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Drug Excretion in the Urine of Military Separatees: A Pilot Study

In October 1970, the Department of Defense received an official inquiry from the Executive Branch of the Federal government pertaining to the prevalence of drug abuse among military separatees. At that time, there was concern over the possible relationship between the apparent epidemic of drug abuse among certain military populations and that among civilians. Persons separated from military service represent an important interface between the military and civilian communities. Since pertinent data were not available, it was determined that a survey was required, with submission of the final report of the survey by April 1971. All four military services were to be represented and objective data were requested. These constraints suggested a survey of the prevalence of drug abuse by means of toxicologic analysis. Accordingly, this pilot study was proposed to provide preliminary data on the prevalence of the urinary excretion of certain drugs of abuse in separatees and to demonstrate the feasibility of subsequent mass screening by toxicologic methods.

Materials and Methods

Population Sample

The population group "all military separatees" is demographically disparate; its characteristics vary seasonally in an unpredictable fashion. Consequently, it was not possible to stratify the sample by demographic characteristics. Neither was it possible to sample the annual separatee population randomly. Practical consideration dictated that the sample be selected from among persons undergoing separation processing at a limited number of

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separation centers. Since persons being separated ordinarily undergo a physical examination before separation, and since this examination includes a routine urinalysis, it seemed most feasible to define the sample population as follows: all persons undergoing routine physical examination upon separation from active duty, including personnel of all four military services, during a designated period of time.

Seven separation centers were chosen for sample collection between 16 February and 3 March 1971. It was estimated that 2500 persons would undergo separation physical examinations at the seven centers during that period of time. Three centers processed primarily Army personnel; two, primarily Air Force personnel; and two, Navy and Marine Corps personnel. The anticipated relative volume at the centers reflected an estimated proportion of all separatees by branch of service as follows: Army, 66 percent; Navy, 22 percent; Air Force, 8 percent; and Marine Corps, 4 percent. Particular interest had been expressed in separatees recently returned from Vietnam. Accordingly, one of the Army centers was selected for the study because it was expected that approximately 900 soldiers returning from Vietnam would undergo separation physical examinations during the period of the study. No such systematic attempt was made to include separatees returning from Europe or other overseas areas. It was not possible to stratify the sampling procedure. Demographic data were recorded at the time of sampling, however, to permit retrospective demographic reconstruction of the sample.

Collection of Specimens

During the physical examinations required for separation from each of the military services, the separatees were required to submit a sample of urine for routine urinalysis. They were not informed that a significant portion of the sample would be used for the study of drug excretion. With supervision of medical personnel, the separatees voided directly into wide-mouth, leak-proof, screw-cap plastic bottles, which were labeled with the grade, branch of service, Social Security number, date, and site of collection. Following collection of the urine and completion of the routine urinalysis, the samples were frozen at the collection sites and retained in the frozen state by the use of dry ice during shipment. The capacity of the plastic bottles was 120 ml, but samples of about 30 to 50 ml were routinely collected. A total of 2443 samples of urine was collected at the seven separation centers.

Computer Program

The Computer Services Division of the Armed Forces Institute of Pathology (AFIP) prepared a program for the input of data to include pay grade, branch of service, collection site, and results of toxicologic studies. The results of the analyses of specimens of urine in which no drugs were found were recorded as negative. Specimens in which drugs were found were recorded by drug in concentrations of milligrams of drug per 100 millilitres of urine. The data available for computer retrieval included total samples collected and analyzed by collection site, pay grade, and branch of service, as well as the quantitative results on the various drugs found in the urine of personnel by pay grade, collection site, and branch of service.

Toxicologic Methods

The Toxicology Branch, AFIP, undertook the examination of the large number of specimens. The procedures developed and used in this study included gas-liquid chromatography and fluorometry [*1*]. Although a high degree of sensitivity was required in this study, the need for specificity was essential to preclude not only misinterpretation but also

false-positive results. During the evaluation, appropriate controls and samples of known concentration were subjected to analysis. The emphasis of the method used was directed toward the specific identification of the drugs. After preliminary studies were completed, a suitable quantity of all specimens of urine was retained for confirmatory studies.

Confirmatory Studies

All urine specimens that indicated the possible presence of any of the drugs under consideration were subjected to confirmatory studies. In the case of a tentative positive test for morphine, 25 ml of the original urine specimen was hydrolyzed with concentrated hydrochloric acid in an autoclave and the presence of morphine established by ultraviolet spectrophotometric inspection [2], as well as by the fluorometric procedure. The finding and identification of any basic drugs were verified by the reexamination of 25 ml of the original urine sample according to the approach described by Goldbaum and Domanski [3]. This procedure utilized characteristic ultraviolet-absorption spectra and the gas chromatographic retention times in the different columns.

Results

During the period 16 February to 3 March 1971, specimens of urine were obtained from 2443 persons undergoing physical examinations prior to separation at the seven centers participating in this study. The results of toxicologic analyses of these specimens, arranged by military service, are presented in Table 1. Codeine, methadone, and meperidine were not detected in any of the specimens submitted. Barbiturates, as well as morphine, were found in the urine of one person. Eleven persons (0.4 percent) had detectable levels of amphetamines (one person was also positive for morphine). Eight persons (0.3 percent) had detectable levels of propoxyphene. Thirty-eight persons (1.6 percent) had detectable concentrations of morphine in their urine.

TABLE 1—*Distribution of positive urine specimens by service and by drug.*

Service	No. in Sample	Specimens Positive for Barbiturate	Amphetamine	Propoxyphene	Morphine
Army	1632	1[a]	6[a]	6	38
Air Force	175	0	0	1	0
Navy	574	0	5	0	0
Marine Corps	62	0	0	1	0
Total	2443	1	11	8	38

[a] One specimen also positive for morphine.

In the Army sample of 1632 persons there were 49 urine specimens (3.0 percent) positive for one or more of the drugs under consideration. In the Navy sample of 574 persons, five specimens were positive (0.9 percent). One of the 175 Air Force specimens (0.6 percent) and one of the 62 Marine specimens (1.8 percent) were positive.

Table 2 presents the distribution of positive urine specimens by drug as well as by pay grade. No specimens from personnel in pay grade E-8 and above were positive. One urine specimen (from an Army E-4) contained 5.0 mg/100 ml of barbiturates and 4.0 mg/100 ml of morphine. Eleven urine specimens contained amphetamines. Six of these specimens were from Army personnel, with the concentrations ranging from 0.1 to 0.3 mg/100 ml. Eight specimens positive for propoxyphene were found, six from Army personnel (0.1

TABLE 2—*Distribution of positive urine specimens by pay grade and by drug for all branches of service.*

Pay Grade	No. in Sample	Number with Urine Positive for Barbiturate	Amphetamine	Propoxyphene	Morphine
Unknown	2	...	...	1	...
E-1	56	...	2	...	4
E-2	150	...	...	...	2
E-3	316	...	3	...	8
E-4	1008	1	2	5	13
E-5	697	...	3	1	11
E-6	67	...	1	...	...
E-7	18	...	...	1	...
E-8	5	...	...	...	...
E-9	1	...	...	...	...
W-1	1	...	...	...	...
W-2	18	...	...	...	...
O-1	1	...	...	...	...
O-2	55	...	...	...	...
O-3	36	...	...	...	...
O-4	8	...	...	...	...
O-5	4	...	...	...	...
Total	2443	1	11	8	38

mg/100 ml) and one each from Air Force (0.1 mg/100 ml) and Marine (0.2 mg/100 ml) personnel.

All 38 specimens positive for morphine were from Army personnel. Table 3 presents the distribution of these specimens by grade and separation center. No positive specimens were found among 173 personnel in pay grade E-6 or above. Of specimens from pay grade E-5 and below, 2.6 percent were positive. By separation center, the ratio of positive specimens among E-5 and below were as follows: Site A, 3.6 percent; Site B, 1.6 percent; and Site C, 0.5 percent. Personnel undergoing separation physical examinations at Site A were primarily recent Vietnam returnees. Table 4 presents the distribution of urine specimens positive for morphine by concentrations at each of the three Army separation centers. Table 5 presents the distribution of urinary morphine concentrations by pay grade. After the study was completed, it was possible to examine a limited sample of records of persons studied for certain characteristics of interest. Table 6 shows the distribution of 12 characteristics among a small sample of enlisted men in grades E-1 to E-3 who were found to be excreting morphine and, for comparison, a similar negative popula-

TABLE 3—*Distribution of prevalence of morphine-positive urine specimens by Army separation center and by pay grade.*

Pay Grade	Prevalence[a] by Separation Centers A	B	C	Prevalence[a] in Total Number Tested
E-1	2/6[a]	1/4	1/7	4/17
E-2	2/7	0/26	0/32	2/65
E-3	8/44	0/14	0/47	8/105
E-4	12/461	1/183	0/97	13/741
E-5	8/307	0/149	3/75	11/531
Subtotal	32/825	2/376	4/258	38/1459
E-6–O-5	0/69	0/17	0/87	0/173
Total	32/894	2/393	4/345	38/1632

[a] Number Positive/Number Tested.

TABLE 4—*Distribution of morphine in urine specimens by concentration of drug and by Army separation center.*

Separation Center	Concentration of Morphine[a] in Urine (mg/100 ml)								
	0[b]	0.1	0.2	0.3	0.5	1.0	2.0	3.0	4.0
A	862	3	5	2	3	9	1	4	5
B	391	1	1	...	...	...	...	...	...
C	341	...	...	...	2	1	...	...	1

[a] Represents total morphine after hydrolysis (free morphine plus conjugated morphine).
[b] None detectable at 0.001 mg/100 ml.

TABLE 5—*Distribution of morphine in urine specimens by concentration of drug and by pay grades E-1 through E-5.*

Pay Grade	Concentration of Morphine[a] in Urine (mg/100 ml)								
	0[b]	0.1	0.2	0.3	0.5	1.0	2.0	3.0	4.0
E-1	13	...	2	1	...	1	...	...	...
E-2	63	1	1	...	...	...	...	...	...
E-3	97	1	...	...	...	3	...	1	2
E-4	728	2	2	...	1	3	1	2	2
E-5	520	...	1	...	4	3	...	1	2

[a] Represents total morphine after hydrolysis (free morphine plus conjugated morphine).
[b] None detectable at 0.001 mg/100 ml.

TABLE 6—*Comparison of selected characteristics, by percent, for men in pay grades E-1 through E-3 with urine positive and negative for concentration of morphine.*

Characteristic	Percent	
	Positive (N[a] = 11)	Negative (N = 38)
Non-high-school graduate	45	32
High-school graduate	55	68
Minority-group member[b]	55	18
Enlisted	45	32
Inducted	55	68
Occupation—supply and service personnel	45	24
Occupation—combat personnel	27	24
Armed Forces Qualification Test, Category IV	57	25
Reduction in grade	78	56
Nonjudicial punishment	56	71
Absent without leave	50	8
Court-martial conviction	56	6

[a] N represents the number of records reviewed for personnel in the sample. For example, among the 11 men in pay grades E-1 through E-3 who showed positive concentrations of morphine in urine, 56 percent had prior convictions by courts-martial.
[b] Includes Negro, Mexican-American, Indian, and Puerto Rican minority-group personnel.

tion. Table 7 shows the same data for a sample of enlisted separatees in pay grades E-4 and E-5.

Discussion

At the onset of this pilot study, constraints were imposed upon the time available and the resources to be committed. The constraints dictated that the sample population

TABLE 7—*Comparison of selected characteristics, by percent, for men in pay grades E-4 and E-5 with urine positive and negative for concentrations of morphine.*

Characteristic	Percent	
	Positive (N^a = 18)	Negative (N = 19)
Non-high-school graduate	21	6
High-school graduate	79	94
Minority-group member[b]	42	11
Enlisted	53	22
Inducted	47	78
Occupation—supply and service personnel	16	30
Occupation—combat personnel	21	18
Armed Forces Qualification Test, Category IV	28	22
Reduction in grade	11	6
Nonjudicial punishment	33	6
Absent without leave	22	0
Court-martial conviction	6	0

[a] N represents the number of records reviewed for personnel in the sample. For example, among men in pay grades E-4 and E-5 who showed positive concentrations of morphine in urine, 79 percent were high-school graduates.

[b] Includes Negro, Mexican-American, Indian, and Puerto Rican minority-group personnel.

selected would not necessarily be a representative random sample drawn from all personnel undergoing separation physical examinations at all separation centers. It was necessary, therefore, to select a limited number of separation centers where large numbers of physical examinations were accomplished. Furthermore, it was not possible to stratify the sample by such variables as season, location of terminal duty station, age, pay grade, or other demographic characteristics. Only a crude stratification by service was possible. It was anticipated that drug usage among Vietnam returnees was likely to be higher than among the remaining military separatee population. Therefore, Site A was selected for this study. A very high proportion (98–99 percent) of personnel separating at Site A were known to be recent Vietnam returnees. The remainder of the Army sample was drawn from Sites B and C, judged to be roughly representative of separatees in the continental United States.

The selection of Navy and Marine Corps separation centers on the West Coast for this study, Sites D and E, biased the sample against inclusion of personnel being separated following sea duty, or duty in Europe, or duty on the eastern seaboard of the United States. The two Air Force separation centers on the East Coast are likely to have been biased against inclusion of returnees from Southeast Asia. For these reasons, as well as the small numbers of personnel involved in some categories, direct comparison of results among services may not be justified. Similarly, the data cannot be generalized to the entire population of separatees. The data are valuable *only* in the context of a "rough-and-ready" estimate. Further, as already indicated, no attempt was made to determine whether any given separatee had acquired any given drug in the course of medical treatment. The mere presence of a drug in a single specimen of urine from any person does not necessarily imply drug abuse. The comments that follow are presented with the foregoing qualifying factors in mind.

The combination of quinine and morphine was specifically looked for, since quinine is used as an adulterant to heroin in some illicit markets. The presence of the combination of quinine and morphine in the urine might imply an illicit source and, therefore, abuse.

Although quinine was detected in ten of the urine specimens, neither morphine nor any of the other drugs was present in these samples.

Barbiturate was found in a single urine specimen in a high concentration. This specimen, from an Army E-4 at Site A, also had a high concentration of morphine. This combination of drugs, as well as the concentrations of these drugs, is unlikely to have been the result of legitimate use.

Amphetamine was found in eleven specimens. One specimen from an Army E-5 at Site A had a low concentration of amphetamine and a high concentration (3.0 mg/100 ml) of morphine. This combination is not likely to have been the result of prescription. Except for a Navy E-6 at Site E who had 3.0 mg/100 ml of amphetamine, all other specimens of urine had low concentrations of amphetamine.

Propoxyphene concentrations encountered in the eight specimens positive for that drug were all low, and drug abuse by these persons cannot be inferred.

It is interesting that of the 38 specimens positive for morphine, 32 were collected at Site A. Donors of specimens obtained from Site A were composed almost entirely (98–99 percent) of Army returnees from Vietnam. Of the total 894 specimens of urine collected at Site A, 32 (or 3.6 percent) were found to be positive for morphine. The 3.6 percent incidence of urine samples positive for morphine has a high probability of reflecting the numbers of persons using heroin in the Far East, because morphine is a metabolite of heroin and neither the separatees nor the personnel stationed at the collection sites were informed of this program. At the time of this study, neither the public nor the troops were aware of the urine testing program.

Table 3 suggests an inverse relationship between prevalence and rank. For pay grades E-1 and E-2 combined, 7.2 percent of specimens were positive; for grade E-3, 7.6 percent. The ratios of positive specimens are much lower for pay grades E-4 and E-5 (1.7 percent and 2.1 percent, respectively). Personnel completing two years' military service are very likely to have attained a pay grade of at least E-4 by the time of the separation physical examination. Separation in grades E-1 and E-2 may be indicative of at least some degree of maladjustment; a relatively high rate of drug abuse in this group would not be surprising.

The apparent differences in prevalence among the three Army separation centers are not accounted for by differences in the distribution by pay grade, but probably are a function of the relative proportion of recent Vietnam returnees undergoing separation physical examinations at each center.

Morphine concentrations of 3.0 mg/100 ml or over were found in ten specimens (Table 4). These levels imply a recent dose, a large dose, or both, of narcotic. Nine of these specimens were obtained from personnel undergoing separation physicals at Site A. Since these personnel very likely spent the preceding 24 hours or so in transit from Vietnam, implication of self-administration is evident. No such conclusions may necessarily be drawn in the remaining specimens with concentrations below 3.0 mg/100 ml. The apparent suggestion in Table 5 of an association of pay grade with concentration is an artifact of sample size.

The data in Tables 6 and 7 are based upon very small samples and therefore may not be statistically valid. Some interesting suggestions appear, however. Generally, persons found to be excreting morphine at the time of separation were more likely than their negative counterparts to be high-school dropout, minority group members who had enlisted, were in supply and service occupations, and had experienced reduction in grade, gone absent without leave, and/or been convicted by courts martial. The profile suggested is neither new nor surprising, except for the suggestion that enlistees (volunteers) are more involved than inductees (draftees).

The data derived from this study cannot validly be interpreted as establishing the prevalence of drug excretion, much less of drug abuse, in military separatees. They may be considered indicators, however, and the experience gained may be useful in planning future statistically definitive surveys in similar populations.

Summary

A pilot study undertaken in February 1971 has provided preliminary data on the prevalence of the urinary excretion of certain drugs of abuse in military separatees and has demonstrated the feasibility of subsequent mass screening of personnel by toxicologic methods. Nearly 2500 samples of urine were collected and examined for morphine, amphetamine, barbiturate, codeine, methadone, meperidine, quinine, and propoxyphene. The demographic characteristics of the sample population are discussed. The study revealed concentrations of one or more drugs in the urine of 66 persons. The drugs codeine, methadone, or meperidine were not found in any of the specimens. Thirty-eight soldiers had morphine in their urine at the time of separation. Thirty-two of these 38 specimens were collected from 894 Army returnees from Vietnam with a prevalence of 3.6 percent among these personnel.

References

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