
LIVING CONDITIONS AND VARIATIONS IN PESTICIDE USE

In this chapter, we evaluate how living conditions and pesticide use varied. We begin by describing the living and working conditions in ODS/DS as reported by the survey respondents, including detailed tabulations in Tables 4.1 through 4.6. Understanding the living conditions gives important background and context in which to place the use of pesticides. Then, in Tables 4.7 to 4.10, we describe the differences in who used each form of pesticide and, of those who used them, how their frequency of use varied. As we will show in the latter half of this chapter, pesticide use varied by many factors, including living conditions.

LIVING AND WORKING CONDITIONS IN THE GULF

In ODS/DS, personnel were stationed in widely varying locations and environments—from urban areas to remote desert locations. As the following tables show, living and working conditions for Army and Marine Corps personnel were very similar in most respects. However, the living and working conditions for Air Force personnel differed markedly. Conditions in the Navy tended to fall somewhere between the conditions in the Air Force and Army/Marine Corps.

Table 4.1 shows where service members reported staying most of the time during the month recorded in the survey. The fraction of personnel in each type of location varied by service, with roughly half of the Army and Marine Corps personnel stationed in the desert, and with most of the remainder in tent cities. In contrast, almost half of the Air Force personnel were located in tent cities, with most of the rest in cities and on air bases.

Respondents were queried about their working conditions, and these varied across services. As Table 4.2 shows, more Army and Marine Corps personnel worked outdoors or in military vehicles than did Air Force or Navy personnel. Air Force personnel were much more likely to work in a building, warehouse, or air-conditioned tent.

Table 4.1
Where Service Members Stayed Most of the Time
During the Survey Month
 (percent)

Location	Air Force	Army	Marine Corps	Navy
City	22	16	9	17
Tent	48	21	31	41
U.S. airbase	3	1	0	0
Non-U.S. airbase	16	3	4	8
Desert	5	52	49	25
Other place	3	2	3	4
Constantly moving	2	1	2	5
Did not answer	2	3	2	0

NOTE: Survey respondents could choose up to two locations. Ninety-eight percent of them chose only one location; the remainder were assigned evenly between the two locations. Totals may not sum to 100 percent because of rounding.

Table 4.2
Where Service Members Worked Most of the Time
During the Survey Month
 (percent)

Location	Air Force	Army	Marine Corps	Navy
Building or warehouse	30	11	10	9
Tent				
Floor, air conditioning	8	2	1	0
Floor, no air conditioning	0	1	2	3
No floor, air conditioning	5	1	0	1
No floor, no air conditioning	2	10	10	19
Military vehicle	21	29	18	14
Outdoors	45	63	70	58
Other place	12	4	5	11

NOTE: Fewer than 1 percent of the Air Force, Army, and Marine Corps respondents indicated working in a tent but could not remember whether it had a floor or air conditioning. Totals may not sum to 100 percent because respondents could choose more than one location.

Similar differences existed in sleeping location, as shown in Table 4.3. Almost half the Air Force personnel slept in air-conditioned tents, and most of the remainder slept in buildings designed for housing. In contrast, about half of the Army, Marine Corps, and Navy personnel slept in tents without air conditioning. Most of the remaining Army and Marine Corps personnel slept outdoors or

Table 4.3
Where Service Members Slept Most of the Time During
the Survey Month
 (percent)

Location	Air Force	Army	Marine Corps	Navy
Building				
Used for housing	33	13	9	30
Not used for housing	4	7	3	0
Missing	1	1	0	0
Tent				
Floor, air conditioning	27	0	1	0
Floor, no air conditioning	2	4	6	16
No floor, air conditioning	19	1	0	0
No floor, no air conditioning	3	48	41	43
Vehicle	1	10	8	2
Outdoors	0	12	27	4
Trailer	3	1	1	1
Other	3	3	3	4

NOTE: Two percent of the Air Force respondents who remembered an air-conditioned tent but not whether it had a floor are not included in the table. Also not included are fewer than 1 percent of the Air Force, Army, and Marine Corps respondents who remembered a tent without air conditioning but not whether it had a floor. The Navy total does not sum to 100 percent because of rounding.

in their vehicles, and most of the remaining Navy personnel slept in buildings used for housing.

As Table 4.4 shows, latrine arrangements differed by service in a similar fashion: the majority of Air Force personnel had inside latrines; in the other services, the majority had outside latrines.

Table 4.4
Type of Latrine Facilities Available to Service Members Who Reported
Sleeping in a Building, Warehouse, or Tent
 (in percent)

Location	Air Force	Army	Marine Corps	Navy
Inside	53	16	16	38
Outside	42	69	69	55
Both inside and outside	5	3	3	4
Not applicable	0	1	1	1
Missing	1	11	11	2

NOTE: Totals may not sum to 100 percent because of rounding.

Eating conditions were of particular interest because of concerns about the exposure of food to pesticides. Table 4.5 shows that, as with the other conditions, the Air Force differed from the other services, with a larger percentage of Air Force personnel eating in buildings and air-conditioned tents. Also, a large fraction of personnel in the other services ate in locations not designated for eating. Undoubtedly, most of them were located with combat units away from mess halls, as the majority of those who said “some other place” indicated “outdoors,” as shown in Table 4.6.

VARIATIONS IN PESTICIDE USE

We explored differences in pesticide use by various demographic characteristics and environmental factors using multivariate statistical methods. Tables 4.7 and 4.8 show who used particular forms of personal and field pesticides by demographic categories. Tables 4.9 and 4.10 show how the frequency of use of personal and field pesticide varied among those who used a particular

Table 4.5
Where Service Members Ate Most of the Time During the Survey Month
(percent)

Location	Air Force	Army	Marine Corps	Navy
Mess hall where food was prepared				
In a building	27	11	15	19
In a tent	46	13	9	22
Floor and air conditioning	24	1	0	1
No floor and air conditioning	12	1	0	2
No floor, no air conditioning	3	9	6	11
Other combinations, incl. don't know	7	2	3	8
In another place	3	2	2	2
Mess hall where food was not prepared	4	7	6	3
Other area specifically for eating	8	28	22	20
Outdoors	1	13	13	7
In a building	4	3	1	8
In a tent	2	9	6	4
In another place	1	3	2	1
Some other place	11	40	48	35
Don't know	0	0	0	0

NOTE: Totals may not sum to 100 percent because of rounding.

Table 4.6
Among Those Reporting “Some Other Place,” Where Service Members Ate
Most of the Time During the Survey Month
 (percent)

Location	Air Force	Army	Marine	
			Corps	Navy
Building not normally used for eating	37	11	7	16
Tent	30	39	24	36
Military vehicle	25	35	28	28
Outdoors	47	69	85	72
Local restaurant or private home	15	4	2	8
Other place	25	5	6	16

NOTE: Totals may not sum to 100 percent because respondents could choose more than one answer.

form. The underlying statistical methodology is described in detail in Appendix C.

In Tables 4.7 and 4.8 we show the overall average odds of use for each pesticide form and the percentage difference in the odds by demographic category.¹ These tables indicate who was *likely* to use a particular form of a pesticide. The first line in each table is the “baseline” odds of use, and then the percentage change from that baseline by various demographic characteristics is listed in each column.² The baseline group varies by each form. For example, in Table 4.7, the baseline group for sprays is Army, Caucasian personnel who lived in a tent city in the winter. For powders, it is Army, male, Caucasian personnel who lived in tent cities. We used asterisks to indicate varying levels of statistical significance—more indicate greater statistical significance. A blank cell indicates that a particular demographic category was not significantly associated with use and therefore was not included in the model.

Tables 4.9 and 4.10 give, for each demographic category, the percentage difference from “baseline” average use, as measured by the number of times used per month for each pesticide form. Combining Tables 4.7 and 4.8 with Tables 4.9

¹The odds are defined as the probability that an individual with a particular set of characteristics will use the pesticide form divided by the probability that he or she will not. The odds can be any number between zero and infinity. An odds of one means that the person is equally likely to use it as not. Odds of less than one means that the person is less likely to use the pesticide form, and an odds greater than one means that the person is more likely to use it.

²Odds are used, rather than probabilities, because it is easy to calculate the change in odds for any individual from the table. For example, in Table 4.7, the baseline individual has an odds of using sprays of 0.79. The odds for an equivalent Air Force person is simply $0.79 \times (1 - 0.34) = 0.52$. That is, it is just the percentage change times the baseline odds. This works for changes in multiple characteristics. For example, the odds for an Air Force person living in a building is $0.79 \times (1 - 0.34) \times (1 - 0.32) = 0.35$.

Table 4.7
Percentage Change from Baseline in the Odds of Use of Personal Pesticides
by Form and Demographic Characteristics

	Spray	Powder	Liquid	Lotion	Flea Collar
Baseline odds of use	0.79	0.06***	0.35***	0.37***	0.03***
Service					
Army	B	B	B	B	B
Air Force	-34%***	-85%***	-72%***	-34%***	-57%*
Marine Corps/Navy	-31%***	-79%***	-18%	-26%*	-12%
Rank					
E-1 to E-5				B	B
E-6 to E-9				0%	62%
Officer				-62%***	-99%***
Time of year					
Winter	B		B		
Summer	+45%**		+56%**		
Gender					
Male		B	B		
Female		-95%***	-55%*		
Occupation					
Non-food service					
Food service					
Location					
Nonurban					
Urban					
Living arrangements					
Tent city	B	B	B		
Building	-32%*	+2%	-32%		
Desert	+15%	+39%	+27%		
Air base	+12%	+239%*	+41%		
"Other" place	+3%	-27%	+80%*		
Race					
Caucasian	B	B	B	B	
African-American	+52%**	+303%***	-41%**	+37%*	
Other	-25%	-45%	-10%	+88%***	

NOTES: The baseline group for a particular form is identified by B in the column. If use did not differ across a demographic, then all the entries for that demographic are blank in the table; thus, it would not be part of the baseline. See Appendix C for details of the modeling methodology.

***p value \leq 0.01; **0.01 < p value \leq 0.05; *0.05 < p value \leq 0.1.

and 4.10, we get a picture of who was more or less likely to use various pesticide forms and, among those who used each form, who used them with greater or lesser frequency. As we discuss below, there are significant differences in both likelihood and frequency of use.

Table 4.8
Percentage Change from Baseline in the Odds of Use of Field Pesticides
by Form and Demographic Characteristics

	Powder	Pellets Etc.	Aerosol	Other Spray	Liquid	No-Pest Strips
Baseline odds of use	0.13***	0.12***	0.35***	0.18***	0.04***	0.07***
Service						
Army	B		B	B	B	
Air Force	-46%***		-10%	+152%***	-77%***	
Marine Corps/Navy	-14%		-41%***	+74%***	+8%	
Rank						
E-1 to E-5			B	B		B
E-6 to E-9			+45%**	+45%**		+129%***
Officer			-30%	+33%		+177%***
Time of year						
Winter		B		B		
Summer		+63%*		+69%***		
Gender						
Male						
Female						
Occupation						
Non-food service	B	B		B	B	
Food service	+116%***	+83%**		+66%**	+192%**	
Location						
Nonurban						
Urban						
Living arrangements						
Tent city			B	B		B
Building			+7%	-5%		+59%
Desert			+9%	-53%***		+67%
Air base			+6%	-39%*		+73%
"Other" place			+88%**	-5%		+38%*
Race						
Caucasian	B		B	B		
African-American	+101%***		+53%**	+50%*		
Other	+104%**		-6%	+11%		

NOTES: The baseline group for a particular form is identified by B in the column. If use did not differ across a demographic, then all the entries for that demographic are blank in the table; thus, it would not be part of the baseline. See Appendix C for details of the modeling methodology.

***p value \leq 0.01; **0.01 < p value \leq 0.05; *0.05 < p value \leq 0.1.

Service Similarities and Differences

The Air Force was clearly different from the other services in terms of both living and working conditions, and these differences carried over to pesticide usage. Air Force personnel slept and ate mainly in buildings or air-conditioned

Table 4.9
Percentage Change from Baseline in Average Use of Personal Pesticides
by Form and Demographic Characteristic

	Spray	Powder	Liquid	Lotion	Flea Collar
Baseline average use (times/mo)	21***	6***	26***	14***	21***
Service					
Army	B	B	B		
Air Force	-26%***	-28%	-39%**		
Marine Corps/Navy	-2%	+172%***	-9%		
Rank					
E-1 to E-5	B	B			
E-6 to E-9	+31%***	+90%**			
Officer	-8%	+69%**			
Time of year					
Winter					B
Summer					-27%*
Gender					
Male				B	
Female				-51%**	
Occupation					
Non-food service	B	B			B
Food service	+52%**	+69%**			+63%*
Location					
Nonurban					
Urban					
Living arrangements					
Tent city			B		
Building			-38%*		
Desert			-33%**		
Air base			-3%		
"Other" place			+55%*		
Race					
Caucasian	B	B		B	B
African-American	+39%***	+145%***		+59%**	-51%*
Other	-13%	-18%		-13%	-37%*

NOTES: The baseline group for a particular form is identified by B in the column. If use did not differ across a demographic, then all the entries for that demographic are blank in the table; thus, it would not be part of the baseline. See Appendix C for details of the modeling methodology.

***p value \leq 0.01; **0.01 < p value \leq 0.05; *0.05 < p value \leq 0.1.

tents, the majority ate in mess halls where food was prepared, and slightly over half had inside latrines. In contrast, the other services slept mainly in tents without air conditioning, outdoors, or in vehicles. The majority ate "some other place," and a smaller fraction ate in mess halls or designated eating areas. Most used outside latrines.

Table 4.10
Percentage Change from Baseline in Average Use of Field Pesticides
by Form and Demographic Characteristic

	Powder	Pellets, Etc.	Aerosol	Other Spray	Liquid	No-Pest Strips
Baseline average use (times/mo)	17***	8***	34***	6***	14***	1/200 sq ft***
Service						
Army	B	B	B	B		
Air Force	-46%***		-55%***	-21%		
Marine Corps/Navy	0%		-25%	-36%***		
Rank						
E-1 to E-5			B	B	B	
E-6 to E-9			+31%**	-7%	+32%	
Officer			-58%**	-37%**	-78%**	
Time of year						
Winter						
Summer						
Gender						
Male	B					
Female	+58%**					
Occupation						
Non-food service				B	B	B
Food service				-32%*	+15%	+116%**
Location						
Nonurban					B	
Urban					+204%	
Living arrangements						
Tent city	B	B	B		B	B
Building	-2%	+12%	-17%		-71%*	+175%***
Desert	-35%*	+158%***	-32%**		+58%	+80%**
Air base	+21%	+160%***	-27%		+118%	+7%
"Other" place	-28%	+133%**	-50%**		-52%	+90%
Race						
Caucasian			B	B		
African-American			+3%	+101%***		
Other			-33%*	+9%		

NOTES: The baseline group for a particular form is identified by B in the column. If use did not differ across a demographic, then all the entries for that demographic are blank in the table; thus, it would not be part of the baseline. See Appendix C for details of the modeling methodology.

***p value \leq 0.01; **0.01 < p value \leq 0.05; *0.05 < p value \leq 0.1.

These differences in living conditions are consistent with the differences between services in the types of pests veterans reported (see Table 3.1). They are also consistent with the variations in pesticide use shown in Tables 4.7 to 4.10.

Overall, Air Force personnel were less likely to use all forms of personal pesticides, and those who used a particular form of pesticide often used the pesticide less frequently. Marine Corps/Navy personnel were also less likely to use personal sprays, powders, and lotions than Army personnel, although those who used powders used them with much greater frequency than their Army counterparts.

Similarly, Air Force personnel were less likely to use or observe the use of powders and liquids, and those who used powders used them less frequently. One difference in this pattern is that Air Force personnel were more likely to use or observe “other” field sprays, although again with less frequency. In contrast to the use of personal pesticides, Marine Corps/Navy use of field pesticides was more like the Air Force than the Army.

Seasonal Differences

Tables 4.7 to 4.10 do not show a general difference in pesticide use across all the forms by season. For personal-use pesticides, sprays and liquids were more likely to be used by more personnel in the summer, although there was no seasonal difference in the frequency of usage. Those who wore flea collars, however, wore them less frequently in the summer. For field-use pesticides, pellets, crystals, and granules, and “other” sprays were used and observed more frequently in the summer. However, all other forms of field-use and personal-use pesticides showed no seasonal differences in either the prevalence or frequency of use.

Demographic Differences

Rank. Some differences by rank existed in the use of personal pesticides. In particular, officers were less likely to use lotions and flea or tick collars, and they used powders less frequently. Senior enlisted personnel used both sprays and powders more frequently. For field-use pesticides, senior enlisted personnel were more likely to use or observe aerosols, other sprays, and No-Pest strips. Officers, on the other hand, were more likely to use or observe the use of No-Pest strips, but they used aerosols, other sprays, and liquids less frequently.

Under the assumption that field-use pesticides were applied equally across the enlisted ranks, we interpret the senior enlisted responses to be more indicative of the actual application of pesticides, as senior enlisted personnel would be more generally aware of such activities. We hypothesized that senior enlisted personnel would be the most likely to have observed field use, so their reports may be a better measure of actual field use. From this, we conclude that the

overall percentage of personnel who used or observed the use of field aerosols, other sprays, and No-Pest strips is likely underestimated in the survey.

Reservists. We also compared reservists³ to active duty personnel in our analyses, although this information is not shown in Tables 4.7 to 4.10. We found no differences in either prevalence or frequency of use using the standard statistical significance level of 0.05. However, we did find evidence that flea or tick collars were more widely worn by reservists: The odds of a reservist wearing a flea or tick collar was 122 percent greater than the odds for active duty personnel ($p = 0.067$). In addition, we estimated that reservists who wore flea or tick collars wore them 40 percent more than their active duty counterparts, although the estimate is statistically insignificant ($p = 0.20$).

However, the estimated differences between reservists and active duty personnel in other forms of pesticide and prevalence of use were small. For example, the next largest result, in terms of increased use, was for personal powders. We estimated that reservists were about 50 percent more likely to use personal powders ($p = 0.25$) with about a 44 percent increase in frequency of use ($p = 0.17$). For all other forms, reservists' use was essentially equivalent to or less than that of active duty personnel. Thus, even without considering statistical significance, no pesticide forms other than flea collars showed evidence of a large differences in either frequency of use or prevalence of use between the two groups.

Gender. We found few differences by gender. Females were less likely to use personal pesticides of a liquid or powder form, and they used lotions less frequently than their male counterparts.

Race. The most consistent demographic showing differential pesticide usage is race. In particular, African-American personnel were more likely to use sprays, powders, and lotions, and more often than their Caucasian counterparts.⁴ They were also less likely to use personal liquids and wore flea or tick collars less frequently. "Other" races were also more likely to use lotions and wore flea or tick collars less frequently. Racial differences extended to field-use pesticides, in which African-American personnel were more likely to use or observe the use of field powders, aerosols, and other sprays. We do not have a satisfactory explanation for the differential reporting of field-use pesticides by race.

³That is, personnel in the Reserves or National Guard during ODS/DS, as defined in the USASCURR Gulf War database.

⁴It is possible for insects to respond to visual cues. If present during ODS/DS, these insects may have been more likely to target dark-skinned personnel, which could have resulted in increased pesticide use. This would not explain the differential reporting of field-use pesticides, however.

Food Service Occupational Differences

We found that food service personnel indicated a higher use of field pesticides. In particular, they were more likely to use or observe the use of “other” sprays; approximately twice as likely to use or observe the use of powders and pellets, granules, and crystals; and almost three times as likely to use or observe the use of liquids. They also reported that No-Pest strips were used or observed at slightly more than twice the baseline density—so that the No-Pest strips were hung on average at the recommended density—and “other” sprays were used with less frequency.

We found fewer differences between food service and other personnel in use of personal pesticides. Food service personnel used sprays, powders, and flea collars roughly 50 percent more often than their non-food service counterparts.

Differences by Living Arrangements

Estimates of use of personal pesticides showed little statistical difference by living arrangements, generally because such differences were already reflected in service differences. As discussed in the Living and Working Conditions section of this chapter, living conditions varied significantly by service. However, use patterns are consistent with the living condition results. For example, personnel who lived in buildings were less likely to use sprays and liquids, and those living in the desert and “other” places were more likely to use them. Similarly, personnel in “other” places used liquids more frequently.

Estimates of use of field pesticides were also consistent. Personnel not living in buildings used or observed the use of pellets, powders, and granules more frequently, and they used or observed the use of aerosols less frequently. Personnel living in buildings used or observed the use of No-Pest strips much more frequently; so did personnel living in the desert. Personnel in the desert were also less likely to use or observe the use of other sprays.

SUMMARY

We found significant differences in living conditions and pesticide use within subpopulations of in-theater Gulf War personnel. The most general differences were by service, where Army personnel used personal pesticides more generally and more frequently. This trend held roughly for field-use pesticides as well, although the Air Force and Marine Corps/Navy reported higher use or observance of use of “other” sprays.

We found some differences in pesticide use by living arrangements; these are consistent with our expectations of how pesticides would be employed. We

also found differences by race, although we cannot explain the differential reporting of use of field pesticides. And, although we found some differences in use of field pesticides by rank, we conclude that the differences probably result because senior personnel are in a position to be more aware of their use, though some of the difference may also be due to differences in living arrangements.

We found few seasonal differences in the use of pesticides. Where there were detectable differences, the pesticides were less widely used in the winter, but there was no difference in the frequency of use among those who used them. The only type of pesticide that showed a change in the frequency of use was flea or tick collars; they were worn less frequently in the summer. We also tested for whether there were statistically significant differences between those who used pesticides and those who did not by season and found the differences insignificant ($p = 0.37$). Furthermore, for pesticide forms that were not statistically significant, the estimated differences between summer and winter use and prevalence were small to modest. That is, none of the statistically insignificant results showed evidence of a large seasonal difference in either frequency of use or prevalence of use for that pesticide form.