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SERUM DIOXIN LEVELS  
IN AIR FORCE HEALTH STUDY PARTICIPANTS

PRELIMINARY REPORT

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## Serum Dioxin Levels in Air Force Health Study

### Participants - Preliminary Report

In 1978 the United States Air Force responded to a Congressional mandate to initiate an epidemiologic study of the possible health effects of exposure to herbicides and their 2,3,7,8 - tetrachlorodibenzo-p-dioxin (referred to as dioxin in this article) contaminants in Air Force veterans who served in the Ranch Hand defoliation operation during the Vietnam conflict. Accordingly, the Air Force developed a protocol for a nonconcurrent prospective study (the Air Force Health Study) of all 1267 members of the Ranch Hand unit and a series of matched Comparisons (1). The Comparisons were selected from the population of Air Force veterans who served in air cargo units stationed in Southeast Asia during the same period as the Ranch Hand unit and who were individually matched to the Ranch Hands on date of birth, rank (officer, enlisted) and occupation (pilot or copilot officer, officer navigator, nonflying officer, flying enlisted, ground enlisted). The Comparisons were assumed to have not been exposed to herbicides or dioxin during the war. The Ranch Hands and their matched Comparisons have been physically examined in 1982 (2), 1985 (3) and were recently examined in 1987-88. They will be examined again in 1992, 1997 and finally in the concluding year 2002.

During 1986, CDC's Division of Environmental Health Laboratory Sciences, Center for Environmental Health and Injury Control, developed a method for measuring dioxin in human serum (4). The measurement, which is based on lipid weight, is highly correlated with paired measurements of dioxin in adipose tissue ( $r=0.98$ ) (5). The application of this measurement to members of the CDC Agent Orange Exposure Study has been reported (6).

This serum dioxin measurement is the basis for the pilot study of Air Force Health Study participants reported here. This pilot study was designed to assess dioxin half-life in Ranch Hand veterans and the validity of the Air Force study design. Air Force Health Study participants invited to participate in this study were enlisted ground crew who served during 1968-69, who held the rank of Staff Sergeant or below, and, if a Ranch Hand, had a herbicide loader or herbicide specialist occupation during their tour. The study goal was to obtain a serum dioxin measurement on 200 such participants, 150 Ranch Hands and 50 Comparisons. Two hundred study subjects satisfying these criteria were identified to CDC for a blood draw during February and March 1987. Shortly after CDC began the scheduling, 61 additional subjects were identified for possible scheduling to assure that the goal of 200 assays would be met. Compliance to the draw was high with 90% of those called consenting to visit one of four regional Red Cross Centers. Two hundred and thirty-one of these 261 subjects were called; 207 of the 231 consented to participate in this study. For a variety of reasons, seven of the 207 were unable to visit the centers. Of the 200 for which serum was obtained, 150 were Ranch Hands and 50 were Comparisons. Of the 150 Ranch Hand specimens, 147 results were quantifiable while 49 quantifiable results were obtained from the 50 Comparison specimens. Four of the specimens were indeterminate due to a failure to meet one or more of the quality control criteria (4) and an insufficient quantity of serum for a repeat analysis. The blood was drawn at each clinic according to a standardized protocol. The numbers of Ranch Hands drawn at the 4 Red Cross Centers namely, Atlanta, Cleveland, Los Angeles and Tulsa, were 43, 39,

37 and 31; the corresponding counts for the Comparisons were 19, 7, 10 and 14. Table 1 shows selected characteristics of the participants by group (Ranch Hand, Comparison).

TABLE 1. Selected characteristics of Air Force Health Study participants in the pilot study by group.

	Ranch Hand (n=150)	Comparison (n=50)
Demographic characteristics		
Age (mean)	46	49
Race (black)	5%	6%
Mean tour length (months) in Southeast Asia	12	25*
Self reported herbicide exposure**		
Military	93%	8%
Leisure	15%	4%
Civilian occupation	5%	4%
Health characteristics		
Current Smoking (cigarette)	51%	37%
Smoking history (pack yrs)	14	12
Current Alcohol use	80%	78%
Alcohol history (drink yrs)	29	30
Percent body fat (mean)	21%	22%

\*Comparisons were based outside of Vietnam and had tours of 2 to 3 years.

\*\*From questionnaire

The dioxin distributions of the 147 Ranch Hands and 49 Comparisons having quantifiable assay results are shown in Figure 1. Thirty eight percent of the assayed Ranch Hands and 98% of the assayed Comparisons had dioxin levels (based on lipid weight) below 20 parts per trillion (ppt), which is considered the upper limit for residents of the United States without known dioxin exposure

(7). Additionally, 21.1% of the Ranch Hands and 98% of the Comparisons had dioxin levels at or below 10 ppt. There is a statistically significant difference between the two groups ( $\chi^2$  test,  $p < 0.0001$ ).

Figure 1. Serum dioxin levels of Ranch Hand and Comparison ground crew participating in the Air Force dioxin pilot study, 1987.

(INSERT FIGURE 1 HERE)

The single Comparison having a level of 21.3 ppt reported exposure to industrial chemicals since 1980 in a steel foundry in Indiana. Summary statistics of current dioxin levels by group are shown in Table 2.

Table 2. Summary statistics of current dioxin levels by group.

	Ranch Hand (n=147)	Comparison (n=49)	Comparison excluding 21.3 ppt level (n=48)
Dioxin level			
Mean (ppt)	49.4	5.2	4.8
Median (ppt)	26.5	4.7	4.6
Mode (ppt)	9.8	2.4	2.4
Minimum (ppt)	3.2	2.0	2.0
Maximum (ppt)	313	21.3	9.7
Standard deviation	56.0	3.0	1.8

The distribution of dioxin levels for Ranch Hands suggests that some Ranch Hands and one Comparison have had unusually heavy dioxin exposure. The serum dioxin measurement quantifies actual dioxin body burden and therefore provides a direct assessment of exposure. No threshold level has been determined as yet for the health effects of dioxin in humans. A full report will be published after dioxin measurements have been completed for all Air Force Health Study participants and after the report has been reviewed by the Agent Orange Working Group of the Domestic Policy Council (Executive Branch).

Sera drawn in 1982 on thirty-six of the Ranch Hands having 1987 dioxin levels above 10 ppt were assayed to allow estimation of dioxin half life in humans as approximately 7 years (8). These developments suggest that only about 2 to 4 dioxin half lives have elapsed since potential Ranch Hand exposure in Vietnam and that serum dioxin can serve as a biological marker for previous dioxin exposure in Air Force Health Study participants. The results of the half life study will be reported in a separate publication.

A procedure for measuring dioxin in serum is available and these measured levels can be directly correlated to those in adipose tissue. However, the assay is extremely expensive and the entire procedure, including sample procurement, should be done only under the laboratory protocol.

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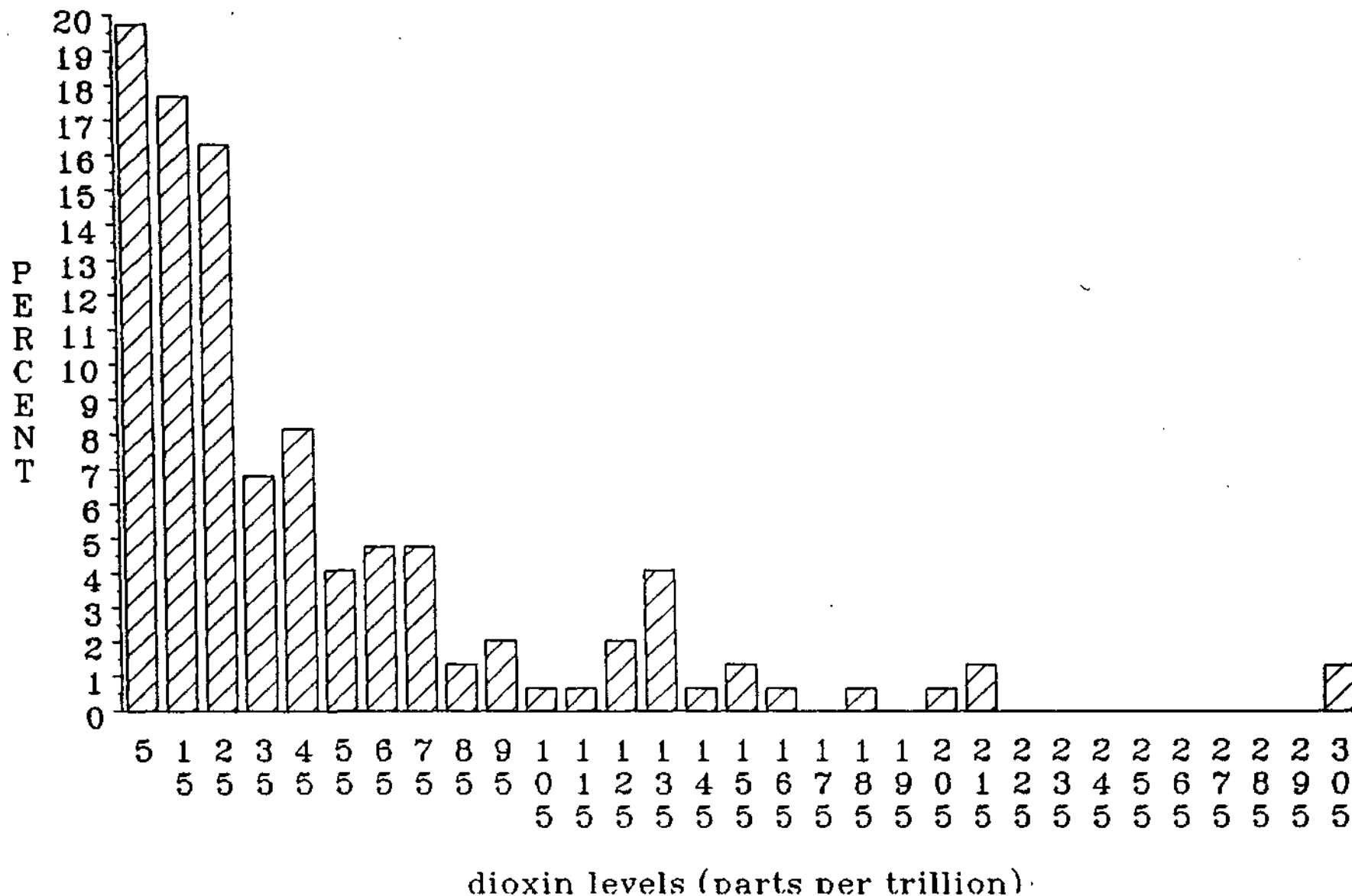
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# Serum dioxin levels of Ranch Hand ground crew participating in the Air Force dioxin pilot study (n=147)



# Serum dioxin levels of Comparison ground crew participating in the Air Force dioxin pilot study (n=49)

