

Cancer Incidence in the United Farmworkers of America (UFW), 1987-1997

Paul K. Mills, Ph.D. and Sandy Kwong, M.P.H.

Cancer Registry of Central California
1320 E. Shaw Ave. Suite 160
Fresno, CA 93710
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Abstract

The purpose of this study was to evaluate cancer incidence in the membership a largely Hispanic farmworker labor union in California, the United Farmworkers of America (UFW) and to examine cancer-site specific distributions as well as histology and stage of cancer at diagnosis in this group. In addition, the relation between time since first joining the union and cancer risk was evaluated.

An electronic record linkage was conducted between a membership roster of the UFW and the database of the California Cancer Registry, the population-based cancer registry in California for the years 1987-1997. Based upon the results of the linkage, morbidity odds ratios were calculated using the distribution of cancer in the California Hispanic population as the reference to determine if risk of specific cancers was higher or lower in the UFW. Also, time since first joining the union was evaluated, as was the proportional distribution of histologic subtypes and stage at diagnosis, again comparing the experience of the UFW membership to the California Hispanic population.

Several types of cancer were elevated in the UFW membership in comparison to the California Hispanic population. Morbidity odds ratios and 95 % confidence limits were elevated for leukemia (O.R.=1.59: 95% C.I.=1.07-2.37), stomach cancer (O.R.=1.69: 95% C.I.=1.24-2.27), uterine cervix cancer (O.R.=1.63: 95% C.I.= 1.11-2.44) and uterine corpus cancer (O.R.=1.68: 95% C.I.= 1.05-2.67). Brain cancer was also elevated although not significantly so (O.R. =1.57: 95% C.I.=0.96-2.53). The histologic distribution of leukemia and brain cancers within the UFW membership did not differ from the distribution in the general California population although small numbers of cancers in the UFW hindered interpretation of these results. Members of the UFW experienced later

stage of disease at diagnosis in comparison to California Hispanics for most major cancer sites but not for breast cancer.

Introduction

Farmers and farmworkers comprise a unique occupational segment of the population. They are exposed to a wide variety of potentially toxic substances in the workplace including solvents, fumes, fertilizers, and ultraviolet radiation in sunlight and pesticides. Unlike workers in other industries, farmers oftentimes live at their workplace and consume many of the products which they produce. Epidemiologic studies have found lower all-cause mortality and lower cancer incidence for all cancer sites combined among farmers compared to the general population which may be attributable to lower smoking prevalence in farmers (Brackbill et al., 1988). However, farmers experience higher risk for several types of cancer. These cancers include leukemia, brain, prostate, skin, non-Hodgkin's lymphoma and others (Zahm et al., 1997).

In the United States previous studies of cancer in farmers have focused primarily on white male farm owners and farm operators in the American mid-west who have been engaged in the cultivation of crops such as corn, wheat and soy which are highly mechanized in nature. The previous studies have not included large numbers of hired farmworkers or minority populations who are often employed on a seasonal basis and who are migratory.

California is the most productive agricultural state in the nation and produces more than twenty billion dollars in various crops and commodities each year. Unlike farms in the mid-West, California farms produce large amounts of vegetables, fruits, nuts, and other labor-intensive crops. Large numbers of farmworkers are needed for the weeding,

pruning and harvesting of crops such as these and between 250,000 and 600,000 hired farmworkers are in California fields depending upon the season of the year. Farmworkers in California are largely of Hispanic ethnicity, are migrants from Mexico, are often undocumented and are poor. They work in the cultivation and harvesting of crops and commodities that are extremely labor intensive (e.g. grapes) and non-mechanized. Exposure potential to agricultural chemicals (e.g. fertilizers and pesticides) are quite high since farmworkers must be in close physical proximity to crops (oftentimes soon after pesticides are applied) and working conditions often preclude the opportunity to wash skin or clothing during work hours. Acute pesticide poisoning incidents are common (MMWR, 1999).

Agricultural labor issues have long been of importance in California because of the need for a plentiful supply of farmworkers to cultivate and harvest crops on a seasonal basis. In order to meet farm labor shortages during the Second World War, for example, the “Bracero” program was initiated. This federal program imported farm laborers from Mexico in order to meet temporary seasonal farm labor needs, after which workers were forced to return to Mexico. However, as farm laborers became organized, particularly in California, labor unions were organized and included the United Farmworkers of America (UFW) which was founded in 1966 by combining the National Farmworkers Association and Agricultural Workers Organizing Committee. This union has represented tens of thousands of California farmworkers including those born in the U.S. and those who are migrants from Mexico.

The state of California has maintained a population-based cancer registry since 1987 and reporting is currently complete through 1997. All residents of California diagnosed with cancer (excluding basal and squamous cell skin cancers and in-situ cancer of the uterine cervix) are accessioned into the registry through review of hospital records, pathology laboratory reports and death certificates. Reporting is more than 95% complete. In this report the results of a cancer registry-based evaluation of cancer in California farmworkers is presented.

Methods

In order to identify a roster of the UFW membership, records of participants in the two benefits programs offered by the union were examined. A roster of “ever” members of the UFW was created from these benefits programs (which are offered to all union members). These programs include the Robert F. Kennedy Medical plan and the Juan De La Cruz Pension Program. The resulting roster created from these programs identified 146,581 farmworkers who had ever been a member of the UFW between 1973 and 1998. Although it is unknown what proportion of the “total” UFW membership is represented by the workers included in the benefits programs it has been estimated that greater than 95% of “ever” UFW members are included in the benefits programs (Blaylock, personal communication, 1999). Early organizing efforts were initiated specifically for the purpose of guaranteeing benefits to the union membership

This roster of farmworkers was electronically linked to the CCR database for the years 1987-1997 using an automated record linkage program (AUTOMATCH). Social security number, first and last name, date of birth, sex, and city of residence were used in the probabilistic linkage program. AUTOMATCH calculates a probability score based on the degree of similarity in the linkage variables. User-defined cutpoints define matches and those which require manual review. (Jaro, 1995). After the computer matching process was complete a number of potential matches were manually reviewed.

The result of the record linkage process identified those members of the UFW were diagnosed with cancer in California between 1988 and 1997. These data were used to calculate morbidity odds ratios (and 95% confidence limits) using data on California Hispanics diagnosed with cancer for the time period 1991-1995 as the reference population. Specifically, the age and sex distribution of cancer of all types in the California Hispanic population was obtained from the California Cancer Registry (Perkins et al., 1998). The age and sex distribution for individual cancer sites was also obtained from this source and, rather than using a proportionate approach, morbidity odds ratios were calculated according to the method suggested by Miettinen (Miettinen and Wang, 1981). Ninety five per cent confidence limits for these adjusted odds ratios were calculated using the method of Cornfield (Cornfield, 1956). Odds ratios were calculated for both sexes combined and on a sex-specific basis for those cancer sites common to both sexes.

Data on first contribution to the benefits programs offered by the union (1973-1997) were utilized to evaluate the association between cancer risk and time at joining the union.

Workers were divided into those joining the union at a relatively early date (1973-1977) and those joining the union in 1978 or later.

Descriptive analyses were also conducted in which the cancers diagnosed among the Hispanic members of the UFW were compared to cancers diagnosed in the general California Hispanic population. Such comparisons were made to evaluate the histology distributions of several types of cancer as well as stage of disease at diagnosis of several types of cancers.

Results

Upon completion of the record linkage, 1001 UFW members were found to be diagnosed with cancer in California between 1987 and 1997. Of this total, 854 (85.3%) were classified as Hispanic by the CCR and 147 (14.7%) were categorized as non-Hispanic. Analyses were subsequently confined to the Hispanic portion of the cancer series since there were not adequate numbers for meaningful analyses in non-Hispanics. Among the Hispanic cases about two thirds (66.5%) were in males and one third were among females.

The largest numbers of cancers diagnosed in the UFW during this time period were due to prostate (168), lung and bronchus (78) uterine cervix (76) and breast cancer (68).

The age distribution of the cancer cases in the UFW is somewhat older than that of cancer in Hispanics in the general population since this is an occupational cohort and no childhood cancers are involved.

Odds Ratio Analysis

The results of the morbidity odds ratio analysis are shown in Table I. Stomach cancer (O.R.=1.69; 95% C.I.: 1.24-2.27) and cancer of the uterine cervix (O.R.=1.63; 95% C.I.: 1.11-2.44) and uterine corpus (O.R.= 1.68; 95% C.I.: 1.05-2.67) were significantly elevated in this population. Leukemia was also significantly elevated (O.R.=1.59; 95% C.I.: 1.07-2.37). Brain cancer (O.R.=1.57; 95% C.I.:0.96-2.53) and skin melanoma (O.R.= 1.39; 95% C.I.: 0.74-2.53) were also elevated though not significantly so while odds ratios for breast cancer (O.R.=0.77; 95% C.I.: 0.57-1.04) and colon cancer (O.R.=0.75; 95% C.I.: 0.53-1.05) were lower than one. For some of the other major cancer sites in this predominantly male labor union (e.g. lung and prostate) the odds ratios were not significantly elevated nor depressed.

On a sex-specific basis, the increased risk of stomach cancer appears to be limited to males only (O.R.=1.87; 95% C.I.: 1.31-2.54) which is statistically significant. Leukemia risk was slightly higher in females versus males while brain cancer risk was higher in males. Malignant melanoma risk is also higher in males.

The date of first contribution made by union members to the medical and pension programs was available for analysis. In order to assess if workplace exposures may have contributed to elevated risk of cancer in the earlier versus later time periods, cancer cases were grouped into those who made a relatively early contribution (between 1973 and 1977) or a relatively late first contribution (after 1978). The resulting odds ratios are shown in Table II. Risk of leukemia was higher among those who were earlier contributors (O.R.=2.06; 95% C.I.: 1.18-3.56) versus those who were later first

contributors (O.R.=1.23; 95% C.I.: 0.66-2.25) and only the odds ratio in the earlier period is statistically significant. Likewise, for brain cancer the odds ratio for the earlier period is higher (O.R.=1.85; 95% C.I.: 0.88-3.69) than the later period (O.R.=1.46; 95% C.I.: 0.73-2.83) although neither is statistically significant. For stomach cancer the odds ratio is significantly elevated in the earlier period (O.R.=1.79; 95% C.I.: 1.14-2.80) but not in the later time period (O.R.=1.52; 0.98-2.33). Only for uterine cervix cancer is the odds ratio significantly elevated in the later time period (O.R.=1.88; 95% C.I.: 1.16-3.06) compared to the earlier time period (O.R.=1.04; 95% C.I.: 0.46-2.28).

Histology and Stage of Disease at Diagnosis

The proportional distribution of histologic subtypes of some types of cancers diagnosed in the UFW membership was compared to histologic subtypes in the general California Hispanic population. For leukemia the comparison was limited to adults in the California Hispanic population since the UFW membership is confined to the adult age groups and leukemia is a leading form of childhood cancer. The comparison for leukemia shows proportionately less acute lymphocytic (11.1% vs. 15.7%) and acute myelocytic leukemia (22.2% vs. 29.1%) in the UFW compared to California Hispanic adults (Figure 1). These deficits appear to be offset by the “all other” category which is more frequent in the UFW membership than in California Hispanics (25.9% vs. 16.9%) as is chronic lymphocytic leukemia. For brain cancer there appears to be equal proportions of glioblastoma and astrocytoma in the UFW and in the California Hispanic population. The only excess in the UFW appears for oligodendroglioma (15.8% vs. 4.2%) but this result is based on very small numbers (Figure 2).

The stage of disease at diagnosis is shown for UFW Hispanics and for California Hispanics in Table III. These results are adjusted for age. In most instances, there is a lower percentage diagnosed at an early stage among the UFW members than among the California Hispanic population. (ACS, 1997). However, for breast cancer this is not the case (55% diagnosed early in the UFW, 55% in California Hispanics). However, for prostate cancer in males the discrepancy is large (64% in California Hispanics and only 33% for UFW members) as it is for colon cancer, especially in males.

Discussion

In this analysis, leukemia, brain and CNS cancer, skin melanoma, stomach cancer and cancers of both the uterine cervix and corpus were found to be more common among the UFW members than among the general California Hispanic population. Results were significant for leukemia, stomach, uterine cervix and uterine corpus cancer. Breast and colon cancers were found less frequently (though not significantly so) and lung and prostate cancer were neither elevated nor depressed. Several other case control studies of cancer in farmers (Burmeister et al., 1982; Blair and White, 1985; Pearce et al., 1986) have noted relative risks for farming ranged from 1.4 to 1.8.

A previous proportionate mortality analysis of California agricultural workers (including both farmworkers and farm owner/managers) found mortality patterns similar to the incidence patterns noted in this study (Stubbs et al., 1984). Among farmworkers in the

mortality study, cancer of the stomach and cancer of other lymphatic tissues were found to be elevated. Colon cancer mortality was lower than expected. The proportionate cancer mortality ratio for cervix cancer was also found to be elevated in that study among female farmworkers. Among the farm owners and managers, cancer mortality was elevated for stomach, prostate, brain and other lymphatic tissues. These findings are in general concordance with our findings concerning stomach, brain, colon and cervical cancer incidence.

The breast, colon, and stomach cancer results in this study may be due to a strong 'migrant effect'. Specifically, rates of breast and colon cancer have been shown to be lower among many immigrant Mexican groups to the U.S. (Mack et al., 1985, Haenszel, 1961) However, rates of these cancer rise to the level of the host country after a few generations of residence in this country. A large proportion of agricultural workers in California undocumented (42%) and of these, 91% are natives of Mexico (Rosenberg et al., 1998). Rates of breast and colon cancer are lower in Mexico than in the U.S.

In comparison, there are virtually no undocumented farmworkers in California who are not of Hispanic ethnicity.

Lung cancer was only slightly lower (5%) in the UFW workers than in California Hispanics in general and this probably reflects a lower prevalence of smoking in these workers, many of whom are recent immigrants from Mexico. These finding are similar to the observations made among the Hispanic population of Los Angeles County (Mack, et al., 1985). Cervix cancer risk is substantially higher in the UFW than among the general California Hispanic population. This excess may be due to a lower level of screening by Pap smears for this form of cancer among female farmworkers. Female farmworkers are

poorer and more mobile than the general population and access to medical care may be more limited.

The proportion of cervix cancer diagnosed at an early stage is lower among the UFW than among the general California Hispanic female population.

The elevation in risk of uterine corpus cancer is more difficult to explain especially since previous studies of Mexican immigrants have shown lower rates of this cancer (Mack et al., 1985). It is also unlikely that use of exogenous hormones for menopausal replacement therapy is high in female farmworkers. Misclassification of the cervical cancers as endometrial cancers may possibly explain this unexpected finding although a more likely explanation may be a lower prevalence of hysterectomy in farmworkers which would increase the number of intact uteri at risk.

Occupational exposures, particularly to pesticides, may explain the elevated risk of leukemia and brain cancer. In the NCI sponsored studies of leukemia among farmers in the mid-west, leukemia risk was increased in association with exposure to the organophosphate pesticides crotoxyphos, diclorvos and famphur and the organochlorine pesticide methoxychlor (Brown et al., 1990). The histologic distribution of leukemia among the UFW workers did not reveal a consistent pattern of excess risk for any particular cell type although there was slightly more chronic lymphocytic leukemia in the UFW compared to California Hispanics. This is consistent with the previous study in Iowa and Minnesota. A recent review of previous studies of leukemia associated with pesticide exposure noted associations for both acute and chronic and lymphocytic and myelocytic leukemias (Linnet, 1996). In a previous correlation analysis, the incidence of

leukemia among Hispanic males in California was found to be strongly correlated with use of the pesticides atrazine, 2,4-D and captan (Mills, 1998).

The odds ratio for brain cancer was elevated in the UFW workers in this study, though not significantly so. Brain cancer incidence has been found to be elevated in previous studies of farmers (Blair et al., 1992). In a case-control study in Italy, brain cancer risk was found to be elevated in farmers exposed to insecticides and fungicides (O.R. =2.00) which was statistically significant (Musicco et al., 1988).

We, however, did not observe elevated risk for non-Hodgkin's lymphoma (O.R. = 1.02) which has been observed in previous studies in this country (Hoar et al., 1986) and abroad (Hardell et al., 1981). An examination of the histologic subtypes of NHL in this population showed proportionately more low grade and intermediate grade tumors compared to the California Hispanic population and proportionately less high grade and unclassified grade tumors (data not shown). Low grade NHL is thought to be similar to chronic lymphocytic leukemia.

Prostate cancer risk among the UFW was not elevated (O.R.=0.93) although previous studies have indicated an association between farming and this form of cancer (e.g. Parker et al., 1999). Prostate cancer incidence rates undoubtedly reflect the use of screening programs for prostate cancer including transurethral ultrasonography and prostate specific antigen which may be less available to hired farmworkers than to the general population, hence the lower odds ratio for this type of cancer in the UFW membership.

Weaknesses of this study include lack of any exposure assessment at the individual level. We are assuming UFW members have distinct and unique occupational exposures, which

may be associated with the altered risks noted but no personal exposure histories are available in this analysis.

As noted previously, a large proportion of farmworkers in California are natives of Mexico and are migratory. However, early organizing efforts by the UFW did not welcome seasonal migrants from Mexico into the membership. Indeed the leadership of the UFW regarded such laborers as “scabs” or strike breakers. This has implications for the completeness of cancer surveillance in the UFW membership in that residents of Mexico would not be accessioned into the CCR and would not be included in the current record linkage. This, however, does not appear to be the case. If, however, UFW workers were transient within the state of California they would give their home address at the time of cancer diagnosis and would be detected by the casefinding procedures of the CCR.

Lower cancer incidence in Hispanics in California has been attributed to the loss of cancer cases among this ethnic group that return to Mexico when they become ill. However an examination of the age-specific distribution of cancer in Hispanics versus non-Hispanics in California reveal lower cancer rates at all adult age categories suggesting that the lower risk experienced by Hispanics is real and not an artifact produced by loss of cases.

Future studies of cancer in this farmworker union include nested case-control studies of selected cancer sites in which detailed work histories will be obtained from study subjects. Also, an all cause cohort mortality study of cancer and non-cancer outcomes is planned.

Conclusion

In this largely Hispanic farm labor union risk of leukemia, stomach, uterine cervix and endometrial cancer was elevated in comparison to all Hispanics in the state of California. Brain cancer was also elevated though not significantly so. In contrast, risk of breast and colon cancer was depressed. There was no clear pattern of increased or decreased cancer risk when comparing the date of first joining the union (earlier versus later) although UFW members tended to be diagnosed with cancer at a later stage than general population Hispanics. In addition, the histologic distribution of leukemia and brain cancer did not differ appreciably from the histologic distribution in the California Hispanic population.

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Table I: Adjusted* Morbidity Odds Ratios and 95% C. L. for Cancer Among Hispanics in the UFW, 1987-1997, by Cancer Site and Sex

Site	Both Sexes Combined			Males			Females		
	No.Cases	O.R.	95%C.L.	No.Cases	O.R.	95%C.L.	No.Cases	O.R.	95%C.L.
Brain	19	1.57	0.96-2.53	15	1.75	0.99-3.01	4	1.14	0.36-3.19
Breast	-----	-----	-----	-----	-----	-----	62	0.77	0.57-1.04
Colon	38	0.75	0.53-1.05	28	0.74	0.50-1.10	10	0.76	0.38-1.47
Hodgkin's Disease	5	0.84	0.27-2.36	3	0.86	0.22-2.80	2	1.58	0.27-6.60
Kidney	27	1.04	0.69-1.55	19	0.93	0.57-1.50	8	1.45	0.66-3.04
Larynx	9	1.00	0.48-2.01	9	1.08	0.52-2.16	0	++	++
Leukemia	28	1.59	1.07-2.37	20	1.55	0.96-2.48	8	1.71	0.78-3.60
Liver	18	1.23	0.74-2.01	15	1.18	0.67-2.02	3	1.56	0.40-5.08
Lung and Bronchus	78	0.95	0.74-1.21	66	1.00	0.77-1.31	12	0.73	0.39-1.35
Skin Melanoma	9	1.39	0.74-2.53	7	1.67	0.80-3.36	2	0.92	0.23-2.98
Multiple Myeloma	8	0.71	0.33-1.48	6	0.70	0.28-1.62	2	0.76	0.13-3.11
Non-Hodgkin's Lymphoma	38	1.02	0.72-1.43	31	1.09	0.74-1.60	7	0.79	0.34-1.74
Ovary	-----	-----	-----	-----	-----	-----	12	1.00	0.53-1.83
Pancreas	17	1.15	0.68-1.90	14	1.52	0.85-2.67	3	0.54	0.14-1.74
Prostate	-----	-----	-----	167	0.93	0.76-1.13	-----	-----	-----
Rectum	23	0.85	0.54-1.31	19	0.88	0.60-1.46	4	0.72	0.23-2.01
Stomach	50	1.69	1.24-2.27	43	1.87	1.32-2.54	7	0.98	0.49-2.52
Testis	-----	-----	-----	5	0.74	0.26-1.96	-----	-----	-----
Thyroid	12	0.94	0.50-1.73	3	0.67	0.17-2.15	9	1.10	0.52-2.25
Urinary Bladder	19	0.67	0.41-1.10	16	0.66	0.39-1.12	3	1.08	0.27-3.51
Uterine Cervix	-----	-----	-----	-----	-----	-----	34	1.63	1.11-2.44
Uterine Corpus	-----	-----	-----	-----	-----	-----	22	1.68	1.05-2.67

*Adjusted for age and for age ad sex where appropriate.

Table II: Age and Sex Adjusted Morbidity Odds Ratios (O.R.) for Cancer in the UFW by Year of First Contribution to the Benefits Programs.

Cancer Site	Year of First Contribution: 1973-1977				Year of First Contribution: 1978-1998			
	No. of Cases	Adjusted O.R.	Lower Limit	Upper Limit	No. of Cases	Adjusted O.R.	Lower Limit	Upper Limit
Brain	9	1.85	0.88	3.69	10	1.46	0.73	2.83
Breast	25	0.94	0.57	1.54	34	0.71	0.47	1.07
Colon	15	0.67	0.38	1.16	23	0.86	0.55	1.34
Hodgkin's Disease	1	0.54	0.03	3.53	3	1.08	0.27	3.53
Kidney	16	1.47	0.86	2.50	11	0.78	0.40	1.45
Larynx	2	0.53	0.09	2.16	7	1.44	0.62	3.15
Leukemia	15	2.06*	1.18	3.56	12	1.23	0.66	2.25
Liver	7	1.12	0.49	2.46	10	1.26	0.63	2.44
Lung /Bronchus	35	0.97	0.67	1.40	42	0.97	0.70	1.36
Skin Melanoma	4	1.14	0.36	3.19	8	1.63	0.75	3.41
Multiple Myeloma	4	0.82	0.26	2.29	4	0.67	0.21	1.88
Non-Hodgkin's Lymphoma	18	1.16	0.69	1.92	18	0.88	0.53	1.45
Ovary	4	0.85	0.27	2.42	7	1.00	0.43	2.22
Pancreas	8	0.98	0.45	2.04	8	0.84	0.38	1.74
Prostate	67	0.83	0.61	1.12	95	1.03	0.79	1.34
Rectum	13	1.13	0.62	2.01	8	0.55	0.25	1.13
Stomach	23	1.79*	1.14	2.80	24	1.52	0.98	2.33
Testis	2	0.40	0.07	1.72	3	0.74	0.18	2.62
Thyroid	5	1.08	0.39	2.74	7	0.90	0.38	1.98
Urinary Bladder	9	0.77	0.37	1.54	9	0.64	0.31	1.27
Uterine Cervix	8	1.04	0.46	2.28	24	1.88	1.16	3.06
Uterine Corpus	10	1.88	0.92	3.75	12	1.67	0.87	3.11
* statistically significant (p<0.05)								

Table III: Percent of Cancers Diagnosed at an Early Stage* in California Hispanics, 1995 and Hispanics in the UFW, 1987-1997, by Sex

SITE/SEX	CALIFORNIA HISPANICS, 1994		HISPANICS IN THE UFW, 1987-1997	
	Number of Cases	Percent Diagnosed at an Early Stage**	Number of Cases	Percent Diagnosed at an Early Stage**
Breast-Female	2126	55	68	55
Prostate-Male	1904	64	168	33
Invasive Cervix-Female	2547	84	76	76
Colorectal- Male	700	35	49	12
Colorectal- Female	583	36	15	22
Melanoma- Male	96	82	9	59
Melanoma- Female	137	89	+	+

*Early-Stage tumors are those diagnosed at the in-situ or localized stage. Stage in the California Hispanics population obtained from ACS, 1997 .
 ** Percentages are age –adjusted
 +Indicates a sample size<5

Figure 1: Leukemia Histology in California Hispanic Adults (1988-1995) and UFW Members (1987-1997)

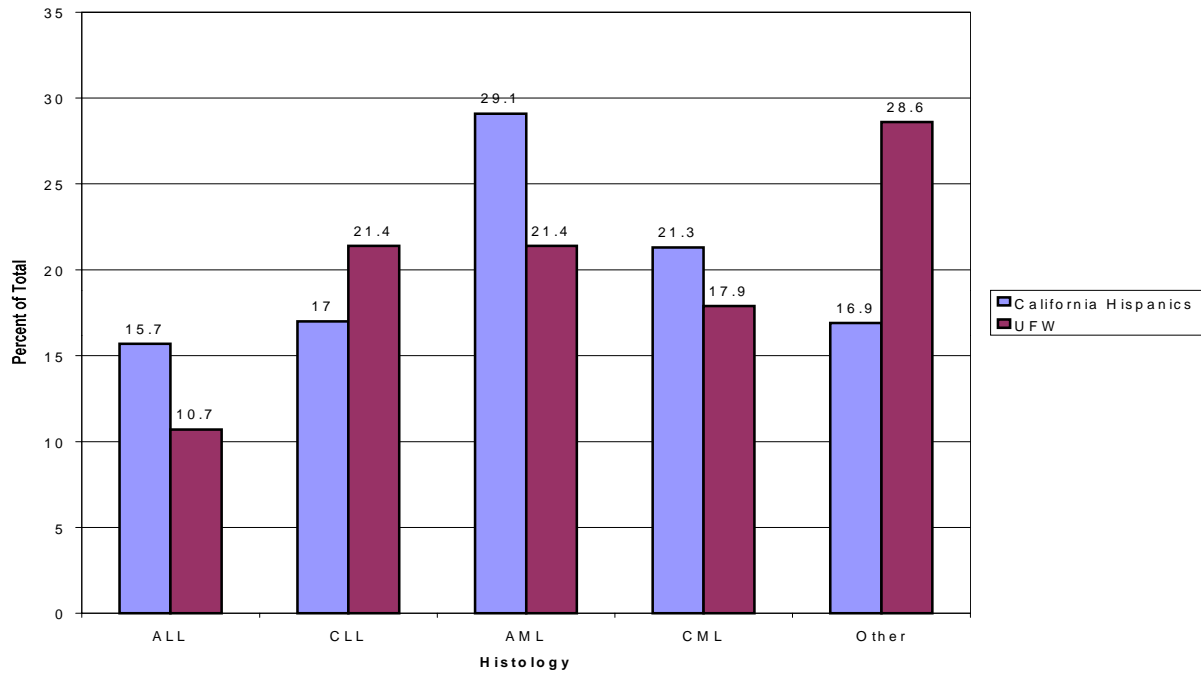


Figure 2: Brain Cancer Histology in California Hispanic Adults (1988-1995) and UFW Members (1987-1997)

