

SERUM TCDD AND PSYCHOLOGICAL FUNCTIONING IN VETERANS OF OPERATION RANCH HAND

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Introduction

Approximately 19 million gallons of herbicide, of which 11.2 million gallons were Agent Orange, were sprayed by U.S. military personnel during the Vietnam War. Considerable research has been conducted investigating the long term health consequences of Agent Orange and its contaminant, 2,3,4,8-tetrachlorodibenzo-p-dioxin (TCDD). As part of this effort, in late 1978 Congress directed the Air Force to investigate the health status of Air Force veterans of Operation Ranch Hand, the unit responsible for the aerial spraying of Agent Orange and other herbicides in Vietnam from 1962 to 1971. The resultant study, the Air Force Health Study, is an ongoing 20-year prospective investigation of the health, mortality experience, and reproductive outcomes of these veterans. A comparison group of Air Force veterans who also served in Southeast Asia during the same period and who were not occupationally exposed to herbicides were included to serve as referents. Longitudinal data have been gathered from a series of physical and psychological exams that began in 1982.

The Air Force Health Study and other studies of TCDD exposure among Vietnam veterans have primarily focused on assessing physical health outcomes. Although psychological outcomes among Vietnam veterans have been studied, only a few studies have examined the association between TCDD exposure and psychological health. The purpose of this study was to assess the personality, emotional status and level of psychopathology of Ranch Hand veterans with varying levels of TCDD exposures measured by serum testing¹.

Materials and Methods

The study seeks to determine whether veterans of Operation Ranch Hand (the personnel tasked with the aerial spraying of herbicides in Vietnam) have experienced adverse health and whether any effects, if they exist, can be attributed to exposure to herbicides or their TCDD contaminant. Ranch Hand veterans were exposed to herbicides during loading operations, while maintaining the aircraft and herbicide spraying equipment, and while in flight. The study compares the current health and cumulative mortality experience of Ranch Hand veterans with a comparison group of other Air Force veterans who served in Southeast Asia during the same period (1962-1971) that the Ranch Hand unit was active and who were not involved with spraying herbicides. Comparisons were matched to Ranch Hand veterans on age, race, and military occupation. All Ranch Hand and Comparison veterans are male. The study includes periodic analyses of noncombat mortality, in-person interviews, and physical and psychological examinations. Results reported here are from

the Minnesota Multiphasic Personality Inventory (MMPI) administered in 1982 and 1985 and the Millon Clinical Multiaxial Inventory (MCMI) administered in 1987 and 1992.

In 1987, blood from willing participants was collected and assayed for TCDD. Participation was voluntary, and consent forms were signed at the examination site. Veterans with no quantifiable TCDD result in 1987, those who refused in 1987, and subjects new to the study in 1992 were also asked to give blood for the assay at the 1992 examination.

Table 1 shows study size reductions. We excluded from all statistical analyses veterans with no TCDD measurement, those with a nonquantifiable TCDD result, and Comparison veterans with a TCDD result greater than 10 parts per trillion (ppt), the value we regard as a threshold for background TCDD exposure. When we computed frequency distributions of missing responses, we found a highly unusual number of veterans were missing answers to exactly 23 questions on the 1982 administration of the MMPI. When we examined the raw values, we found that 30 veterans (15 Ranch Hands and 15 Comparisons) had strings of 23 consecutive missing answers with the strings appearing at different locations and with no apparent pattern. Because we were unable to explain these missing responses, we excluded these 30 veterans from the analyses. We excluded one Ranch Hand veteran who was not administered either inventory due to illness. In addition, at the 1985 examination, two Comparison veterans left 30 or more questions unanswered, and we excluded their MMPI results as being uninterpretable. We also excluded from the MCMI analyses any veteran with a sum of raw scores for scales 1 through 8 less than 94 or with greater than 165 (indicating an unusual need to conceal personal difficulties or to exaggerate emotional disturbances) or with a Validity Index greater than 1 (suggesting careless, random, or confused responding).

Table 1. Sample Sizes by Examination Year Among US Air Force Veterans Who Served in Southeast Asia from 1962 to 1971.

Comparison	MMPI		MCMI	
	1982	1985	1987	1992
Compliant	1,223	1,292	1,298	1,280
Missing TCDD	-111	-70	-26	-23
Nonquantifiable TCDD	-36	-41	-43	-34
TCDD > 10 ppt	-24	-25	-25	-24
MMPI not scorable ^a	-15			
Refused		-2	-1	-2
Neither inventory administered				
MMPI uninterpretable		-2		
MCMI exclusions:				
Sum of S1-S8 invalid			-1	-2
Validity index >1				
Net	1,037	1,152	1,202	1,195

Table 1. (Continued)

Operation Ranch Hand	MMPI		MCMI	
	1982	1985	1987	1992
Compliant	1,046	1,017	996	953
Missing TCDD	-93	-51	-24	-12
Nonquantifiable TCDD	-15	-16	-15	-10
MMPI not scorable ^a	-15			
Refused	-1	-2	-3	-1
Neither inventory administered	-1			
MMPI not interpretable				
MCMI exclusions:				
Sum of S1-S8 invalid				-3
Validity index >1			-1	
Net	921	948	953	927

^a Unable to score Minnesota Multiphasic Personality Inventory (MMPI) due to loss of some answers.

We analyzed K-corrected T-scores for each of the basic MMPI scales and defined abnormal on these scales as a T-score of 70 or greater. On the MCMI we analyzed the base rate scores for the personality patterns, the pathological personality disorders, and the clinical symptom syndromes. We used the Weight Factor to adjust the scores for the scales in the latter two categories. As we were interested in examining the presence of personality and symptom syndromes, we used a base rate score of 75 or greater as our definition of abnormal on the MCMI scales.

We estimated the initial TCDD dose at the end of the tour of duty in Vietnam in Ranch Hand veterans having current TCDD levels above background using a constant half-life of 8.7 years and assigned each veteran to one of four exposure categories, named "Comparison," "Background," "Low," and "High," according to his group, TCDD level, and initial TCDD level. The Comparison category was comprised of Comparisons with TCDD ≤ 10 ppt. The Background category was comprised of Ranch Hands with TCDD ≤ 10 ppt. The Low and High categories were comprised of Ranch Hands with TCDD > 10 ppt. The cutpoint separating the Low and High categories (94 ppt) was the median estimated initial TCDD level among all Ranch Hand veterans having current TCDD > 10 ppt.

We computed the point estimate of the odds ratio (OR) and associated 95% confidence interval (CI) of having an elevated MMPI or MCMI scale score using SAS[®] PROC LOGISTIC (SAS Institute Inc., 1997) with adjustment for Age (continuous, in years), Race (black, non-black), Rank (officer, enlisted), Marital Status (married, not married), and a Combat Index developed for this study. The combat index was computed as a weighted sum of indicators of positive responses to fifteen questions, with positive ("yes") responses indicated by 1 and negative ("no") responses indicated by 0. Each veteran was assigned to one of four strata depending on whether his sum fell into the ranges 0-2, 3-5, 6-8, or 9 and over, the approximate quartiles of the distribution. Combat index stratum was indicated in the logistic regression model by three dummy covariates. We used main effects models throughout without any stepwise reduction. When the number of veterans

with an elevated MMPI or MCMI scale score was small, there were sometimes no veterans with scores in the abnormal range having a particular value of a discrete covariate, meaning that the covariate could not be used to adjust the logistic regression. Whenever this happened, we removed the covariate for all logistic models involving the likelihood of that abnormality.

Results and Discussion

We found few associations between TCDD level and clinical elevations on the MMPI scales, and the direction of the associations that were found were inconsistent. In the 1982 assessment, Ranch Hand veterans in the Background category were approximately 3 times more likely than Comparison veterans to have an elevated F scale and approximately 2 times more likely than Comparison veterans to have elevated Scales 8 (Sc) and 0 (Si); Ranch Hand veterans in the High category were 50% more likely than Comparison veterans to have elevations on Scales 2 (D) and 3 (Hy); and the Ranch Hand veterans in the Low category were 60% more likely than Comparison veterans to have an elevated Scale 7 (Pt) and approximately 2 times more likely to have an elevated scale F (Validity). In the 1985 assessment, Ranch Hand veterans in the High category were 60% less likely than Comparison veterans to have an elevated Scale 5 (Mf) and 40% less likely than Comparison veterans to have an elevated Scale 9 (Ma).

Contrasts between Ranch Hand exposure categories and the Comparison category revealed that only veterans in the Background category were significantly more likely to have elevated MCMI scale scores, with all of these occurring on the 1992 administration of the MCMI. These elevations were primarily in the basic personality patterns. Ranch Hand veterans in the Background category were approximately 2 times more likely than Comparison veterans to have elevated base rate scores on the Schizoid, Avoidant, Passive-Aggressive, and Paranoid scales. These veterans were also 50% more likely than Comparison veterans to have elevated base rate scores on the Antisocial scale and 20% more likely to have elevations on the Narcissistic scale. In addition, Ranch Hand veterans in the Background category were 2 times more likely than Comparison veterans to report symptoms suggestive of a psychotic delusional disorder.

On the other hand, in several of the contrasts, Ranch Hand veterans in the Low category were less likely than Comparison veterans to have elevated MCMI scores (however, in most of these contrasts, the upper confidence limit was equal to 1.0). In the 1987 administration of the MCMI, Ranch Hand veterans within the Low category were less likely than Comparison veterans to have elevations on the Dependent, Somatoform, and Drug Abuse scales. In 1992, Ranch Hand veterans in the Low category were less likely than Comparison veterans to have elevations on the Schizoid and Drug Abuse scales. Ranch Hand veterans in the High category scored similarly to Comparison veterans on the MCMI. The one exception was on the 1987 assessment; Ranch Hand veterans in the High category were less likely than Comparison veterans to report symptoms suggestive of a somatoform disorder.

In summary, the results of this study suggest that there are few consistent psychological abnormalities associated with TCDD exposure among Ranch Hand veterans.

Reference

Barrett D, Morris R, Jackson Jr W., and Michalek J. (In submission)