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10 NEOPLASIA ASSESSMENT

10.1 INTRODUCTION

10.1.1 Background

Between 1977 and 1988, numerous long-term exposure studies established the multi-organ carcinogenicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (dioxin) in experimental animals (1-8). The oncogenic response to dioxin occurs in multiple strains and species, in both sexes, and by several routes of administration: dermal (5), feeding (1, 2) and gavage (3, 4, 6), and intraperitoneal injection (7). Across a wide dose range and duration of exposure, dioxin can be considered a “complete” carcinogen solely responsible for a variety of malignant tumors at multiple sites (9). In rats, it has produced tumors of the liver, thyroid, adrenal cortex, lung, nasopharynx, tongue, brain, kidney, and breast (1, 2, 4); in mice, tumors of the liver, thymus, breast, stomach, and skin (3-6); and in the Syrian Hamster, a squamous cell carcinoma of the skin (7). The histopathologic characteristics of the neoplastic response demonstrated even greater variety—more than 30 distinct malignancies have been characterized microscopically (10).

As summarized in a recent review article (11), much of the basic research into the carcinogenicity of dioxin in laboratory animals has focused on the properties of the aryl hydrocarbon (Ah) receptor and the induction of the cytochrome P-450 enzyme system (11-17). The biologic basis for the assessment of risk related to dioxin exposure has been well established in molecular, biochemical, and pharmacologic studies and reviews (13, 18-24). The Ah receptor has been isolated from the tissues of several human organs (25-28) and the comparative properties of animal and human receptors have been studied (29, 30). These experiments have demonstrated far fewer Ah receptor sites and a significant reduction in dioxin binding affinity in human cells relative to rodent cell lines. These results suggest that at any level of exposure, humans may be less at risk for dioxin toxicity than laboratory animals (24).

Despite the conclusive evidence that dioxin is a potent carcinogen in animal experiments, the carcinogenicity of dioxin in humans remains controversial (31-36). The limitations of most epidemiological studies are well recognized and include the recall bias inherent in the retrospective collection of data, confounding by exposure to other potential toxins, histologic misclassification, and the lack of accurate indices of prior exposure to dioxin (31, 37, 38). Despite these limitations, the Institute of Medicine has concluded that there is “sufficient” evidence to establish an association, although not a causal relation, between dioxin exposure and the occurrence of soft tissue sarcoma (STS), non-Hodgkin’s lymphoma, and Hodgkin’s disease. The evidence for an association with respiratory cancers, prostate cancer, and multiple myeloma was considered “limited/suggestive” (39). Each of these malignancies is among the clinical endpoints included in mortality and morbidity data collected in this and previous examinations of the Air Force Health Study (AFHS).

Most of the longitudinal studies of dioxin toxicity have included malignancy as a clinical endpoint and have been based on cohorts of veterans who served during the Vietnam era (40-49) and of civilian populations exposed to dioxin by occupation (50-59) or as a consequence of industrial accidents (60-64). The development of assay techniques that quantitate the tissue concentration of dioxin in parts per quadrillion (65) and the validation of the reproducibility and reliability of the serum dioxin assay in parts per trillion (ppt) (66) have placed epidemiological studies of dioxin toxicity on a much more scientific footing. The serial analysis of serum dioxin levels from specimens taken 15 to 25 years after exposure has demonstrated that the best estimate for the half-life of dioxin in humans is 8.7 years (67). Although

an increasing number of published studies have incorporated serum dioxin levels into their analyses (68-73), few have examined the incidence of malignancy and associated mortality in relation to this index of dioxin exposure (44, 50, 52, 59, 60, 63).

As part of the National Institute of Occupational Safety and Health's (NIOSH) Dioxin Registry, cause-specific mortality was determined in 5,172 workers exposed to dioxin at chemical production plants (50). The mean dioxin level of 253 members of the exposed cohort was 233 ppt versus 7 ppt in the unexposed cohort. In the entire group of exposed workers, there was a slight but statistically significant increase in mortality from all cancers combined but not from those associated with dioxin exposure (non-Hodgkin's lymphoma, Hodgkin's disease, and STS). In a subcohort of 1,520 workers with longer exposure (greater than 1 year; mean serum dioxin of 418 ppt) and greater latency (more than 20 years since first exposure), there was a further increase in the mortality from all cancers combined (15% excess), a 42 percent excess of respiratory cancers, and a ninefold excess of STS sarcoma (35). In the most recently published report from the NIOSH study, which extended the period of observation for another 6 years through 1993, the standardized mortality ratio for all cancers combined in the cohort with the highest exposure was 1.60 and for lung cancer, 1.65 (74).

Although methodological limitations of the NIOSH study such as tissue classification (75), confounding (34, 61), and others (10) have been commented upon in the literature, some of the results are consistent with those of several other occupational epidemiological studies from Germany. In a 34-year follow-up of German factory workers exposed during a chemical explosion in 1953, the increase in mortality from all cancers combined was statistically significant only after a latency period of greater than 20 years (63). Similarly, in another mortality study of herbicide production workers who were followed over a 32-year period and whose exposure was verified by adipose tissue level (average dioxin level of 296 ng/kg), the increase in all-cancer mortality was significant only in those with more than 1-year exposure and latency period greater than 20 years. In this group, a significant increase in mortality was noted from both lung and hematopoietic cancers with a threefold increase in risk for non-Hodgkin's lymphoma (52). In the most recently published report of this study, the mortality follow-up was extended another 3 years and the significant increase in all-cancer mortality was confirmed (59). Taken together, the NIOSH and German studies are consistent with a carcinogenic effect of dioxin in humans with demonstrable dose-response and latency effects.

By far the most extreme human exposure to dioxin occurred consequent to the industrial explosion at Seveso, Italy, in 1976 (60, 64, 76, 77). In the population closest to the explosion (Zone A), serum levels of dioxin ranged from 828 ppt to 56,000 ppt, the highest ever recorded (78). In the most recent follow-up report published (60), residents of Zone B, farther from the source of contamination with serum dioxin levels ranging from 74 ppt to 526 ppt shortly after the accident, statistically significant increases in several cancers were noted, including primary hepatic and hematopoietic cancers and, particularly, non-Hodgkin's lymphoma in men and, in women, cancers of the gallbladder and biliary tree. The Seveso studies are limited by the small sample sizes (particularly in the group most heavily exposed), the limited data available on serum dioxin levels, and the lack of sufficient latency for the development of cancer.

In the incorporation of serial serum dioxin data into longitudinal analyses, the AFHS is unique among those that have examined the incidence of malignancy in Vietnam War veterans. During the 1992 examinations, after 10 years of observation, the median serum dioxin level in the Ranch Hand cohort was nearly three times that of the Comparison group (12.5 ppt versus 4.1 ppt) (44). Further, stratification of the Ranch Hand cohort by occupation revealed significantly higher median levels of serum dioxin in the enlisted groundcrew (24.1 ppt) and enlisted flyers (17.8 ppt) than in the officers (7.7 ppt).

In the 1992 follow-up examination, Ranch Hands continued to have a slightly higher history of benign and malignant skin neoplasms than Comparisons, but group differences were no longer significant. A

statistically significant inverse dose-response effect was noted, as basal cell skin cancer decreased as the level of serum dioxin increased. In contrast to the 1987 examinations, when Ranch Hands were found to have significantly more benign systemic neoplasms relative to Comparisons, in the 1992 examinations, the occurrence of benign systemic neoplasms was similar in each cohort with no evidence for a dose-response effect. There were no significant group differences in the morbidity or mortality associated with any systemic malignancy, nor was there any increased risk associated with current or initial levels of serum dioxin. In a recently published AFHS article, based on data collected through the 1992 examination, there was no significant increase in cancer risk in Ranch Hands with the highest levels of serum dioxin, nor was there any consistent evidence for a dose-response effect (79).

The term “neoplasm” is used throughout this report and refers to any new growth that may or may not be malignant. Malignant neoplasms are those neoplasms capable of invasion and metastasis. Malignant and benign neoplasms, carcinomas in situ, and neoplasms of uncertain behavior or unspecified nature, as well as skin and systemic neoplasms, were studied. “Systemic neoplasm” denotes a nonskin neoplasm.

10.1.2 Summary of Previous Analyses of the Air Force Health Study

10.1.2.1 1982 Baseline Study Summary Results

Cancer received major emphasis during the AFHS baseline examination in 1982. The neoplasia assessment used data from both the in-home questionnaire and the review-of-systems questionnaire obtained during the physical examination, as well as data from the examination itself. All data were verified by a medical records review. In addition, tabulation of mortality count data from the Baseline Mortality Report was used in conjunction with cancer morbidity information. The overall results did not show a significant difference in systemic cancer between the two groups, but did show significantly more skin cancer ($p=0.03$) in the Ranch Hand group.

Of 50 reported systemic cancers from the Ranch Hand and Comparison groups, 28 (14 in each group) were verified by medical records and pathology reports. A visual inspection of anatomic sites showed a slight excess of genitourinary cancer and oropharyngeal cancer but a relative deficit of digestive system neoplasms in Ranch Hands. A combined morbidity-mortality assessment derived from the initial 1:1 match (Ranch Hand to the Original Comparison member) disclosed similar distributions. One case of STS and one case of Hodgkin’s disease were confirmed, both in the Comparison group.

Questionnaire data verified by a medical records review revealed significantly more skin cancer in Ranch Hands (odds ratio 2.35). Basal cell carcinoma accounted for 83.9 percent of the reported skin cancers in both groups and was concentrated anatomically on the face, head, and neck. The few melanoma and squamous cell cancers were distributed evenly between the Ranch Hand and Comparison groups. Skin cancer in both groups was associated with exposure to industrial chemicals ($p=0.03$). Adjustments for occupational exposures (e.g., asbestos, degreasing chemicals) did not alter the increased rate of skin cancer in the Ranch Hand group. Outdoor occupations subsequent to military service as a covariate did not account for the significant skin cancer association.

10.1.2.2 1985 Follow-up Study Summary Results

The baseline and 1985 follow-up data were combined for the assessment of lifetime history of cancer; occurrences of cancer prior to their service in Southeast Asia (SEA) were excluded.

For the unadjusted analyses (Blacks and non-Blacks included), Ranch Hands had a significantly greater frequency of a verified skin neoplasm (malignant, benign, or uncertain behavior or unspecified nature) than Comparisons. There were no significant unadjusted group differences in non-Black participants for

basal cell carcinoma, squamous cell carcinoma, melanoma, or all malignant skin neoplasms. For verified sun exposure-related malignant skin neoplasms, Ranch Hands had a marginally significantly greater frequency than Comparisons. The groups did not differ significantly for verified and suspected sun exposure-related malignant skin neoplasms. The adjusted group contrast for the sun exposure-related skin cancers, the majority of which were basal cell carcinomas, also was significant ($p=0.030$).

The unadjusted group contrasts for all systemic cancers combined were not significant. There was one new occurrence of an STS (Ranch Hand) and one suspected cancer of the lymphatic system (Ranch Hand), in addition to the one previously reported STS and one Hodgkin's disease in the Comparison group. There were no cases of non-Hodgkin's lymphoma in either group at the time of the 1985 report.

10.1.2.3 1987 Follow-up Study Summary Results

The unadjusted analysis of all verified neoplasms indicated that the proportion of Ranch Hands with a neoplasm was significantly greater than that of Comparisons. After including suspected neoplasms with verified neoplasms, the Ranch Hand proportion was marginally greater than the Comparison proportion. The majority of malignant neoplasms observed in Ranch Hands were basal cell carcinomas, a nonlife-threatening form of skin cancer. When the analysis was performed only on skin neoplasms for non-Black participants, significantly more Ranch Hands had a skin neoplasm than did Comparisons.

In the unadjusted analyses of verified basal cell carcinoma, a marginally significant group difference was found. After adjustment for age, residential history, sun exposure, ethnic background, and ionizing radiation exposure, the Ranch Hand risk was statistically significantly increased for verified basal cell carcinoma. Also, Ranch Hands had a significantly higher percentage of participants with multiple verified basal cell carcinomas than did Comparisons.

Sun exposure-related malignant skin neoplasms also exhibited group differences. (Approximately 90 percent of the participants with a sun exposure-related malignant neoplasm had a basal cell carcinoma.) In both the unadjusted and adjusted analyses, Ranch Hands exhibited a significantly increased risk for these neoplasms.

No significant group differences were found in the analyses of systemic neoplasms by number, behavior (malignant, benign, or uncertain behavior or unspecified nature), or site. Thus, the increase in overall malignancy was because of elevated relative risks for skin cancer (basal cell carcinoma). The number of STS and non-Hodgkin's lymphoma was comparable in the two groups.

10.1.2.4 Serum Dioxin Analysis of 1987 Follow-up Study Summary Results

The analyses generally did not establish a positive association between dioxin and the presence of a skin neoplasm. Significant relative risks were found for the skin neoplasm analyses; although, the relative risks were almost always less than 1.0. For the analyses focusing on enlisted flyers with a basal cell carcinoma of other sites (and a sun exposure-related malignant skin neoplasm of other sites), relative risks were found to be significant and greater than 1.0. These differences were not noted in the enlisted groundcrew who, as a group, had higher levels of serum dioxin than the enlisted flyers.

In general, the analyses of all systemic neoplasms combined produced some significant or marginally significant relative risks greater than 1.0. The relative risk for participants with a benign systemic neoplasm was significantly greater than 1.0. The relative risk of malignant systemic neoplasms was generally not significantly increased with increases in dioxin levels.

The study provided no evidence of increased history of malignant neoplasms most commonly suspected as being associated with exposure to chlorophenols (Hodgkin's disease, non-Hodgkin's lymphoma, and STS). The number of participants with these specific malignancies was small; therefore, the statistical power to detect small or moderately elevated relative risks was low. There is no evidence of a relation between dioxin and either skin or systemic malignancies in these data. There was a suggestion of a dose-response relation between dioxin and benign systemic neoplasms.

10.1.2.5 1992 Follow-up Study Summary Results

Analyses of all Ranch Hands and Comparisons indicated no significant difference between the two groups with regard to benign or malignant neoplasms. All statistically significant associations between initial dioxin and benign or malignant neoplasm endpoints for Ranch Hands showed an inverse dose-response relation. In the categorized dioxin analyses occurrence of neoplasms for Ranch Hands in the background and low dioxin categories was often greater than the occurrence for Comparisons before adjustment for covariates. After adjustment, the only significantly increased risks were for Ranch Hands in the low category (overall skin neoplasms and malignancies of the colon and rectum). In contrast, the occurrence of neoplasms of any type for Ranch Hands in the high dioxin category was never significantly elevated and was often less than the occurrence for Comparisons. Parallel to analyses using initial dioxin, results observed when current dioxin was used as the measure of exposure often indicated a negative dose-response relation, although this was statistically significant in the adjusted analyses only for benign skin neoplasms. In summary, there appeared to be no overall difference between Ranch Hands and Comparisons, and there was no evidence to suggest a positive dose-response relation between dioxin and neoplastic disease.

10.1.3 Parameters for the 1997 Neoplasia Assessment

10.1.3.1 Dependent Variables

The neoplasia assessment was based on the occurrence of neoplasms (both benign and malignant) after service in SEA. Information on the occurrence of neoplasms was indicated in the health questionnaires and the physical examinations at the 1982 baseline examination and at the 1985, 1987, and 1992 follow-up studies and was coded according to conventions in the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) manual. This information was combined with data collected at the 1997 follow-up examination to form a complete neoplastic history for each participant.

The neoplasia assessment was based on the number of participants with a neoplasm and not on the number of neoplasms. A participant was considered to have an adverse health condition for the neoplasia assessment if he had one or more neoplasms.

10.1.3.1.1 Medical Records Data

During the 1997 health interview, each study participant was asked a series of questions on the occurrence of cancer since the date of his last health interview. The self-reported conditions were verified by a medical records review and combined with cancer information collected at previous AFHS examinations. Only verified neoplasms were used in the neoplasia assessment.

Some possible neoplastic conditions were discovered by the physicians at the physical examination. Contingent upon participant authorization, suspicious skin lesions were biopsied and the pathology determined; no other invasive procedures were used to detect systemic neoplasms.

10.1.3.1.1.1 Skin Neoplasms

The analysis of skin neoplasms was divided into two sets. Analysis Set 1 consisted of analyses of skin neoplasms by behavior type. Four behavior types were examined: (1) all skin neoplasms, (2) malignant skin neoplasms only, (3) benign skin neoplasms only, and (4) skin neoplasms of uncertain behavior or unspecified nature.

Analysis Set 2 consisted of analyses of malignant skin neoplasms by cell type. The following four cell types were analyzed: (1) basal cell carcinomas, (2) squamous cell carcinomas, (3) nonmelanoma (basal cell carcinomas, squamous cell carcinomas, and malignant epithelial neoplasms not otherwise specified), and (4) melanoma. Analysis of basal cell carcinomas was conducted for all sites combined and by site. The following four sites were examined for basal cell carcinomas: (1) ear, face, head, and neck; (2) trunk; (3) upper extremities; and (4) lower extremities.

There were relatively few Black participants in this study (approximately 5%). With the exception of one Black participant with a pre-SEA melanoma, Blacks have been observed to exhibit only benign skin neoplasms in all phases of the study to date. Consequently, skin neoplasm analyses, except for the analyses of benign skin neoplasms, were limited to non-Blacks. Both Blacks and non-Blacks were included in the analysis of benign skin neoplasms. Participants with a pre-SEA skin neoplasm were excluded from the analysis of the skin neoplasm variables.

10.1.3.1.1.2 Systemic Neoplasms

The systemic neoplasms were analyzed by behavior and anatomical site. As with skin neoplasms, each analysis was conducted using verified data. The analysis of the systemic neoplasms was divided into two sets, described below.

Analysis Set 1 consisted of analyses of systemic neoplasms by behavior type. The following four behavior types were examined: (1) all systemic neoplasms, (2) malignant systemic neoplasms, (3) benign systemic neoplasms, and (4) systemic neoplasms of uncertain behavior or unspecified nature.

Analysis Set 2 consisted of analyses of malignant systemic neoplasms by the following sites: (1) ear, eye, head, face, and neck; (2) oral cavity, pharynx, and larynx; (3) esophagus; (4) brain; (5) thymus and mediastinum; (6) thyroid gland; (7) bronchus and lung; (8) liver; (9) colon and rectum; (10) kidney and bladder; (11) prostate; (12) testicles; (13) extrahepatic bile duct; (14) ill-defined sites; (15) connective and other soft tissues; and (16) carcinomas in situ of the penis.

In addition to the analyses described above, the number of participants with Hodgkin's disease, non-Hodgkin's lymphoma, and a malignant systemic neoplasm of lymphoid and histiocytic tissue was analyzed.

Participants with a pre-SEA malignant systemic neoplasm or a pre-SEA systemic neoplasm of uncertain behavior or an unspecified nature were excluded from the analysis of the systemic neoplasm variables.

10.1.3.1.1.3 Skin and Systemic Neoplasms

Statistical analysis was performed on all malignant neoplasms, which was a combination of malignant skin and malignant systemic neoplasms. In addition, statistical analysis was performed on all neoplasms, which was a combination of all skin and all systemic neoplasms (benign, malignant, and uncertain behavior). Participants with a pre-SEA skin neoplasm, a pre-SEA malignant systemic neoplasm, or a pre-SEA systemic neoplasm of uncertain behavior or an unspecified nature were excluded from the analysis of this variable.

10.1.3.1.2 Laboratory Examination Data

The prostate-specific antigen (PSA) test was developed to detect prostate enlargement and prostate cancer. Each participant had his PSA measured as a standard part of the laboratory assay. This measurement was continuous in nature, and the units were ng/ml. An analysis was performed on the continuous measurement, as well as on a discrete form. The discrete form of PSA was categorized as high or normal, based on a cutpoint of 4 ng/ml.

10.1.3.2 Covariates

In the analysis of the 1997 examination results, covariates in adjusted statistical analyses assessing skin neoplasms included age, military occupation, skin color, hair color, eye color, skin reaction to sun after the first exposure, skin reaction to sun after repeated exposure, lifetime exposure to ionizing radiation and industrial chemicals (yes or no), and average lifetime residential history. A composite skin-reaction index, which is a composite of the two individual reactions of skin to sun covariates, also was investigated.

Age, race, and military occupation were determined from military records. Information on skin, hair, and eye color was obtained at the 1997 physical examination for participants who did not attend the 1985, 1987, and 1992 examinations, and this information was combined with data from participants who previously provided this information. Information on the skin reaction to sun after the first exposure and after repeated exposure was reported by the participant during the questionnaire phase at the 1997 examination. Also, the participants' lifetime exposures through 1992 to ionizing radiation, industrial chemicals, and herbicides (used in the analysis of systemic neoplasms, discussed below) was updated with information reported in the 1997 questionnaire.

The emphasis on choosing risk factors related to cancer was increased during the 1985 follow-up study and has been emphasized since that time. In particular, the interval health questionnaire was modified to collect information on each geographic location in which a participant lived for more than 12 months. Because ultraviolet light exposure has been acknowledged as the primary cause of basal cell carcinomas, this information was used to compute a cumulative sun-exposure index based on residential history. An average lifetime residential history was estimated by dividing the total degree-years (i.e., the sum of the product of latitude [degrees] and the number of years lived at each residence) from all residences by the total number of residential years reported on questionnaires since 1985. Average lifetime residential history was dichotomized as less than 37 degrees latitude (southerly) or greater than or equal to 37 degrees latitude (northerly), which was the approximate median in previous AFHS examinations.

Covariates in adjusted statistical analyses assessing systemic neoplasms and PSA included age, race, lifetime exposure to ionizing radiation and herbicides, lifetime cigarette smoking history (in pack-years), and lifetime alcohol history (in drink-years).

Lifetime cigarette smoking history was based on questionnaire data. For lifetime cigarette smoking history, the respondent's average smoking was estimated over his lifetime based on his responses to the 1997 questionnaire, with 1 pack-year defined as 365 packs of cigarettes smoked during a single year.

Each participant was asked about his drinking patterns throughout his lifetime. When a participant's drinking patterns changed, he was asked to describe how his alcohol consumption differed and the duration of time that the drinking pattern lasted. The participant's average daily alcohol consumption was determined for each of the reported drinking pattern periods throughout his lifetime, and an estimate of the corresponding total number of drink-years was derived. One drink-year was the equivalent of drinking 1.5 ounces of an 80-proof alcoholic beverage, one 12-ounce beer, or one 5-ounce glass of wine per day for 1 year.

Almost all Ranch Hands reported herbicide exposure at some point in their lifetime (see Chapter 8, Covariate Associations with Estimates of Dioxin Exposure). Consequently, herbicide exposure in Ranch Hands was of limited use as a risk factor for explaining the presence of a systemic neoplasm. Therefore, many of the Model 2 and Model 4 analyses of systemic neoplasms and PSA, which were based on Ranch Hands only, did not use herbicide exposure as a covariate. Analyses that did not use herbicide exposure as a covariate are specified in footnotes to the table.

Categories of covariates and definitions are summarized below:

- Skin Color: dark, medium, pale, dark peach, and pale peach (classified for analysis purposes as (1) dark, medium, pale, or (2) dark peach, pale peach).
- Hair Color: black, dark brown, light brown, blonde, red, and bald (classified for analysis purposes as (1) black, dark brown, or (2) light brown, blonde, red, bald).
- Eye Color: brown, hazel, green, gray, and blue (classified for analysis purposes as (1) brown, (2) hazel, green, or (3) gray, blue).
- Skin Reaction to Sun After First Exposure: burns painfully, burns, becomes red, and no reaction.
- Skin Reaction to Sun After Repeated Exposure: freckles with no tan, tans mildly, tans moderately, and tans deep brown.
- Composite Skin-Reaction Index: a composite variable based on two reactions of skin to sun exposure variables was defined as follows: (1) burns painfully or freckles with no tan, (2) burns or tans mildly, and (3) all other reactions.
- Average Lifetime Residential History: average latitude less than 37 degrees and average greater than or equal to 37 degrees.
- Exposure to Carcinogens: ionizing radiation, industrial chemicals, and herbicides (yes or no for each). These exposures represent lifetime exposure based on self-reported questionnaire data from the 1997 examination combined with previous examinations.

10.1.4 Statistical Methods

Table 10-1 summarizes the statistical analysis performed for the neoplasia assessment. The first part of this table identifies the dependent variables, covariates, exclusions, and the statistical methods. This information is presented in the following four sections: skin neoplasms, systemic neoplasms, skin and systemic neoplasms combined, and PSA. Data source, data form, and cutpoints are summarized at the end of the table. The second part of the table describes the covariates. A covariate was used in its continuous form whenever possible for all adjusted analyses; if necessary, or if the covariate was inherently discrete (e.g., military occupation), or if a categorized form was needed to develop measures of association with the dependent variable, the covariate was categorized as shown in Table 10-1.

Table 10-1. Statistical Analysis for the Neoplasia Assessment

Dependent Variables

Category	Site	Covariates ^a	Exclusions ^b	Statistical Analysis and Methods
<u>Skin Neoplasms</u>				
<i>Behavior</i>				
All	All Sites Combined	(1)	(a)	U:LR A:LR
Malignant	All Sites Combined	(1)	(a)	U:LR A:LR L:LR
Benign	All Sites Combined	(1)	(b)	U:LR A:LR
Uncertain Behavior or Unspecified Nature	All Sites Combined	(1)	(a)	U:LR,CS A:LR
<i>Cell Type and Site</i>				
Basal Cell Carcinoma	All Sites Combined Ear, Face, Head, and Neck Trunk Upper Extremities Lower Extremities	(1)	(a)	U:LR A:LR
Squamous Cell Carcinoma	All Sites Combined	(1)	(a)	U:LR A:LR
Nonmelanoma	All Sites Combined	(1)	(a)	U:LR A:LR
Melanoma	All Sites Combined	(1)	(a)	U:LR,CS A:LR
<u>Systemic Neoplasms</u>				
<i>Behavior</i>				
All	All Sites Combined	(2)	(c)	U:LR A:LR
Malignant	All Sites Combined	(2)	(c)	U:LR A:LR L:LR
Benign	All Sites Combined	(2)	(c)	U:LR A:LR L:LR
Uncertain Behavior or Unspecified Nature	All Sites Combined	(2)	(c)	U:LR A:LR
<i>Site</i>				
Malignant	Eye, Ear, Face, Head, and Neck	(2)	(c)	U:LR A:LR
Malignant	Oral Cavity, Pharynx, and Larynx	(2)	(c)	U:LR A:LR

Table 10-1. Statistical Analysis for the Neoplasia Assessment (Continued)

Category	Site	Covariates ^a	Exclusions ^b	Statistical Analysis and Methods
Malignant	Esophagus	--	(c)	Descriptive
Malignant	Brain	--	(c)	Descriptive
Malignant	Thymus, Heart, and Mediastinum	(2)	(c)	U:LR,CS A:LR
Malignant	Thyroid Gland	(2)	(c)	U:LR,CS A:LR
Malignant	Bronchus and Lung	(2)	(c)	U:LR,CS A:LR
Malignant	Liver	(2)	(c)	U:LR,CS A:LR
Malignant	Colon and Rectum	(2)	(c)	U:LR A:LR
Malignant	Kidney and Bladder	(2)	(c)	U:LR,CS A:LR
Malignant	Prostate	(2)	(c)	U:LR A:LR
Malignant	Testicles	(2)	(c)	U:LR,CS A:LR
Malignant	Extrahepatic Bile Duct	--	(c)	Descriptive
Malignant	Ill-Defined Sites	--	(c)	Descriptive
Malignant	Connective and Other Soft Tissues	(2)	(c)	U:LR,CS A:LR
Carcinoma In Situ	Penis	--	(c)	Descriptive
Hodgkin's Disease	--	(2)	(c)	U:LR,CS A:LR
Non-Hodgkin's Lymphoma	--	(2)	(c)	U:LR,CS A:LR
Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue	--	(2)	(c)	U:LR,CS A:LR
<i>Skin and Systemic Neoplasms</i>				
All	All Sites Combined	(3)	(d)	U:LR A:LR

Variable (Units)	Data Form	Cutpoints	Covariates ^a	Exclusions ^b	Statistical Analysis and Methods
<u>Prostate-Specific Antigen</u>					
Prostate-Specific Antigen (ng/ml)	D/C	High: >4 Normal: ≤4	(2)	(e)	U:LR,GLM A:LR,GLM

Dependent Variables (Except for PSA)

Data Source: Review of medical records and verification based on AFHS 1997 follow-up questionnaires and physical examinations, except for PSA, which was measured by Scripps Clinic in 1997.

Data Form: Discrete.

Cutpoints: Yes or No.

Table 10-1. Statistical Analysis for the Neoplasia Assessment (Continued)

^a Covariates:

(1): age, military occupation, skin color, hair color, eye color, skin reaction to sun after first exposure, skin reaction to sun after repeated exposure, composite skin-reaction index, residential history, ionizing radiation exposure, and industrial chemicals exposure.

(2): age, race, military occupation, ionizing radiation exposure, herbicide exposure, lifetime cigarette smoking history, lifetime alcohol history.

(3): age, race, military occupation, skin color, hair color, eye color, skin reaction to sun after first exposure, skin reaction to sun after repeated exposure, composite skin-reaction index, residential history, ionizing radiation exposure, industrial chemicals exposure, herbicide exposure, lifetime cigarette smoking history, lifetime alcohol history.

^b Exclusions:

(a): participants with pre-SEA skin neoplasms, Blacks.

(b): participants with pre-SEA skin neoplasms.

(c): participants with pre-SEA uncertain behavior neoplasms, participants with pre-SEA malignant systemic neoplasms.

(d): participants with pre-SEA skin neoplasms, participants with pre-SEA uncertain behavior neoplasms, participants with pre-SEA malignant systemic neoplasms.

(e): participants with a prostatectomy or radiation treatment on the prostate gland.

Covariates

Variable (Units)	Data Source	Data Form	Cutpoints
Age (years)	MIL	D/C	Born ≥1942 Born <1942
Race	MIL	D	Black Non-Black
Occupation	MIL	D	Officer Enlisted Flyer Enlisted Groundcrew
Skin Color	PE	D	Non-Peach: Dark, Medium, Pale Peach: Dark Peach, Pale Peach
Hair Color	PE	D	Black, Dark Brown Light Brown, Blonde, Red, Bald
Eye Color	PE	D	Brown Hazel, Green Gray, Blue
Skin Reaction to Sun After First Exposure	Q-SR	D	Burns Painfully Burns Becomes Red No Reaction
Skin Reaction to Sun After Repeated Exposure	Q-SR	D	Freckles with No Tan Tans Mildly Tans Moderately Tans Deep Brown

Table 10-1. Statistical Analysis for the Neoplasia Assessment (Continued)

Variable (Units)	Data Source	Data Form	Cutpoints
Composite Skin-Reaction Index	Q-SR	D	<ul style="list-style-type: none"> • Burns Painfully After 2 Hours, or Freckles with No Tan After Repeated Exposure • Burns After 2 Hours, or Tans Mildly After Repeated Exposure • All Other Reactions
Average Lifetime Residential History	Q-SR	D	Latitude <37° Latitude ≥37°
Ionizing Radiation Exposure	Q-SR	D	Yes No
Industrial Chemicals Exposure	Q-SR	D	Yes No
Herbicide Exposure	Q-SR	D	Yes No
Lifetime Cigarette Smoking History (pack-years)	Q-SR	D/C	0 >0-10 >10
Lifetime Alcohol History (drink-years)	Q-SR	D/C	0 >0-40 >40

Abbreviations

Data Source: MIL: Air Force military records
PE: 1997 physical examination
Q-SR: Health questionnaires (self-reported)

Data Form: D: Discrete analysis only
D/C: Discrete and continuous analysis for dependent variables; appropriate form for analysis (either discrete or continuous) for covariates

Statistical Analysis: U: Unadjusted analysis
A: Adjusted analysis
L: Longitudinal analysis

Statistical Methods: CS: Chi-square contingency table analysis (continuity-adjusted for 2x2 tables)
GLM: General linear models analysis
LR: Logistic regression analysis

Many covariates were available for use in adjusted analyses of skin and systemic neoplasms. In addition, the number of neoplasms was small for many of the dependent variables. The modeling strategy for this clinical area was to include as many covariates as feasible. When the number of participants with a history of a particular neoplasm was too small to support analysis including all covariates, elimination of covariates was necessary to develop and support meaningful analysis. The covariates that were removed from analysis for a given health endpoint and model are specified in footnotes to the table.

Table 10-2 provides a summary of the number of participants with missing covariate data. In addition, the number of participants excluded is provided.

Table 10-2. Number of Participants Excluded or with Missing Data for the Neoplasia Assessment

Variable	Variable Use	Dioxin					
		Group		(Ranch Hands Only)		Categorized Dioxin	
		Ranch Hand	Comparison	Initial	1987	Ranch Hand	Comparison
Hair Color	COV	0	2	0	0	0	2
Skin Reaction to Sun after First Exposure	COV	1	0	0	1	1	0
Skin Reaction to Sun after Repeated Exposure	COV	1	0	0	1	1	0
Composite Skin-Reaction Index	COV	1	0	0	1	1	0
Lifetime Cigarette Smoking History	COV	2	1	1	2	2	1
Lifetime Alcohol History	COV	6	2	3	6	6	1
Blacks	EXC	55	73	36	55	55	70
Pre-SEA Skin Neoplasm	EXC	10	11	7	10	10	11
Pre-SEA Malignant Systemic Neoplasm	EXC	5	0	4	5	5	0
Pre-SEA Systemic Neoplasm of Uncertain Behavior	EXC	5	2	3	5	5	2
Prostatectomy or Radiation Treatment on Prostate Gland	EXC	41	61	24	40	40	61

Note: COV = Covariate.

EXC = Exclusion.

870 Ranch Hands and 1,251 Comparisons.

482 Ranch Hands for initial dioxin; 863 Ranch Hands for 1987 dioxin.

863 Ranch Hands and 1,213 Comparisons for categorized dioxin.

10.1.4.1 Longitudinal Analysis

Longitudinal analysis of malignant skin neoplasms, malignant systemic neoplasms, and benign systemic neoplasms was conducted to evaluate the association between exposure and the change in neoplasm status between the 1982 baseline examination and the 1997 follow-up examination.

10.2 RESULTS

10.2.1 Dependent Variable-Covariate Associations

The associations between the dependent variables examined in the neoplasia assessment and the covariates used in the adjusted analyses were investigated, and the results are presented in Appendix F, Table F-2. These associations are pairwise between the dependent variable and the covariate and are not adjusted for any other covariates. The exclusions specified in Table 10-1 were used in the dependent variable-covariate associations described below.

Tests of covariate association were conducted for any skin neoplasm and malignant skin neoplasms. Results were similar for both variables. Significant associations with age ($p < 0.001$ for both) were found, where older participants displayed a greater history of a skin neoplasm or a malignant skin neoplasm than did younger participants. Significant associations also were found with occupation ($p = 0.004$ and $p < 0.001$, respectively). More benign or malignant skin neoplasms were found for officers, followed by enlisted flyers, and then enlisted groundcrew. Skin color was associated with skin neoplasms and malignant skin neoplasms ($p < 0.001$ and $p = 0.003$, respectively). A higher percentage of skin neoplasms was found for participants with peach-colored skin as compared to participants with non-peach-colored skin. A significant association also was found between malignant skin neoplasms and hair color ($p = 0.025$). More participants with light brown, blonde, or red hair had malignant skin neoplasms than did participants with black or dark brown hair. Eye color displayed a significant association with both variables ($p = 0.026$ and $p = 0.023$ for any skin neoplasm and any malignant skin neoplasm, respectively). Participants with brown eyes exhibited the smallest percentage of skin neoplasms.

Significant associations also were found between any skin and malignant skin neoplasms and both sun reaction covariates ($p < 0.001$ for each). The percentage of participants with skin neoplasms increased as the levels of sun sensitivity increased for both covariates. In addition, the composite skin-reaction index displayed significant associations with both variables ($p < 0.001$ for both). For the skin-reaction index, the skin neoplasms and malignant skin neoplasms increased as the reaction to sun increased. The associations with average lifetime residential history were significant ($p = 0.017$ and $p < 0.001$, respectively). The occurrence of both types of neoplasms was greater for those participants who had lived in more southerly latitudes than in the northern latitudes. Ionizing radiation exposure also displayed significant associations with both variables ($p = 0.002$ and $p = 0.031$, respectively). More skin neoplasms and malignant skin neoplasms were observed for those participants who reported exposure to ionizing radiation than for those who did not report exposure.

Results from the covariate association tests for benign skin neoplasms were significant only for skin color ($p = 0.025$). Participants with peach-colored skin showed more benign skin neoplasms (24.6%) than did participants with non-peach-colored skin (19.8%).

The covariate association test results for (a) any basal cell carcinoma and (b) basal cell carcinoma of the ear, face, head, or neck were similar. Each variable displayed a significant association with age and occupation ($p < 0.001$ for each association). The history of a basal cell carcinoma was higher for older participants and highest for officers. Associations with skin color were also significant for both basal cell carcinoma variables ($p = 0.019$ and $p = 0.018$, respectively), revealing more basal cell carcinomas for participants with peach-colored skin than for participants with non-peach-colored skin. Hair color also was associated significantly with both variables ($p = 0.019$ and $p = 0.005$). Participants with lighter hair colors displayed more of the two basal cell carcinoma dependent variables than did participants with darker hair colors. Basal cell carcinoma was significantly associated with eye color ($p = 0.034$). The smallest percentage of participants with basal cell carcinoma was for those with brown eyes.

Significant associations with any basal cell carcinoma and basal cell carcinoma of the ear, face, head, or neck also were found for both sun reaction covariates ($p < 0.001$ for each). Basal cell carcinomas increased as the levels of sun sensitivity increased. In addition, the composite skin-reaction index displayed significant associations with both covariates ($p < 0.001$ for both), where basal cell carcinoma increased as the reaction to sun increased. Significant associations also were found for both variables with the average lifetime residential history ($p < 0.001$ for both variables). The occurrence of basal cell carcinoma was greater for participants who had lived in the more southerly latitudes. A significant association with ionizing radiation exposure was found for basal cell carcinoma of the ear, face, head, or

neck ($p=0.049$). This association revealed more basal cell carcinomas for participants reporting exposure to ionizing radiation.

Tests of covariate association conducted for basal cell carcinoma on the trunk and basal cell carcinoma on the upper extremities showed similar results. Each variable was associated significantly with age ($p=0.007$ and $p=0.031$, respectively). Older participants had more basal cell carcinomas on the trunk and upper extremities than did younger participants. Occupation was also a significant covariate ($p<0.001$ for both). Officers had more basal cell carcinomas of the trunk or upper extremities. Eye color was associated significantly with basal cell carcinoma of the upper extremities ($p=0.005$). Participants with hazel or green eyes had more basal cell carcinomas.

Significant associations with basal cell carcinoma of the trunk and basal cell carcinoma of the upper extremities were also found for both skin reaction to sun after the first exposure ($p=0.006$ and $p<0.001$, respectively) and skin reaction to sun after repeated exposure ($p<0.001$ for both dependent variables). The occurrence of basal cell carcinomas increased as the sensitivity to sun increased. In addition, the composite skin-reaction index displayed significant associations with both variables ($p<0.001$ for both basal cell carcinoma variables), where basal cell carcinoma of the trunk or upper extremities increased as the sensitivity to sun increased. Significant associations also were found for both basal cell carcinoma variables with average lifetime residential history ($p<0.001$ and $p=0.039$, respectively). Basal cell carcinoma of the trunk or upper extremities was higher for participants who had lived in the more southerly latitudes.

Tests of association for squamous cell carcinoma showed several significant findings. A significant association with age ($p=0.002$) displayed more squamous cell carcinomas for older participants (3.0%) than for younger participants (0.9%). The association with occupation also was significant ($p=0.007$). More squamous cell carcinomas were found for officers (3.3%), then enlisted flyers (1.6%), and enlisted groundcrew (1.2%). The associations with both skin reaction to sun covariates also were significant ($p=0.011$ for reaction after first exposure and $p<0.001$ for reaction after repeated exposure). Both skin reaction to sun covariates displayed more squamous cell carcinomas as skin sensitivity to sun increased. The composite skin-reaction index association with squamous cell carcinoma was significant ($p<0.001$). Squamous cell carcinoma increased as the reaction to sun increased. Squamous cell carcinoma for participants who had lived in the more southerly latitudes had occurred more often than for participants who had lived in the northern latitudes ($p=0.009$).

Several covariates were associated significantly with nonmelanoma. Significantly more nonmelanomas ($p<0.001$) were observed in older participants (20.3%) than in younger participants (9.7%). Nonmelanoma also was associated significantly with occupation ($p<0.001$). Nonmelanoma was highest for officers (20.0%), then enlisted flyers (16.0%), and enlisted groundcrew (11.5%). The significant association between nonmelanoma and skin color ($p=0.003$) displayed more nonmelanoma for participants with peach-colored skin than for participants with non-peach-colored skin (17.1% vs. 11.2%). The association between nonmelanoma and hair color was significant ($p=0.016$). Those participants with lighter hair colors exhibited more nonmelanomas (18.7%) compared to those with darker hair colors (14.4%). A significant association between nonmelanoma and eye color showed a smaller percentage of nonmelanoma in participants with brown eyes ($p=0.039$).

Both skin reaction to sun covariates were significant ($p<0.001$ for both covariates) and showed more nonmelanomas as the skin sensitivity to sun increased. The composite skin-reaction index association with nonmelanoma also was significant ($p<0.001$). Nonmelanoma increased as the reaction to sun increased. Nonmelanomas were significantly greater for participants who had lived in more southerly latitudes ($p<0.001$).

A significant association between melanoma and average lifetime residential history was observed ($p=0.008$). Melanoma was significantly greater for participants who had lived in more northerly latitudes.

Tests of covariate association for any systemic neoplasm were significant for age ($p<0.001$), occupation ($p=0.008$), and herbicide exposure ($p=0.003$). A history of systemic neoplasms was higher for older participants (37.2%) than for younger participants (21.8%). Officers displayed the largest occurrence of a systemic neoplasm (33.9%), followed by enlisted flyers (31.1%), then enlisted groundcrew (27.1%). In addition, participants reporting exposure to herbicides exhibited more systemic neoplasms (32.7%) compared to those who did not report exposure to herbicides (26.4%).

Several covariates displayed a significant association with malignant systemic neoplasms. Age was significant ($p<0.001$), with older participants showing more malignant systemic neoplasms (10.2%) than younger participants (2.4%). A significant association between malignant systemic neoplasms and occupation was found ($p<0.001$), with the largest occurrence in officers (8.6%) and enlisted flyers (8.6%), followed by enlisted groundcrew (4.4%). The association with ionizing radiation exposure also was significant ($p=0.004$). For participants who had reported exposure to ionizing radiation, 9.5 percent had a malignant systemic neoplasm compared to 5.8 percent of participants who had not reported exposure. The association between malignant systemic neoplasms and herbicide exposure was significant ($p=0.004$). Participants who had reported being exposed to herbicides had more malignant systemic neoplasms (8.0%) than participants who had not reported being exposed (4.6%). Lifetime cigarette smoking history also was associated significantly with malignant systemic neoplasms ($p<0.001$). Participants who had smoked the heaviest (in terms of pack-years) had more malignant systemic neoplasms.

Benign systemic neoplasms displayed significant associations with age ($p<0.001$) and herbicide exposure ($p=0.045$). Older participants exhibited more benign systemic neoplasms (28.9%) than did younger participants (19.2%). A greater percentage of participants who had reported being exposed to herbicides had more benign systemic neoplasms (26.1%) than those participants who had not reported exposure to herbicides (22.1%).

Covariate association tests with systemic neoplasms of uncertain behavior or unspecified nature revealed a significant result for occupation ($p=0.031$). Officers displayed the most systemic neoplasms of uncertain behavior or unspecified nature (2.9%), followed by enlisted groundcrew (1.5%), then enlisted flyers (0.9%).

A significant association between age and a malignant systemic neoplasm of the eye, ear, face, head, or neck was found ($p=0.035$). Older participants had more malignant systemic neoplasms of the eye, ear, face, head, or neck (1.4%) than did younger participants (0.4%).

Tests of covariate association for malignant systemic neoplasms of the oral cavity, pharynx, and larynx were significant for age ($p=0.041$). Older participants displayed more malignant systemic neoplasms of the oral cavity, pharynx, and larynx (0.9%) than did younger participants (0.1%).

Malignant systemic neoplasms of the bronchus and lung were associated significantly with lifetime cigarette smoking history ($p<0.001$). Only participants who had smoked the most (>10 pack-years) showed a malignant systemic neoplasm of the bronchus or lung (1.4%).

Several significant results were revealed from the covariate association tests conducted for malignant systemic neoplasms of the kidney and bladder. A significant association with age ($p=0.014$) showed more malignant systemic neoplasms of the kidney or bladder in older participants (1.3%) than in younger

participants (0.2%). The association with lifetime cigarette smoking history was significant ($p < 0.001$). Malignant systemic neoplasms of the kidney or bladder increased with smoking. The association with lifetime alcohol history also was significant ($p < 0.001$). The greatest percentage of participants with malignant systemic neoplasms of the kidney or bladder was for non-drinkers (3.4%).

Tests of covariate association for malignant systemic neoplasms of the prostate revealed several significant results. Older participants had significantly more ($p < 0.001$) malignant systemic neoplasms of the prostate (5.3%) than did younger participants (0.2%). A significant association with occupation ($p = 0.002$) revealed more malignant systemic neoplasms of the prostate in officers (4.6%), followed by enlisted flyers (3.3%), then enlisted groundcrew (1.7%). A significant result also was found with ionizing radiation exposure ($p = 0.044$). For participants reporting exposure to ionizing radiation, 4.5 percent had a malignant systemic neoplasm of the prostate, compared to 2.6 percent who did not report exposure. Results also were significant for the tests of association with herbicide exposure ($p = 0.035$). The percentage of participants reporting exposure to herbicides with malignant systemic neoplasms was 3.7 percent, compared to 2.0 percent who did not report exposure to herbicides. Lifetime cigarette smoking history showed a significant association with malignant systemic neoplasms of the prostate ($p = 0.017$). The greatest occurrence of malignant systemic neoplasms of the prostate was for participants who had smoked the most (4.1%).

Covariate association tests conducted for all malignant skin and systemic neoplasms and all skin and systemic neoplasms were similar. Age, race, and occupation each were significant for both variables ($p < 0.001$ for each test). Older participants showed more neoplasms for both variables than did younger participants. Skin and systemic neoplasms occurred more often in non-Blacks than in Blacks. Officers showed more skin and systemic neoplasms than did enlisted flyers and enlisted groundcrew. Skin color was associated significantly with both dependent variables ($p < 0.001$ for each). Participants with peach-colored skin had more skin and systemic neoplasms than did participants with non-peach-colored skin. The association between hair color and all malignant skin and systemic neoplasms was significant ($p < 0.001$). Participants who had lighter hair colors had more malignant skin or systemic neoplasms. Eye color associations for both variables were each significant ($p < 0.001$ for both tests). Participants with brown eyes showed the smallest occurrence of a skin or systemic neoplasm.

Significant associations with all malignant skin and systemic neoplasms and all skin and systemic neoplasms also were found for both skin reaction to sun and the composite skin-reaction index covariates ($p < 0.02$ for all tests). Skin or systemic neoplasms increased as skin sensitivity to the sun increased. A significant association also was found for all malignant skin and systemic neoplasms with the average lifetime residential history covariate ($p < 0.001$). Malignant skin or systemic neoplasms occurred more often for participants who lived in more southerly latitudes. The ionizing radiation exposure and herbicide exposure covariate tests were each significant for both variables ($p < 0.02$ for all tests). Participants reporting exposure to either ionizing radiation or herbicides displayed more skin and systemic neoplasms (both malignant systemic neoplasms and all systemic neoplasms combined) than did participants who did not report exposure.

Covariate association tests for both the continuous and discrete forms of PSA were significant for age ($p < 0.001$ for PSA in both discrete and continuous forms) and occupation ($p < 0.001$, continuous, and $p = 0.014$, discrete). PSA levels and the proportion of participants with high PSA levels increased with age. Enlisted groundcrew showed the lowest average levels of PSA and the lowest percentage of participants with high PSA levels.

10.2.2 Exposure Analysis

The following section presents results of the statistical analysis of the dependent variables shown in Table 10-1. Dependent variables were derived from a medical records review and verification and a laboratory measurement of PSA at the 1997 follow-up examination.

Four models were examined for each dependent variable given in Table 10-1. The analyses of these models are presented below. Further details on dioxin and the modeling strategy are found in Chapters 2 and 7, respectively. These analyses were performed both unadjusted and adjusted for relevant covariates. Model 1 examined the relation between the dependent variable and group (i.e., Ranch Hand or Comparison). In this model, exposure was defined as “yes” for Ranch Hands and “no” for Comparisons without regard to the magnitude of the exposure. As an attempt to quantify exposure, three contrasts of Ranch Hands and Comparisons were performed along with the overall Ranch Hand versus Comparison contrast. These three contrasts compared Ranch Hands and Comparisons within each occupational category (officers, enlisted flyers, and enlisted groundcrew). As described in Table 2-8 and previous reports, the average levels of exposure to dioxin were highest for enlisted groundcrew, followed by enlisted flyers, then officers.

Model 2 explored the relation between the dependent variable and an extrapolated initial dioxin measure for Ranch Hands who had a 1987 dioxin measurement greater than 10 ppt. If a participant did not have a 1987 dioxin level, the 1992 level was used to estimate the initial dioxin level. If a participant did not have a 1987 or a 1992 dioxin level, the 1997 level was used to estimate the initial dioxin level. A statistical adjustment for the percentage of body fat at the time of the participant’s blood measurement of dioxin was included in this model to account for body-fat-related differences in elimination rate (80).

Model 3 divided the Ranch Hands examined in Model 2 into two categories based on their initial dioxin measures. These two categories are referred to as “low Ranch Hand” and “high Ranch Hand.” Two additional categories, Ranch Hands with 1987 serum dioxin levels at or below 10 ppt and Comparisons with 1987 serum dioxin levels at or below 10 ppt, were formed and included in the model. Ranch Hands with 1987 serum dioxin levels at or below 10 ppt are referred to as the “background Ranch Hand” category. Dioxin levels in 1992 were used if the 1987 level was not available, and dioxin levels in 1997 were used if the 1987 and 1992 levels were not available. These four categories—Comparisons, background Ranch Hands, low Ranch Hands, and high Ranch Hands—were used in Model 3 analyses. The relation between the dependent variable in each of the three Ranch Hand categories and the dependent variable in the Comparison category was examined. A fourth contrast, exploring the relation of the dependent variable in the combined low and high Ranch Hand categories relative to Comparisons, also was conducted. This combination is referred to in the tables as the “low plus high Ranch Hand” category. As in Model 2, a statistical adjustment for the percentage of body fat at the time of the participant’s blood measurement of dioxin was included in this model.

Model 4 examined the relation between the dependent variable and 1987 lipid-adjusted dioxin levels in all Ranch Hands with a dioxin measurement. If a participant did not have a 1987 dioxin measurement, the 1992 measurement was used to determine the dioxin level. If a participant did not have a 1987 or a 1992 dioxin measurement, the 1997 measurement was used to determine the dioxin level.

Some participants had multiple neoplasms, and a participant may be represented in more than one table; therefore, totals added across tables may not agree. For example, 496 of the 2,121 participants in this study (29.8%) had at least two neoplasms and 94 (10.8%) had at least two malignant neoplasms.

10.2.2.1 Medical Records Review

10.2.2.1.1 Skin Neoplasms (All Sites Combined)

Significant group differences were found for all occupations combined and within the officer and enlisted flyer occupational strata in both the Model 1 unadjusted and adjusted analyses of a history of skin neoplasms (Table 10-3(a,b): Est. RR=1.29, p=0.007; Adj. RR=1.32, p=0.005, for all occupations; Est. RR=1.36, p=0.034; Adj. RR=1.38, p=0.030, for officers; and Est. RR=1.64, p=0.040; Adj. RR=1.66, p=0.040, for enlisted flyers). Each contrast displayed more Ranch Hands than Comparisons with skin neoplasms. Results were nonsignificant for the enlisted groundcrew contrasts (p>0.33 for both the unadjusted and adjusted analyses).

Table 10-3. Analysis of Skin Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>805</i>	<i>325 (40.4)</i>	<i>1.29 (1.07,1.55)</i>	<i>0.007</i>
	<i>Comparison</i>	<i>1,168</i>	<i>402 (34.4)</i>		
Officer	Ranch Hand	329	150 (45.6)	1.36 (1.02,1.81)	0.034
	Comparison	480	183 (38.1)		
Enlisted Flyer	Ranch Hand	140	56 (40.0)	1.64 (1.02,2.63)	0.040
	Comparison	173	50 (28.9)		
Enlisted Groundcrew	Ranch Hand	336	119 (35.4)	1.12 (0.84,1.50)	0.433
	Comparison	515	169 (32.8)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.32 (1.09,1.60)</i>	<i>0.005</i>
Officer	1.38 (1.03,1.85)	0.030
Enlisted Flyer	1.66 (1.02,2.69)	0.040
Enlisted Groundcrew	1.16 (0.86,1.56)	0.339

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	138	63 (45.7)	0.78 (0.67,0.91)	0.001
Medium	150	64 (42.7)		
High	151	42 (27.8)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-3. Analysis of Skin Neoplasms (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
	Adjusted Relative Risk		
n	(95% C.I.) ^a		p-Value
439	0.81 (0.68,0.98)		0.028

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Number (%)		Est. Relative Risk (95% C.I.) ^{ab}	p-Value
		Yes			
Comparison	1,133	389 (34.3)			
Background RH	359	155 (43.2)		1.49 (1.17,1.90)	0.001
Low RH	210	94 (44.8)		1.54 (1.14,2.07)	0.005
High RH	229	75 (32.8)		0.91 (0.67,1.23)	0.546
Low plus High RH	439	169 (38.5)		1.17 (0.93,1.47)	0.183

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
		(95% C.I.) ^a		
Comparison	1,131			
Background RH	358	1.46 (1.13,1.88)		0.004
Low RH	210	1.49 (1.10,2.04)		0.011
High RH	229	1.05 (0.76,1.45)		0.747
Low plus High RH	439	1.25 (0.98,1.58)		0.073

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-3. Analysis of Skin Neoplasms (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.)^a	p-Value
Low	273	114 (41.8)	0.88 (0.80,0.97)	
Medium	256	120 (46.9)		
High	269	90 (33.5)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
797	0.92 (0.82,1.03)		0.147

^a Relative risk for a twofold increase in 1987 dioxin.

Results from both the unadjusted and adjusted Model 2 analyses indicated a significant inverse relation between initial dioxin and skin neoplasms (Table 10-3(c,d): Est. RR=0.78, p=0.001; Adj. RR=0.81, p=0.028, respectively). As initial dioxin in Ranch Hands increased, the occurrence of skin neoplasms decreased.

The Model 3 analyses contrasting Ranch Hands in both the background dioxin category and low dioxin category with Comparisons displayed significant results in the unadjusted and adjusted analyses of skin neoplasms (Table 10-3(e,f): Est. RR=1.49, p=0.001; Adj. RR=1.46, p=0.004; and Est. RR=1.54, p=0.005; Adj. RR=1.49, p=0.011, respectively). A marginally significant difference between Ranch Hands in the low plus high dioxin category and Comparisons was revealed in the adjusted analysis of skin neoplasms (Table 10-3(f): Adj. RR=1.25, p=0.073). Each contrast displayed more Ranch Hands than Comparisons with skin neoplasms. All other Model 3 contrasts were nonsignificant (Table 10-3(e,f): p>0.18).

The Model 4 unadjusted analysis revealed a significant inverse relation between skin neoplasms and 1987 dioxin levels (Table 10-3(g): Est. RR=0.88, p=0.012). After adjustment for covariates, the association was nonsignificant (Table 10-3(h): p=0.147).

10.2.2.1.2 Malignant Skin Neoplasms

The Model 1 enlisted flyer contrast revealed a marginally significantly higher percentage of a history of malignant skin neoplasms for Ranch Hands than for Comparisons in both the unadjusted and adjusted analyses (Table 10-4(a,b): Est. RR=1.79, p=0.059; Adj. RR=1.86, p=0.055, respectively). All other Model 1 contrasts were nonsignificant (Table 10-4(a,b): p>0.16).

Table 10-4. Analysis of Malignant Skin Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	144 (17.9)	1.14 (0.90,1.45)	0.274
	<i>Comparison</i>	1,168	187 (16.0)		
Officer	Ranch Hand	329	77 (23.4)	1.24 (0.88,1.74)	0.218
	Comparison	480	95 (19.8)		
Enlisted Flyer	Ranch Hand	140	29 (20.7)	1.79 (0.98,3.29)	0.059
	Comparison	173	22 (12.7)		
Enlisted Groundcrew	Ranch Hand	336	38 (11.3)	0.81 (0.53,1.24)	0.329
	Comparison	515	70 (13.6)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED			
Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
<i>All</i>	1.19 (0.93,1.54)		0.175
Officer	1.29 (0.90,1.85)		0.161
Enlisted Flyer	1.86 (0.99,3.51)		0.055
Enlisted Groundcrew	0.86 (0.56,1.34)		0.509

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	138	31 (22.5)	0.79 (0.64,0.96)	0.015
Medium	150	30 (20.0)		
High	151	18 (11.9)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
439	0.87 (0.68,1.12)	0.287

^a Relative risk for a twofold increase in initial dioxin.

Table 10-4. Analysis of Malignant Skin Neoplasms (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Number (%)		Est. Relative Risk (95% C.I.) ^{ab}	p-Value
			Yes		
Comparison	1,133		179 (15.8)		
Background RH	359		65 (18.1)	1.21 (0.88,1.66)	0.237
Low RH	210		47 (22.4)	1.52 (1.06,2.19)	0.023
High RH	229		32 (14.0)	0.84 (0.56,1.27)	0.417
Low plus High RH	439		79 (18.0)	1.12 (0.83,1.51)	0.457

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
			(95% C.I.) ^a	
Comparison	1,131			
Background RH	358		1.13 (0.81,1.58)	0.476
Low RH	210		1.45 (0.98,2.14)	0.062
High RH	229		1.19 (0.76,1.85)	0.453
Low plus High RH	439		1.30 (0.95,1.80)	0.104

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for Log ₂ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%)		Estimated Relative Risk (95% C.I.) ^a	p-Value
			Yes		
Low	273		48 (17.6)	0.92 (0.81,1.04)	0.187
Medium	256		56 (21.9)		
High	269		40 (14.9)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 10-4. Analysis of Malignant Skin Neoplasms (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log₂ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
797	1.06 (0.91,1.25)	0.447

^a Relative risk for a twofold increase in 1987 dioxin.

A significant inverse relation between initial dioxin levels and malignant skin neoplasms was revealed in the Model 2 unadjusted analysis (Table 10-4(c): Est. RR=0.79, p=0.015). Results were nonsignificant after adjustment for covariates (Table 10-4(d): p=0.287).

The Model 3 unadjusted analysis showed significantly more Ranch Hands in the low dioxin category with malignant skin neoplasms than Comparisons (Table 10-4(e): Est. RR=1.52, p=0.023). After adjustment for covariates, the result was marginally significant (Table 10-4(f): Adj. RR=1.45, p=0.062). All other Model 3 contrasts and the Model 4 analysis results were nonsignificant (Table 10-4(e-h): p>0.10).

10.2.2.1.3 Benign Skin Neoplasms

The Model 1 unadjusted analysis showed a significant difference in the history of benign skin neoplasms between Ranch Hands and Comparisons when examined across all occupations and within the officer stratum (Table 10-5(a): Est. RR=1.31; p=0.010; Est. RR=1.42, p=0.031, respectively). Both contrasts displayed more Ranch Hands than Comparisons with benign skin neoplasms. Results were also significant in the adjusted analysis (Table 10-5(b): Adj. RR=1.31, p=0.011; Adj. RR=1.41, p=0.035, respectively). All other Model 1 contrasts were nonsignificant (Table 10-5(a,b): p≥0.22).

Table 10-5. Analysis of Benign Skin Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>860</i>	<i>225 (26.2)</i>	<i>1.31 (1.07,1.61)</i>	<i>0.010</i>
	<i>Comparison</i>	<i>1,240</i>	<i>264 (21.3)</i>		
Officer	Ranch Hand	336	96 (28.6)	1.42 (1.03,1.96)	0.031
	Comparison	487	107 (22.0)		
Enlisted Flyer	Ranch Hand	150	34 (22.7)	1.40 (0.82,2.40)	0.220
	Comparison	185	32 (17.3)		
Enlisted Groundcrew	Ranch Hand	374	95 (25.4)	1.21 (0.89,1.64)	0.229
	Comparison	568	125 (22.0)		

Table 10-5. Analysis of Benign Skin Neoplasms (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.31 (1.07,1.61)</i>	<i>0.011</i>
Officer	1.41 (1.02,1.95)	0.035
Enlisted Flyer	1.41 (0.82,2.43)	0.220
Enlisted Groundcrew	1.20 (0.88,1.63)	0.257

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^b	p-Value
Low	154	42 (27.3)	0.82 (0.69,0.98)	0.022
Medium	161	40 (24.8)		
High	160	27 (16.9)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
475	0.79 (0.64,0.97)	0.020

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,202	258 (21.5)		
Background RH	378	115 (30.4)	1.64 (1.26,2.13)	<0.001
Low RH	233	58 (24.9)	1.21 (0.87,1.67)	0.261
High RH	242	51 (21.1)	0.96 (0.68,1.34)	0.802
Low plus High RH	475	109 (23.0)	1.07 (0.83,1.38)	0.592

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-5. Analysis of Benign Skin Neoplasms (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,200		
Background RH	377	1.64 (1.25,2.15)	<0.001
Low RH	233	1.21 (0.87,1.69)	0.265
High RH	242	0.95 (0.67,1.36)	0.798
Low plus High RH	475	1.07 (0.82,1.39)	0.603

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	286	87 (30.4)	0.85 (0.77,0.95)	0.003
Medium	280	79 (28.2)		
High	287	58 (20.2)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
852	0.84 (0.74,0.95)		0.005

^a Relative risk for a twofold increase in 1987 dioxin.

Both the unadjusted and adjusted Model 2 analyses displayed a significant inverse association between initial dioxin and benign skin neoplasms (Table 10-5(c,d): Est. RR=0.82; p=0.022; Adj. RR=0.79, p=0.020, respectively). As initial dioxin in Ranch Hands increased, benign skin neoplasms decreased.

Significant results from the Model 3 unadjusted and adjusted analyses revealed more benign skin neoplasms for Ranch Hands in the background dioxin category than for Comparisons (Table 10-5(e,f): Est. RR=1.64, p<0.001; Adj. RR=1.64, p<0.001, respectively). All other Model 3 contrasts were nonsignificant (Table 10-5(e,f): p>0.26).

Results from the Model 4 analysis of benign skin neoplasms were similar in both the unadjusted and adjusted analyses. A significant inverse association was found between 1987 dioxin and benign skin neoplasms (Table 10-5(g,h): Est. RR=0.85, p=0.003; Adj. RR=0.84, p=0.005, respectively).

10.2.2.1.4 Skin Neoplasms of Uncertain Behavior or Unspecified Nature

All results from the Model 1 through 4 analyses of skin neoplasms of uncertain behavior or unspecified nature were nonsignificant (Table 10-6(a-h): p>0.11 for each analysis).

Table 10-6. Analysis of Skin Neoplasms of Uncertain Behavior or Unspecified Nature

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED						
Occupational Category	Group	n	Number (%)		Est. Relative Risk (95% C.I.)	p-Value
			Yes	No		
<i>All</i>	<i>Ranch Hand</i>	<i>805</i>	<i>7 (0.9)</i>		<i>1.27 (0.46,3.52)</i>	<i>0.645</i>
	<i>Comparison</i>	<i>1,168</i>	<i>8 (0.7)</i>			
Officer	Ranch Hand	329	0 (0.0)		--	0.397 ^a
	Comparison	480	3 (0.6)			
Enlisted Flyer	Ranch Hand	140	0 (0.0)		--	0.999 ^a
	Comparison	173	1 (0.6)			
Enlisted Groundcrew	Ranch Hand	336	7 (2.1)		2.72 (0.79,9.36)	0.113
	Comparison	515	4 (0.8)			

^a P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with a skin neoplasm of uncertain behavior or unspecified nature.

--: Results not presented because of the sparse number of Ranch Hands with a skin neoplasm of uncertain behavior or unspecified nature.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.18 (0.42,3.36)</i>	<i>0.755</i>
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	2.57 (0.73,9.10)	0.144

--: Results not presented because of the sparse number of Ranch Hands with a skin neoplasm of uncertain behavior or unspecified nature.

Note: Results are not adjusted for skin reaction to sun after repeated exposure because of the sparse number of Ranch Hands with a skin neoplasm of uncertain behavior or unspecified nature.

Table 10-6. Analysis of Skin Neoplasms of Uncertain Behavior or Unspecified Nature (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) ^b	p-Value
		Yes		
Low	138	1 (0.7)	0.87 (0.44,1.75)	0.696
Medium	150	3 (2.0)		
High	151	1 (0.7)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
439	0.88 (0.42,1.85)	0.732

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for occupation, skin color, eye color, skin reaction to sun after first exposure, skin reaction to sun after repeated exposure, composite skin-reaction index, and industrial chemicals exposure because of the sparse number of Ranch Hands with a skin neoplasm of uncertain behavior or unspecified nature.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
		Yes		
Comparison	1,133	8 (0.7)		
Background RH	359	2 (0.6)	0.80 (0.17,3.80)	0.777
Low RH	210	3 (1.4)	2.03 (0.53,7.72)	0.300
High RH	229	2 (0.9)	1.22 (0.26,5.84)	0.800
Low plus High RH	439	5 (1.1)	1.56 (0.49,4.91)	0.449

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-6. Analysis of Skin Neoplasms of Uncertain Behavior or Unspecified Nature (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,131		
Background RH	358	0.92 (0.18,4.75)	0.921
Low RH	210	1.91 (0.47,7.69)	0.363
High RH	229	0.89 (0.18,4.41)	0.889
Low plus High RH	439	1.28 (0.40,4.14)	0.675

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for skin reaction to sun after repeated exposure because of the sparse number of participants with a skin neoplasm of uncertain behavior or unspecified nature.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	
				p-Value
Low	273	1 (0.4)	1.16 (0.72,1.86)	0.542
Medium	256	2 (0.8)		
High	269	4 (1.5)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
798	1.11 (0.69,1.81)		0.664

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for occupation, skin color, eye color, skin reaction to sun after first exposure, skin reaction to sun after repeated exposure, composite skin-reaction index, and industrial chemicals exposure because of the sparse number of Ranch Hands with a skin neoplasm of uncertain behavior or unspecified nature.

10.2.2.1.5 Basal Cell Carcinoma (All Sites Combined)

The difference in the history of any basal cell carcinoma within the enlisted flyer stratum was marginally significant and higher for Ranch Hands than for Comparisons in the Model 1 unadjusted analysis (Table 10-7(a,b): Est. RR=1.85, p=0.060). The result was significant after covariate adjustment (Table 10-7(b): Adj. RR=1.97, p=0.046). All other Model 1 contrasts were nonsignificant (Table 10-7(a,b): p>0.12).

Table 10-7. Analysis of Basal Cell Carcinoma (All Sites Combined)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	121 (15.0)	<i>1.16 (0.89,1.49)</i>	<i>0.269</i>
	<i>Comparison</i>	1,168	155 (13.3)		
Officer	Ranch Hand	329	67 (20.4)	1.28 (0.89,1.83)	0.181
	Comparison	480	80 (16.7)		
Enlisted Flyer	Ranch Hand	140	26 (18.6)	1.85 (0.98,3.50)	0.060
	Comparison	173	19 (11.0)		
Enlisted Groundcrew	Ranch Hand	336	28 (8.3)	0.75 (0.46,1.20)	0.226
	Comparison	515	56 (10.9)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.21 (0.92,1.59)</i>	<i>0.169</i>
Officer	1.34 (0.92,1.96)	0.129
Enlisted Flyer	1.97 (1.01,3.85)	0.046
Enlisted Groundcrew	0.80 (0.49,1.30)	0.363

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	138	28 (20.3)	0.67 (0.53,0.85)	<0.001
Medium	150	27 (18.0)		
High	151	10 (6.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-7. Analysis of Basal Cell Carcinoma (All Sites Combined) (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
439	0.70 (0.53,0.94)	0.014

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Number (%)		Est. Relative Risk (95% C.I.) ^{ab}	p-Value
		Yes			
Comparison	1,133	150 (13.2)			
Background RH	359	56 (15.6)		1.24 (0.89,1.73)	0.212
Low RH	210	42 (20.0)		1.62 (1.11,2.38)	0.012
High RH	229	23 (10.0)		0.72 (0.45,1.14)	0.160
Low plus High RH	439	65 (14.8)		1.06 (0.76,1.47)	0.727

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
		(95% C.I.) ^a		
Comparison	1,131			
Background RH	358	1.16 (0.81,1.65)		0.427
Low RH	210	1.59 (1.06,2.39)		0.026
High RH	229	0.99 (0.60,1.64)		0.979
Low plus High RH	439	1.24 (0.88,1.77)		0.223

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-7. Analysis of Basal Cell Carcinoma (All Sites Combined) (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.)^a	p-Value
Low	273	42 (15.4)	0.87 (0.76,0.99)	
Medium	256	49 (19.1)		
High	269	30 (11.2)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
797	0.99 (0.83,1.18)		0.924

^a Relative risk for a twofold increase in 1987 dioxin.

An inverse association between initial dioxin and any basal cell carcinoma was significant in both the unadjusted and adjusted Model 2 analyses (Table 10-7(c,d): Est. RR=0.67, p<0.001; Adj. RR=0.70, p=0.014, respectively). As initial dioxin in Ranch Hands increased, the percentage of participants with a basal cell carcinoma decreased.

Ranch Hands in the low dioxin category exhibited more basal cell carcinomas than did Comparisons in both the unadjusted and adjusted Model 3 analyses (Table 10-7(e,f): Est. RR=1.62, p=0.012; Adj. RR=1.59, p=0.026, respectively). All other Model 3 contrasts were nonsignificant (Table 10-7(e,f): p≥0.16).

The Model 4 unadjusted analysis revealed a significant inverse association between any basal cell carcinoma and 1987 dioxin levels (Table 10-7(g): Est. RR=0.87, p=0.037). After adjustment for covariates, the association was nonsignificant (Table 10-7(h): p=0.924).

10.2.2.1.6 Basal Cell Carcinoma (Ear, Face, Head, and Neck)

The Model 1 adjusted analysis revealed a marginally significant result within the enlisted flyer stratum, indicating more basal cell carcinomas of the ear, face, head, and neck in Ranch Hands than in Comparisons (Table 10-8(b): Adj. RR=1.83, p=0.097). All other Model 1 contrasts were nonsignificant (Table 10-8(a,b): p≥0.12).

Table 10-8. Analysis of Basal Cell Carcinoma (Ear, Face, Head, and Neck)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	93 (11.6)	1.14 (0.86,1.52)	0.370
	<i>Comparison</i>	1,168	120 (10.3)		
Officer	Ranch Hand	329	49 (14.9)	1.23 (0.82,1.84)	0.328
	Comparison	480	60 (12.5)		
Enlisted Flyer	Ranch Hand	140	22 (15.7)	1.71 (0.87,3.37)	0.120
	Comparison	173	17 (9.8)		
Enlisted Groundcrew	Ranch Hand	336	22 (6.6)	0.77 (0.45,1.31)	0.334
	Comparison	515	43 (8.4)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.20 (0.89,1.62)	0.242
Officer	1.29 (0.84,1.97)	0.244
Enlisted Flyer	1.83 (0.90,3.72)	0.097
Enlisted Groundcrew	0.84 (0.48,1.45)	0.527

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	138	21 (15.2)	0.63 (0.48,0.83)	<0.001
Medium	150	24 (16.0)		
High	151	5 (3.3)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
439	0.62 (0.44,0.87)	0.003

^a Relative risk for a twofold increase in initial dioxin.

Table 10-8. Analysis of Basal Cell Carcinoma (Ear, Face, Head, and Neck) (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.) ^{ab}	
Comparison	1,133	115 (10.2)		
Background RH	359	43 (12.0)	1.21 (0.83,1.76)	0.316
Low RH	210	33 (15.7)	1.65 (1.08,2.50)	0.020
High RH	229	17 (7.4)	0.71 (0.41,1.20)	0.199
Low plus High RH	439	50 (11.4)	1.06 (0.73,1.53)	0.762

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	p-Value
		(95% C.I.) ^a	
Comparison	1,131		
Background RH	358	1.19 (0.80,1.77)	0.386
Low RH	210	1.54 (0.98,2.42)	0.061
High RH	229	0.95 (0.54,1.67)	0.846
Low plus High RH	439	1.19 (0.80,1.77)	0.379

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin Category Summary Statistics			Estimated Relative Risk	
1987 Dioxin	n	Number (%) Yes	(95% C.I.) ^a	p-Value
Low	273	32 (11.7)	0.84 (0.72,0.98)	0.021
Medium	256	37 (14.5)		
High	269	24 (8.9)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 10-8. Analysis of Basal Cell Carcinoma (Ear, Face, Head, and Neck) (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log₂ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
797	0.89 (0.74,1.09)	0.257

^a Relative risk for a twofold increase in 1987 dioxin.

A significant inverse relation between initial dioxin and basal cell carcinomas of the ear, face, head, and neck was found in both the Model 2 unadjusted and adjusted analyses (Table 10-8(c,d): Est. RR=0.63, p<0.001; Adj. RR=0.62, p=0.003, respectively). As initial dioxin in Ranch Hands increased, basal cell carcinomas of the ear, face, head, and neck decreased.

The Model 3 unadjusted analysis indicated more basal cell carcinomas of the ear, face, head, and neck for Ranch Hands in the low dioxin category than for Comparisons (Table 10-8(e): Est. RR=1.65, p=0.020). Results were marginally significant after adjustment for covariates (Table 10-8(f): Adj. RR=1.54, p=0.061). All other Model 3 contrasts were nonsignificant (Table 10-8 (e,f): p>0.19).

The Model 4 unadjusted analysis displayed a significant inverse relation between 1987 dioxin levels and basal cell carcinomas of the ear, face, head, and neck (Table 10-8(g): Est. RR=0.84, p=0.021). After adjustment for covariates, the result was nonsignificant (Table 10-8(h): p=0.257).

10.2.2.1.7 Basal Cell Carcinoma (Trunk)

All results from the analyses of basal cell carcinoma of the trunk from Models 1 through 3 and from the unadjusted analysis of Model 4 were nonsignificant (Table 10-9(a-g): p>0.10 for each analysis). After adjustment for covariates in Model 4, the result was significant, indicating an increase in basal cell carcinomas of the trunk as 1987 dioxin levels increased (Table 10-9(h): Adj. RR=1.51, p=0.016).

Table 10-9. Analysis of Basal Cell Carcinoma (Trunk)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	40 (5.0)	1.25 (0.81,1.92)	0.318
	<i>Comparison</i>	1,168	47 (4.0)		
Officer	Ranch Hand	329	29 (8.8)	1.50 (0.88,2.57)	0.135
	Comparison	480	29 (6.0)		
Enlisted Flyer	Ranch Hand	140	6 (4.3)	2.54 (0.62,10.33)	0.194
	Comparison	173	3 (1.7)		
Enlisted Groundcrew	Ranch Hand	336	5 (1.5)	0.50 (0.18,1.40)	0.188
	Comparison	515	15 (2.9)		

Table 10-9. Analysis of Basal Cell Carcinoma (Trunk) (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.24 (0.79,1.94)</i>	<i>0.357</i>
Officer	1.47 (0.85,2.57)	0.170
Enlisted Flyer	2.47 (0.59,10.26)	0.214
Enlisted Groundcrew	0.52 (0.19,1.48)	0.222

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^b	p-Value
Low	138	9 (6.5)	0.79 (0.56,1.13)	0.184
Medium	150	7 (4.7)		
High	151	6 (4.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
439	1.18 (0.75,1.86)	0.470

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for skin reaction to sun after first exposure because of the sparse number of Ranch Hands with a basal cell carcinoma on the trunk.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,133	46 (4.1)		
Background RH	359	18 (5.0)	1.28 (0.73,2.25)	0.383
Low RH	210	14 (6.7)	1.67 (0.90,3.10)	0.105
High RH	229	8 (3.5)	0.83 (0.39,1.79)	0.638
Low plus High RH	439	22 (5.0)	1.16 (0.68,1.99)	0.589

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-9. Analysis of Basal Cell Carcinoma (Trunk) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.)^a	
			p-Value
Comparison	1,131		
Background RH	358	0.99 (0.55,1.79)	0.984
Low RH	210	1.60 (0.83,3.11)	0.161
High RH	229	1.46 (0.63,3.36)	0.374
Low plus High RH	439	1.53 (0.85,2.73)	0.153

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.)^a	p-Value
Low	273	14 (5.1)	0.96 (0.77,1.19)	0.695
Medium	256	15 (5.9)		
High	269	11 (4.1)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
797	1.51 (1.07,2.13)		0.016

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for skin reaction to sun after first exposure because of the sparse number of Ranch Hands with a basal cell carcinoma on the trunk.

10.2.2.1.8 Basal Cell Carcinoma (Upper Extremities)

Results from the analysis of basal cell carcinoma of the upper extremities were nonsignificant for Models 1, 3, and 4 (Table 10-10(a-b,e-h): $p > 0.10$ for each analysis). The unadjusted Model 2 analysis revealed a significant inverse association between initial dioxin and basal cell carcinoma of the upper extremities (Table 10-10(c): Est. RR=0.51, $p=0.024$). After adjustment for covariates, the association was nonsignificant (Table 10-10(d): $p=0.219$).

Table 10-10. Analysis of Basal Cell Carcinoma (Upper Extremities)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	21 (2.6)	<i>0.80 (0.46,1.37)</i>	<i>0.405</i>
	<i>Comparison</i>	1,168	38 (3.3)		
Officer	Ranch Hand	329	17 (5.2)	1.04 (0.55,1.96)	0.915
	Comparison	480	24 (5.0)		
Enlisted Flyer	Ranch Hand	140	1 (0.7)	0.62 (0.06,6.85)	0.693
	Comparison	173	2 (1.2)		
Enlisted Groundcrew	Ranch Hand	336	3 (0.9)	0.38 (0.11,1.35)	0.134
	Comparison	515	12 (2.3)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.76 (0.44,1.34)</i>	<i>0.340</i>
Officer	0.98 (0.51,1.89)	0.947
Enlisted Flyer	0.56 (0.05,6.30)	0.635
Enlisted Groundcrew	0.38 (0.11,1.37)	0.139

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	138	5 (3.6)	0.51 (0.26,0.99)	0.024
Medium	150	5 (3.3)		
High	151	0 (0.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
439	0.56 (0.21,1.51)	0.219

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for eye color, ionizing radiation exposure, and skin reaction to sun after first exposure because of the sparse number of Ranch Hands with a basal cell carcinoma on the upper extremities.

Table 10-10. Analysis of Basal Cell Carcinoma (Upper Extremities) (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Number (%)		Est. Relative Risk (95% C.I.)^{ab}	p-Value
		Yes			
Comparison	1,133	37 (3.3)			
Background RH	359	11 (3.1)		0.99 (0.50,1.97)	0.981
Low RH	210	7 (3.3)		1.00 (0.44,2.27)	0.993
High RH	229	3 (1.3)		0.37 (0.11,1.22)	0.102
Low plus High RH	439	10 (2.3)		0.60 (0.28,1.29)	0.188

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
		(95% C.I.)^a		
Comparison	1,131			
Background RH	358	0.74 (0.36,1.52)		0.416
Low RH	210	0.93 (0.39,2.21)		0.876
High RH	229	0.64 (0.18,2.23)		0.484
Low plus High RH	439	0.77 (0.34,1.71)		0.518

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%)		Estimated Relative Risk	
		Yes		(95% C.I.)^a	p-Value
Low	273	9 (3.3)		0.77 (0.56,1.07)	0.107
Medium	256	8 (3.1)			
High	269	4 (1.5)			

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 10-10. Analysis of Basal Cell Carcinoma (Upper Extremities) (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
797	1.00 (0.63,1.57)	0.987

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for eye color and skin reaction to sun after first exposure because of the sparse number of Ranch Hands with a basal cell carcinoma on the upper extremities.

10.2.2.1.9 Basal Cell Carcinoma (Lower Extremities)

All results from Models 1 through 4 of the analysis of basal cell carcinoma of the lower extremities were nonsignificant (Table 10-11(a-h): p>0.32 for each analysis).

Table 10-11. Analysis of Basal Cell Carcinoma (Lower Extremities)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	5 (0.6)	1.45 (0.42,5.04)	0.556
	<i>Comparison</i>	1,168	5 (0.4)		
Officer	Ranch Hand	329	4 (1.2)	1.96 (0.44,8.80)	0.381
	Comparison	480	3 (0.6)		
Enlisted Flyer	Ranch Hand	140	0 (0.0)	--	--
	Comparison	173	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	336	1 (0.3)	0.77 (0.07,8.48)	0.828
	Comparison	515	2 (0.4)		

--: Results not presented because of the sparse number of participants with a basal cell carcinoma on the lower extremities.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.38 (0.39,4.85)	0.616
Officer	1.83 (0.40,8.33)	0.436
Enlisted Flyer	--	--
Enlisted Groundcrew	0.78 (0.07,8.71)	0.839

--: Results not presented because of the sparse number of participants with a basal cell carcinoma on the lower extremities.

Note: Results are not adjusted for skin reaction to sun after first exposure or skin reaction to sun after repeated exposure because of the sparse number of participants with a basal cell carcinoma on the lower extremities. Results for all occupations combined also are not adjusted for occupation because of the sparse number of participants with a basal cell carcinoma on the lower extremities.

Table 10-11. Analysis of Basal Cell Carcinoma (Lower Extremities) (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	138	1 (0.7)	1.09 (0.39,3.02)	0.867
Medium	150	0 (0.0)		
High	151	1 (0.7)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
439	1.46 (0.50,4.26)	0.511

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for occupation, skin color, hair color, eye color, skin reaction to sun after first exposure, skin reaction to sun after repeated exposure, composite skin-reaction index, and ionizing radiation exposure because of the sparse number of Ranch Hands with a basal cell carcinoma on the lower extremities.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,133	5 (0.4)		
Background RH	359	3 (0.8)	2.07 (0.48,8.80)	0.327
Low RH	210	1 (0.5)	1.04 (0.12,8.97)	0.972
High RH	229	1 (0.4)	0.91 (0.10,7.91)	0.932
Low plus High RH	439	2 (0.5)	0.97 (0.19,5.06)	0.971

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-11. Analysis of Basal Cell Carcinoma (Lower Extremities) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.)^a	p-Value
Comparison	1,131		
Background RH	358	1.89 (0.43,8.34)	0.398
Low RH	210	0.90 (0.10,8.17)	0.928
High RH	229	1.03 (0.12,9.27)	0.976
Low plus High RH	439	0.97 (0.18,5.16)	0.971

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for occupation and skin reaction to sun after first exposure because of the sparse number of participants with a basal cell carcinoma on the lower extremities.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.)^a	p-Value
Low	273	3 (1.1)	0.85 (0.45,1.59)	0.597
Medium	256	1 (0.4)		
High	269	1 (0.4)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
797	0.91 (0.42,1.98)		0.803

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for occupation, skin reaction to sun after first exposure, and skin reaction to sun after repeated exposure because of the sparse number of Ranch Hands with a basal cell carcinoma on the lower extremities.

10.2.2.1.10 Squamous Cell Carcinoma

All results were nonsignificant from the Model 1 through 4 analyses of squamous cell carcinoma (Table 10-12(a-h): p>0.13 for each analysis).

Table 10-12. Analysis of Squamous Cell Carcinoma

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	20 (2.5)	1.33 (0.72,2.45)	0.367
	<i>Comparison</i>	1,168	22 (1.9)		
Officer	Ranch Hand	329	11 (3.3)	1.00 (0.46,2.19)	0.994
	Comparison	480	16 (3.3)		
Enlisted Flyer	Ranch Hand	140	3 (2.1)	1.87 (0.31,11.36)	0.495
	Comparison	173	2 (1.2)		
Enlisted Groundcrew	Ranch Hand	336	6 (1.8)	2.32 (0.65,8.29)	0.194
	Comparison	515	4 (0.8)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED			
Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
<i>All</i>	1.46 (0.77,2.78)		0.250
Officer	1.10 (0.49,2.49)		0.813
Enlisted Flyer	1.86 (0.29,11.86)		0.514
Enlisted Groundcrew	2.67 (0.73,9.76)		0.139

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	
				p-Value
Low	138	3 (2.2)	0.95 (0.58,1.55)	0.821
Medium	150	3 (2.0)		
High	151	4 (2.7)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
439	0.98 (0.52,1.85)	0.944

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for skin reaction to sun after repeated exposure because of the sparse number of Ranch Hands with a squamous cell carcinoma.

Table 10-12. Analysis of Squamous Cell Carcinoma (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Number (%)		Est. Relative Risk (95% C.I.) ^{ab}	p-Value
		Yes			
Comparison	1,133	20 (1.8)			
Background RH	359	10 (2.8)		1.69 (0.78,3.66)	0.187
Low RH	210	6 (2.9)		1.60 (0.63,4.04)	0.320
High RH	229	4 (1.8)		0.94 (0.32,2.78)	0.907
Low plus High RH	439	10 (2.3)		1.21 (0.55,2.66)	0.634

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.) ^a	p-Value
Comparison	1,131		
Background RH	358	1.53 (0.68,3.45)	0.306
Low RH	210	1.52 (0.56,4.10)	0.408
High RH	229	1.74 (0.53,5.69)	0.363
Low plus High RH	439	1.63 (0.69,3.82)	0.262

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for Log ₂ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%)		Estimated Relative Risk (95% C.I.) ^a	p-Value
		Yes			
Low	273	8 (2.9)		0.95 (0.70,1.29)	0.744
Medium	256	6 (2.3)			
High	269	6 (2.2)			

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 10-12. Analysis of Squamous Cell Carcinoma (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
797	1.07 (0.70,1.63)	0.749

^a Relative risk for a twofold increase in 1987 dioxin.

10.2.2.1.11 Nonmelanoma

Both the unadjusted and adjusted Model 1 analyses of nonmelanoma revealed a significant difference between Ranch Hand and Comparison enlisted flyers (Table 10-13(a,b): Est. RR=1.89, p=0.042; Adj. RR=2.00, p=0.035, respectively). Nonmelanoma was higher in Ranch Hands than in Comparisons. All other Model 1 contrasts were nonsignificant (Table 10-13(a,b): p>0.14).

The Model 2 unadjusted analysis revealed a significant inverse association between initial dioxin and nonmelanoma (Table 10-13(c): Est. RR=0.73, p=0.003). After adjustment for covariates, the association was marginally significant (Table 10-13(d): Adj. RR=0.79, p=0.075).

The Model 3 unadjusted analysis revealed that Ranch Hands in the low dioxin category had a greater history of nonmelanoma than Comparisons (Table 10-13(e): Est. RR=1.49, p=0.034). The result was marginally significant after adjustment for covariates (Table 10-13(f): Adj. RR=1.43, p=0.081). All other Model 3 contrasts were nonsignificant (Table 10-13(e,f): p>0.20).

Table 10-13. Analysis of Nonmelanoma

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	134 (16.7)	1.13 (0.88,1.44)	0.345
	<i>Comparison</i>	1,168	176 (15.1)		
Officer	Ranch Hand	329	73 (22.2)	1.25 (0.89,1.77)	0.203
	Comparison	480	89 (18.5)		
Enlisted Flyer	Ranch Hand	140	29 (20.7)	1.89 (1.02,3.49)	0.042
	Comparison	173	21 (12.1)		
Enlisted Groundcrew	Ranch Hand	336	32 (9.5)	0.72 (0.46,1.12)	0.143
	Comparison	515	66 (12.8)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.18 (0.91,1.53)	0.219
Officer	1.31 (0.91,1.90)	0.144
Enlisted Flyer	2.00 (1.05,3.81)	0.035
Enlisted Groundcrew	0.76 (0.48,1.22)	0.258

Table 10-13. Analysis of Nonmelanoma (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^b	p-Value
Low	138	29 (21.0)	0.73 (0.59,0.90)	0.003
Medium	150	29 (19.3)		
High	151	14 (9.3)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log₂ (Initial Dioxin)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
439	0.79 (0.60,1.03)		0.075

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,133	169 (14.9)		
Background RH	359	62 (17.3)	1.23 (0.89,1.70)	0.203
Low RH	210	44 (21.0)	1.49 (1.03,2.16)	0.034
High RH	229	28 (12.2)	0.77 (0.50,1.18)	0.231
Low plus High RH	439	72 (16.4)	1.06 (0.78,1.44)	0.729

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-13. Analysis of Nonmelanoma (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.)^a	
		p-Value	
Comparison	1,131		
Background RH	358	1.16 (0.82,1.64)	
Low RH	210	1.43 (0.96,2.13)	
High RH	229	1.06 (0.67,1.69)	
Low plus High RH	439	1.22 (0.88,1.71)	

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.)^a	
			p-Value	
Low	273	46 (16.9)	0.89 (0.78,1.01)	
Medium	256	52 (20.3)		
High	269	36 (13.4)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
797	1.02 (0.86,1.21)		0.786

^a Relative risk for a twofold increase in 1987 dioxin.

A marginally significant association between 1987 dioxin levels and nonmelanoma was revealed from the Model 4 unadjusted analysis (Table 10-13(g): Est. RR=0.89, p=0.074). After adjustment for covariates, the result was nonsignificant (Table 10-13(h): p=0.786).

10.2.2.1.12 Melanoma

All analyses of melanoma in Models 1, 2, and 4 were nonsignificant (Table 10-14(a-d,g-h): p>0.11 for each analysis). All contrasts from the unadjusted analysis of Model 3 were nonsignificant (Table 10-14(e): p>0.11 for each contrast). After adjustment for covariates, a marginally significant difference was found between Ranch Hands in the low plus high dioxin category and Comparisons (Table 10-14(f): Adj. RR=2.44, p=0.062). Melanoma was higher for Ranch Hands than for Comparisons. All other adjusted Model 3 contrasts were nonsignificant (Table 10-14(f): p>0.12).

Table 10-14. Analysis of Melanoma

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	805	16 (2.0)	1.80 (0.86,3.77)	0.117
	<i>Comparison</i>	1,168	13 (1.1)		
Officer	Ranch Hand	329	9 (2.7)	1.90 (0.70,5.16)	0.207
	Comparison	480	7 (1.5)		
Enlisted Flyer	Ranch Hand	140	0 (0.0)	--	0.999 ^a
	Comparison	173	1 (0.6)		
Enlisted Groundcrew	Ranch Hand	336	7 (2.1)	2.17 (0.68,6.90)	0.189
	Comparison	515	5 (1.0)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with a melanoma.

--: Results not presented because of the sparse number of Ranch Hands with a melanoma.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.78 (0.83,3.79)	0.136
Officer	1.92 (0.69,5.30)	0.211
Enlisted Flyer	--	--
Enlisted Groundcrew	2.01 (0.62,6.50)	0.246

--: Results not presented because of the sparse number of Ranch Hands with a melanoma.

Note: Results are not adjusted for skin reaction to sun after first exposure because of the sparse number of Ranch Hands with a melanoma.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	138	4 (2.9)	1.12 (0.69,1.80)	0.660
Medium	150	1 (0.7)		
High	151	4 (2.7)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-14. Analysis of Melanoma (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
n		
439	1.28 (0.76,2.16)	0.366

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for occupation, skin color, skin reaction to sun after first exposure, and skin reaction to sun after repeated exposure because of the sparse number of Ranch Hands with a melanoma.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.) ^{ab}	
Comparison	1,133	12 (1.1)		
Background RH	359	7 (2.0)	1.76 (0.68,4.54)	0.240
Low RH	210	5 (2.4)	2.32 (0.81,6.68)	0.117
High RH	229	4 (1.8)	1.74 (0.55,5.49)	0.341
Low plus High RH	439	9 (2.1)	2.00 (0.83,4.83)	0.122

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.) ^a	p-Value
Comparison	1,131		
Background RH	358	1.56 (0.59,4.16)	0.373
Low RH	210	2.17 (0.73,6.48)	0.164
High RH	229	2.71 (0.76,9.67)	0.124
Low plus High RH	439	2.44 (0.96,6.23)	0.062

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for skin reaction to sun after first exposure because of the sparse number of participants with a melanoma.

Table 10-14. Analysis of Melanoma (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log ₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	273	5 (1.8)	1.05 (0.76,1.46)	0.761
Medium	256	7 (2.7)		
High	269	4 (1.5)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.) ^a		p-Value
797	1.18 (0.81,1.71)		0.399

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for occupation and skin reaction to sun after repeated exposure because of the sparse number of Ranch Hands with a melanoma.

10.2.2.1.13 Systemic Neoplasms (All Sites Combined)

Results from the analyses of a history of all systemic neoplasms in Models 1, 2, and 4 were nonsignificant (Table 10-15(a-d,g-h): $p > 0.12$ for each analysis). In the unadjusted analysis of Model 3, a marginally significant difference in the percentage of participants with any systemic neoplasm was found between Ranch Hands in the low dioxin category and Comparisons (Table 10-15(e): Est. RR=1.31, $p=0.072$). The occurrence of any systemic neoplasm was higher for Ranch Hands in the low dioxin category than for Comparisons. After adjustment for covariates, the contrast was nonsignificant (Table 10-15(f): $p=0.927$). The contrast of Ranch Hands in the background dioxin category and Comparisons was marginally significant in the adjusted Model 3 analysis (Table 10-15(f): Adj. RR=0.76, $p=0.076$). A greater percentage of Comparisons than Ranch Hands in the background dioxin category had a systemic neoplasm. All other Model 3 contrasts were nonsignificant (Table 10-15(e,f): $p > 0.25$).

Table 10-15. Analysis of Systemic Neoplasms (All Sites Combined)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	855	267 (31.2)	1.07 (0.89,1.29)	0.482
	<i>Comparison</i>	1,242	370 (29.8)		
Officer	Ranch Hand	332	110 (33.1)	0.95 (0.70,1.27)	0.716
	Comparison	489	168 (34.4)		
Enlisted Flyer	Ranch Hand	147	49 (33.3)	1.20 (0.75,1.91)	0.443
	Comparison	187	55 (29.4)		
Enlisted Groundcrew	Ranch Hand	376	108 (28.7)	1.15 (0.86,1.54)	0.352
	Comparison	566	147 (26.0)		

Table 10-15. Analysis of Systemic Neoplasms (All Sites Combined) (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.88 (0.70,1.12)</i>	<i>0.307</i>
Officer	0.77 (0.56,1.07)	0.125
Enlisted Flyer	0.98 (0.60,1.61)	0.937
Enlisted Groundcrew	0.98 (0.70,1.36)	0.888

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^b	p-Value
Low	155	57 (36.8)	0.93 (0.80,1.07)	0.308
Medium	160	52 (32.5)		
High	157	46 (29.3)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
469	1.00 (0.84,1.20)	0.980

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,204	358 (29.7)		
Background RH	376	109 (29.0)	0.98 (0.76,1.26)	0.864
Low RH	232	83 (35.8)	1.31 (0.98,1.76)	0.072
High RH	240	72 (30.0)	1.00 (0.74,1.36)	0.995
Low plus High RH	472	155 (32.8)	1.14 (0.91,1.44)	0.253

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-15. Analysis of Systemic Neoplasms (All Sites Combined) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,202		
Background RH	373	0.76 (0.57,1.03)	0.076
Low RH	230	0.98 (0.70,1.38)	0.927
High RH	239	0.95 (0.67,1.36)	0.794
Low plus High RH	469	0.97 (0.73,1.28)	0.823

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	284	83 (29.2)	1.02 (0.92,1.12)	0.734
Medium	281	94 (33.5)		
High	283	87 (30.7)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
842	1.05 (0.93,1.18)		0.399

^a Relative risk for a twofold increase in 1987 dioxin.

10.2.2.1.14 Malignant Systemic Neoplasms

The unadjusted Model 1 analysis within the enlisted flyer stratum revealed significantly more Ranch Hands than Comparisons with a malignant systemic neoplasm (Table 10-16(a): Est. RR=2.20, p=0.049). After adjustment for covariates the contrast was nonsignificant (Table 10-16(b): p=0.132). All other Model 1 contrasts were nonsignificant (Table 10-16(a,b): p>0.11).

Table 10-16. Analysis of Malignant Systemic Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%)	Est. Relative Risk	p-Value
			Yes	(95% C.I.)	
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>67 (7.8)</i>	<i>1.32 (0.94,1.86)</i>	<i>0.112</i>
	<i>Comparison</i>	<i>1,249</i>	<i>75 (6.0)</i>		
Officer	Ranch Hand	335	32 (9.6)	1.23 (0.76,2.01)	0.403
	Comparison	494	39 (7.9)		
Enlisted Flyer	Ranch Hand	149	18 (12.1)	2.20 (1.00,4.81)	0.049
	Comparison	187	11 (5.9)		
Enlisted Groundcrew	Ranch Hand	377	17 (4.5)	1.03 (0.55,1.93)	0.937
	Comparison	568	25 (4.4)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.12 (0.74,1.70)</i>	<i>0.592</i>
Officer	1.09 (0.63,1.88)	0.766
Enlisted Flyer	1.91 (0.82,4.43)	0.132
Enlisted Groundcrew	0.82 (0.41,1.67)	0.589

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.) ^b	p-Value
Low	156	19 (12.2)	0.62 (0.46,0.84)	0.001
Medium	161	20 (12.4)		
High	159	6 (3.8)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
472	0.82 (0.57,1.18)	0.272

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Table 10-16. Analysis of Malignant Systemic Neoplasms (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Number (%)		Est. Relative Risk (95% C.I.) ^{ab}	p-Value
		Yes			
Comparison	1,211	73	(6.0)		
Background RH	378	21	(5.6)	0.91 (0.55,1.51)	0.727
Low RH	234	34	(14.5)	2.65 (1.72,4.09)	<0.001
High RH	242	11	(4.6)	0.74 (0.39,1.43)	0.374
Low plus High RH	476	45	(9.5)	1.39 (0.91,2.13)	0.132

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a		p-Value
Comparison	1,209			
Background RH	375	0.73	(0.42,1.29)	0.279
Low RH	232	1.94	(1.16,3.24)	0.012
High RH	240	0.86	(0.41,1.78)	0.680
Low plus High RH	472	1.28	(0.77,2.13)	0.345

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin Category Summary Statistics			Estimated Relative Risk	
1987 Dioxin	n	Number (%) Yes	(95% C.I.) ^a	p-Value
Low	286	15 (5.2)	0.96 (0.81,1.14)	0.641
Medium	282	32 (11.4)		
High	286	19 (6.6)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 10-16. Analysis of Malignant Systemic Neoplasms (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
847	1.06 (0.84,1.34)	0.599

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The unadjusted analysis of malignant systemic neoplasms revealed a significant inverse relation with initial dioxin (Table 10-16(a): Est. RR=0.62, p=0.001). The association was nonsignificant after adjustment for covariates (Table 10-16(d): p=0.272).

The Model 3 contrast between Ranch Hands in the low dioxin category and Comparisons was significant in both the unadjusted and adjusted analyses. A greater percentage of participants with malignant systemic neoplasms was observed in Ranch Hands than in Comparisons (Table 10-16(e,f): Est. RR=2.65, p<0.001; Adj. RR=1.94, p=0.012, respectively). All other Model 3 contrasts, as well as the Model 4 analyses, were nonsignificant (Table 10-16(e-h): p>0.13 for all remaining analyses).

10.2.2.1.15 Benign Systemic Neoplasms

Results from each of the analyses of benign systemic neoplasms in Models 1 through 4 were nonsignificant (Table 10-17(a-h): p>0.15 for each analysis).

Table 10-17. Analysis of Benign Systemic Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	855	217 (25.4)	<i>1.07 (0.88,1.31)</i>	<i>0.495</i>
	<i>Comparison</i>	1,242	299 (24.1)		
Officer	Ranch Hand	332	82 (24.7)	0.91 (0.66,1.25)	0.545
	Comparison	489	130 (26.6)		
Enlisted Flyer	Ranch Hand	147	40 (27.2)	1.11 (0.68,1.82)	0.668
	Comparison	187	47 (25.1)		
Enlisted Groundcrew	Ranch Hand	376	95 (25.3)	1.23 (0.91,1.67)	0.186
	Comparison	566	122 (21.6)		

Table 10-17. Analysis of Benign Systemic Neoplasms (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.93 (0.73,1.19)</i>	<i>0.574</i>
Officer	0.78 (0.55,1.10)	0.155
Enlisted Flyer	0.95 (0.56,1.59)	0.831
Enlisted Groundcrew	1.11 (0.79,1.57)	0.548

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^b	p-Value
Low	155	43 (27.7)	1.03 (0.88,1.20)	0.718
Medium	160	37 (23.1)		
High	157	41 (26.1)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
469	0.99 (0.82,1.19)	0.903

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,204	289 (24.0)		
Background RH	376	93 (24.7)	1.05 (0.80,1.38)	0.710
Low RH	232	58 (25.0)	1.05 (0.76,1.46)	0.760
High RH	240	63 (26.3)	1.12 (0.81,1.53)	0.500
Low plus High RH	472	121 (25.6)	1.08 (0.85,1.39)	0.521

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-17. Analysis of Benign Systemic Neoplasms (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,202		
Background RH	373	0.89 (0.66,1.22)	0.479
Low RH	230	0.86 (0.60,1.23)	0.400
High RH	239	1.00 (0.69,1.45)	0.996
Low plus High RH	469	0.93 (0.69,1.24)	0.613

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	284	70 (24.7)	1.03 (0.93,1.14)	0.582
Medium	281	72 (25.6)		
High	283	72 (25.4)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
842	1.01 (0.89,1.14)		0.905

^a Relative risk for a twofold increase in 1987 dioxin.

10.2.2.1.16 Systemic Neoplasms of Uncertain Behavior or Unspecified Nature

Results from each of the analyses of systemic neoplasms of uncertain behavior or unspecified nature from Models 1 through 4 were nonsignificant (Table 10-18(a-h): p>0.18 for each analysis).

Table 10-18. Analysis of Systemic Neoplasms of Uncertain Behavior or Unspecified Nature

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	16 (1.9)	0.93 (0.49,1.75)	0.814
	<i>Comparison</i>	1,249	25 (2.0)		
Officer	Ranch Hand	335	11 (3.3)	1.26 (0.56,2.84)	0.583
	Comparison	494	13 (2.6)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	0.63 (0.06,6.96)	0.702
	Comparison	187	2 (1.1)		
Enlisted Groundcrew	Ranch Hand	377	4 (1.1)	0.60 (0.19,1.92)	0.388
	Comparison	568	10 (1.8)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	0.71 (0.34,1.47)	0.355
Officer	0.96 (0.40,2.31)	0.925
Enlisted Flyer	0.45 (0.04,5.19)	0.523
Enlisted Groundcrew	0.44 (0.13,1.50)	0.190

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	156	5 (3.2)	0.84 (0.49,1.47)	0.534
Medium	161	1 (0.6)		
High	159	2 (1.3)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
472	1.16 (0.58,2.31)	0.678

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Table 10-18. Analysis of Systemic Neoplasms of Uncertain Behavior or Unspecified Nature (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)		p-Value
		Yes	Est. Relative Risk (95% C.I.) ^{ab}	
Comparison	1,211	25 (2.1)		
Background RH	378	8 (2.1)		0.845
Low RH	234	6 (2.6)		0.657
High RH	242	2 (0.8)		0.187
Low plus High RH	476	8 (1.7)		0.392

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a		p-Value
		Comparison	1,209	
Background RH	375	0.72 (0.30,1.76)		0.475
Low RH	232	0.85 (0.32,2.26)		0.744
High RH	240	0.40 (0.09,1.89)		0.250
Low plus High RH	472	0.58 (0.22,1.58)		0.288

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED			Analysis Results for Log ₂ (1987 Dioxin + 1)	
1987 Dioxin Category Summary Statistics			Estimated Relative Risk (95% C.I.) ^a	
1987 Dioxin	n	Number (%) Yes		p-Value
Low	286	8 (2.8)	0.84 (0.59,1.20)	0.329
Medium	282	5 (1.8)		
High	286	3 (1.1)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 10-18. Analysis of Systemic Neoplasms of Uncertain Behavior or Unspecified Nature (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (1987 Dioxin + 1)		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
n		
847	1.07 (0.67,1.72)	0.767

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.17 Malignant Systemic Neoplasms (Eye, Ear, Face, Head, and Neck)

Results from each of the analyses of malignant systemic neoplasms of the eye, ear, face, head, and neck in Models 1, 3, and 4 were nonsignificant (Table 10-19(a-b,e-h): $p > 0.13$ for each analysis). The unadjusted analysis of Model 2 revealed a marginally significant association between initial dioxin and malignant systemic neoplasms of the eye, ear, face, head, and neck (Table 10-19(c): Est. RR=0.50, $p=0.081$). After adjustment for covariates, the Model 2 result was nonsignificant (Table 10-19(d): $p=0.666$).

Table 10-19. Analysis of Malignant Systemic Neoplasms (Eye, Ear, Face, Head, and Neck)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	9 (1.1)	1.09 (0.46,2.60)	0.848
	<i>Comparison</i>	1,249	12 (1.0)		
Officer	Ranch Hand	335	6 (1.8)	2.23 (0.63,7.98)	0.216
	Comparison	494	4 (0.8)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	0.41 (0.04,4.03)	0.448
	Comparison	187	3 (1.6)		
Enlisted Groundcrew	Ranch Hand	377	2 (0.5)	0.60 (0.12,3.11)	0.543
	Comparison	568	5 (0.9)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	0.98 (0.35,2.75)	0.974
Officer	2.07 (0.53,8.16)	0.298
Enlisted Flyer	0.38 (0.04,4.02)	0.424
Enlisted Groundcrew	0.49 (0.08,2.87)	0.429

Table 10-19. Analysis of Malignant Systemic Neoplasms (Eye, Ear, Face, Head and Neck) (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.) ^b	p-Value
Low	156	4 (2.6)	0.50 (0.20,1.23)	
Medium	161	1 (0.6)		
High	159	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
472	0.79 (0.27,2.33)	0.666

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the eye, ear, face, head, and neck. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.) ^{ab}	
Comparison	1,211	12 (1.0)		
Background RH	378	3 (0.8)	0.72 (0.20,2.58)	0.612
Low RH	234	5 (2.1)	2.24 (0.78,6.43)	0.134
High RH	242	1 (0.4)	0.46 (0.06,3.53)	0.451
Low plus High RH	476	6 (1.3)	1.00 (0.29,3.41)	0.995

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-19. Analysis of Malignant Systemic Neoplasms (Eye, Ear, Face, Head and Neck) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,209		
Background RH	375	0.64 (0.16,2.59)	0.533
Low RH	232	1.94 (0.58,6.44)	0.281
High RH	240	0.49 (0.06,4.31)	0.520
Low plus High RH	472	0.96 (0.24,3.82)	0.956

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	286	2 (0.7)	0.85 (0.53,1.36)	0.494
Medium	282	5 (1.8)		
High	286	2 (0.7)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
847	1.04 (0.57,1.91)		0.897

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the eye, ear, face, head, and neck. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.18 Malignant Systemic Neoplasms (Oral Cavity, Pharynx, and Larynx)

Results from each of the analyses of malignant systemic neoplasms of the oral cavity, pharynx, and larynx from Models 1 through 4 were nonsignificant (Table 10-20(a-h): p>0.29 for each analysis).

Table 10-20. Analysis of Malignant Systemic Neoplasms (Oral Cavity, Pharynx, and Larynx)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	4 (0.5)	0.83 (0.24,2.84)	0.762
	<i>Comparison</i>	1,249	7 (0.6)		
Officer	Ranch Hand	335	2 (0.6)	1.48 (0.21,10.54)	0.697
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	0.63 (0.06,6.96)	0.702
	Comparison	187	2 (1.1)		
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)	0.50 (0.05,4.83)	0.550
	Comparison	568	3 (0.5)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	0.63 (0.16,2.44)	0.501
Officer	1.35 (0.17,10.61)	0.777
Enlisted Flyer	0.52 (0.04,6.28)	0.603
Enlisted Groundcrew	0.31 (0.03,3.40)	0.336

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	156	1 (0.6)	0.97 (0.39,2.41)	0.953
Medium	161	1 (0.6)		
High	159	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
472	1.15 (0.34,3.88)	0.822

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the oral cavity, pharynx, and larynx. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Table 10-20. Analysis of Malignant Systemic Neoplasms (Oral Cavity, Pharynx, and Larynx) (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)		p-Value
		Yes	Est. Relative Risk (95% C.I.) ^{ab}	
Comparison	1,211	7 (0.6)		
Background RH	378	1 (0.3)	0.43 (0.05,3.52)	0.431
Low RH	234	2 (0.9)	1.51 (0.31,7.30)	0.612
High RH	242	1 (0.4)	0.75 (0.09,6.18)	0.791
Low plus High RH	476	3 (0.6)	1.06 (0.25,4.39)	0.938

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
		Yes	(95% C.I.) ^a	
Comparison	1,209			
Background RH	375		0.39 (0.04,3.56)	0.401
Low RH	232		1.01 (0.18,5.59)	0.987
High RH	240		0.56 (0.06,5.33)	0.614
Low plus High RH	472		0.75 (0.16,3.59)	0.719

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED			Analysis Results for Log ₂ (1987 Dioxin + 1)	
1987 Dioxin Category Summary Statistics			Estimated Relative Risk	
1987 Dioxin	n	Number (%) Yes	(95% C.I.) ^a	p-Value
Low	286	0 (0.0)	1.23 (0.66,2.29)	0.526
Medium	282	2 (0.7)		
High	286	2 (0.7)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

Table 10-20. Analysis of Malignant Systemic Neoplasms (Oral Cavity, Pharynx, and Larynx) (Continued)

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log₂ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
847	1.60 (0.65,3.97)	0.296

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the oral cavity, pharynx, and larynx. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.19 Malignant Systemic Neoplasms (Esophagus)

Because of the absence of malignant systemic neoplasms of the esophagus in Ranch Hands, statistical analysis was not performed. A malignant systemic neoplasm of the esophagus was observed in two Comparisons. One Comparison was a non-Black enlisted flyer, and the other Comparison was a non-Black enlisted groundcrew.

10.2.2.1.20 Malignant Systemic Neoplasms (Brain)

Because of the presence of a malignant systemic neoplasm of the brain in only one Ranch Hand, statistical analysis was not performed. This participant was a non-Black officer.

10.2.2.1.21 Malignant Systemic Neoplasms (Thymus, Heart, and Mediastinum)

A sparse number of participants exhibited a malignant systemic neoplasm of the thymus, heart, or mediastinum, which limited the analyses. The unadjusted contrasts analyzed from Model 1 were nonsignificant (Table 10-21(a): $p > 0.32$ for each contrast). Model 2 analysis was not performed because no Ranch Hands with a malignant neoplasm of the thymus, heart, or mediastinum had an initial dioxin estimate. The Model 3 unadjusted analysis revealed a marginally significant difference between Ranch Hands in the background dioxin category and Comparisons (Table 10-21(e): $p = 0.089$). Two Ranch Hands in the background category had a malignant systemic neoplasm of the thymus, heart, or mediastinum (0.5%), contrasted with zero Comparisons. The Model 4 unadjusted and adjusted analyses showed a significant inverse association between 1987 dioxin levels and a malignant systemic neoplasm of the thymus, heart, or mediastinum (Table 10-21(g,h): Est. RR=0.33; $p = 0.038$; Adj. RR=0.31, $p = 0.017$, respectively). As 1987 dioxin levels increased, the percentage of Ranch Hands with a malignant systemic neoplasm of the thymus, heart, or mediastinum decreased.

Table 10-21. Analysis of Malignant Systemic Neoplasms (Thymus, Heart, and Mediastinum)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	2 (0.2)	--	0.325 ^a
	<i>Comparison</i>	1,249	0 (0.0)		
Officer	Ranch Hand	335	1 (0.3)	--	0.845 ^a
	Comparison	494	0 (0.0)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)	--	0.836 ^a
	Comparison	568	0 (0.0)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	--	--
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin)	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)	p-Value
Low	156	0 (0.0)	--	--
Medium	161	0 (0.0)		
High	159	0 (0.0)		

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-21. Analysis of Malignant Systemic Neoplasms (Thymus, Heart, and Mediastinum) (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
n	Adjusted Relative Risk (95% C.I.)		p-Value
--	--		--

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.)	
Comparison	1,211	0 (0.0)		
Background RH	378	2 (0.5)	--	0.089 ^a
Low RH	234	0 (0.0)	--	--
High RH	242	0 (0.0)	--	--
Low plus High RH	476	0 (0.0)	--	--

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.)	
			p-Value
Comparison	--		
Background RH	--	--	--
Low RH	--	--	--
High RH	--	--	--
Low plus High RH	--	--	--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the thymus, heart, and mediastinum.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-21. Analysis of Malignant Systemic Neoplasms (Thymus, Heart, and Mediastinum) (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log ₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^a	p-Value
Low	286	2 (0.7)	0.33 (0.12,0.92)	0.038
Medium	282	0 (0.0)		
High	286	0 (0.0)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (1987 Dioxin + 1)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
847	0.31 (0.09,1.04)	0.017

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race and occupation because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thymus, heart, and mediastinum. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.22 Malignant Systemic Neoplasms (Thyroid Gland)

Because of the sparse number of participants with a history of a malignant systemic neoplasm of the thyroid gland, analysis was limited. The Model 1 contrasts revealed nonsignificant differences between Ranch Hands and Comparisons (Table 10-22(a,b): p>0.37 for each).

Table 10-22. Analysis of Malignant Systemic Neoplasms (Thyroid Gland)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>2 (0.2)</i>	<i>1.45 (0.20,10.33)</i>	<i>0.710</i>
	<i>Comparison</i>	<i>1,249</i>	<i>2 (0.2)</i>		
Officer	Ranch Hand	335	2 (0.6)	2.96 (0.27,32.79)	0.376
	Comparison	494	1 (0.2)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	0 (0.0)	--	0.999 ^a
	Comparison	568	1 (0.2)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the thyroid gland.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the thyroid gland.

Table 10-22. Analysis of Malignant Systemic Neoplasms (Thyroid Gland) (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.46 (0.20,10.39)</i>	<i>0.708</i>
Officer	3.08 (0.28,34.40)	0.362
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the thyroid gland.

Note: Results are not adjusted for race and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thyroid gland. Results for all occupations combined also are not adjusted for occupation because of the sparse number of participants with a malignant systemic neoplasm of the thyroid gland. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^b	p-Value
Low	156	2 (1.3)	0.12 (0.01,2.59)	0.046
Medium	161	0 (0.0)		
High	159	0 (0.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
n	Analysis Results for Log₂ (Initial Dioxin) Adjusted Relative Risk (95% C.I.)^a	p-Value
473	0.12 (0.01,2.84)	0.059

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, ionizing radiation exposure, and lifetime cigarette smoking history because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thyroid gland. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Table 10-22. Analysis of Malignant Systemic Neoplasms (Thyroid Gland) (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.)^{ab}	
Comparison	1,211	2 (0.2)		
Background RH	378	0 (0.0)	--	0.999 ^c
Low RH	234	2 (0.9)	5.42 (0.76,38.74)	0.092
High RH	242	0 (0.0)	--	0.999 ^c
Low plus High RH	476	2 (0.4)	--	0.680 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the thyroid gland.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thyroid gland.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
		(95% C.I.)^a		
Comparison	1,209			
Background RH	375		--	--
Low RH	232	5.18 (0.71,37.60)		0.104
High RH	240		--	--
Low plus High RH	472		--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thyroid gland.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thyroid gland. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Table 10-22. Analysis of Malignant Systemic Neoplasms (Thyroid Gland) (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.)^a	p-Value
Low	286	0 (0.0)	0.90 (0.34,2.40)	
Medium	282	2 (0.7)		
High	286	0 (0.0)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
848	0.95 (0.34,2.70)		0.925

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, ionizing radiation exposure, and lifetime cigarette smoking history because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the thyroid gland. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

A significant inverse association between initial dioxin and a malignant systemic neoplasm of the thyroid gland was found from the Model 2 unadjusted analysis (Table 10-22(c): Est. RR=0.12, p=0.046). After adjustment for covariates, the result was marginally significant (Table 10-22(d): Adj. RR=0.12, p=0.059).

A marginally significant difference between Ranch Hands in the low dioxin category and Comparisons was observed in the unadjusted Model 3 analyses (Table 10-22(e): Est. RR=5.42, p=0.092). The occurrence of a malignant systemic neoplasm of the thyroid gland was higher for Ranch Hands in the low dioxin category than for Comparisons. The difference was nonsignificant after adjustment for covariates (Table 10-22(f): p=0.104). All other Model 3 contrasts, as well as the Model 4 analyses, were nonsignificant (Table 10-22(e,g-h): p≥0.68 for all remaining analyses).

10.2.2.1.23 Malignant Systemic Neoplasms (Bronchus and Lung)

Because of the sparse number of participants with a malignant systemic neoplasm of the bronchus or lung, analysis was limited. The unadjusted Model 1 analysis revealed a significant difference between Ranch Hands and Comparisons when examined across all occupations (Table 10-23(a): Est. RR=4.88, p=0.008). The results were marginally significant after adjustment for covariates (Table 10-23(b): Adj. RR=3.66, p=0.070). All other Model 1 contrasts were nonsignificant (Table 10-23(a,b): p>0.11).

Table 10-23. Analysis of Malignant Systemic Neoplasms (Bronchus and Lung)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>10 (1.2)</i>	<i>4.88 (1.34,17.79)</i>	<i>0.008</i>
	<i>Comparison</i>	<i>1,249</i>	<i>3 (0.2)</i>		
Officer	Ranch Hand	335	5 (1.5)	3.73 (0.72,19.33)	0.117
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	3 (2.0)	3.82 (0.39,37.13)	0.248
	Comparison	187	1 (0.5)		
Enlisted Groundcrew	Ranch Hand	377	2 (0.5)	--	0.310 ^a
	Comparison	568	0 (0.0)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the bronchus and lung.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the bronchus and lung.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>3.66 (0.78,17.13)</i>	<i>0.070</i>
Officer	3.51 (0.57,21.64)	0.176
Enlisted Flyer	2.58 (0.21,31.26)	0.456
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the bronchus and lung.

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of the bronchus and lung.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	156	4 (2.6)	0.46 (0.20,1.04)	0.030
Medium	161	4 (2.5)		
High	159	0 (0.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

**Table 10-23. Analysis of Malignant Systemic Neoplasms (Bronchus and Lung)
(Continued)**

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)^a	p-Value
472	0.53 (0.21,1.34)	0.144

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the bronchus and lung. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.)^{ab}	
Comparison	1,211	3 (0.3)		
Background RH	378	2 (0.5)	2.14 (0.35,12.94)	0.408
Low RH	234	8 (3.4)	14.26 (3.75,54.20)	<0.001
High RH	242	0 (0.0)	--	0.999 ^c
Low plus High RH	476	8 (1.7)	--	0.003 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the bronchus and lung.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the bronchus and lung.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 10-23. Analysis of Malignant Systemic Neoplasms (Bronchus and Lung)
(Continued)**

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,209		
Background RH	375	1.52 (0.21,11.09)	0.678
Low RH	232	8.67 (1.74,43.23)	0.008
High RH	240	--	--
Low plus High RH	472	--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the bronchus and lung.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of the bronchus and lung.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED			
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a
Low	286	1 (0.4)	0.98 (0.64,1.50) 0.915
Medium	282	6 (2.1)	
High	286	3 (1.1)	

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
847	1.15 (0.63,2.11)		0.638

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the bronchus and lung. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 2 analysis of a malignant systemic neoplasm of the bronchus and lung revealed a significant inverse association with initial dioxin (Table 10-23(c): Est. RR=0.46, p=0.030). After adjustment for covariates, the association was nonsignificant (Table 10-23(d): p=0.144).

A significantly greater percentage of Ranch Hands in the low dioxin category had a malignant systemic neoplasm of the bronchus and lung than Comparisons in both the unadjusted and adjusted Model 3 analyses (Table 10-23(e): Est. RR=14.26, p<0.001; Adj. RR=8.67, p=0.008, respectively). The Model 4 unadjusted and adjusted analyses of malignant systemic neoplasms of the bronchus and lung revealed nonsignificant results (Table 10-23(g,h): p=0.638).

10.2.2.1.24 Malignant Systemic Neoplasms (Liver)

Because of the sparse number of participants with a malignant systemic neoplasm of the liver, analysis was limited. All Model 1 analyses were nonsignificant (Table 10-24(a,b): p>0.65). Results from the Model 2 analysis of malignant systemic neoplasms of the liver also were nonsignificant (Table 10-24(c,d): p≥0.14 for all analyses).

Table 10-24. Analysis of Malignant Systemic Neoplasms (Liver)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED						
Occupational Category	Group	n	Number (%)		Est. Relative Risk (95% C.I.)	p-Value
			Yes	No		
<i>All</i>	<i>Ranch Hand</i>	861	2 (0.2)		1.45 (0.20,10.33)	0.710
	<i>Comparison</i>	1,249	2 (0.2)			
Officer	Ranch Hand	335	0 (0.0)		--	0.999 ^a
	Comparison	494	1 (0.2)			
Enlisted Flyer	Ranch Hand	149	1 (0.7)		--	0.909 ^a
	Comparison	187	0 (0.0)			
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)		1.51 (0.09,24.18)	0.772
	Comparison	568	1 (0.2)			

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the liver.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the liver.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	1.57 (0.22,11.35)	0.655
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	1.72 (0.11,27.93)	0.703

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the liver.

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Table 10-24. Analysis of Malignant Systemic Neoplasms (Liver) (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	156	0 (0.0)	1.76 (0.73,4.22)	0.231
Medium	161	1 (0.6)		
High	159	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
472	2.06 (0.82,5.15)	0.140

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of participants with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,211	2 (0.2)		
Background RH	378	0 (0.0)	--	0.999 ^c
Low RH	234	0 (0.0)	--	0.999 ^c
High RH	242	2 (0.8)	5.70 (0.78,41.53)	0.086
Low plus High RH	476	2 (0.4)	--	0.680 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the liver.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the liver.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-24. Analysis of Malignant Systemic Neoplasms (Liver) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,209		
Background RH	375	--	--
Low RH	232	--	--
High RH	240	7.06 (0.70,71.25)	0.098
Low plus High RH	472	--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the liver.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	
				p-Value
Low	286	0 (0.0)	2.10 (0.92,4.78)	0.080
Medium	282	0 (0.0)		
High	286	2 (0.7)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
847	2.52 (1.03,6.15)		0.042

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of participants with a malignant systemic neoplasm of the liver. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The unadjusted and adjusted Model 3 analyses displayed a marginally significant difference between Ranch Hands in the high dioxin category and Comparisons (Table 10-24(e,f): Est. RR=5.70, p=0.086; Adj. RR=7.06, p=0.098, respectively). The percentage of Ranch Hands in the high dioxin category with a malignant systemic neoplasm of the liver was greater than the percentage of Comparisons. The results in all other Model 3 unadjusted analyses were nonsignificant (Table 10-24(e): p≥0.68).

The Model 4 unadjusted analysis revealed a marginally significant positive association between 1987 dioxin levels and a malignant systemic neoplasm of the liver (Table 10-24(g): Est. RR=2.10, p=0.080). After adjustment for covariates, the result was significant (Table 10-24(h): Est. RR=2.52, p=0.042).

10.2.2.1.25 Malignant Systemic Neoplasms (Colon and Rectum)

All results from the analyses of malignant systemic neoplasms of the colon and rectum from Models 1, 2, and 4 were nonsignificant (Table 10-25(a-d,g-h): p>0.29 for each analysis).

Table 10-25. Analysis of Malignant Systemic Neoplasms (Colon and Rectum)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>7 (0.8)</i>	<i>1.27 (0.46,3.52)</i>	<i>0.645</i>
	<i>Comparison</i>	<i>1,249</i>	<i>8 (0.6)</i>		
Officer	Ranch Hand	335	3 (0.9)	2.22 (0.37,13.38)	0.383
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	2 (1.3)	1.26 (0.18,9.04)	0.819
	Comparison	187	2 (1.1)		
Enlisted Groundcrew	Ranch Hand	377	2 (0.5)	0.75 (0.14,4.13)	0.743
	Comparison	568	4 (0.7)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.50 (0.41,5.47)</i>	<i>0.536</i>
Officer	2.59 (0.37,17.95)	0.335
Enlisted Flyer	1.57 (0.19,13.30)	0.678
Enlisted Groundcrew	0.85 (0.13,5.78)	0.872

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of the colon and rectum.

Table 10-25. Analysis of Malignant Systemic Neoplasms (Colon and Rectum) (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	156	0 (0.0)	0.76 (0.39,1.49)	0.405
Medium	161	5 (3.1)		
High	159	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
n	Adjusted Relative Risk (95% C.I.) ^a		p-Value
472	0.93 (0.42,2.07)		0.855

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the colon and rectum. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,211	8 (0.7)		
Background RH	378	1 (0.3)	0.49 (0.06,3.94)	0.500
Low RH	234	5 (2.1)	3.02 (0.97,9.45)	0.057
High RH	242	1 (0.4)	0.51 (0.06,4.15)	0.528
Low plus High RH	476	6 (1.3)	1.22 (0.33,4.51)	0.764

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-25. Analysis of Malignant Systemic Neoplasms (Colon and Rectum) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,209		
Background RH	375	0.60 (0.06,5.76)	0.658
Low RH	232	3.28 (0.77,13.90)	0.107
High RH	240	0.57 (0.05,5.85)	0.632
Low plus High RH	472	1.34 (0.27,6.56)	0.717

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of the colon and rectum.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	286	1 (0.4)	1.18 (0.74,1.91)	0.495
Medium	282	2 (0.7)		
High	286	4 (1.4)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
847	1.44 (0.72,2.86)		0.291

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the colon and rectum. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 3 unadjusted analysis of malignant systemic neoplasms of the colon and rectum displayed a marginally significant difference between Ranch Hands in the low dioxin category and Comparisons. The occurrence of a malignant systemic neoplasm of the colon and rectum was higher for Ranch Hands in the low dioxin category than for Comparisons (Table 10-25(e): Est. RR=3.02, p=0.057). The result was

nonsignificant after adjustment for covariates (Table 10-25(f): $p=0.107$). All other Model 3 contrasts were nonsignificant (Table 10-25(e,f): $p\geq 0.50$).

10.2.2.1.26 *Malignant Systemic Neoplasms (Kidney and Bladder)*

Because of the sparse number of participants with a history of a malignant systemic neoplasm of the kidney or bladder, analysis was limited. Across all occupations, the difference between Ranch Hands and Comparisons was significant, with more malignant systemic neoplasms of the kidney and bladder occurring in Ranch Hands than in Comparisons (Table 10-26(a): Est. RR=2.68, $p=0.046$). After adjustment for covariates, the result was marginally significant (Table 10-26(b): Adj. RR=3.12, $p=0.061$). All other Model 1 contrasts, as well as the results from the Model 2 and Model 4 analyses, were nonsignificant (Table 10-26(a-d,g-h): $p>0.17$).

Table 10-26. Analysis of Malignant Systemic Neoplasms (Kidney and Bladder)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>11 (1.3)</i>	<i>2.68 (0.99,7.28)</i>	<i>0.046</i>
	<i>Comparison</i>	<i>1,249</i>	<i>6 (0.5)</i>		
Officer	Ranch Hand	335	5 (1.5)	1.48 (0.43,5.16)	0.537
	Comparison	494	5 (1.0)		
Enlisted Flyer	Ranch Hand	149	3 (2.0)	--	0.172 ^a
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	3 (0.8)	4.55 (0.47,43.89)	0.190
	Comparison	568	1 (0.2)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the kidney and bladder.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the kidney and bladder.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>3.12 (0.88,11.04)</i>	<i>0.061</i>
Officer	1.86 (0.43,8.16)	0.409
Enlisted Flyer	--	--
Enlisted Groundcrew	4.20 (0.36,49.46)	0.254

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the kidney and bladder.

**Table 10-26. Analysis of Malignant Systemic Neoplasms (Kidney and Bladder)
(Continued)**

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%)	Estimated Relative Risk (95% C.I.) ^b	p-Value
		Yes		
Low	156	2 (1.3)	0.72 (0.37,1.41)	0.312
Medium	161	4 (2.5)		
High	159	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
Adjusted Relative Risk			
n	(95% C.I.) ^a		p-Value
472	1.05 (0.47,2.38)		0.899

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
		Yes		
Comparison	1,211	6 (0.5)	2.04 (0.57,7.34)	0.273
Background RH	378	4 (1.1)		
Low RH	234	5 (2.1)		
High RH	242	2 (0.8)		
Low plus High RH	476	7 (1.5)		
			2.76 (0.87,8.80)	0.085

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

**Table 10-26. Analysis of Malignant Systemic Neoplasms (Kidney and Bladder)
(Continued)**

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,209		
Background RH	375	2.26 (0.49,10.35)	0.292
Low RH	232	4.44 (1.04,18.95)	0.044
High RH	240	3.26 (0.46,23.17)	0.237
Low plus High RH	472	3.80 (0.88,16.46)	0.075

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	286	3 (1.1)	1.03 (0.69,1.53)	0.902
Medium	282	5 (1.8)		
High	286	3 (1.1)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
847	1.14 (0.66,1.96)		0.634

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

A significantly greater percentage of Ranch Hands in the low dioxin category had a malignant systemic neoplasm of the kidney and bladder than Comparisons in both the unadjusted and adjusted Model 3 analyses (Table 10-26(e,f): Est. RR=4.44, p=0.015; Adj. RR=4.44, p=0.044, respectively). The results were marginally significant when Ranch Hands in the low and high dioxin categories were combined (Table 10-26(e,f): Est. RR=2.76, p=0.085; Adj. RR=3.80, p=0.075, respectively). All other Model 3 contrasts were nonsignificant (Table 10-26(e,f): p>0.23).

10.2.2.1.27 Malignant Systemic Neoplasms (Prostate)

All results from the Model 1 analysis of malignant systemic neoplasms of the prostate were nonsignificant (Table 10-27(a,b): $p > 0.15$).

A significant inverse association between initial dioxin and malignant systemic neoplasms of the prostate was found in the unadjusted Model 2 analysis (Table 10-27(c): Est. RR=0.52, $p=0.007$). After adjustment for covariates, the association was nonsignificant (Table 10-27(d): $p=0.254$).

Table 10-27. Analysis of Malignant Systemic Neoplasms (Prostate)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>26 (3.0)</i>	<i>0.97 (0.58,1.60)</i>	<i>0.893</i>
	<i>Comparison</i>	<i>1,249</i>	<i>39 (3.1)</i>		
Officer	Ranch Hand	335	13 (3.9)	0.76 (0.38,1.50)	0.427
	Comparison	494	25 (5.1)		
Enlisted Flyer	Ranch Hand	149	7 (4.7)	2.26 (0.65,7.86)	0.201
	Comparison	187	4 (2.1)		
Enlisted Groundcrew	Ranch Hand	377	6 (1.6)	0.90 (0.33,2.50)	0.844
	Comparison	568	10 (1.8)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.69 (0.38,1.25)</i>	<i>0.219</i>
Officer	0.58 (0.27,1.22)	0.151
Enlisted Flyer	1.54 (0.41,5.75)	0.521
Enlisted Groundcrew	0.59 (0.19,1.84)	0.360

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	156	8 (5.1)	0.52 (0.30,0.89)	0.007
Medium	161	7 (4.4)		
High	159	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-27. Analysis of Malignant Systemic Neoplasms (Prostate) (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
472	0.68 (0.33,1.37)	0.254

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the prostate. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.) ^{ab}	
Comparison	1,211	39 (3.2)		
Background RH	378	9 (2.4)	0.73 (0.35,1.52)	0.398
Low RH	234	12 (5.1)	1.63 (0.84,3.16)	0.150
High RH	242	4 (1.7)	0.51 (0.18,1.44)	0.202
Low plus High RH	476	16 (3.4)	0.90 (0.46,1.75)	0.757

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	p-Value
		(95% C.I.) ^a	
Comparison	1,209		
Background RH	375	0.48 (0.21,1.07)	0.072
Low RH	232	0.91 (0.42,1.97)	0.818
High RH	240	0.61 (0.19,1.93)	0.404
Low plus High RH	472	0.75 (0.35,1.60)	0.453

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-27. Analysis of Malignant Systemic Neoplasms (Prostate) (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.)^a	p-Value
Low	286	7 (2.5)	0.82 (0.62,1.10)	
Medium	282	12 (4.3)		
High	286	6 (2.1)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
847	0.83 (0.56,1.23)		0.353

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 3 adjusted analysis revealed a marginally significant difference in malignant systemic neoplasms of the prostate between Ranch Hands in the background dioxin category and Comparisons (Table 10-27(f): Adj. RR=0.48, p=0.072). More Comparisons than Ranch Hands had a malignant systemic neoplasm of the prostate. All other Model 3 contrasts and the results from the Model 4 analyses were nonsignificant (Table 10-27(e-h): p≥0.15 for all remaining analyses).

10.2.2.1.28 Malignant Systemic Neoplasms (Testicles)

Because of the sparse number of participants with a malignant systemic neoplasm of the testicles, analysis was limited. All Model 1 analyses were nonsignificant (Table 10-28(a): p>0.13 for each contrast examined). Results from Model 2 analyses also were nonsignificant (Table 10-28(c,d): p>0.41).

Table 10-28. Analysis of Malignant Systemic Neoplasms (Testicles)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	861	3 (0.4)	--	0.134 ^a
	<i>Comparison</i>	1,249	0 (0.0)		
Officer	Ranch Hand	335	1 (0.3)	--	0.845 ^a
	Comparison	494	0 (0.0)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	--	0.909 ^a
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)	--	0.836 ^a
	Comparison	568	0 (0.0)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	--	--
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	156	1 (0.6)	0.65 (0.21,1.98)	0.413
Medium	161	2 (1.2)		
High	159	0 (0.0)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-28. Analysis of Malignant Systemic Neoplasms (Testicles) (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
472	0.77 (0.22,2.64)	0.663

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for race and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the testicles. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.)	
Comparison	1,211	0 (0.0)		
Background RH	378	0 (0.0)	--	--
Low RH	234	2 (0.9)	--	0.024 ^a
High RH	242	1 (0.4)	--	0.371 ^a
Low plus High RH	476	3 (0.6)	--	0.034 ^a

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)	p-Value
Comparison	--		
Background RH	--	--	--
Low RH	--	--	--
High RH	--	--	--
Low plus High RH	--	--	--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of the testicles.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-28. Analysis of Malignant Systemic Neoplasms (Testicles) (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	
			p-Value	
Low	286	0 (0.0)	1.22 (0.59,2.50)	
Medium	282	1 (0.4)	0.599	
High	286	2 (0.7)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
847	1.35 (0.54,3.37)		0.517

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of the testicles. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

Significant differences were found in the unadjusted Model 3 analysis between Ranch Hands in the low dioxin category and Comparisons, and between Ranch Hands in the low plus high dioxin category and Comparisons (Table 10-28(e,f): p=0.024 and p=0.034, respectively). More Ranch Hands had a malignant systemic neoplasm of the testicles than did Comparisons. The adjusted Model 3 analysis was not possible because of the sparse number of neoplasms of the testicles. The remaining unadjusted Model 3 contrast and the Model 4 analyses were nonsignificant (Table 10-28(e,g-h): p>0.37 for each remaining analysis).

10.2.2.1.29 Malignant Systemic Neoplasms (Extrahepatic Bile Duct)

Because of the presence of a malignant systemic neoplasm of the extrahepatic bile duct in only one Ranch Hand, statistical analysis was not possible. This participant was a non-Black enlisted flyer.

10.2.2.1.30 Malignant Systemic Neoplasms (Ill-Defined Sites)

Only one Comparison had a malignant systemic neoplasm of ill-defined sites, which precluded statistical analysis. This Comparison was a non-Black enlisted flyer.

10.2.2.1.31 Malignant Systemic Neoplasms (Connective and Other Soft Tissues)

Because of the sparse number of participants with a malignant systemic neoplasm of the connective or other soft tissues, analysis was limited. All results from the analyses performed were nonsignificant (Table 10-29(a-h): p>0.15 for each analysis).

Table 10-29. Analysis of Malignant Systemic Neoplasms (Connective and Other Soft Tissues)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%)	Est. Relative Risk	p-Value
			Yes	(95% C.I.)	
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>1 (0.1)</i>	<i>0.73 (0.07,8.01)</i>	<i>0.790</i>
	<i>Comparison</i>	<i>1,249</i>	<i>2 (0.2)</i>		
Officer	Ranch Hand	335	0 (0.0)	--	--
	Comparison	494	0 (0.0)		
Enlisted Flyer	Ranch Hand	149	1 (0.7)	--	0.909 ^a
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	0 (0.0)	--	0.667 ^a
	Comparison	568	2 (0.4)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.79 (0.05,12.82)</i>	<i>0.870</i>
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.) ^b	p-Value
Low	156	0 (0.0)	2.44 (0.70,8.47)	0.168
Medium	161	0 (0.0)		
High	159	1 (0.6)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-29. Analysis of Malignant Systemic Neoplasms (Connective and Other Soft Tissues) (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
475	2.39 (0.68,8.37)	0.179

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for age, race, occupation, ionizing radiation exposure, and lifetime alcohol history because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.) ^{ab}	
Comparison	1,211	2 (0.2)		
Background RH	378	0 (0.0)	--	0.999 ^c
Low RH	234	0 (0.0)	--	0.999 ^c
High RH	242	1 (0.4)	2.34 (0.21,26.43)	0.493
Low plus High RH	476	1 (0.2)	--	0.999 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of participants with a malignant systemic neoplasm of connective and other soft tissues.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-29. Analysis of Malignant Systemic Neoplasms (Connective and Other Soft Tissues) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,209		
Background RH	375	--	--
Low RH	232	--	--
High RH	240	3.17 (0.17,57.71)	0.436
Low plus High RH	472	--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	
				p-Value
Low	286	0 (0.0)	2.36 (0.73,7.65)	0.151
Medium	282	0 (0.0)		
High	286	1 (0.4)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
852	2.36 (0.72,7.79)		0.155

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for age, race, occupation, ionizing radiation exposure, and lifetime alcohol history because of the sparse number of Ranch Hands with a malignant systemic neoplasm of connective and other soft tissues. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.32 Carcinoma In Situ (Penis)

Because of the presence of carcinoma in situ of the penis in only one Comparison and no Ranch Hands, statistical analysis was not performed. The Comparison was a non-Black enlisted groundcrew.

10.2.2.1.33 Hodgkin's Disease

Because of the sparse number of participants with a history of Hodgkin's disease, analysis was limited. All results were nonsignificant (Table 10-30(a-h): $p > 0.29$ for each analysis).

Table 10-30. Analysis of Hodgkin's Disease

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%)	Est. Relative Risk	p-Value
			Yes	(95% C.I.)	
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>1 (0.1)</i>	<i>0.48 (0.05,4.65)</i>	<i>0.507</i>
	<i>Comparison</i>	<i>1,249</i>	<i>3 (0.2)</i>		
Officer	Ranch Hand	335	1 (0.3)	0.74 (0.07,8.16)	0.803
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	0 (0.0)	--	0.999 ^a
	Comparison	568	1 (0.2)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with Hodgkin's disease.

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.29 (0.03,3.23)</i>	<i>0.291</i>
Officer	0.47 (0.04,5.86)	0.554
Enlisted Flyer	--	--
Enlisted Groundcrew	--	--

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

Note: Results are not adjusted for race because of the sparse number of participants with Hodgkin's disease. Results for all occupations combined also are not adjusted for occupation because of the sparse number of participants with Hodgkin's disease.

Table 10-30. Analysis of Hodgkin's Disease (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin)	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)	p-Value
Low	156	0 (0.0)	--	--
Medium	161	0 (0.0)		
High	159	0 (0.0)		

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
n	Adjusted Relative Risk (95% C.I.)		p-Value
--	--		--

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,211	3 (0.3)		
Background RH	378	1 (0.3)	0.92 (0.09,9.02)	0.945
Low RH	234	0 (0.0)	--	0.999 ^c
High RH	242	0 (0.0)	--	0.999 ^c
Low plus High RH	476	0 (0.0)	--	0.656 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with Hodgkin's disease.

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-30. Analysis of Hodgkin's Disease (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.)^a	p-Value
Comparison	1,209		
Background RH	375	0.55 (0.05,6.15)	0.624
Low RH	232	--	--
High RH	240	--	--
Low plus High RH	472	--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of Ranch Hands with Hodgkin's disease.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for occupation and race because of the sparse number of participants with Hodgkin's disease.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	
				p-Value
Low	286	1 (0.4)	0.67 (0.15,2.97)	0.583
Medium	282	0 (0.0)		
High	286	0 (0.0)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
848	0.70 (0.08,6.51)		0.745

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of Ranch Hands with Hodgkin's disease. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.34 Non-Hodgkin's Lymphoma

Because of the sparse number of participants with non-Hodgkin's lymphoma, analysis was limited. All results were nonsignificant (Table 10-31(a-h): $p > 0.18$ for each analysis).

Table 10-31. Analysis of Non-Hodgkin's Lymphoma

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>1 (0.1)</i>	<i>0.48 (0.05,4.65)</i>	<i>0.507</i>
	<i>Comparison</i>	<i>1,249</i>	<i>3 (0.2)</i>		
Officer	Ranch Hand	335	0 (0.0)	--	0.657 ^a
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	--	--
	Comparison	187	0 (0.0)		
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)	1.51 (0.09,24.18)	0.772
	Comparison	568	1 (0.2)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.18 (0.01,2.61)</i>	<i>0.186</i>
Officer	--	--
Enlisted Flyer	--	--
Enlisted Groundcrew	0.61 (0.02,15.18)	0.762

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

Note: Results are not adjusted for race because of the sparse number of participants with non-Hodgkin's lymphoma. Results for all occupations combined also are not adjusted for occupation because of the sparse number of participants with non-Hodgkin's lymphoma.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin)	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)	p-Value
Low	156	0 (0.0)	--	--
Medium	161	0 (0.0)		
High	159	0 (0.0)		

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-31. Analysis of Non-Hodgkin's Lymphoma (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (Initial Dioxin)			
	Adjusted Relative Risk (95% C.I.)		p-Value
n			
--	--		--

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%)	Est. Relative Risk	p-Value
		Yes	(95% C.I.) ^{ab}	
Comparison	1,211	3 (0.3)		
Background RH	378	1 (0.3)	0.92 (0.09,9.02)	0.944
Low RH	234	0 (0.0)	--	0.999 ^c
High RH	242	0 (0.0)	--	0.999 ^c
Low plus High RH	476	0 (0.0)	--	0.656 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
		(95% C.I.) ^a		
Comparison	1,209			
Background RH	375	0.24 (0.01,4.90)		0.351
Low RH	232	--		--
High RH	240	--		--
Low plus High RH	472	--		--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for race and occupation because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma.

Table 10-31. Analysis of Non-Hodgkin's Lymphoma (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log ₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%)	Estimated Relative Risk	
		Yes	(95% C.I.) ^a	p-Value
Low	286	1 (0.4)	0.60 (0.13,2.70)	
Medium	282	0 (0.0)		
High	286	0 (0.0)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.) ^a		
852	0.31 (0.01,7.88)		0.443

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, ionizing radiation exposure, and lifetime alcohol history because of the sparse number of Ranch Hands with non-Hodgkin's lymphoma. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.35 Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue

Because of the sparse number of participants with other malignant systemic neoplasms of lymphoid and histiocytic tissue, analysis was limited. All results were nonsignificant (Table 10-32 (a-h): p>0.33 for each analysis).

Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>861</i>	<i>2 (0.2)</i>	<i>0.72 (0.13,3.97)</i>	<i>0.706</i>
	<i>Comparison</i>	<i>1,249</i>	<i>4 (0.3)</i>		
Officer	Ranch Hand	335	1 (0.3)	0.74 (0.07,8.16)	0.803
	Comparison	494	2 (0.4)		
Enlisted Flyer	Ranch Hand	149	0 (0.0)	--	0.999 ^a
	Comparison	187	1 (0.5)		
Enlisted Groundcrew	Ranch Hand	377	1 (0.3)	1.51 (0.09,24.18)	0.772
	Comparison	568	1 (0.2)		

^a P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>0.70 (0.10,5.03)</i>	<i>0.724</i>
Officer	0.69 (0.05,9.34)	0.781
Enlisted Flyer	--	--
Enlisted Groundcrew	1.57 (0.08,31.01)	0.767

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Note: Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)	p-Value
Low	160	0 (0.0)	--	--
Medium	162	0 (0.0)		
High	160	0 (0.0)		

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.)	p-Value
--	--	--

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue (Continued)

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Number (%)		Est. Relative Risk (95% C.I.)^{ab}	p-Value
		Yes	No		
Comparison	1,211	2 (0.2)			
Background RH	378	2 (0.5)		2.64 (0.37,19.03)	0.336
Low RH	234	0 (0.0)		--	0.999 ^c
High RH	242	0 (0.0)		--	0.999 ^c
Low plus High RH	476	0 (0.0)		--	0.919 ^c

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c P-value determined using a chi-square test with continuity correction because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adjusted Relative Risk		p-Value
		(95% C.I.)^a		
Comparison	1,209			
Background RH	375		1.90 (0.15,23.45)	0.618
Low RH	232		--	--
High RH	240		--	--
Low plus High RH	472		--	--

^a Relative risk and confidence interval relative to Comparisons.

--: Results not presented because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Results are not adjusted for race because of the sparse number of participants with a malignant systemic neoplasm of lymphoid and histiocytic tissue.

Table 10-32. Analysis of Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for Log ₂ (1987 Dioxin + 1)		
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^a		p-Value
Low	286	1 (0.4)	0.68 (0.24,1.96)		0.466
Medium	282	1 (0.4)			
High	286	0 (0.0)			

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log ₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.) ^a		p-Value
847	0.63 (0.09,4.17)		0.580

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for race, occupation, and ionizing radiation exposure because of the sparse number of Ranch Hands with a malignant systemic neoplasm of lymphoid and histiocytic tissue. Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

10.2.2.1.36 All Malignant Skin and Systemic Neoplasms

A marginally significant difference between Ranch Hands and Comparisons was found in the unadjusted Model 1 analysis of all skin and systemic neoplasms for all occupations combined (Table 10-33(a): Est. RR=1.20, p=0.099). The contrast of Ranch Hand and Comparisons enlisted flyers was significant in the unadjusted Model 1 analysis (Table 10-33(a): Est. RR=1.78, p=0.034). More Ranch Hands than Comparisons exhibited a history of a malignant skin or systemic neoplasm. After adjustment for covariates, both results were nonsignificant (Table 10-33(b): p>0.10 for each contrast). All other Model 1 contrasts were nonsignificant (Table 10-33(a,b): p>0.11).

Table 10-33. Analysis of All Malignant Skin and Systemic Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	851	186 (21.9)	1.20 (0.97,1.49)	0.099
	<i>Comparison</i>	1,238	234 (18.9)		
Officer	Ranch Hand	330	95 (28.8)	1.29 (0.94,1.77)	0.112
	Comparison	487	116 (23.8)		
Enlisted Flyer	Ranch Hand	148	39 (26.4)	1.78 (1.04,3.02)	0.034
	Comparison	185	31 (16.8)		
Enlisted Groundcrew	Ranch Hand	373	52 (13.9)	0.89 (0.62,1.29)	0.546
	Comparison	566	87 (15.4)		

Table 10-33. Analysis of All Malignant Skin and Systemic Neoplasms (Continued)

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.06 (0.80,1.41)</i>	<i>0.668</i>
Officer	1.14 (0.79,1.65)	0.470
Enlisted Flyer	1.63 (0.91,2.92)	0.103
Enlisted Groundcrew	0.78 (0.51,1.19)	0.247

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^b	p-Value
Low	150	41 (27.3)	0.74 (0.62,0.89)	0.001
Medium	160	45 (28.1)		
High	159	23 (14.5)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED			
Analysis Results for Log₂ (Initial Dioxin)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
465	0.91 (0.72,1.14)		0.396

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.)^{ab}	p-Value
Comparison	1,200	226 (18.8)		
Background RH	375	76 (20.3)	1.12 (0.83,1.49)	0.464
Low RH	228	68 (29.8)	1.82 (1.33,2.51)	<0.001
High RH	241	41 (17.0)	0.87 (0.60,1.26)	0.457
Low plus High RH	469	109 (23.2)	1.25 (0.96,1.62)	0.103

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-33. Analysis of All Malignant Skin and Systemic Neoplasms (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.)^a	p-Value
Comparison	1,196		
Background RH	372	0.84 (0.60,1.20)	0.339
Low RH	226	1.51 (1.03,2.21)	0.035
High RH	239	1.01 (0.66,1.57)	0.952
Low plus High RH	465	1.23 (0.88,1.71)	0.221

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk	
			(95% C.I.)^a	p-Value
Low	284	57 (20.1)	0.94 (0.84,1.05)	0.281
Medium	275	74 (26.9)		
High	285	54 (19.0)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
837	1.10 (0.94,1.27)		0.227

^a Relative risk for a twofold increase in 1987 dioxin.

The unadjusted analysis of Model 2 displayed a significant inverse relation between initial dioxin and malignant skin and systemic neoplasms (Table 10-33(c): Est. RR=0.74, p=0.001). After adjustment for covariates, the association was nonsignificant (Table 10-33(d): p=0.396).

Both the unadjusted and adjusted Model 3 analyses revealed a significant difference in malignant skin and systemic neoplasms between Ranch Hands in the low dioxin category and Comparisons (Table 10-33(e,f): Est. RR=1.82, p<0.001; Adj. RR=1.51, p=0.035, respectively). More Ranch Hands in the low dioxin category than Comparisons had a malignant skin and systemic neoplasm. All other Model 3 contrasts and all results from the Model 4 analysis were nonsignificant (Table 10-33(e-h): p>0.10 for each analysis).

10.2.2.1.37 All Skin and Systemic Neoplasms

The Model 1 unadjusted analysis of all skin and systemic neoplasms revealed a significant difference between Ranch Hands and Comparisons when examined across all occupations (Table 10-34(a): Est. RR=1.25, p=0.014). A marginally significant difference within officers also was found in the unadjusted analysis (Table 10-34(a): Est. RR=1.29, p=0.079). Both contrasts showed more Ranch Hands than Comparisons with a history of a skin or systemic neoplasm. The contrasts were nonsignificant after adjustment for covariates (Table 10-34(b): p>0.72 for each contrast). All other Model 1 contrasts were also nonsignificant (Table 10-34(a,b): p>0.15).

A significant inverse association between initial dioxin and the occurrence of a skin or systemic neoplasm was found in the Model 2 unadjusted analysis (Table 10-34(c): Est. RR=0.84, p=0.017). After adjustment for covariates, the result was nonsignificant (Table 10-34(d): p=0.244).

Table 10-34. Analysis of All Skin and Systemic Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) Yes	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>847</i>	<i>473 (55.8)</i>	<i>1.25 (1.05,1.49)</i>	<i>0.014</i>
	<i>Comparison</i>	<i>1,231</i>	<i>620 (50.4)</i>		
Officer	Ranch Hand	329	202 (61.4)	1.29 (0.97,1.72)	0.079
	Comparison	482	266 (55.2)		
Enlisted Flyer	Ranch Hand	146	84 (57.5)	1.37 (0.88,2.12)	0.158
	Comparison	185	92 (49.7)		
Enlisted Groundcrew	Ranch Hand	372	187 (50.3)	1.17 (0.90,1.51)	0.253
	Comparison	564	262 (46.5)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED			
Occupational Category	Adjusted Relative Risk (95% C.I.)		p-Value
<i>All</i>	<i>1.04 (0.83,1.30)</i>		<i>0.756</i>
Officer	1.06 (0.77,1.46)		0.725
Enlisted Flyer	1.15 (0.72,1.84)		0.557
Enlisted Groundcrew	0.98 (0.72,1.33)		0.881

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	150	92 (61.3)	0.84 (0.73,0.97)	0.017
Medium	159	95 (59.8)		
High	157	72 (45.9)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-34. Analysis of All Skin and Systemic Neoplasms (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
	Adjusted Relative Risk (95% C.I.) ^a	p-Value
n		
463	0.90 (0.76,1.07)	0.244

^a Relative risk for a twofold increase in initial dioxin.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) Yes	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,193	602 (50.5)		
Background RH	374	211 (56.4)	1.30 (1.03,1.64)	0.030
Low RH	227	137 (60.4)	1.49 (1.11,1.99)	0.007
High RH	239	122 (51.1)	1.01 (0.76,1.33)	0.969
Low plus High RH	466	259 (55.6)	1.22 (0.98,1.51)	0.076

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
Comparison	1,189		
Background RH	371	1.01 (0.76,1.33)	0.956
Low RH	225	1.15 (0.83,1.61)	0.396
High RH	238	0.93 (0.67,1.30)	0.684
Low plus High RH	463	1.04 (0.79,1.35)	0.799

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-34. Analysis of All Skin and Systemic Neoplasms (Continued)

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) Yes	Estimated Relative Risk (95% C.I.)^a	p-Value
Low	283	161 (56.9)	0.93 (0.85,1.02)	0.149
Medium	275	163 (59.3)		
High	282	146 (51.8)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk (95% C.I.)^a		p-Value
834	0.99 (0.88,1.11)		0.854

^a Relative risk for a twofold increase in 1987 dioxin.

In the Model 3 unadjusted analysis, a significantly higher percentage of Ranch Hands in the background, low, and low plus high dioxin categories had an occurrence of a skin or systemic neoplasm, relative to Comparisons (Table 10-34(e): Est. RR=1.30; p=0.030; Est. RR=1.49, p=0.007; and Est. RR=1.22, p=0.076, respectively). After adjustment for covariates, results were nonsignificant for each contrast (Table 10-34(f): p>0.39 for each adjusted contrast). All other Model 3 contrasts and the results from the Model 4 analysis were nonsignificant (Table 10-34(e-h): p>0.14 for each remaining analysis).

10.2.2.2 Laboratory Examination Variables

10.2.2.2.1 Prostate-Specific Antigen (PSA) (Continuous)

All results from the Model 1 unadjusted and adjusted analyses of continuous PSA were nonsignificant (Table 10-35(a,b): p≥0.59 for all Model 1 analyses).

Table 10-35. Analysis of PSA (ng/ml) (Continuous)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Mean ^a	Difference of Means (95% C.I.) ^b	p-Value ^c
<i>All</i>	<i>Ranch Hand</i>	829	1.104	-0.016 --	0.671
	<i>Comparison</i>	1,190	1.120		
Officer	Ranch Hand	320	1.195	-0.034 --	0.613
	Comparison	458	1.229		
Enlisted Flyer	Ranch Hand	141	1.241	0.007 --	0.949
	Comparison	180	1.234		
Enlisted Groundcrew	Ranch Hand	368	0.985	-0.020 --	0.693
	Comparison	552	1.005		

^a Transformed from natural logarithm scale.

^b Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

^c P-value is based on difference of means on natural logarithm scale.

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED					
Occupational Category	Group	n	Adjusted Mean ^a	Difference of Adj. Means (95% C.I.) ^b	p-Value ^c
<i>All</i>	<i>Ranch Hand</i>	823	1.202	0.003 --	0.946
	<i>Comparison</i>	1,188	1.199		
Officer	Ranch Hand	319	1.157	-0.037 --	0.590
	Comparison	457	1.194		
Enlisted Flyer	Ranch Hand	139	1.289	0.040 --	0.719
	Comparison	179	1.249		
Enlisted Groundcrew	Ranch Hand	365	1.177	0.028 --	0.668
	Comparison	552	1.149		

^a Transformed from natural logarithm scale.

^b Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

^c P-value is based on difference of means on natural logarithm scale.

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				Analysis Results for Log₂ (Initial Dioxin)^b		
Initial Dioxin Category Summary Statistics				R²	Slope (Std. Error)^c	p-Value
Initial Dioxin	n	Mean^a	Adj. Mean^{ab}			
Low	148	1.305	1.288	0.037	-0.071 (0.027)	0.010
Medium	154	1.037	1.036			
High	156	0.979	0.992			

^a Transformed from natural logarithm scale.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c Slope and standard error based on natural logarithm of PSA versus log₂ (initial dioxin).

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Table 10-35. Analysis of PSA (ng/ml) (Continuous) (Continued)

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED					
Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)		
Initial Dioxin	n	Adj. Mean^a	R²	Adj. Slope (Std. Error)^b	p-Value
Low	147	0.975	0.114	-0.045 (0.031)	0.152
Medium	154	0.806			
High	154	0.811			

^a Transformed from natural logarithm scale.

^b Slope and standard error based on natural logarithm of PSA versus log₂ (initial dioxin).

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED					
Dioxin Category	n	Mean^a	Adj. Mean^{ab}	Difference of Adj. Mean vs. Comparisons (95% C.I.)^c	p-Value^d
Comparison	1,152	1.125	1.127		
Background RH	365	1.118	1.099	-0.028 --	0.587
Low RH	222	1.199	1.205	0.078 --	0.227
High RH	236	1.006	1.023	-0.104 --	0.079
Low plus High RH	458	1.095	1.108	-0.019 --	0.692

^a Transformed from natural logarithm scale.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

^c Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

^d P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-35. Analysis of PSA (ng/ml) (Continuous) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED				
Dioxin Category	n	Adj. Mean^a	Difference of Adj. Mean vs. Comparisons (95% C.I.)^b	
			p-Value^c	
Comparison	1,151	1.201		
Background RH	362	1.163	-0.038 --	0.527
Low RH	221	1.258	0.057 --	0.441
High RH	234	1.209	0.008 --	0.919
Low plus High RH	455	1.232	0.031 --	0.600

^a Transformed from natural logarithm scale.

^b Difference of means after transformation to original scale; confidence interval on difference of means not presented because analysis was performed on natural logarithm scale.

^c P-value is based on difference of means on natural logarithm scale.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)		
1987 Dioxin	n	Mean^a	R²	Adjusted Slope (Std. Error)^b	p-Value
Low	276	1.133	0.005	-0.037 (0.018)	0.043
Medium	268	1.192			
High	279	1.003			

^a Transformed from natural logarithm scale.

^b Slope and standard error based on natural logarithm of PSA versus log₂ (1987 dioxin + 1).

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED					
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)		
1987 Dioxin	n	Adj. Mean^a	R²	Adjusted Slope (Std. Error)^b	p-Value
Low	275	1.111	0.076	-0.021 (0.020)	0.312
Medium	265	1.135			
High	277	1.033			

^a Transformed from natural logarithm scale.

^b Slope and standard error based on natural logarithm of PSA versus log₂ (1987 dioxin + 1).

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

The unadjusted Model 2 analysis revealed a significant inverse association between initial dioxin and continuous PSA (Table 10-35(c): slope=-0.071, p=0.010). After adjustment for covariates, the association was nonsignificant (Table 10-35(d): p=0.152).

A marginally significant difference in mean continuous PSA levels was found between Ranch Hands in the high dioxin category and Comparisons in the Model 3 unadjusted analysis (Table 10-35(e): difference of means=-0.104, p=0.079). After adjustment for covariates, the difference was nonsignificant (Table 10-35(f): p=0.919). All other Model 3 contrasts were also nonsignificant (Table 10-35(e,f): p>0.22).

A significant inverse association between 1987 dioxin and continuous PSA levels was revealed from the unadjusted Model 4 analysis (Table 10-35(g): adjusted slope=-0.037, p=0.043). After adjustment for covariates, the association was nonsignificant (Table 10-35(h): p=0.312).

10.2.2.2.2 PSA (Discrete)

A marginally significant difference in the percentage of participants with abnormally high PSA levels between Ranch Hand and Comparison officers was found in the Model 1 unadjusted analysis (Table 10-36(a): Est. RR=1.59, p=0.086). After adjustment for covariates, the contrast was nonsignificant (Table 10-36(b): p=0.216). All other Model 1 contrasts were nonsignificant (Table 10-36(a,b): p>0.21).

Table 10-36. Analysis of PSA (Discrete)

(a) MODEL 1: RANCH HANDS VS. COMPARISONS – UNADJUSTED					
Occupational Category	Group	n	Number (%) High	Est. Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>Ranch Hand</i>	<i>829</i>	<i>54 (6.5)</i>	<i>1.07 (0.74,1.53)</i>	<i>0.730</i>
	<i>Comparison</i>	<i>1,190</i>	<i>73 (6.1)</i>		
Officer	Ranch Hand	320	31 (9.7)	1.59 (0.94,2.69)	0.086
	Comparison	458	29 (6.3)		
Enlisted Flyer	Ranch Hand	141	10 (7.1)	0.84 (0.37,1.93)	0.681
	Comparison	180	15 (8.3)		
Enlisted Groundcrew	Ranch Hand	368	13 (3.5)	0.66 (0.34,1.29)	0.223
	Comparison	552	29 (5.3)		

(b) MODEL 1: RANCH HANDS VS. COMPARISONS – ADJUSTED		
Occupational Category	Adjusted Relative Risk (95% C.I.)	p-Value
<i>All</i>	<i>1.02 (0.64,1.60)</i>	<i>0.947</i>
Officer	1.45 (0.80,2.63)	0.216
Enlisted Flyer	0.78 (0.32,1.90)	0.578
Enlisted Groundcrew	0.68 (0.33,1.41)	0.302

Table 10-36. Analysis of PSA (Discrete) (Continued)

(c) MODEL 2: RANCH HANDS – INITIAL DIOXIN – UNADJUSTED				
Initial Dioxin Category Summary Statistics			Analysis Results for Log ₂ (Initial Dioxin) ^a	
Initial Dioxin	n	Number (%) High	Estimated Relative Risk (95% C.I.) ^b	p-Value
Low	148	19 (12.8)	0.53 (0.37,0.77)	<0.001
Medium	154	13 (8.4)		
High	156	2 (1.3)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

(d) MODEL 2: RANCH HANDS – INITIAL DIOXIN – ADJUSTED		
Analysis Results for Log ₂ (Initial Dioxin)		
n	Adjusted Relative Risk (95% C.I.) ^a	p-Value
455	0.61 (0.40,0.93)	0.014

^a Relative risk for a twofold increase in initial dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

(e) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – UNADJUSTED				
Dioxin Category	n	Number (%) High	Est. Relative Risk (95% C.I.) ^{ab}	p-Value
Comparison	1,152	71 (6.2)		
Background RH	365	20 (5.5)	0.85 (0.51,1.42)	0.526
Low RH	222	22 (9.9)	1.69 (1.02,2.79)	0.040
High RH	236	12 (5.1)	0.85 (0.45,1.59)	0.603
Low plus High RH	458	34 (7.4)	1.18 (0.76,1.84)	0.454

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

Table 10-36. Analysis of PSA (Discrete) (Continued)

(f) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY – ADJUSTED			
Dioxin Category	n	Adjusted Relative Risk	
		(95% C.I.)^a	
		p-Value	
Comparison	1,151		
Background RH	362	0.76 (0.43,1.37)	
Low RH	221	1.42 (0.79,2.56)	
High RH	234	1.04 (0.51,2.16)	
Low plus High RH	455	1.21 (0.71,2.08)	

^a Relative risk and confidence interval relative to Comparisons.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin > 10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin > 10 ppt, Initial Dioxin > 94 ppt.

(g) MODEL 4: RANCH HANDS – 1987 DIOXIN – UNADJUSTED				
1987 Dioxin Category Summary Statistics			Analysis Results for Log₂ (1987 Dioxin + 1)	
1987 Dioxin	n	Number (%) High	Estimated Relative Risk	
			(95% C.I.)^a	
			p-Value	
Low	276	15 (5.4)	0.91 (0.75,1.10)	
Medium	268	26 (9.7)		
High	279	13 (4.7)		

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Low = ≤7.9 ppt; Medium = >7.9–19.6 ppt; High = >19.6 ppt.

(h) MODEL 4: RANCH HANDS – 1987 DIOXIN – ADJUSTED			
Analysis Results for Log₂ (1987 Dioxin + 1)			
n	Adjusted Relative Risk		p-Value
	(95% C.I.)^a		
817	1.05 (0.81,1.35)		0.735

^a Relative risk for a twofold increase in 1987 dioxin.

Note: Results are not adjusted for herbicide exposure because of the sparse number of Ranch Hands who did not report herbicide exposure.

The Model 2 unadjusted and adjusted analyses of discrete PSA revealed a significant inverse relation between initial dioxin and discrete PSA levels (Table 10-36(c,d): Est. RR=0.53, p<0.001; Adj. RR=0.61, p=0.014, respectively). As initial dioxin in Ranch Hands increased, the prevalence of abnormally high PSA levels decreased.

A significant difference in the percentage of Ranch Hands in the low dioxin category with abnormally high PSA levels and Comparisons was observed in the unadjusted Model 3 analysis (Table 10-36(e): Est. RR=1.69, p=0.040). After adjustment for covariates, the result was nonsignificant (Table 10-36(f):

p=0.246). All other Model 3 analysis results, as well as Model 4 results, were also nonsignificant (Table 10-36(e-h): $p>0.31$ for each).

10.2.3 Longitudinal Analysis

Longitudinal analyses were conducted on three variables—malignant skin neoplasms, malignant systemic neoplasms, and benign systemic neoplasms—to examine whether changes across time differed with respect to group membership (Model 1), initial dioxin (Model 2), and categorized dioxin (Model 3). Model 4 was not examined in longitudinal analyses because 1987 dioxin, the measure of exposure in these models, changes over time and is not available for all participants for 1982 or 1997.

The longitudinal analyses for all of these variables investigated the difference between the 1982 examination and the 1997 examination. These analyses were used to investigate the temporal effects of herbicide or dioxin exposure during the 15-year period between 1982 and 1997. Participants who were abnormal in 1982 were not included in the analyses. The purpose of the longitudinal analysis was to examine the effects of dioxin exposure across time. Participants who were abnormal in 1982 were not considered to be at risk for developing neoplasms, because the condition already existed at the time of the first collection of data for the AFHS (1982). Only participants considered normal at the 1982 examination (i.e., no neoplasm) were considered to be at risk when the effects of herbicide or dioxin exposure over this period of time were explored; therefore, the rate of abnormalities under this restriction approximates an incidence rate between 1982 and 1997. That is, an incidence rate is a measure of the rate at which people without a condition develop the condition during a specified period of time (81). Summary statistics are provided for reference purposes for the 1985, 1987, and 1992 examinations. All three models were adjusted for age; Models 2 and 3 also were adjusted for the percentage of body fat at the time of the blood measurement of dioxin.

10.2.3.1 Medical Records Review

10.2.3.1.1 Malignant Skin Neoplasms

The longitudinal analysis results for participants with no malignant skin neoplasms in 1982 were nonsignificant for Models 1, 2, and 3 (Table 10-37(a-c): $p>0.31$ for each analysis).

Table 10-37. Longitudinal Analysis of Malignant Skin Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS						
Occupational Category	Group	Number (%) Yes/(n) Examination				
		1982	1985	1987	1992	1997
<i>All</i>	<i>Ranch Hand</i>	<i>41 (5.1)</i> <i>(809)</i>	<i>62 (7.8)</i> <i>(791)</i>	<i>82 (10.5)</i> <i>(783)</i>	<i>114 (14.5)</i> <i>(788)</i>	<i>137 (16.9)</i> <i>(809)</i>
	<i>Comparison</i>	<i>31 (3.2)</i> <i>(967)</i>	<i>60 (6.3)</i> <i>(949)</i>	<i>70 (7.4)</i> <i>(942)</i>	<i>113 (11.9)</i> <i>(948)</i>	<i>157 (16.2)</i> <i>(967)</i>
Officer	Ranch Hand	21 (6.8) (307)	33 (10.9) (303)	44 (14.7) (300)	61 (20.1) (303)	71 (23.1) (307)
	Comparison	15 (4.0) (374)	31 (8.4) (368)	36 (9.9) (362)	64 (17.3) (370)	83 (22.2) (374)
Enlisted Flyer	Ranch Hand	9 (6.1) (147)	12 (8.3) (144)	16 (11.3) (142)	24 (16.7) (144)	29 (19.7) (147)
	Comparison	3 (2.1) (144)	7 (4.9) (143)	9 (6.3) (142)	15 (10.6) (142)	19 (13.2) (144)
Enlisted Groundcrew	Ranch Hand	11 (3.1) (355)	17 (4.9) (344)	22 (6.5) (341)	29 (8.5) (341)	37 (10.4) (355)
	Comparison	13 (2.9) (449)	22 (5.0) (438)	25 (5.7) (438)	34 (7.8) (436)	55 (12.3) (449)
No in 1982						
Occupational Category	Group	n in 1997	Number (%) Yes in 1997	Adj. Relative Risk (95% C.I.)^a	p-Value^a	
<i>All</i>	<i>Ranch Hand</i>	<i>768</i>	<i>96 (12.5)</i>	<i>0.92 (0.69,1.23)</i>	<i>0.594</i>	
	<i>Comparison</i>	<i>936</i>	<i>126 (13.5)</i>			
Officer	Ranch Hand	286	50 (17.5)	0.90 (0.60,1.36)	0.628	
	Comparison	359	68 (18.9)			
Enlisted Flyer	Ranch Hand	138	20 (14.5)	1.33 (0.66,2.70)	0.427	
	Comparison	141	16 (11.4)			
Enlisted Groundcrew	Ranch Hand	344	26 (7.6)	0.78 (0.47,1.31)	0.348	
	Comparison	436	42 (9.6)			

^a Relative risk, confidence interval, and p-values are in reference to a contrast of 1982 and 1997 results; results adjusted for age in 1997.

Note: Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant skin neoplasm in 1982 (see Chapter 7, Statistical Methods).

Table 10-37. Longitudinal Analysis of Malignant Skin Neoplasms (Continued)

(b) MODEL 2: RANCH HANDS — INITIAL DIOXIN					
Initial Dioxin	Number (%) Yes/(n) Examination				
	1982	1985	1987	1992	1997
Low	11 (7.4) (148)	19 (13.1) (145)	21 (14.3) (147)	27 (18.8) (144)	30 (20.3) (148)
Medium	9 (5.7) (158)	11 (7.1) (155)	15 (9.7) (155)	22 (14.2) (155)	30 (19.0) (158)
High	4 (2.6) (153)	6 (4.0) (150)	9 (6.1) (148)	13 (8.7) (150)	17 (11.1) (153)

Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	No in 1982		Adj. Relative Risk (95% C.I.)^b	p-Value
	n in 1997	Number (%) Yes in 1997		
Low	137	19 (13.9)	0.88 (0.69,1.13)	0.313
Medium	149	21 (14.1)		
High	149	13 (8.7)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

^b Relative risk for a twofold increase in initial dioxin.

Notes: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant skin neoplasm in 1982 (see Chapter 7, Statistical Methods).

Table 10-37. Longitudinal Analysis of Malignant Skin Neoplasms (Continued)

(c) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY					
Dioxin Category	Number (%) Yes/(n)				
	Examination				
	1982	1985	1987	1992	1997
Comparison	29 (3.1) (939)	58 (6.3) (924)	67 (7.3) (916)	108 (11.7) (921)	151 (16.1) (939)
Background RH	17 (4.9) (344)	26 (7.7) (336)	37 (11.3) (328)	52 (15.6) (334)	60 (17.4) (344)
Low RH	17 (7.6) (224)	26 (11.9) (218)	28 (12.7) (221)	40 (18.4) (218)	46 (20.5) (224)
High RH	7 (3.0) (235)	10 (4.3) (232)	17 (7.4) (229)	22 (9.5) (231)	31 (13.2) (235)
Low plus High RH	24 (5.2) (459)	36 (8.0) (450)	45 (10.0) (450)	62 (13.8) (449)	77 (16.8) (459)

Dioxin Category	No in 1982		Adj. Relative Risk (95% C.I.)^{ab}	p-Value^b
	n in 1997	Number (%) Yes in 1997		
Comparison	910	122 (13.4)		
Background RH	327	43 (13.2)	0.94 (0.65,1.38)	0.770
Low RH	207	29 (14.0)	0.98 (0.63,1.53)	0.936
High RH	228	24 (10.5)	0.87 (0.54,1.40)	0.571
Low plus High RH	435	53 (12.2)	0.92 (0.65,1.31)	0.655

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

Notes: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin >10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin >10 ppt, Initial Dioxin > 94 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant skin neoplasm in 1982 (see Chapter 7, Statistical Methods).

10.2.3.1.2 Malignant Systemic Neoplasms

For participants with no malignant systemic neoplasms in 1982, differences between Ranch Hands and Comparisons examined within the enlisted flyer stratum were marginally significant (Table 10-38(a): Adj. RR=2.43, p=0.062). The percentage of participants who developed a malignant systemic neoplasm after 1982 was higher for Ranch Hand enlisted flyers than for Comparison enlisted flyers (11.0% vs. 4.8%, respectively). All other Model 1 contrasts were nonsignificant (Table 10-38(a): p>0.11).

Table 10-38. Longitudinal Analysis of Malignant Systemic Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS						
Occupational Category	Group	Number (%) Yes/(n) Examination				
		1982	1985	1987	1992	1997
<i>All</i>	<i>Ranch Hand</i>	<i>7 (0.9)</i> <i>(810)</i>	<i>13 (1.6)</i> <i>(792)</i>	<i>19 (2.4)</i> <i>(784)</i>	<i>31 (3.9)</i> <i>(788)</i>	<i>63 (7.8)</i> <i>(810)</i>
	<i>Comparison</i>	<i>10 (1.0)</i> <i>(974)</i>	<i>13 (1.4)</i> <i>(956)</i>	<i>16 (1.7)</i> <i>(949)</i>	<i>32 (3.4)</i> <i>(954)</i>	<i>62 (6.4)</i> <i>(974)</i>
Officer	Ranch Hand	4 (1.3) (306)	8 (2.7) (302)	11 (3.7) (299)	15 (5.0) (301)	31 (10.1) (306)
	Comparison	5 (1.3) (380)	8 (2.1) (374)	9 (2.5) (368)	19 (5.1) (375)	36 (9.5) (380)
Enlisted Flyer	Ranch Hand	1 (0.7) (146)	2 (1.4) (143)	2 (1.4) (141)	8 (5.6) (143)	17 (11.6) (146)
	Comparison	0 (0.0) (145)	0 (0.0) (144)	1 (0.7) (143)	4 (2.8) (143)	7 (4.8) (145)
Enlisted Groundcrew	Ranch Hand	2 (0.6) (358)	3 (0.9) (347)	6 (1.7) (344)	8 (2.3) (344)	15 (4.2) (358)
	Comparison	5 (1.1) (449)	5 (1.1) (438)	6 (1.4) (438)	9 (2.1) (436)	19 (4.2) (449)

Occupational Category	Group	No in 1982		Adj. Relative Risk (95% C.I.)^a	p-Value^a
		n in 1997	Number (%) Yes in 1997		
<i>All</i>	<i>Ranch Hand</i>	<i>803</i>	<i>56 (7.0)</i>	<i>1.38 (0.92,2.06)</i>	<i>0.118</i>
	<i>Comparison</i>	<i>964</i>	<i>52 (5.4)</i>		
Officer	Ranch Hand	302	27 (8.9)	1.11 (0.64,1.93)	0.716
	Comparison	375	31 (8.3)		
Enlisted Flyer	Ranch Hand	145	16 (11.0)	2.43 (0.96,6.19)	0.062
	Comparison	145	7 (4.8)		
Enlisted Groundcrew	Ranch Hand	356	13 (3.7)	1.30 (0.59,2.87)	0.509
	Comparison	444	14 (3.2)		

^a Relative risk, confidence interval, and p-values are in reference to a contrast of 1982 and 1997 results; results adjusted for age in 1997.

Note: Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

Table 10-38. Longitudinal Analysis of Malignant Systemic Neoplasms (Continued)

(b) MODEL 2: RANCH HANDS — INITIAL DIOXIN					
Initial Dioxin	Number (%) Yes/(n)				
	Examination				
	1982	1985	1987	1992	1997
Low	1 (0.7) (150)	2 (1.4) (147)	5 (3.4) (149)	7 (4.8) (145)	19 (12.7) (150)
Medium	4 (2.5) (158)	7 (4.5) (155)	7 (4.5) (155)	13 (8.4) (155)	19 (12.0) (158)
High	0 (0.0) (152)	0 (0.0) (149)	0 (0.0) (147)	0 (0.0) (149)	5 (3.3) (152)

Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	No in 1982		Adj. Relative Risk (95% C.I.)^b	p-Value
	n in 1997	Number (%) Yes in 1997		
Low	149	18 (12.1)	0.71 (0.50,1.00)	0.036
Medium	154	15 (9.7)		
High	152	5 (3.3)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

^b Relative risk for a twofold increase in initial dioxin.

Note: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

(c) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY					
Dioxin Category	Number (%) Yes/(n)				
	Examination				
	1982	1985	1987	1992	1997
Comparison	10 (1.1) (946)	13 (1.4) (931)	16 (1.7) (923)	31 (3.3) (927)	61 (6.5) (946)
Background RH	2 (0.6) (344)	4 (1.2) (336)	7 (2.1) (328)	11 (3.3) (334)	20 (5.8) (344)
Low RH	3 (1.3) (225)	6 (2.7) (219)	9 (4.1) (222)	16 (7.3) (218)	33 (14.7) (225)
High RH	2 (0.9) (235)	3 (1.3) (232)	3 (1.3) (229)	4 (1.7) (231)	10 (4.3) (235)
Low plus High RH	5 (1.1) (460)	9 (2.0) (451)	12 (2.7) (451)	20 (4.5) (449)	43 (9.4) (460)

Table 10-38. Longitudinal Analysis of Malignant Systemic Neoplasms (Continued)

Dioxin Category	No in 1982		Adj. Relative Risk (95% C.I.) ^{ab}	p-Value ^b
	n in 1997	Number (%) Yes in 1997		
Comparison	936	51 (5.5)		
Background RH	342	18 (5.3)	0.89 (0.50,1.57)	0.687
Low RH	222	30 (13.5)	2.58 (1.57,4.25)	<0.001
High RH	233	8 (3.4)	0.88 (0.40,1.91)	0.740
Low plus High RH	455	38 (8.4)	1.48 (0.89,2.48)	0.132

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin ≤ 10 ppt.

Background (Ranch Hand): 1987 Dioxin ≤ 10 ppt.

Low (Ranch Hand): 1987 Dioxin >10 ppt, 10 ppt < Initial Dioxin ≤ 94 ppt.

High (Ranch Hand): 1987 Dioxin >10 ppt, Initial Dioxin > 94 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a malignant systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

The Model 2 longitudinal analysis revealed a significant inverse association between initial dioxin and malignant systemic neoplasms after 1982 (Table 10-38(b): Adj. RR=0.71, p=0.036). The percentage of Ranch Hands at the 1997 follow-up examination with a malignant systemic neoplasm since 1982 decreased as initial dioxin levels increased.

A significantly higher percentage of malignant systemic neoplasms in Ranch Hands in the low dioxin category than Comparisons was found from the Model 3 analysis (Table 10-38(c): Adj. RR=2.58, p<0.001). All other Model 3 longitudinal contrasts were nonsignificant (Table 10-38(c): p>0.13).

10.2.3.1.3 Benign Systemic Neoplasms

All longitudinal analysis results for a history of benign systemic neoplasms since 1982 were nonsignificant for Models 1, 2, and 3 (Table 10-39(a-c): p>0.11).

Table 10-39. Longitudinal Analysis of Benign Systemic Neoplasms

(a) MODEL 1: RANCH HANDS VS. COMPARISONS						
Occupational Category	Group	Number (%) Yes/(n) Examination				
		1982	1985	1987	1992	1997
<i>All</i>	<i>Ranch Hand</i>	<i>44 (5.4)</i> <i>(810)</i>	<i>69 (8.7)</i> <i>(792)</i>	<i>111 (14.2)</i> <i>(784)</i>	<i>145 (18.4)</i> <i>(788)</i>	<i>213 (26.3)</i> <i>(810)</i>
	<i>Comparison</i>	<i>69 (7.1)</i> <i>(974)</i>	<i>98 (10.3)</i> <i>(956)</i>	<i>132 (13.9)</i> <i>(949)</i>	<i>178 (18.7)</i> <i>(954)</i>	<i>259 (26.6)</i> <i>(974)</i>
Officer	Ranch Hand	19 (6.2) (306)	27 (8.9) (302)	45 (15.1) (299)	53 (17.6) (301)	81 (26.5) (306)
	Comparison	35 (9.2) (380)	46 (12.3) (374)	56 (15.2) (368)	74 (19.7) (375)	115 (30.3) (380)
Enlisted Flyer	Ranch Hand	10 (6.9) (146)	14 (9.8) (143)	24 (17.0) (141)	33 (23.1) (143)	42 (28.8) (146)
	Comparison	8 (5.5) (145)	12 (8.3) (144)	24 (16.8) (143)	30 (21.0) (143)	40 (27.6) (145)
Enlisted Groundcrew	Ranch Hand	15 (4.2) (358)	28 (8.1) (347)	42 (12.2) (344)	59 (17.2) (344)	90 (25.1) (358)
	Comparison	26 (5.8) (449)	40 (9.1) (438)	52 (11.9) (438)	74 (17.0) (436)	104 (23.2) (449)

Occupational Category	Group	No in 1982			
		n in 1997	Number (%) Yes in 1997	Adj. Relative Risk (95% C.I.)^a	p-Value^a
<i>All</i>	<i>Ranch Hand</i>	<i>766</i>	<i>169 (22.1)</i>	<i>1.07 (0.84,1.35)</i>	<i>0.585</i>
	<i>Comparison</i>	<i>905</i>	<i>190 (21.0)</i>		
Officer	Ranch Hand	287	62 (21.6)	0.90 (0.62,1.32)	0.601
	Comparison	345	80 (23.2)		
Enlisted Flyer	Ranch Hand	136	32 (23.5)	1.02 (0.58,1.78)	0.953
	Comparison	137	32 (23.4)		
Enlisted Groundcrew	Ranch Hand	343	75 (21.9)	1.26 (0.88,1.80)	0.202
	Comparison	423	78 (18.4)		

^a Relative risk, confidence interval, and p-values are in reference to a contrast of 1982 and 1997 results; results adjusted for age in 1997.

Note: Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a benign systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

Table 10-39. Longitudinal Analysis of Benign Systemic Neoplasms (Continued)

(b) MODEL 2: RANCH HANDS — INITIAL DIOXIN					
Initial Dioxin	Number (%) Yes/(n)				
	Examination				
	1982	1985	1987	1992	1997
Low	11 (7.3) (150)	15 (10.2) (147)	24 (16.1) (149)	25 (17.2) (145)	41 (27.3) (150)
Medium	11 (7.0) (158)	16 (10.3) (155)	18 (11.6) (155)	27 (17.4) (155)	38 (24.1) (158)
High	5 (3.3) (152)	14 (9.4) (149)	20 (13.6) (147)	27 (18.1) (149)	42 (27.6) (152)

Initial Dioxin Category Summary Statistics			Analysis Results for Log₂ (Initial Dioxin)^a	
Initial Dioxin	No in 1982		Adj. Relative Risk (95% C.I.)^b	p-Value
	n in 1997	Number (%) Yes in 1997		
Low	139	30 (21.6)	1.16 (0.97,1.38)	0.114
Medium	147	27 (18.4)		
High	147	37 (25.2)		

^a Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

^b Relative risk for a twofold increase in initial dioxin.

Notes: Low = 27-63 ppt; Medium = >63-152 ppt; High = >152 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a benign systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

(c) MODEL 3: RANCH HANDS AND COMPARISONS BY DIOXIN CATEGORY					
Dioxin Category	Number (%) Yes/(n)				
	Examination				
	1982	1985	1987	1992	1997
Comparison	66 (7.0) (946)	95 (10.2) (931)	128 (13.9) (923)	172 (18.6) (927)	251 (26.5) (946)
Background RH	17 (4.9) (344)	24 (7.1) (336)	48 (14.6) (328)	65 (19.5) (334)	90 (26.2) (344)
Low RH	17 (7.6) (225)	25 (11.4) (219)	34 (15.3) (222)	37 (17.0) (218)	57 (25.3) (225)
High RH	10 (4.3) (235)	20 (8.6) (232)	28 (12.2) (229)	42 (18.2) (231)	64 (27.2) (235)
Low plus High RH	27 (5.9) (460)	45 (10.0) (451)	62 (13.8) (451)	79 (17.6) (449)	121 (26.3) (460)

Table 10-39. Longitudinal Analysis of Benign Systemic Neoplasms (Continued)

Dioxin Category	No in 1982		Adj. Relative Risk (95% C.I.) ^{ab}	p-Value ^b
	n in 1997	Number (%) Yes in 1997		
Comparison	880	185 (21.0)		
Background RH	327	73 (22.3)	1.05 (0.77,1.43)	0.754
Low RH	208	40 (19.2)	0.85 (0.58,1.25)	0.413
High RH	225	54 (24.0)	1.30 (0.91,1.85)	0.144
Low plus High RH	433	94 (21.7)	1.06 (0.80,1.41)	0.679

^a Relative risk and confidence interval relative to Comparisons.

^b Adjusted for percent body fat at the time of the blood measurement of dioxin and age in 1997.

Note: RH = Ranch Hand.

Comparison: 1987 Dioxin \leq 10 ppt.

Background (Ranch Hand): 1987 Dioxin \leq 10 ppt.

Low (Ranch Hand): 1987 Dioxin $>$ 10 ppt, 10 ppt $<$ Initial Dioxin \leq 94 ppt.

High (Ranch Hand): 1987 Dioxin $>$ 10 ppt, Initial Dioxin $>$ 94 ppt.

Summary statistics for 1985 are provided for reference purposes for participants who attended the 1982, 1985, and 1997 examinations. Summary statistics for 1987 are provided for reference purposes for participants who attended the 1982, 1987, and 1997 examinations. Summary statistics for 1992 are provided for reference purposes for participants who attended the 1982, 1992, and 1997 examinations. Statistical analyses are based only on participants who did not have a benign systemic neoplasm in 1982 (see Chapter 7, Statistical Methods).

10.3 DISCUSSION

In ambulatory medicine, the recommendation that asymptomatic individuals undergo periodic physical examinations is based largely on the assumption that such screening may reveal occult malignancy. Although the guidelines for the frequency and content of such examinations are subject to debate, there is no doubt that early detection affords the best and, in most forms of cancer, the only chance for cure. While no one screening test is absolutely reliable, the scope and depth of the protocol employed in this longitudinal study far exceed that considered routine in clinical practice.

As the anatomic point of contact with industrial toxins and as the only organ system with a clearly defined clinical endpoint (i.e., chloracne) for dioxin exposure, the skin deserves the special emphasis it has received in this study. Although there is no evidence that dioxin exposure causes—or that chloracne is associated with—basal cell carcinomas, the Ranch Hand cohort was found to be at increased risk for the occurrence of these skin cancers in the 1982, 1985, 1987, and 1992 AFHS examinations. As in previous examinations, skin lesions considered to be suggestive of skin cancer were biopsied. Although blind to the participant exposure status, examiners performed a similar number of biopsies in the Ranch Hand (54 out of 869, or 6.2%) and Comparison (68 out of 1,251, or 5.4%) cohorts.

Consistent with each of the preceding examinations, Ranch Hands continued to have a slightly higher history of benign and malignant skin neoplasms than Comparisons, including that of basal cell skin cancers at all sites (15.0% of Ranch Hands vs. 13.3% of Comparisons). In neither the current nor the 1992 examination were the group differences significant. Further, although the statistical significance varied, in all of the exposure analyses employing initial and 1987 serum dioxin levels, an inverse dose-response relation was documented with basal cell skin cancers decreasing as the level of serum dioxin

increased. The current results are consistent with results of the exposure analyses from both the 1987 and 1992 examinations. Once again, although group differences were not statistically significant, cutaneous melanoma and squamous cell skin cancers were greater in Ranch Hands than in Comparisons.

In the 1987 examination, one of the few statistically significant findings was an increase of benign systemic neoplasms in the Ranch Hand cohort relative to Comparisons (10.2% vs. 4.1%) in a pattern consistent with a dose-response effect. In the 1992 and 1997 examinations, the occurrence of benign systemic neoplasms was close to equal in both cohorts (16.4% vs. 15.6% and 25.4% vs. 24.1%, respectively), and in neither study did the exposure analyses reveal any association with either initial or 1987 serum dioxin levels.

Consistent with all previous examinations, the overall history of systemic malignancies at all sites combined was similar in the Ranch Hand and Comparison cohorts. In two specific diagnostic categories, statistically significant group differences were noted to the adverse effect of Ranch Hands. Malignancies of the kidney and bladder and of the bronchus and lung were more common in Ranch Hands than in Comparisons (1.3% vs. 0.5% and 1.2% vs. 0.2%, respectively). In neither case did the exposure analyses reveal any evidence for a dose-response effect associated with prior exposure to dioxin. Hodgkin's disease, non-Hodgkin's lymphoma, and STS, widely regarded as related to dioxin exposure, were both rare and less prevalent in Ranch Hands than in Comparisons (0.1% vs. 0.2% of each of Hodgkin's disease and non-Hodgkin's lymphoma). Five participants in the 1997 examination (two Ranch Hands and three Comparisons) had been diagnosed as having STS. One of the Ranch Hands was an officer with a dioxin level of 9.7 ppt measured in blood collected in 1987 and the other was an enlisted groundcrew member with a dioxin level of 124.9 ppt measured in blood collected in 1982. The three Comparisons were an enlisted flyer with a dioxin level of 4.9 ppt measured in blood collected in 1992, an enlisted groundcrew member with a dioxin level of 2.4 ppt measured in blood collected in 1987, and an officer with a dioxin level of 6.7 ppt measured in blood collected in 1987. An additional Ranch Hand with STS died subsequent to the 1985 AFHS physical examination and had no dioxin measurement. The prevalence of STS among participants who attended the 1997 physical is 2 out of 870 (0.23%) among Ranch Hands and 3 out of 1,251 (0.24%) among Comparisons. The prevalence of STS among all participants who were compliant to at least one examination, regardless of the presence or absence of dioxin levels (Ranch Hand n=1,111, Comparison n=1,571), is 3 out of 1,111, (0.27%) among Ranch Hands and 3 out of 1,571 (0.19%) among Comparisons (relative risk=1.41, 95% confidence interval: [0.29,6.99]).

The 1992 examination was the first to incorporate PSA into the study protocol. This diagnostic test has proven highly valuable in the early detection of silent prostate cancer. Related to development of benign enlargement of the prostate gland, with age a gradual rise in this index over time would be anticipated and was documented in current PSA levels relative to 1992. By discrete and continuous analyses, PSA levels were similar in Ranch Hands and Comparisons and prostate cancer in the two cohorts was nearly identical. Further, in all exposure analyses, there was no association between prostate cancer and either initial or 1987 serum dioxin levels.

Dependent variable-covariate associations confirm the increased risk of various systemic cancers in association with well established risk factors including age, cigarette use, and alcohol consumption. Eye and hair color, fair complexion, age, and residence in southern latitudes all contributed strongly to risk for the development of basal cell skin cancers. Cigarette use and alcohol consumption were strongly associated with the occurrence of bladder and lung cancer. A significant increase in prostate and basal cell skin cancers was noted in officers relative to the enlisted occupational strata. These findings are more likely to have a socio-economic than biologic basis and may reflect more frequent dermatological examinations and PSA screenings by officers relative to enlisted men.

At the end of 15 years of surveillance, Ranch Hands as a group exhibited a nonsignificant increase in the risk of malignant neoplastic disease relative to Comparisons (relative risk=1.06, 95% confidence interval: [0.80,1.41]). Contrasts by military occupation were inconsistent and, therefore, not supportive of an adverse effect of herbicide or dioxin exposure on the occurrence of malignancies. Ranch Hand enlisted groundcrew, the occupation with the highest dioxin levels and, presumably, the highest herbicide exposure, exhibited a decreased prevalence (relative risk=0.78, 95% confidence interval: [0.51,1.19]). Enlisted flyers (relative risk=1.63, 95% confidence interval: [0.91,2.92]), and officers (relative risk=1.14, 95% confidence interval: [0.79,1.65]), occupations with lower dioxin levels, exhibited nonsignificant increases in the prevalence of malignant disease. The risk of malignant disease was not significantly increased among Ranch Hands having the highest dioxin levels (relative risk=1.01, 95% confidence interval: [0.66,1.57]). Longitudinal analyses found no significant group differences with regard to the risk of malignancy and no pattern suggestive of an adverse relation between herbicide or dioxin exposure and the occurrence of malignant neoplastic disease.

10.4 SUMMARY

Skin and systemic neoplasms, verified from a medical records review, and PSA were examined in the neoplasia assessment. Each health endpoint was examined for an association with exposure group (Model 1), initial dioxin (Model 2), categorized dioxin (Model 3), and 1987 dioxin levels (Model 4). Complete adjusted analyses were limited for many of the site-specific malignant systemic neoplasms because of the sparse number of neoplasms.

10.4.1 Model 1: Group Analysis

Several significant results were observed in the Model 1 adjusted analysis of the neoplasia endpoints. Each significant result showed more Ranch Hands than Comparisons with the specific skin or systemic type neoplasm; however, no significant results were found within the enlisted groundcrew stratum, the military occupational category believed to have been, on average, the most heavily exposed. Significantly more Ranch Hands than Comparisons had skin neoplasms (all types combined). This finding was true for officers and enlisted flyers, as well as all occupations combined. Ranch Hand enlisted flyers had a marginally significant increase in malignant skin neoplasms in relation to Comparison enlisted flyers. An increase in benign skin neoplasms was observed in Ranch Hands over Comparisons, both when combining all occupations and when restricted to officers. Ranch Hand enlisted flyers exhibited an increase in basal cell carcinoma in relation to Comparison enlisted flyers. This result was primarily because of a marginally significant increase of basal cell carcinoma on the ear, face, head, or neck. Ranch Hand enlisted flyers showed an increase of nonmelanoma relative to Comparisons. This result also was primarily because of the increase in basal cell carcinoma in Ranch Hand enlisted flyers. Ranch Hands showed a marginally significant increase over Comparisons in malignant systemic neoplasms of the bronchus and lung and of the kidney and bladder. Complete results of the Model 1 analyses are shown in Table 10-40.

Table 10-40. Summary of Group Analysis (Model 1) for Neoplasia Variables (Ranch Hands vs. Comparisons)

Variable	UNADJUSTED			
	All	Officer	Enlisted Flyer	Enlisted Groundcrew
Medical Records				
Any Skin Neoplasm	+0.007	+0.034	+0.040	NS
Malignant Skin Neoplasm	NS	NS	NS*	ns
Benign Skin Neoplasm	+0.010	+0.031	NS	NS
Skin Neoplasm of Uncertain Behavior or Unspecified Nature	NS	ns	ns	NS
Any Basal Cell Carcinoma	NS	NS	NS*	ns
Basal Cell Carcinoma on Eye, Ear, Face, Head, and Neck	NS	NS	NS	ns
Basal Cell Carcinoma on Trunk	NS	NS	NS	ns
Basal Cell Carcinoma on Upper Extremities	ns	NS	ns	ns
Basal Cell Carcinoma on Lower Extremities	NS	NS	--	ns
Squamous Cell Carcinoma	NS	NS	NS	NS
Nonmelanoma	NS	NS	+0.042	ns
Melanoma	NS	NS	ns	NS
Any Systemic Neoplasm	NS	ns	NS	NS
Malignant Systemic Neoplasm	NS	NS	+0.049	NS
Benign Systemic Neoplasm	NS	ns	NS	NS
Systemic Neoplasm of Uncertain Behavior or Unspecified Nature	ns	NS	ns	ns
Malignant Systemic Neoplasm of Eye, Ear, Face, Head, and Neck	NS	NS	ns	ns
Malignant Systemic Neoplasm of Oral Cavity, Pharynx, and Larynx	ns	NS	ns	ns
Malignant Systemic Neoplasm of Thymus, Heart, and Mediastinum	NS	NS	--	NS
Malignant Systemic Neoplasm of Thyroid Gland	NS	NS	--	ns
Malignant Systemic Neoplasm of Bronchus and Lung	+0.008	NS	NS	NS
Malignant Systemic Neoplasm of Liver	NS	ns	NS	NS
Malignant Systemic Neoplasm of Colon and Rectum	NS	NS	NS	ns
Malignant Systemic Neoplasm of Kidney and Bladder	+0.046	NS	NS	NS
Malignant Systemic Neoplasm of Prostate	ns	ns	NS	ns
Malignant Systemic Neoplasm of Testicles	NS	NS	NS	NS
Malignant Systemic Neoplasm of Connective and Other Soft Tissues	ns	--	NS	ns
Hodgkin's Disease	ns	ns	--	ns
Non-Hodgkin's Lymphoma	ns	ns	--	NS

Table 10-40. Summary of Group Analysis (Model 1) for Neoplasia Variables (Ranch Hands vs. Comparisons) (Continued)

Variable	UNADJUSTED			
	All	Officer	Enlisted Flyer	Enlisted Groundcrew
Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue	ns	ns	ns	NS
All Malignant Skin and Systemic Neoplasms	NS*	NS	+0.034	ns
All Skin and Systemic Neoplasms	+0.014	NS*	NS	NS
Laboratory				
Prostate-Specific Antigen (C)	ns	ns	NS	ns
Prostate-Specific Antigen (D)	NS	NS*	ns	ns

Notes: NS or ns: Not significant ($p > 0.10$).

NS*: Marginally significant ($0.05 < p \leq 0.10$).

C: Continuous analysis.

D: Discrete analysis.

+: Relative risk ≥ 1.00 .

--: Analysis not performed because of the sparse number of participants with an abnormality.

P-value given if $p \leq 0.05$.

A capital "NS" denotes a relative risk of 1.00 or greater for discrete analysis or differences of means nonnegative for continuous analysis. A lowercase "ns" denotes a relative risk less than 1.00 for discrete analysis or difference of means negative for continuous analysis.

Variable	ADJUSTED			
	All	Officer	Enlisted Flyer	Enlisted Groundcrew
Medical Records				
Any Skin Neoplasm	+0.005	+0.030	+0.040	NS
Malignant Skin Neoplasm	NS	NS	NS*	ns
Benign Skin Neoplasm	+0.011	+0.035	NS	NS
Skin Neoplasm of Uncertain Behavior or Unspecified Nature	NS	--	--	NS
Any Basal Cell Carcinoma	NS	NS	+0.046	ns
Basal Cell Carcinoma on Eye, Ear, Face, Head, and Neck	NS	NS	NS*	ns
Basal Cell Carcinoma on Trunk	NS	NS	NS	ns
Basal Cell Carcinoma on Upper Extremities	ns	ns	ns	ns
Basal Cell Carcinoma on Lower Extremities	NS	NS	--	ns
Squamous Cell Carcinoma	NS	NS	NS	NS
Nonmelanoma	NS	NS	+0.035	ns
Melanoma	NS	NS	--	NS
Any Systemic Neoplasm	ns	ns	ns	ns
Malignant Systemic Neoplasm	NS	NS	NS	ns
Benign Systemic Neoplasm	ns	ns	ns	NS
Systemic Neoplasm of Uncertain Behavior or Unspecified Nature	ns	ns	ns	ns

Table 10-40. Summary of Group Analysis (Model 1) for Neoplasia Variables (Ranch Hands vs. Comparisons) (Continued)

Variable	ADJUSTED			
	All	Officer	Enlisted Flyer	Enlisted Groundcrew
Malignant Systemic Neoplasm of Eye, Ear, Face, Head, and Neck	ns	NS	ns	ns
Malignant Systemic Neoplasm of Oral Cavity, Pharynx, and Larynx	ns	NS	ns	ns
Malignant Systemic Neoplasm of Thymus, Heart, and Mediastinum	--	--	--	--
Malignant Systemic Neoplasm of Thyroid Gland	NS	NS	--	--
Malignant Systemic Neoplasm of Bronchus and Lung	NS*	NS	NS	--
Malignant Systemic Neoplasm of Liver	NS	--	--	NS
Malignant Systemic Neoplasm of Colon and Rectum	NS	NS	NS	ns
Malignant Systemic Neoplasm of Kidney and Bladder	NS*	NS	--	NS
Malignant Systemic Neoplasm of Prostate	ns	ns	NS	ns
Malignant Systemic Neoplasm of Testicles	--	--	--	--
Malignant Systemic Neoplasm of Connective and Other Soft Tissues	ns	--	--	--
Hodgkin's Disease	ns	ns	--	--
Non-Hodgkin's Lymphoma	ns	--	--	ns
Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue	ns	ns	--	NS
All Malignant Skin and Systemic Neoplasms	NS	NS	NS	ns
All Skin and Systemic Neoplasms	NS	NS	NS	ns
Laboratory				
Prostate-Specific Antigen (C)	NS	ns	NS	NS
Prostate-Specific Antigen (D)	NS	NS	ns	ns

Notes: NS or ns: Not significant ($p > 0.10$).

NS*: Marginally significant ($0.05 < p \leq 0.10$).

C: Continuous analysis.

D: Discrete analysis.

+: Relative risk ≥ 1.00 .

--: Analysis not performed because of the sparse number of participants with an abnormality.

P-value given if $p \leq 0.05$.

A capital "NS" denotes a relative risk of 1.00 or greater for discrete analysis or differences of means nonnegative for continuous analysis. A lowercase "ns" denotes a relative risk less than 1.00 for discrete analysis or difference of means negative for continuous analysis.

10.4.2 Model 2: Initial Dioxin Analysis

The Model 1 group analysis showed significant Ranch Hand increases in the history of neoplasms relative to Comparisons. In contrast, analysis of the association of initial dioxin with neoplasms within Ranch Hands showed several significant results, but all dose-response relations were inverse in nature. As initial dioxin increased, the occurrence of a neoplasm decreased. Significant inverse dose-response related to skin neoplasms included all skin neoplasms, benign skin neoplasms, basal cell carcinoma, and basal cell carcinoma on the ear, face, head, and neck. The analysis of nonmelanoma was marginally significant.

The analysis of malignant systemic neoplasms of the thyroid gland was marginally significant, but this type of neoplasm decreased as initial dioxin increased. The prevalence of high PSA levels also decreased as initial dioxin increased. Results of all Model 2 analyses are shown in Table 10-41.

Table 10-41. Summary of Initial Dioxin Analysis (Model 2) for Neoplasia Variables (Ranch Hands Only)

Variable	Unadjusted	Adjusted
Medical Records		
Any Skin Neoplasm	-0.001	-0.028
Malignant Skin Neoplasm	-0.015	ns
Benign Skin Neoplasm	-0.022	-0.020
Skin Neoplasm of Uncertain Behavior or Unspecified Nature	ns	ns
Any Basal Cell Carcinoma	<-0.001	-0.014
Basal Cell Carcinoma on Eye, Ear, Face, Head, and Neck	<-0.001	-0.003
Basal Cell Carcinoma on Trunk	ns	NS
Basal Cell Carcinoma on Upper Extremities	-0.024	ns
Basal Cell Carcinoma on Lower Extremities	NS	NS
Squamous Cell Carcinoma	ns	ns
Nonmelanoma	-0.003	ns*
Melanoma	NS	NS
Any Systemic Neoplasm	ns	NS
Malignant Systemic Neoplasm	-0.001	ns
Benign Systemic Neoplasm	NS	ns
Systemic Neoplasm of Uncertain Behavior or Unspecified Nature	ns	NS
Malignant Systemic Neoplasm of Eye, Ear, Face, Head, and Neck	ns*	ns
Malignant Systemic Neoplasm of Oral Cavity, Pharynx, and Larynx	ns	NS
Malignant Systemic Neoplasm of Thymus, Heart, and Mediastinum	--	--
Malignant Systemic Neoplasm of Thyroid Gland	-0.046	ns*
Malignant Systemic Neoplasm of Bronchus and Lung	-0.030	ns
Malignant Systemic Neoplasm of Liver	NS	NS
Malignant Systemic Neoplasm of Colon and Rectum	ns	ns
Malignant Systemic Neoplasm of Kidney and Bladder	ns	NS

Table 10-41. Summary of Initial Dioxin Analysis (Model 2) for Neoplasia Variables (Ranch Hands Only) (Continued)

Variable	Unadjusted	Adjusted
Malignant Systemic Neoplasm of Prostate	-0.007	ns
Malignant Systemic Neoplasm of Testicles	ns	ns
Malignant Systemic Neoplasm of Connective and Other Soft Tissues	NS	NS
Hodgkin's Disease	--	--
Non-Hodgkin's Lymphoma	--	--
Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue	--	--
All Malignant Skin and Systemic Neoplasms	-0.001	ns
All Skin and Systemic Neoplasms	-0.017	ns
Laboratory		
Prostate-Specific Antigen (C)	-0.010	ns
Prostate-Specific Antigen (D)	<-0.001	-0.014

Notes: NS or ns: Not significant ($p > 0.10$).

ns*: Marginally significant ($0.05 < p \leq 0.10$).

C: Continuous analysis.

D: Discrete analysis.

--: Relative risk < 1.00 for discrete analysis; slope negative for continuous analysis.

--: Analysis not performed because of the sparse number of Ranch Hands with an abnormality.

P-value given if $p \leq 0.05$.

A capital "NS" denotes a relative risk of 1.00 or greater. A lowercase "ns" denotes a relative risk less than 1.00 for discrete analysis or slope negative for continuous analysis.

10.4.3 Model 3: Categorized Dioxin Analysis

The unadjusted analysis of the skin neoplasia variables revealed several significant results. A significant increase of Ranch Hands in the background category relative to Comparisons was seen for all skin neoplasms combined and benign skin neoplasm. Only one contrast of Ranch Hands in the high dioxin category with Comparisons exhibited a marginally significant increase (neoplasm of the liver). Most significant results showed an increase in neoplasms of Ranch Hands in the low dioxin category relative to Comparisons. Significant or marginally significant increases of skin neoplasms in Ranch Hands in the low dioxin category were seen for all skin neoplasms, malignant skin neoplasms, basal cell carcinoma (primarily eye, ear, face, head, or neck) and nonmelanoma.

Similar to the skin neoplasm analyses, most results that were significant or marginally significant for the systemic neoplasm analyses were from the contrast of Ranch Hands in the low dioxin category with Comparisons. Any malignant systemic neoplasm, a malignant systemic neoplasm of bronchus and lung, a malignant systemic neoplasm of kidney and bladder, and a malignant systemic neoplasm of testicles were increased in Ranch Hands in the low dioxin category relative to Comparisons. In addition, an increase in all malignant skin and systemic neoplasms was observed for Ranch Hands in the low dioxin category. Complete results of the Model 3 analyses are shown in Table 10-42.

Table 10-42. Summary of Categorized Dioxin Analysis (Model 3) for Neoplasia Variables (Ranch Hands vs. Comparisons)

Variable	UNADJUSTED			
	Background Ranch Hands vs. Comparisons	Low Ranch Hands vs. Comparisons	High Ranch Hands vs. Comparisons	Low plus High Ranch Hands vs. Comparisons
Medical Records				
Any Skin Neoplasm	+0.001	+0.005	ns	NS
Malignant Skin Neoplasm	NS	+0.023	ns	NS
Benign Skin Neoplasm	+<0.001	NS	ns	NS
Skin Neoplasm of Uncertain Behavior or Unspecified Nature	ns	NS	NS	NS
Any Basal Cell Carcinoma	NS	+0.012	ns	NS
Basal Cell Carcinoma on Eye, Ear, Face, Head, and Neck	NS	+0.020	ns	NS
Basal Cell Carcinoma on Trunk	NS	NS	ns	NS
Basal Cell Carcinoma on Upper Extremities	ns	NS	ns	ns
Basal Cell Carcinoma on Lower Extremities	NS	NS	ns	ns
Squamous Cell Carcinoma Nonmelanoma	NS	NS	ns	NS
Melanoma	NS	+0.034	ns	NS
Any Systemic Neoplasm	ns	NS*	NS	NS
Malignant Systemic Neoplasm	ns	+<0.001	ns	NS
Benign Systemic Neoplasm	NS	NS	NS	NS
Systemic Neoplasm of Uncertain Behavior or Unspecified Nature	NS	NS	ns	ns
Malignant Systemic Neoplasm of Eye, Ear, Face, Head, and Neck	ns	NS	ns	NS
Malignant Systemic Neoplasm of Oral Cavity, Pharynx, and Larynx	ns	NS	ns	NS
Malignant Systemic Neoplasm of Thymus, Heart, and Mediastinum	NS*	--	--	--
Malignant Systemic Neoplasm of Thyroid Gland	ns	NS*	ns	NS
Malignant Systemic Neoplasm of Bronchus and Lung	NS	+<0.001	ns	+0.003
Malignant Systemic Neoplasm of Liver	ns	ns	NS*	NS
Malignant Systemic Neoplasm of Colon and Rectum	ns	NS*	ns	NS
Malignant Systemic Neoplasm of Kidney and Bladder	NS	+0.015	NS	NS*
Malignant Systemic Neoplasm of Prostate	ns	NS	ns	ns
Malignant Systemic Neoplasm of Testicles	--	+0.024	NS	+0.034
Malignant Systemic Neoplasm of Connective and Other Soft Tissues	ns	ns	NS	NS
Hodgkin's Disease	ns	ns	ns	ns
Non-Hodgkin's Lymphoma	ns	ns	ns	ns

Table 10-42. Summary of Categorized Dioxin Analysis (Model 3) for Neoplasia Variables (Ranch Hands vs. Comparisons) (Continued)

Variable	UNADJUSTED			
	Background Ranch Hands vs. Comparisons	Low Ranch Hands vs. Comparisons	High Ranch Hands vs. Comparisons	Low plus High Ranch Hands vs. Comparisons
Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue	NS	ns	ns	ns
All Malignant Skin and Systemic Neoplasms	NS	+<0.001	ns	NS
All Skin and Systemic Neoplasms	+0.030	+0.007	NS	NS*
Laboratory				
Prostate-Specific Antigen (C)	ns	NS	ns*	ns
Prostate-Specific Antigen (D)	ns	+0.040	ns	NS

Notes: NS or ns: Not significant ($p > 0.10$).

NS* or ns*: Marginally significant ($0.05 < p \leq 0.10$).

C: Continuous analysis.

D: Discrete analysis.

+: Relative risk ≥ 1.00 .

--: Analysis not performed because of the sparse number of participants with an abnormality.

P-value given if $p \leq 0.05$.

A capital “NS” denotes a relative risk of 1.00 or greater for discrete analysis or differences of means nonnegative for continuous analysis. A lowercase “ns” denotes a relative risk less than 1.00 for discrete analysis or difference of means negative for continuous analysis.

Variable	ADJUSTED			
	Background Ranch Hands vs. Comparisons	Low Ranch Hands vs. Comparisons	High Ranch Hands vs. Comparisons	Low plus High Ranch Hands vs. Comparisons
Medical Records				
Any Skin Neoplasm	+0.004	+0.011	NS	NS*
Malignant Skin Neoplasm	NS	NS*	NS	NS
Benign Skin Neoplasm	+0.001	NS	ns	NS
Skin Neoplasm of Uncertain Behavior or Unspecified Nature	ns	NS	ns	NS
Any Basal Cell Carcinoma	NS	+0.026	ns	NS
Basal Cell Carcinoma on Eye, Ear, Face, Head, and Neck	NS	NS*	ns	NS
Basal Cell Carcinoma on Trunk	ns	NS	NS	NS
Basal Cell Carcinoma on Upper Extremities	ns	ns	ns	ns
Basal Cell Carcinoma on Lower Extremities	NS	ns	NS	ns
Squamous Cell Carcinoma	NS	NS	NS	NS
Nonmelanoma	NS	NS*	NS	NS
Melanoma	NS	NS	NS	NS*
Any Systemic Neoplasm	ns*	ns	ns	ns
Malignant Systemic Neoplasm	ns	+0.012	ns	NS
Benign Systemic Neoplasm	ns	ns	NS	ns
Systemic Neoplasm of Uncertain Behavior or Unspecified Nature	ns	ns	ns	ns

Table 10-42. Summary of Categorized Dioxin Analysis (Model 3) for Neoplasia Variables (Ranch Hands vs. Comparisons) (Continued)

Variable	ADJUSTED			
	Background Ranch Hands vs. Comparisons	Low Ranch Hands vs. Comparisons	High Ranch Hands vs. Comparisons	Low plus High Ranch Hands vs. Comparisons
Malignant Systemic Neoplasm of Eye, Ear, Face, Head, and Neck	ns	NS	ns	ns
Malignant Systemic Neoplasm of Oral Cavity, Pharynx, and Larynx	ns	NS	ns	ns
Malignant Systemic Neoplasm of Thymus, Heart, and Mediastinum	--	--	--	--
Malignant Systemic Neoplasm of Thyroid Gland	--	NS	--	--
Malignant Systemic Neoplasm of Bronchus and Lung	NS	+0.008	--	--
Malignant Systemic Neoplasm of Liver	--	--	NS*	--
Malignant Systemic Neoplasm of Colon and Rectum	ns	NS	ns	NS
Malignant Systemic Neoplasm of Kidney and Bladder	NS	+0.044	NS	NS*
Malignant Systemic Neoplasm of Prostate	ns*	ns	ns	ns
Malignant Systemic Neoplasm of Testicles	--	--	--	--
Malignant Systemic Neoplasm of Connective and Other Soft Tissues	--	--	NS	--
Hodgkin's Disease	ns	--	--	--
Non-Hodgkin's Lymphoma	ns	--	--	--
Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue	NS	--	--	--
All Malignant Skin and Systemic Neoplasms	ns	+0.035	NS	NS
All Skin and Systemic Neoplasms	NS	NS	ns	NS
Laboratory				
Prostate-Specific Antigen (C)	ns	NS	NS	NS
Prostate-Specific Antigen (D)	ns	NS	NS	NS

Notes: NS or ns: Not significant ($p > 0.10$).

NS* or ns*: Marginally significant ($0.05 < p \leq 0.10$).

C: Continuous analysis.

D: Discrete analysis.

+: Relative risk ≥ 1.00 .

--: Analysis not performed because of the sparse number of participants with an abnormality.

P-value given if $p \leq 0.05$.

A capital "NS" denotes a relative risk of 1.00 or greater for discrete analysis or differences of means nonnegative for continuous analysis. A lowercase "ns" denotes a relative risk less than 1.00 for discrete analysis or difference of means negative for continuous analysis.

10.4.4 Model 4: 1987 Dioxin Analysis

Results from the adjusted 1987 dioxin analysis of neoplasms showed few significant results. As 1987 dioxin increased, significant increases in basal cell carcinoma on the trunk and a malignant neoplasm of the liver were found. Significant decreases with increasing levels of 1987 dioxin were found for benign skin neoplasms and a malignant neoplasm of the thymus, heart, or mediastinum. Other results that were significant in the unadjusted analysis were nonsignificant after adjustment for covariates. Results of all analyses of 1987 dioxin are provided in Table 10-43.

Table 10-43. Summary of 1987 Dioxin Analysis (Model 4) for Neoplasia Variables (Ranch Hands Only)

Variable	Unadjusted	Adjusted
Medical Records		
Any Skin Neoplasm	-0.012	ns
Malignant Skin Neoplasm	ns	NS
Benign Skin Neoplasm	-0.003	-0.005
Skin Neoplasm of Uncertain Behavior or Unspecified Nature	NS	NS
Any Basal Cell Carcinoma	-0.037	ns
Basal Cell Carcinoma on Eye, Ear, Face, Head, and Neck	-0.021	ns
Basal Cell Carcinoma on Trunk	ns	+0.016
Basal Cell Carcinoma on Upper Extremities	ns	NS
Basal Cell Carcinoma on Lower Extremities	ns	ns
Squamous Cell Carcinoma	ns	NS
Nonmelanoma	ns*	NS
Melanoma	NS	NS
Any Systemic Neoplasm	NS	NS
Malignant Systemic Neoplasm	ns	NS
Benign Systemic Neoplasm	NS	NS
Systemic Neoplasm of Uncertain Behavior or Unspecified Nature	ns	NS
Malignant Systemic Neoplasm of Eye, Ear, Face, Head, and Neck	ns	NS
Malignant Systemic Neoplasm of Oral Cavity, Pharynx, and Larynx	NS	NS
Malignant Systemic Neoplasm of Thymus, Heart, and Mediastinum	-0.038	-0.017
Malignant Systemic Neoplasm of Thyroid Gland	ns	ns
Malignant Systemic Neoplasm of Bronchus and Lung	ns	NS
Malignant Systemic Neoplasm of Liver	NS*	+0.042
Malignant Systemic Neoplasm of Colon and Rectum	NS	NS
Malignant Systemic Neoplasm of Kidney and Bladder	NS	NS
Malignant Systemic Neoplasm of Prostate	ns	ns
Malignant Systemic Neoplasm of Testicles	NS	NS
Malignant Systemic Neoplasm of Connective and Other Soft Tissues	NS	NS
Hodgkin's Disease	ns	ns

Table 10-43. Summary of 1987 Dioxin Analysis (Model 4) for Neoplasia Variables (Ranch Hands Only) (Continued)

Variable	Unadjusted	Adjusted
Non-Hodgkin's Lymphoma	ns	ns
Other Malignant Systemic Neoplasms of Lymphoid and Histiocytic Tissue	ns	ns
All Malignant Skin and Systemic Neoplasms	ns	NS
All Skin and Systemic Neoplasms	ns	ns
Laboratory		
Prostate-Specific Antigen (C)	-0.043	ns
Prostate-Specific Antigen (D)	ns	NS

Notes: NS or ns: Not significant ($p > 0.10$).

NS* or ns*: Marginally significant ($0.05 < p \leq 0.10$).

C: Continuous analysis.

D: Discrete analysis.

+: Relative risk ≥ 1.00 .

-: Relative risk < 1.00 for discrete analysis; slope negative for continuous analysis.

P-value given if $p \leq 0.05$.

A capital "NS" denotes a relative risk of 1.00 or greater. A lowercase "ns" denotes a relative risk less than 1.00 for discrete analysis or slope negative for continuous analysis.

10.5 CONCLUSION

Several analyses showed significantly more Ranch Hands than Comparisons with a history of malignant skin or systemic neoplasms; however, no significant results were found within the enlisted groundcrew stratum, the military occupational category believed to have been, on average, the most heavily exposed. When the association between initial dioxin and malignant neoplasms was examined within Ranch Hands, the neoplasm occurrence decreased as initial dioxin increased. A significant increase of malignant neoplasms for Ranch Hands in the low dioxin category relative to Comparisons was observed, but there was no such increase in Ranch Hands in the high dioxin category. In summary, at the end of 15 years of surveillance, Ranch Hands do not exhibit a significantly increased risk for neoplastic disease, nor do they show a positive dose-response relation between dioxin and malignant neoplastic conditions.

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