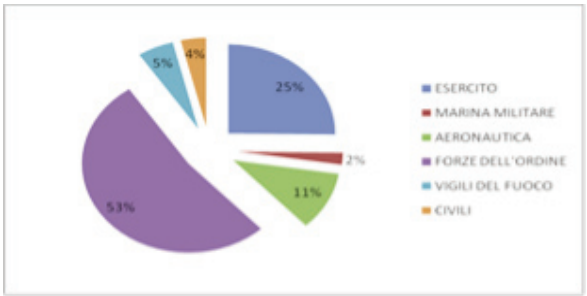
Graph. 1 - Overview of people screened.

Results

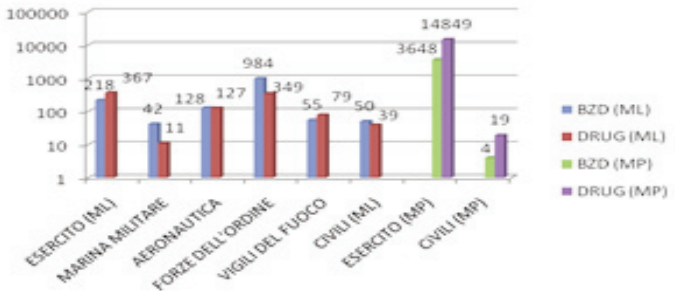
During the period under review, approximately 16,800 urine samples were screened from about 12,000 persons. The apparent discrepancy in numbers between the number of samples and the number of people is often due to the same person being screened several times (for preventive and occupational medicine, and for recurrent positives).In the latter case (recurrence), especially if there is a sufficiently long time lapse with respect to the retention time of the metabolites in the urine ***(Tab. 1)*** between two determinations, any positivity is generally attributed to a new intake, which leads to the assumption that the use of substances is not occasional. This is an element of undoubted prognostic and medico-legal value, naturally in connection with other variables. Requests for investigations, regardless of the reason, are broken down as follows ***(Graph. 1).***

The preponderance of Italian Army personnel (91%) is evident, with the Police Forces (Carabinieri, Guardia di Finanza, State Police and Penitentiary Police) in a leading position (about 6%) compared with the other two services, the Fire Brigade and civilian personnel (about 1% each). However, it must be considered that there is a similar preponderance, for the Army, of preventive services («spot» checks, checks for military licences and for Occupational Medicine) that our laboratory carries out for external personnel at the request of the various bodies in the area of responsibility, in addition to analytical determinations carried out at the request of the medical authorities (medical commissions and Observation Department) within this DMML as part of a medico-legal assessment.

Excluding, therefore, the analytical services delivered to external personnel (preventive rationale), those delivered in the medico-legal field become more comparable among all the Services/Corps, as shown in ***Graph. 2***: here the Army covers a 25% proportion. With regard to processed requests, results related to drug-testing or/and BZD and broken down by Service/Corps are shown in ***Graph 3***: first of all, to make the quantities comparable, given the numerical preponderance of Preventive



Graph. 2 - Overview of people screened in FM assessment.



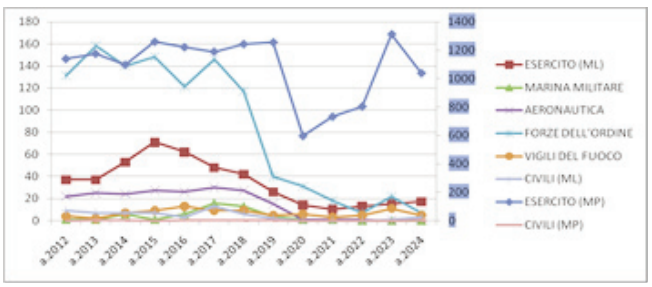
Graph. 3 - Overview of examinations by Service/Corps.

Medicine (PM) services for the Army, the «y» axis of the values was expressed in logarithmic terms on a base of 10; for the rest, PM services were also carried out for civilian personnel, although residual. Considering only internal analyses (left-hand side of the graph), in the forensic field (FM) the request for urinary BZD determination generally prevails over that for drug testing (with which it is often also associated), especially in the Police and State Corps.

Considering the trend of requests processed over time, the picture shown in ***Graph. 4*** emerges, which is a combination in which the PM performance trend for the Armed Forces, with its value axis on the right, has been superimposed on everything else to better visualise the curve obtained, allowing easier comparison. This shows, among other things, a relative preponderance of requests in the FM area for the Police Forces, which, as shown above, mainly concerned BZD. However, this was relatively constant until 2018, with a drastic decline in the following years and a minimum in 2022. This can be explained by the fact that it was at this time that the Psychiatric Service of this Department decreased its requests for drug tests and urinary BZDs. On the other hand, as far as the Army is concerned, we observe a peak in forensic and preventive medicine services in 2015, followed by a clear decline, particularly in preventive medicine, in 2020. There was a slow recovery in subsequent years, with a substantial restoration of the previous trend. This is evidently to be attributed to the reduction of activities during the COVID-19 lock-down. For the other services, the Fire Brigade and civilians, the trend after 2020 must be considered stationary.

In light of these results, apart from 92 samples (0.54% of the total) which were rejected due to unsuitability for analysis at level 1 or for some other reason (sample not received or removal of the subject during collection), there were 611 samples positive for at least one substance, i.e. approximately 3.64% of the total, divided between 454 BZDs (2.70% of the total) and 174 drug tests (1.03% of the total), which were often associated. Considering that the total number of BZDs and drug tests/person is around 4,700 and 14,600 respectively, the percentage of positivity of the total between drug tests and BZDs will be 1.10% and 10.75% respectively, the latter concerning mainly the medico-legal field. A synoptic overview of the above is given in ***Tab. 2.***

Given the numerical, positivity and even conceptual gap between the two types of substances, illicit drugs being drugs and medicinal drugs (except for 'self-medication') BZDs, it is advisable to consider them separately, even though sometimes, as will be seen, positives can be associated in the same person, but are not always indicative of actual BZD consumption, since high doses of the metabolites of all drugs can lead to a false positive result for BZDs. In any case, for economic and organisational reasons, this laboratory only requests a confirmatory test for drugs under the law. Generally speaking, the subject 'peacefully' admits to taking BZDs without the need for a medico-legal adversarial procedure, as in the case of drugs. The comparison between drug test positives and BZD positives shows first of all that positives recorded in connection with Preventive/Occupational Medicine and Forensic Medicine (FM) were only identified within the Army. A picture of raw posi-



Graph. 4 - Trend in testing procedures over the years.

Tab. 2 - Overview of results.

Analyses	Examined	Positives	%. of positives on type of analytes tested*	%. of positives on urine samples**
Drug testing	15800	174	1.10%	1.03%
Benzodiazepines	4220	454	10.75%	2.70%
Totals	20020***	628	3.13%	3.74%

* BZD or Substances of Abuse, tests often performed on the same urine sample, as required.
** These percentages are calculated based on the total of 16795 urine samples (net of rejected samples) on which BZD and/or substance of abuse catabolites were determined.
*** No. given by the sum of procedures, whether BZD is associated with a substance of abuse.

Tab. 3 - Overview of positives.

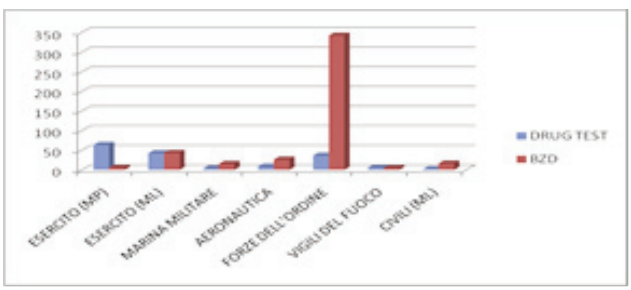
	Drug test No.	BZD No.
Army (PM)	64	6
Army (FM)	43	44
Navy	4	16
Air Force	9	27
Law Enforcement	37	343
Fire brigade	6	5
Civilians (FM)	2	17

tives therefore emerges as shown in ***Tab. 3*** and ***Graph. 5***.

Graph. 5 shows a trend in positive results that is essentially parallel to that of requests in comparison with ***Graph. 3***. This parallelism becomes clearer when considering only Forensic Medicine determinations: there is a reversal of the trend related to the more frequent positives for substances of abuse in PM compared to the higher frequency of positives for BZD in FM. This trend appears to be more pronounced for law enforcement agencies, in line with the trend in requests highlighted above. When assessing the percentages of the annual total of determinations by type of substance (drug test or BZD), the picture in ***Graph. 6*** emerges, which is also of a combined type in that the order of magnitude of the percentages of drug test positivity (right-hand value axis), is lower than that of BZDs (left-hand value axis) by a factor of 10.

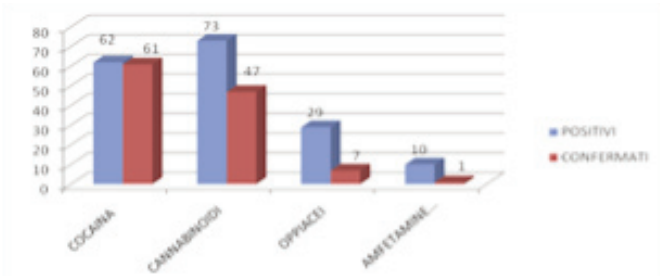
A peak in benzodiazepine (BZD) positives in 2015, with more than one positive result for every two determinations (55.88%), is evident, which then fades the following year until declining from 2017 to 2020.

With regard to the analytes, it should be noted that the four basic substances of drugs according to the law (Amphetamines/Methamphetamines, Cannabinoids, Cocaine and Opiates) were taken into account, meaning that Methadone and Ecstasy (MDMA), for technical reasons, were incorporated into Opiates and Amphetamines/Methamphetamines respectively. It should be emphasised that a drug test positive indicated above will be confirmed by the Level 2 test. There were in fact several cases of false positive ***(Graph. 7)***. In one case the sample was not accepted due to flaws in the compilation of the accompanying documenta-



Graph. 5 - Samples tested positive at Level 1.

Graph. 6 - % BZD and drug positives on annual totals.



Graph. 7 - Comparison of positivity in the level 1 test and the confirmatory test.

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A comparison of the number of positive samples per substance at Level 1 with the number of confirmations shows that, from cocaine to cannabinoids, opiates and amphetamines, the percentage of confirmations decreases progressively. In particular, only one sample of cocaine, out of a total of 62, was unconfirmed, while for cannabinoids the proportion of confirmed cases decreases markedly to the point where unconfirmed cases for opiates (9 out of 29 confirmations) and amphetamines/methamphetamines (only 1 out of 10 confirmations) predominate. It is evident that cannabinoids in this context are relatively frequent; however, in terms of true positivity, cocaine is of relevance. Substances that generally cross-react with cannabinoids, reported in the anamneses of Annex C (22), are mostly NSAIDs, (Ibuprofen, Niflumic acid); antihistamines, amiloride, sertraline, hyoscine are also reported in anamneses.

Opiates often include codeine (i.e. methyl morphine) associated with NSAIDs, which is considered by some to be a drug at high doses, but which falls within the prescribing discretion of physicians. Beta-2 agonists are also reported. With regard to amphetamines and methamphetamines, triprolidine- and pseudo-ephedrine-based preparations (zerinol®, actigrip® , Actifed®) as well as imodium® , riopan® , spasmomen®, and unspecified supplements are reported in the anamnesis. ***Tab. 4*** shows the substances which, according to existing literature, cross-react with the substances in question, giving false positives.

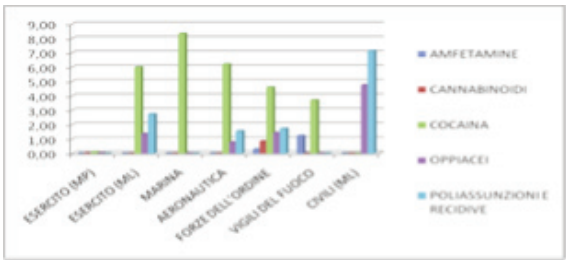
In view of the above, ***Graph. 8*** shows the trend of confirmed positives in the various Services/Corps in the years under review, in percentage against the number of determinations per Services /Corps per year.

When lumping all Preventive Medicine determinations together (those related to the Army plus the residual 19 determinations for civilian personnel with no positive results***, Graph. 3***) it may make sense to compare the Forensic Medicine positives and Preventive Medicine positives over the years, as shown in ***Graph. 9***.

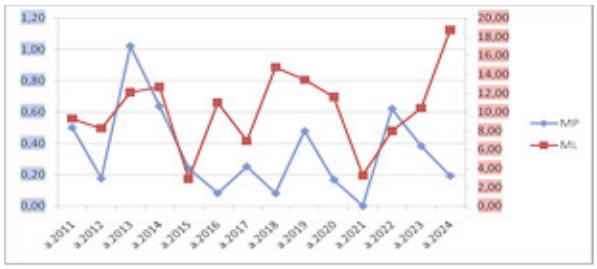
A peak of positives for external personnel emerges in 2013 (about 1/100 determinations) compared with a minimum of positives for internal personnel in 2015 and a maximum in 2024 bordering on 20%, meaning that 1 in 5 (20%) of drug tests in the medico-legal sphere were likely to have a positive result, later confirmed. All this is explained in the context of the different significance of a preventive, screening assessment compared to an assessment carried out in the medico-legal field. While the former identifies a possible positive in a relatively large number of persons, the latter tends to ascertain whether a subject, already known to have tested positive or suspected positive, re-presented this characteristic or whether the suspicion was confirmed.

Tab. 4 - Substances interfering with Level 1 analyses.

Test substance	Cross-reagent substances (possible sources of false positives)
Amphetamine	LabelatolRanitidinePseudoephedrine; Nafazolin nitrate; Chlorphenamine maletateTricyclic antidepressants
Cannabinoids	Niflumic acid; Ibuprofen
Cocaine	Lidocaine; Carbocaine (e.g., in dental extractions)
Opiates	Codeine (methyl morphine); Buprenorphine hydrochloride



Graph. 8 - Services/Corps positives as % of total determinations.



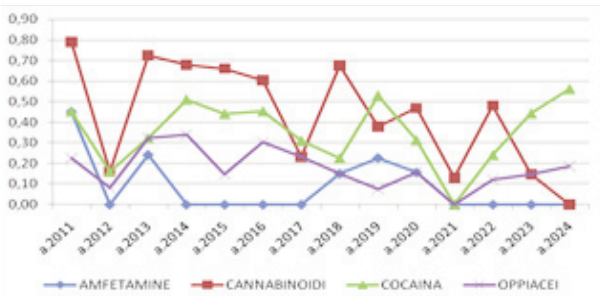
Graph. 9 - Positive % for drug tests in Preventive Medicine and Occupational Medicine.

It is interesting to consider the trend of confirmed positives over time, as shown in ***Graph. 10***, where it is evident that the preponderance of positives is attributable to cannabinoids and cocaine, amphetamines/methamphetamines being very residual, except for sporadic peaks.

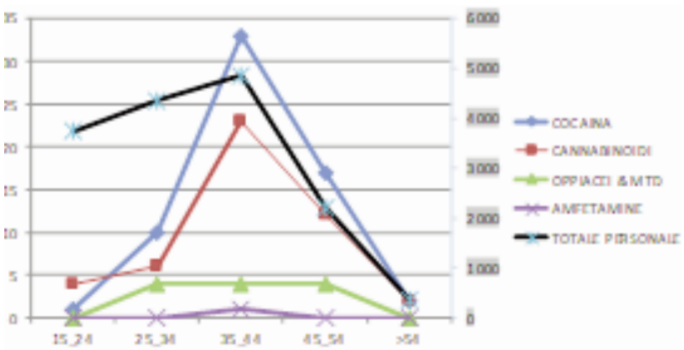
However, it is worth noting that, although cannabinoid positives had a relative preponderance in the years 2012-2018, it cannot be said that the phenomenon has decreased, given the fact that the number of requests for drug tests in the medico-legal area also decreased from 2018 onwards. Despite this, the relative increase in positive tests for cocaine and for opiates is evident, which is consistent with the data in existing literature except for cannabinoids. For the latter the age factor may also be concealed.

Graph. 11 shows that in the 15-24 age group the number of positives for cannabinoids is greater than for cocaine, but numerically this group is underrepresented (3,762 persons) in the sample compared with the 25-34 age group (5,632 persons), given the fact that in the general population the use of cannabinoids is more common in young people (2, 23). The sample under review shows that the peak age of positives has shifted by one group age compared to what is reported in the literature (1).

Going back to Figure 8, some reflections should be made with regard to poly-drug use and recurrences. In all, there were 24 cases, which revealed positives for more than one substance, given mostly by



Graph. 10 - Trend in positives by substance.



Graph. 11 - Positivity by substance across age groups.

Tab. 5 - Overview of polydrug users and repeat users by substance and by Service/Corps.

	Cocaine	**Canna-binoids**	**Opiates**	**Totals**	**Army**	**Air Force**	**Law Enforcement**	**Civilians**	**Totals**
Polyaddicts	13	10	2	14	7	1	5	1	14
Repeat users	9	9	3	16	6	2	6	2	16
Totals	17 (21)	15 (19)	3 (5)	24 (30)	10 (13)	3	8 (11)	3	24 (30)

cocaine plus cannabinoids (8 cases + 4 recurrences of polydrug use), followed by cocaine plus opiates (2 cases), cocaine plus opiates and methadone (1 case) and methadone plus opiates (1 case). In one case there was a previous cocaine positive and a second cannabinoid positive. It should also be noted that in 16 cases positivity was recurrent in measurements so far apart as to suggest non-occasional intake ***(Tab. 5)***.

Although they cover a small percentage of the military population, the double positive cases and the tendency to relapse nevertheless concern people suffering from an overt abuse problem (addiction). This problem can only be eradicated with a multidisciplinary and continuous approach over time, given the high relapse rate among poly/multi-addicts. Regarding the breakdown of positives according to gender, it should be noted that only 3 women (2 in the State Police and 1 in the EI) tested positive, among them 1 (State Police) positive for cannabinoids due to reported therapeutic use of these substances. Applying the Chi square (χ^2) to ascertain whether there is a relationship between PM or FM tests and substances or/and positivity with time periods, to calculate the theoretical frequencies to be used for the relevant calculations, values of less than unity were obtained. Similar results were obtained in the theoretical contingency tables FM/PM vs. years of analysis. For these reasons, it was not possible to consider this type of test reliable, the result of which gives a value of less than unity in any case. Applying the χ^2test can be more useful and reliable in view of the findings in ***Graph. 4,*** focussing on the relevance of the period before and after 2019 and the positives in both PM and FM.

Against this background, it is evident that even if we merge the frequencies and thus obtain theoretical frequencies greater than unity, the χ^2does not reach the critical value of 3.84 associated with the minimum α level of statistical significance at 5% for one degree of freedom. This confirms what is empirically ascertainable: no relevance emerges between increase in positivity and the period considered nor between positivity and armed forces. To get an idea of the dimensions of the phenomenon, an initial reference was made to what is reported in the literature on the Armed Forces in Italy - over a more limited period than the one considered here - and the general population as a term of comparison (23) in the same period. Some elements of this assessment were compared with more recent data (2) referring to the age groups most compatible with those of this work, as shown in ***Tab.6*** It emerges that, between 2013 and 2022, annual drug use has almost doubled, with cannabis being the most widely used substance. However, the proportion compared to other substances varies, with an increase in cocaine and opiates, as well as the emergence of new psychoactive substances (NPS).

Taking as a starting point the predicted downward trend between 2010 and 2012 (1.23), the question was whether; by comparing the Reports to Parliament (2.23), it would continue to decline in the years up to 2022, resulting in a picture as in ***Tab. 7*** and ***Graph. 13***. In the latter, to make the trends related to cannabis abuse and other substances comparable, it was necessary to rework the axis of values in logarithmic form on a base of 10 and, for this purpose, to multiply all

Tab. 6 - Contingency table - National situation comparison between 2013 and 2022.

Actual frequencies, relative totals and overall total				**Expected frequencies**	
	PM	FM	Total	PM	FM
Years 2011-2018	33	69	102	35,60	66,40
Years 2019-2024	19	28	47	16,40	30,60
Total	52	97	149	χ^2= 0.91 < 3.84	

	2014 Report to Parliament [23]	2023 Report to Parliament [2]
Use of an illegal substance at least once in the year	~ **5%** (4.96% or 2300000 persons for 2012)	~ **10%** (approx. 10900000 as of 2017)
Most used substances	Cannabis (79.44%) > Cocaine (2.02%)> Heroin (1.01%), stimulants (1.21) >Hallucinogens (0.4%); poly-abuse 13.51% (see also Graph.15)	Cannabis (63%) > Opiates (12%)> Cocaine (8%)> Stimulants (7%); Hallucinogens (5%); NPS 5%. Not reported poly-drug use*

*What is shown in this field is a reworking of the graph Graph. 2.1.4 on page 74 of the Report. The acronym NPS stands for New Psychoactive Substances. The considerations on p. 68 show that the population is predominantly male with an average age of 35.

Tab. 7 - Consumption in the last year in the Italian adult population in the years 2006-2022.

	2006	2008	2010*	2011**	2012*	2014**	2017**	2022**
Hallucinogens	0,6	0,6	0,21	0,30	0,19	0,30	0,30	0,90
Heroin	1,4	1,7	0,24	0,40	0,14	0,80	0,50	01,40
Stimulants	0,6	0,8	0,29	0,40	0,13	0,50	0,40	1,00
Cocaine	2,3	2,2	0,89	1,30	0,60	1,10	1,20	1,40
Cannabinoids	11,1	14	5,33	8,50	4,01	9,00	10,40	10,80

* See Favasuli et al. (1, p.6) and GPS-DPA 2010 and GPS-DPA 2012 Studies - Anti-Drug Policy Department in [23], p.17
** From CNR-IFC in [2], p. 75-85 with reference to 'Consumption in the last year' only

percentages by 10 to eliminate values below unity.

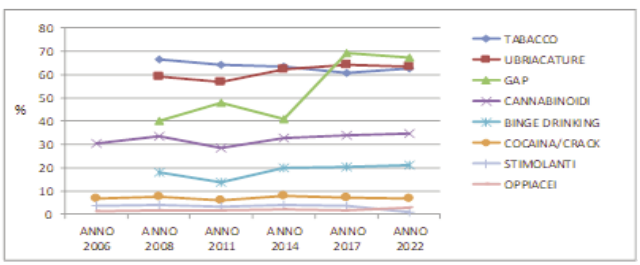
It is evident that the downward trend depicted in ***Graph. 12*** in the area enclosed by the rectangle drawn between 2010 and 2012 with some trend lines, is a parenthesis between two periods when trends were higher for all five substances considered. Cannabinoids still occupy first place, followed by cocaine and opiates. After a relatively slight decline in the years 2010-2012, they 'regain ground' in the following years, so much so that, according to the annual report of 2023([2]),, they represent an upward trend can be expected for all substances.

In ***Graph. 13*** The above substances were categorised alongside with other substances/behaviours that are conducive to abuse. Leaving aside cocaine/crack, stimulants and opiates, a substantially parallel trend can be seen as to cannabinoids, binge drinking on the one hand and drunkenness on the other, while pathological gambling (PG), after a surge from 2014 to 2017, tend to decrease, although it remains at higher levels than in 2014. Tobacco also appears to be decreasing.

Turning to the military context, it is appropriate to begin with a comparison of the general population and the military population over the period 2011–2015, before presenting the findings relevant to our situation.

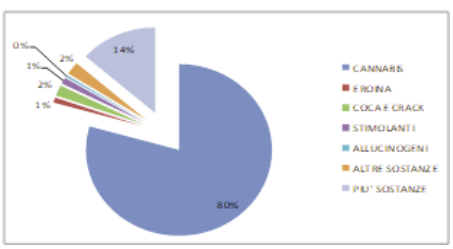
Graph. 14 shows the percentage compo-

Graph. 12 - Trend of abuse in the Italian population in the years 2006-2022.
Sources: Annual reports to Parliament on the drug phenomenon - years 2014 [23] and 2022 [2].

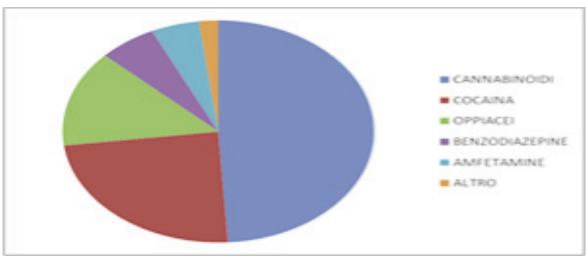


Graph. 13 - Comparison of cannabis and other intake in the 18-64 year-old population.

Source: CNR-IFC, in [2], pp. 75 - 134: Combination of data on 'lifetime consumption' of cannabinoids versus tobacco, alcohol and gambling in the years 2006-2022.



Graph. 14 - Percentage composition of positives in the population (year 2012).



Graph. 15 - Percentages of positivity by substance categories found in screened military personnel - 2011-2015.

sition of drug positives in the Italian population in 2012, as also anticipated in ***Tab. 6***, while the distribution of the percentage of positives in the military in the above-mentioned period had the distribution shown in ***Graph. 15.***

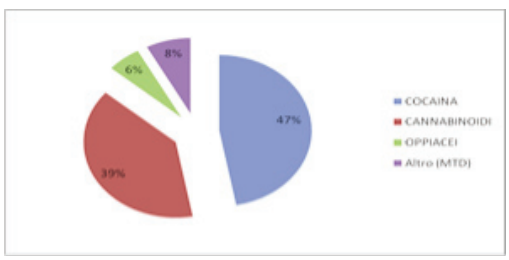
This made it possible to compare data from this department with the military population ***(Graph. 16)***.

It is worth noting that cocaine (BDZ deliberately excluded) is more prevalent than cannabinoids. On the other hand, ***Graph. 17*** shows that, during the review period, the sample evaluated at this laboratory was smaller than the national Armed Forces/Carabinieri sample, with a higher proportion of permanent service personnel. These personnel are older than the population's peak age for this substance (see Graph 11). However, there are no comparisons in that publication for the Police Forces other than the Carabinieri, nor for the Fire Brigade and civilian personnel.

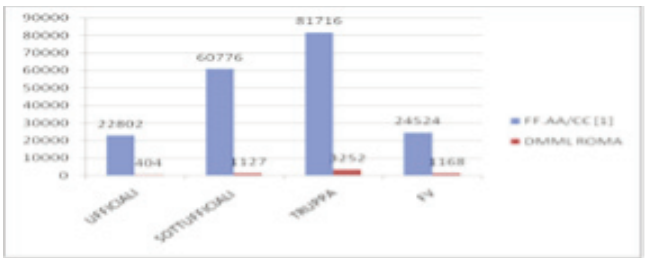
Finally, it is worth comparing the present day (2023) with the findings of a past study carried out at this DMML concerning the period immediately before the period considered (2007–2010). In relative percentage terms, there was a steady decline in substance use in psychiatric diagnoses, which fell from 6% in 2007 to 4% in 2008 and 2009, and then to 2% in 2010 (lower than current values). In 2023, however, the following emerges:

- about 5,300 eligibility files with about 700 psychiatric diagnoses (~13% of the total)
- about 19 diagnoses reporting the use of substances and alcohol (**2.71%**, up from 2010).

It is therefore evident that in this case, too, the trend indicated in this publication (3) constitutes another 'parenthesis' in a wider fluctuation. For the technical reasons mentioned above, we ignore the trend over these twelve years. However, the percentage has risen slightly from 2% to 2.71%, and there is good reason to believe that the phenomenon is underestimated. This is partly due to the decline in requests beginning in 2019 and exacerbated by the lockdown in 2020. The second phase of the study involved analysing 25 urine samples to capture any substantial changes in catabolite concentration. This was done in view of the samples being stored in freezing conditions, and the thermal stress they had undergone by the time they underwent Level 2 testing. This included the necessary thawing and refreezing processes up to the present time. Since a triple positive (cocaine, opiates and benzodiazepines) was occasionally found in a urine sample (now disposed of) on the same day as the initial test, in addition to the evaluation by the alternative method and preparation of the sample for the usual Level 2 test, a small 4cc urine sample was stored in two 2cc aliquots to be retested the following day, after storage of the two aliquots at room temperature and in the refrigerator, respectively. Urine samples were thus taken from 22 persons, 20 men and 2 women: for one the urine was collected

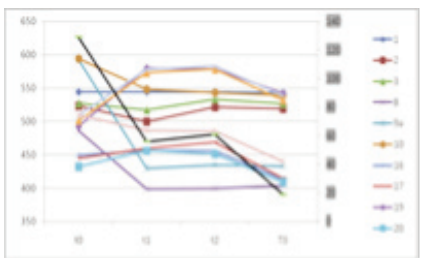


Graph. 16 - Total positive drug tests, years 2011-2015 DMML, Rome.

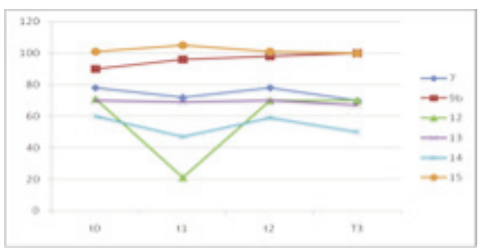


Graph. 17 - Graph 17 - Number of screened subjects by category. Years 2011-2015.

From [1] Tab.V p. 8.



Graph. 18 - Trend in cocaine-like concentrations.



Graph. 19 - Trend in cannabinoid concentrations.

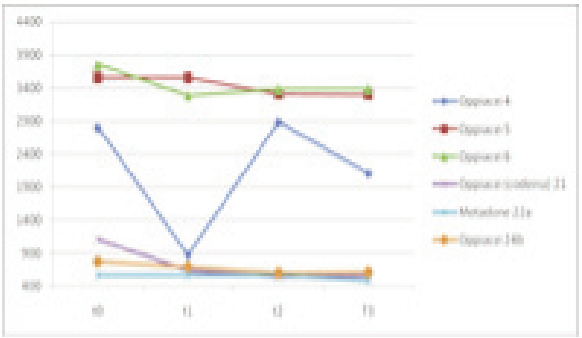
Tab. 8 - Urine samples retested prior to disposal.

Person	Urine samples stored until disposal				Concentrations measured ng/mL					
	N°	Date 1st level	Positivity	Result of 2nd level	t_0Initial conc	t_1	t_2 a T.a.		t_3 to T.a	
A	1	25/1/22	Cocaine	Confirmed	544	544	544		543	
	2	7/6/22	Cocaine	Confirmed	523	500	521		519	
	3	7/12/23	Cocaine	Confirmed	527	517	533		526	
B	4*	9/1/23	Opiates	Negative	2800	873	2883		2110	
C	5	25/10/22	Opiates	Not carried out	3650	3560	3308		3300	
	6	13/4/23	Opiates	Confirmed	3752	3291	3388		3392	
D	7	26/5/22	Cannabinoids	Negative	78	72	78		70	
E	8	18/7/23	Cocaine	Confirmed	486	399	400		404	
F	9a	18/7/23	Cocaine	Confirmed	593	430	435		433	
	9b		Cannabinoids	Confirmed	90	96	98		100	
G	10	9/3/23	Cocaine	Confirmed	594	548	543		539	
H	11	22/6/23	BZD	Not sent	819	822	917		914	
I	12	15/11/22	Cannabinoids	Confirmed	71	51	70		70	
K	13	10/11/22	Cannabinoids	Negative	70	69	70		67	
L	14	20/9/21	Cannabinoids	Negative	60	47	59		50	
M	15	16/10/23	Cannabinoids	Confirmed	101	105	101	99	100	99
N	16	16/10/23	Cocaine	Confirmed	449	456	456	468	413	423
O (♀)	17	19/10/23	Cocaine	Confirmed	445	460	469	464	415	417
P	18	6/2/24	Cocaine	Confirmed	129	56	61	57	19	20
Q	19	22/2/24	Cocaine	Confirmed	492	580	578	577	542	537
R	20	11/4/24	Cocaine	Confirmed	432	456	451	456	409	416
S	21	16/4/24	Opiates	Negative**	1115	630	546	651	554	581
T (♀)	22	23/4/24	Methadone	Not carried out	568	568	569	590	494	412
			BZD		310	269	266	229	265	244
U	23	20/5/24	Cocaine	Confirmed	501	573	578	573	532	528
V***	24	24/6/24	Cocaine	Confirmed	509	578	583	574	539	533
			Opiates	Confirmed	769	697	603	615	618	613
			BZD	Not carried out	113	111	112	125	111	118
Z	25	11/11/24	Cocaine	Confirmed	510	487	486	485	440	443

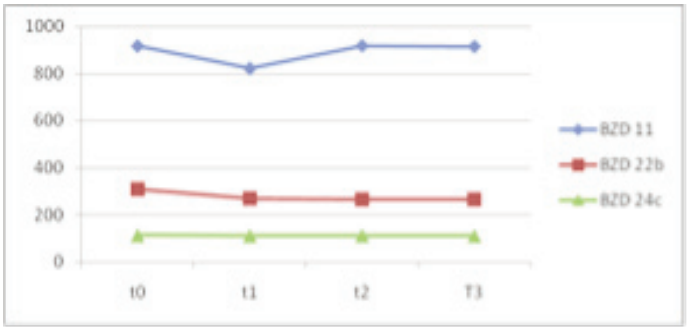
*Sample 4 was also positive for alcoholuria;** Codeine in drug history; ***Same person as in Graph 22

three times, for another 2, for all the others only once.

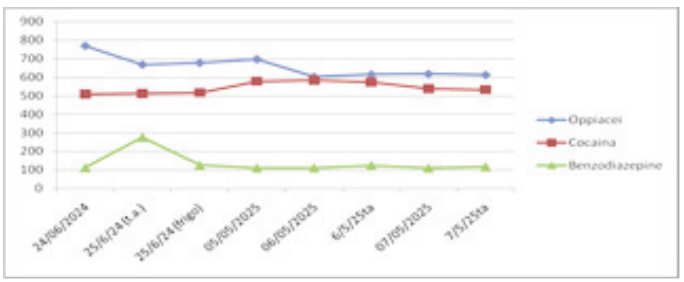
Tab. 8 shows that cocaine tends to be confirmed on the Level 2 test, while cannabinoids and opiates are less likely to due to the possibility of false positives. It is evident that the concentration tends to decrease between time $t_0$and t_1; especially for cannabinoids, opiates and BZDs, but then increases at time $t_{(2)}$ (samples 4, 11 and 12) up to the original concentration ($t_{0)}$. This underestimation may



Graph. 20 - Trend in opiate concentrations.



Graph. 21 - Trend of BZD.



Graph. 22 - Trend in concentrations at different temperatures and over time in a sample.

be due to the presence of possible non-covalent bonds (e.g. hydrogen bonds, van der Waals forces and hydrophobic interactions) between the metabolite and other molecules in the biological liquid. These bonds are favoured above all by freezing; at cooler temperatures, the molecules are detached by thermal agitation.

(BZD in ***graph 22***). Clearly, the normal fluctuations of the analytical method are also included where the final concentration appears to exceed the initial one (***Graph. 19***, sample 9b). Compared to the other molecules, cocaine (***Graph. 18***), evidently because it is more hydrophilic, tends to decrease in concentration between time $t_0$and t_3, especially in samples 8, 9a and 18, which were subjected to greater thermal stress, an effect that is most evident at a relatively very low concentration (sample 18 shown in the secondary y-axis on the right). Conversely, other samples describe fluctuating trends. In any case, these are small concentration nuances, justifiable in the context of Level 1 determinations. ***Graph. 22*** shows that after de-freezing little changes between storage in a refrigerator and at a temperature between 20 and 22°C.

Discussion

Clearly, the trend in findings related to substance use reflects, on the one hand, the requests of those in authority and, on the other hand, the availability of psychological/psychiatric investigations following the detection of substance use. For this reason, the trend of positive results over the years does not reflect national trends in general, or military trends in particular. This may be due to several factors, including fewer requests for testing, the lockdown and reduced personnel, as well as the inevitable decay of drug concentrations due to delayed detection. It is not known whether the shortage of tests carried out at this location has been offset by an increase in testing at other laboratories. However, the following general 'rule' is evident: the better prepared a health service is — even a forensic one — the more accurately it reflects the trend of a phenomenon in the reference population.

In any case, the preponderance of positivity for cocaine, especially in recent times, is reflected in the increase of the phenomenon at a national level, as evidenced by the consultation of national data in general (2, 12, 23) and in the military context. Although lower than that for cocaine, the positivity for cannabinoids is still relevant given that cannabinoids and cannabis sativa derivatives are considered 'soft drugs' in the common understanding. This may lead to an underestimation of the problem, which may become insidious and unmanageable, in the same way as others such as alcoholism, pathological gambling (GAP) and smoking, with which it is compatible in terms of frequency ***(Graph. 14)***.

However, even when the magnitude is low, the risk becomes appreciable when multiplied by frequency, due to the long-term effects of THC and the Gate-Theory, which sees cannabis use as a precursor to heavier drugs. In this study, however, positive tests for cannabinoids were carried out at a later age than positive tests for cocaine. These elements make a

preventive approach even more necessary, especially at a younger age and during the recruitment process. Since January 2025, this has been the case for aspirant enlisted personnel at the Recruitment Centres. In fact, in the first four months of activity, two positive cannabinoid tests were recorded out of approximately 1,000 tests (0.2%), specifically among those aged 15–24.

Conclusions

The drug phenomenon has bio-psycho-social connotations that must always be borne in mind when assessing the health status of a military community as part of the wider population in which it operates. When considering preventive, curative and forensic medicine over time, the latter should be an expression of the results of the former and a verification point. On the other hand, if we consider 4Ps Medicine, the timeline becomes circular, or better spiral-shaped, and Forensic medicine can provide a starting point for future curative, preventive and rehabilitative interventions aimed at improving the situation. At an epidemiological and supra-individual level, it can provide data that lead to the timely implementation of measures to avoid the adverse outcomes examined in this study.

In this regard, it should be noted that in the «P» of Prevention several authors - including M. Jarmoulle, 1986; T. Kuehlein, 2010 - incorporate quaternary prevention, i.e. overmedication, in relation to, for example, the long-term effects of cognitive decline associated with BZD abuse (P. Gareri & coll., 2018) in individuals predisposed to Alzheimer's disease.

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Disclosures:

The Authors declare that they have no relationships relevant to the contents of this paper to Disclose.

Manuscript received on 12/05/2025; reviewed on 15/05/2025; accepted on 12/06/2025.