Cancer Survival in California Hispanic Farmworkers, 1988-2001

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ABSTRACT: ***Context:*** *Although epidemiologic studies have identified elevated cancer risk in farmworkers for some cancer types, little is known about cancer survival in this population.* ***Purpose:*** *To determine if cancer survival differs between a Hispanic farmworker population and the general Hispanic population in California.* ***Methods:*** *Hispanic United Farm Workers of America union members and California Hispanics diagnosed from 1988 to 2001 with a first primary cancer were identified from the California Cancer Registry. Kaplan-Meier observed 5-year cause-specific survival rates were calculated, and log-rank tests assessed population differences. Cox proportional hazards models for the most common cancers provided age-, stage-, and year of diagnosis–adjusted hazard ratios.* ***Findings:*** *Observed 5-year cancer-specific survival rates were lower for Hispanic United Farm Workers of America men compared to California Hispanic men for all cancer sites combined (53.7% vs 57.7%, respectively) and colorectal cancer (48.1% vs 60.6%, respectively) and higher for non-Hodgkin's lymphoma (86.7% vs 57.6%, respectively). Only non-Hodgkin's lymphoma survival differences remained significant (P = .021) after adjusting for age and stage at diagnosis. No statistically significant survival differences were detected between United Farm Workers of America and California Hispanic women.* ***Conclusions:*** *Although survival was generally similar between United Farm Workers of America members and California Hispanics, lower crude survival among United Farm Workers of America men for all sites combined and colorectal cancer warrants public health measures to address barriers to cancer screening in California's Hispanic farm-working populations. Histology-specific analyses with larger sample sizes are required before reaching conclusions on non-Hodgkin's lymphoma survival differences.*

Since the 1950s, the agricultural industry in California has evolved from a largely family-run farming operation, where farm owners and their family members accounted for 40% of the agricultural labor force, to a business with an 85% hired workforce.[1] California's hired farmworkers are predominantly foreign born (92%) and Hispanic (96%).[1] A majority receive less than 7 years of formal education and are often unable to speak English, impoverished, and undocumented.[1,2] Furthermore, 70% of the workforce lacks health insurance.[1]

Hired farmworkers are exposed to physically demanding working conditions and a multitude of potentially toxic compounds including fumes, diesel exhaust, chemical fertilizers, pesticides, and dust all of which may adversely affect health.[3] Occupational risks extend to fatal injuries with farming enduring the 12th

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highest rate of fatal injuries in the nation.[4] Although farmers experience mortality deficits for overall mortality, total cancer mortality, and mortality from heart disease,[5,6] an excess of deaths from accidents[7,8] and nonmalignant respiratory diseases[9] is experienced. Cancer risk is also elevated in this population for multiple myeloma and cancers of the buccal cavity, liver, lung, pharynx, prostate, stomach, and testis.[10] Specifically among California farmworkers, increased incidence is observed for leukemia and cancers of the cervix, stomach, and uterine corpus.[11]

Despite evidence of elevated cancer risk and hazardous occupational exposures, few studies have investigated cancer specifically in farmworkers, and, to our knowledge, no studies have explored cancer survival in this occupational population. Hispanic members of the United Farm Workers of America (UFW) labor union were studied to assess cancer outcomes in farmworkers. The objective of the current study was to determine if cancer survival differs between Hispanic UFW members and the general Hispanic population in California.

Methods

Study Populations. Data on cancer cases were obtained from the California Cancer Registry (CCR), a statewide population-based cancer surveillance program. CCR consists of 10 regional registries reporting to a central registry in Sacramento, Calif. The regional registries are all current members of the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program with the San Francisco-Oakland region first joining in 1973 followed by Los Angeles County and the San Jose-Monterey region in 1992, and the remaining counties (Greater California) in 2001.[12] CCR's regional registries also attained North American Association of Central Cancer Registries certification at the gold (for the majority of regions) or silver level since North American Association of Central Cancer Registries began certification in 1995.[13]

CCR collects data on all malignant cancer diagnoses (excluding basal and squamous cell skin cancers and in situ cancer of the uterine cervix) among California's 33.8 million residents.[14] Since full operation in 1988, the registry has identified over 1.7 million malignant tumors. Standardized data collection and quality control procedures were mandated with the creation of the registry[15-18] and involve both active (contact with hospitals and physician's offices) and passive (linkage with databases including state mortality records and Department of Motor Vehicles registration files) methods for case ascertainment and follow-up. A majority of cancer cases are actively identified from California hospitals with cancer programs approved by the American College of Surgeons. CCR case reporting is 95% complete within 18 months of the close of each calendar year, and follow-up is 95% complete as demonstrated by Laurent et al.[19] The specific CCR methods are reported elsewhere.[20]

Farmworkers were identified from a roster of UFW union members enrolled between 1973 and 1996. The roster was generated by combining records of individuals enrolled in 2 benefit programs offered to all union members—the Robert F. Kennedy Medical Plan and the Juan de la Cruz Pension Program. Several validation checks were used to verify the records within the roster including SSNChecker (identifies invalid and out-of-range social security numbers) and cross-linking with Medi-Cal (California's health insurance program for low-income individuals) and California Department of Motor Vehicles databases. When any part of the identification record was determined invalid, the entire entry was removed from the roster. The edited roster of UFW members was electronically linked to the CCR database to identify UFW members diagnosed with cancer in California using an automated record linkage program (AUTOMATCH). This program calculated probability scores based on the degree of similarity in linkage variables (social security number, first and last names, date of birth, gender, and city of residence) between the UFW and CCR databases. User-defined cutpoints distinguished matches from nonmatches[21] while potential matches were reviewed manually. The Hispanic farmworker population for this analysis consisted of those individuals identified in the linkage. A comparison group of California Hispanics diagnosed with cancer was identified from the CCR database (Surveillance Research Program, National Cancer Institute SEER*Stat software [http://www.seer.cancer.gov/seerstat] version 5.3.1). The UFW and California Hispanics are not mutually exclusive groups. The California Hispanic population may include UFW farmworkers and non-UFW farmworkers. However, this overlap is minimal as an estimated 350,000-700,000 farmworkers are employed in California depending on the time of year[22] resulting in only 3%-6% of the 10.8 million Hispanics in California[14] working in the farming industry.

The study included 1,186 Hispanic UFW (hereafter called UFW) members and 178,718 Hispanics in California who were diagnosed with a first malignant tumor between 1988 and 2001. For both groups, Hispanic ethnicity was determined using CCR data. CCR classifies ethnicity as non-Hispanic white,

non-Hispanic black, non-Hispanic Asian/Pacific Islanders, non-Hispanic American Indians Alaskan Natives, and Hispanics in mutually exclusive categories. Hispanic ethnicity is based on (1) information from the medical records, (2) surname (last name) checked against the Hispanic surname list based on 1980 US Census data, and (3) if available for female cases, the maiden name (father's last name) checked against the Hispanic surname list. All cases were at least 18 years of age at diagnosis. Cases with multiple cancers were included; however, only the first primary cancer was analyzed. Excluded from the analysis were in situ cases (except urinary bladder cancer) and cases diagnosed by death certificate or autopsy only. Vital status was ascertained till December 31, 2002.

Study Variables. Cancer stage at diagnosis was based on 3 SEER summary staging variables (SEER Summary Stage 1977, Extent of Disease converted to SEER Summary Stage 1977, and Extent of Disease converted to SEER Summary Stage 2000), and these were applied to cases diagnosed during 1988-1993, 1994-2000, and 2001, respectively, to account for changes in staging over the study period.[23] The staging variables categorize cancers as in situ, localized, regional, distant, and unknown,[24] which were regrouped into early (in situ urinary bladder and localized), late (regional and distant), and unknown for the analysis. The 1977 and 2000 SEER summary staging schemes differ, resulting in changes across the staging categories. For example, a case originally determined to be localized under the 1977 scheme may be classified as regional within the 2000 parameters. A majority of the reclassifications result in staging regional as distant or vice versa,[25] which would not result in changes from early to late stage within the current analysis. Only 5 cancer sites (lung, melanoma of the skin, ovary, prostate, and stomach) show discrepancies between localized and regional/distant stages and therefore between early and late stages. However, few changes in the overall distribution of localized disease resulted from the 1977 to the 2000 staging schemes,[26] and therefore misclassification was minimized. Only prostate cancer was somewhat incompatible; the distribution of localized disease changed from 86.3% under the 1977 staging scheme to 77.5% with the 2000 parameters.[26]

Survival time was measured in days from diagnosis to death or censoring. The minimum survival time was 0 days. Study participants did not have an equal possible duration of follow-up. For example, cases diagnosed in 1988 had a maximum possible survival time of 15 years (approximately 5,475 days), while cases diagnosed in 2001 only had 1 year of potential follow-up before censoring. Use of cases with less than 5 years of follow-up contributes to the analysis as demonstrated by Cutler and Ederer.[27] Cause of death was determined from the death certificate. Age and year of diagnosis were analyzed as continuous variables.

Statistical Analysis. The distribution of cancer site, stage and age at diagnosis, and length of follow-up time was calculated for the UFW and California Hispanic populations individually. The Kaplan-Meier method[28] was used to estimate observed cancer-specific 5-year survival for all cancer sites combined and individual cancer sites with a minimum of 10 cases. Observed 5-year cancer-specific survival rates estimate the probability of surviving 5 years after cancer diagnosis if cancer is the only cause of death. Patients dying from causes other than cancer, lacking a death certificate, or alive at last follow-up were censored at the date of noncancer death, date of last follow-up, or December 31, 2002 (whichever occurred first). Analyses were stratified by gender, and the statistical significance of observed survival differences between UFW and California Hispanic populations was assessed using the log-rank test.

For the most common male and female cancers (including female breast, female cervix, colorectal, lung, male non-Hodgkin's lymphoma, and male prostate), Cox proportional hazards models[29] were used to estimate the hazard ratio for risk of cancer death between the UFW and California Hispanic populations and 95% confidence intervals. The California Hispanics served as a reference group. The statistical significance of age, stage, and year of diagnosis on risk of cancer death was determined independently using *P* values from the univariate analysis. Multivariate Cox proportional hazards determined the impact of farmworker status on risk of death after adjusting for biologically important prognostic factors (age and stage at diagnosis) and, when statistically significant, year of diagnosis. The assumption of proportional hazards was tested by visually examining the log-log plots. Statistical significance was defined as *P* values less than .05. All analyses were completed using the Statistical Package for the Social Sciences (SPSS version 13.0.1, Chicago, Ill).

The Institutional Review Board at the Public Health Institute in Oakland, Calif, approved this study protocol.

Findings

Between 1988 and 2001, 1,186 UFW members were diagnosed with malignant disease (818 men and 368 women) and met the study criteria. At diagnosis, mean

age was 65 years (range: 19-94) among men and 54 years (range: 24-87) among women. During the same time period, 178,718 California Hispanics (87,901 men and 90,817 women) were diagnosed with malignant cancer and met the study criteria. California Hispanic men were younger (*M* = 61 years, range: 18-106) and women were older (*M* = 58 years, range: 18-110) than UFW members at diagnosis. Median time from cancer diagnosis to last follow-up was approximately 5 months longer for California Hispanic versus UFW men and 3 months longer for California Hispanic versus UFW women.

Table 1 describes the distribution of cancer diagnoses and early-stage diagnoses by site, gender, and population. Among UFW men, the most frequently diagnosed cancers included prostate (n = 256), lung (n = 93), colorectal (n = 69), and stomach (n = 49) accounting for 57.1% of cancer diagnoses. The most common cancers in California Hispanic men differed slightly; prostate cancer diagnoses were most common (n = 25,069) followed by colorectal cancer (n = 9,089), lung cancer (n = 8,799), and non-Hodgkin's lymphoma (n = 5,005). In female UFW members, 53.8% of diagnosed cancers were breast (n = 103), cervix (n = 52), corpus uterus (n = 22), and colorectal (n = 21). Again, female California Hispanics differed slightly with breast (n = 27,111), cervix (n = 7,625), colorectal (n = 8,054), and lung (n = 6,109) cancers diagnosed most frequently. Compared to California Hispanics, UFW men and women experienced lower proportions of early-stage diagnoses for all cancer sites combined and screenable cancers including cervix, colorectal, and prostate cancers. Conversely, non-Hodgkin's lymphoma was more frequently diagnosed at early tumor stages in UFW versus California Hispanic men.

Table 2 shows unadjusted observed 5-year cancer-specific survival rates by gender and study group. UFW men experienced statistically significant survival deficits for all cancer sites combined and colorectal cancer. Conversely, non-Hodgkin's lymphoma observed survival was superior among UFW men. No statistically significant observed survival differences were detected between UFW and California Hispanic women.

Table 3 presents the Cox proportional hazards models for the 4 most common male and female cancers. After adjusting for age and stage at diagnosis, poorer colorectal cancer survival among UFW men was no longer statistically significant. On the contrary, UFW men experienced a 66% decreased risk of death from non-Hodgkin's lymphoma compared to California Hispanic men in the adjusted model. Year of cancer diagnosis did not influence the hazard ratios for any cancer site except cervix cancer (data not shown). No statistically significant differences in risk of death were detected between UFW and California Hispanic women.

Conclusions

To our knowledge, this is the first study to compare cancer survival between farmworkers and non-farmworkers of similar ethnicity. Observed 5-year unadjusted cancer-specific survival was significantly worse in UFW versus California Hispanic men for all cancer sites combined and colorectal cancer. However, advanced stage and older age at diagnosis accounted for these observed survival deficits. Conversely, UFW men experienced a statistically significant decreased risk of death due to non-Hodgkin's lymphoma after adjusting for age and stage at diagnosis. No evidence of observed survival differences was detected between UFW and California Hispanic women.

Five-year California Hispanic observed cancer-specific survival rates calculated in the current analysis are similar, although slightly lower than those published by Jemal et al in the "Annual Report to the Nation on the Status of Cancer" based on SEER data, particularly for screen-sensitive cancers (breast, cervix, colorectal, and prostate) and rapidly fatal cancers (lung, pancreas, and stomach).[30] California Hispanic observed survival estimates were at least 4 percentage points lower in our analysis for all sites combined, male brain, leukemia, and male non-Hodgkin's lymphoma when compared to the estimates for the SEER Hispanic population. Lower survival rates may be expected in our California Hispanic population due to inclusion of the data of 4 earlier years (1988-2001) not assessed in the SEER Hispanic survival estimates by Jemal et al (1992-2000). Additionally, SEER regions encompassing Hispanic populations (New Mexico, San Jose-Monterey, and Los Angeles) are primarily urban with the exception of New Mexico. In contrast, the Hispanic population in our study includes cases diagnosed throughout the entire state of California (both urban and rural) and may contain a greater proportion of rural cases. Rural regions face issues regarding access to care and shortages of oncology specialists, which may contribute to reduced survival. Social class may also vary between the California and SEER Hispanic populations and be reflected in survival differences. Only 2 cancer sites examined showed greater than 4 percentage points better survival in California versus SEER Hispanics: male liver (22.1% vs 15.1%) and female corpus uterus (92.5% vs 85.4%).

Poorer observed survival, as described in men for all cancer sites combined and colorectal cancer, may have been anticipated in the UFW population.

Table 1. Cancer Diagnoses From 1988 to 2001 Among California Hispanics and Hispanic UFW Union Members Residing in California by Cancer Site, Early Tumor Stage* at Diagnosis, and Gender†‡

	Male				Female			
	CAH		UFW		CAH		UFW	
Cancer Site	Total	Early Stage %	Total	Early Stage %	Total	Early Stage %	Total	Early Stage %
All sites	87,901	40.7	818	35.1	90,817	40.5	368	38.0
Brain and nervous system	1,701	68.2	16	56.3	§	§	§	§
Breast (female)	—	—	—	—	27,111	53.2	103	52.4
Cervix	—	—	—	—	7,625	50.5	52	44.2
Colorectal	9,089	33.7	69	17.4	8,054	32.5	21	23.8
Corpus uterus	—	—	—	—	5,045	68.1	22	54.5
Kidney	3,087	46.0	27	55.6	2,097	53.9	10	60.0
Larynx	1,173	60.9	15	60.0	§	§	§	§
Liver	2,959	25.7	31	29.0	§	§	§	§
Lung and bronchus	8,799	11.2	93	8.6	6,109	14.4	17	5.9%
Melanoma (skin)	1,075	68.4	11	72.7	§	§	§	§
Myeloma	1,379	6.4	12	8.3	§	§	§	§
Non-Hodgkin's lymphoma	5,005	25.5	40	35.0	3,808	26.0	14	28.6
Ovary	—	—	—	—	3,560	19.4	18	33.3
Pancreas	2,055	6.1	23	8.7	§	§	§	§
Prostate	25,069	69.8	256	56.3	—	—	—	—
Soft tissue	845	52.4	11	45.5	§	§	§	§
Stomach	3,651	14.4	49	10.2	2,636	17.1	15	13.3
Thyroid	§	§	§	§	3,786	57.1	19	57.9
Urinary bladder	3,342	80.6	30	80.0	§	§	§	§

*Early stage tumor defined as in situ or localized for urinary bladder or localized for all other sites.
†Data source: SEER, California Incidence, Dept. of Finance population estimates, March 2005.
‡CAH, California Hispanic; UFW, United Farm Workers of America.
§Less than 10 total UFW cases for all stages combined.

Although UFW members received medical benefits while participating in the union, these individuals are not necessarily current union members and may or may not have been insured at the time of cancer diagnosis. The rural and migrant nature of farm-working employment may also contribute to differences in access to and utilization of care, negatively impacting both cancer screening and treatment regimens. Additionally, accessible cancer care may be of lower quality. As demonstrated for lung and colon cancers, hospitals performing greater volumes of cancer-related surgeries enjoy higher cancer survival rates than smaller hospital settings with fewer patients.[31,32]

For colorectal cancer, UFW men were diagnosed with more advanced tumors. As this is a highly preventable disease through screening, underutilization of screening tools likely contributed to advanced-stage diagnoses and ultimately reduced survival. In a focus group study of Hispanic migrant agricultural workers in Wisconsin, study participants identified information, cultural, and socioeconomic barriers to primary and secondary cancer prevention methods.[33] These agricultural workers lacked knowledge of cancer causes and treatment, expressed shame of physical examination by doctors, and were concerned about the cost of health services, time constraints due to long workdays, and lack of transportation to receive medical care.[33] A survey of agricultural labor camps in Monterey County, Calif, found that Hispanic colorectal cancer screening rates were low with 0% of agricultural labor camp men over age 50 reporting a blood stool test compared to 20%-30% of men and women in the general Hispanic community.[34] The estimates for male labor camp workers were also lower than the estimates from the National Health Interview Survey in 1998

Table 2. Five-year Observed Cancer-Specific Survival Rates Among Hispanics and Hispanic UFW Union Members Residing in California by Cancer Site and Gender, Diagnosed From 1988 to 2001*†

	Male			Female		
	5-y Survival			5-y Survival		
Cancer Site	CAH (%)	UFW (%)	Log-Rank Test (*P*)	CAH (%)	UFW (%)	Log-Rank Test (*P*)
All sites	57.7	53.7	.018‡	61.5	61.1	.913
Brain and nervous system	37.3	39.8	.774	§	§	§
Breast (female)	—	—	—	81.6	77.2	.633
Cervix	—	—	—	78.5	73.0	.376
Colorectal	60.6	48.1	.011‡	61.3	64.9	.990
Corpus uterus	—	—	—	92.5	90.2	.611
Kidney	61.5	80.8	.168	68.2	64.3	.674
Larynx	75.9	78.6	.524	§	§	§
Leukemia	42.2	29.3	.330	40.1	44.4	.762
Liver	22.1	21.1	.761	§	§	§
Lung and bronchus	13.9	12.4	.157	18.8	25.8	.710
Melanoma (skin)	74.8	66.7	.869	§	§	§
Myeloma	36.5	38.6	.958	§	§	§
Non-Hodgkin's lymphoma	57.6	86.7	.010‡	62.7	82.5	.382
Ovary	—	—	—	49.4	58.7	.632
Pancreas	6.6	0.0	.987	§	§	§
Prostate	88.3	87.8	.589	—	—	—
Soft tissue	71.6	88.9	.648	§	§	§
Stomach	26.1	10.6	.265	27.4	21.8	.817
Thyroid	§	§	§	95.5	100.0	.373
Urinary bladder	82.9	88.1	.250	§	§	§

*Data source: SEER, California Incidence, Dept. of Finance population estimates, March 2005.
†CAH, California Hispanic; UFW, United Farm Workers of America.
‡$P < .05$.
§Less than 10 total UFW cases.

that reported that 18% and 20% of the general Hispanic population surveyed underwent fecal occult blood testing and sigmoidoscopy, respectively.[35] These studies support the concept that underutilization of colorectal cancer screening procedures by UFW members may contribute to the reduced 5-year observed survival rates in our analysis.

One unexpected study finding was better non-Hodgkin's lymphoma observed survival in UFW men compared to California Hispanic men. Non-Hodgkin's lymphoma survival rates vary considerably by histologic subtype. For example, follicular histology is associated with 5-year survival rates around 70% compared to diffuse large B cell (50%) and lymphoblastic lymphoma (20%).[36] Conceivably, UFW men may be more susceptible to less-deadly non-Hodgkin's lymphoma subtypes than other California Hispanic cases due to differences in occupational exposures or other unknown factors. However, the small number of UFW cases and the multitude of different histologic types limited the feasibility of a histology-specific analysis. UFW men alone were classified into 16 different non-Hodgkin's lymphoma subtypes. Additionally, possible misclassification of leukemias and Hodgkin's lymphomas as non-Hodgkin's lymphoma or vice versa may have occurred. In a pathologic review of California's Greater Bay Area Cancer Registry, expert pathologists found that 2% of non-Hodgkin's lymphoma diagnoses were actually other malignancies, primarily leukemias, and 2% of Hodgkin's lymphoma cases were non-Hodgkin's lymphoma.[37,38] Although these misclassifications did not affect overall survival, differential misclassification of non-Hodgkin's lymphoma by physicians diagnosing

Table 3. Hazard Ratios (95% CI) for Death due to Cancer Among Hispanic UFW Union Members Residing in California Diagnosed With Cancer From 1988 to 2001 Relative to the California Hispanic Population by Gender*†

	Hazard Ratio (95% CI)			
	Male		Female	
Variables in Model	CAH	UFW	CAH	UFW
Breast (female)				
Crude	—	—	1.00	1.12 (0.71, 1.75)
Age	—	—	1.00	1.07 (0.68, 1.67)
Stage	—	—	1.00	1.15 (0.74, 1.81)
Age and stage	—	—	1.00	1.14 (0.73, 1.79)
Cervix				
Crude	—	—	1.00	1.29 (0.73, 2.28)
Age		—	1.00	1.26 (0.71, 2.23)
Stage	—	—	1.00	1.15 (0.65, 2.02)
Year of diagnosis	—	—	1.00	1.32 (0.75, 2.33)
Age, stage, and year of diagnosis		—	1.00	1.15 (0.65, 2.03)
Colorectal				
Crude	1.00	1.61 (1.11, 2.33)‡	1.00	1.00 (0.45, 2.22)
Age	1.00	1.56 (1.07, 2.26)‡	1.00	1.08 (0.49, 2.41)
Stage	1.00	1.40 (0.97, 2.04)	1.00	0.93 (0.42, 2.07)
Age and stage	1.00	1.35 (0.93, 1.95)	1.00	1.01 (0.45, 2.24)
Lung and bronchus				
Crude	1.00	1.19 (0.93, 1.52)	1.00	0.89 (0.46, 1.71)
Age	1.00	1.15 (0.90, 1.47)	1.00	0.89 (0.46, 1.71)
Stage	1.00	1.13 (0.88, 1.45)	1.00	0.82 (0.43, 1.58)
Age and stage	1.00	1.09 (0.86, 1.40)	1.00	0.81 (0.42, 1.55)
Non-Hodgkin's lymphoma				
Crude	1.00	0.34 (0.14, 0.81)‡	—	—
Age	1.00	0.30 (0.13, 0.72)‡	—	—
Stage	1.00	0.39 (0.16, 0.93)‡	—	—
Age and stage	1.00	0.34 (0.14, 0.81)‡	—	—
Prostate				
Crude	1.00	0.90 (0.61, 1.32)	—	—
Age	1.00	0.88 (0.60, 1.30)	—	—
Stage	1.00	0.72 (0.49, 1.06)	—	—
Age and stage	1.00	0.75 (0.51, 1.11)	—	—

*Data source: SEER, California Incidence, Dept. of Finance population estimates, March 2005.
†CI, confidence interval; CAH, California Hispanic; UFW, United Farm Workers of America.
‡$P < .05$.

UFW workers compared to those diagnosing other California Hispanics may have impacted observed survival estimates in the current analysis. Improved survival among UFW men with non-Hodgkin's lymphoma may also have occurred by chance; these results require confirmation in a study with larger case numbers and histology-specific analyses.

Study results should be interpreted with caution as this analysis was limited by a number of factors. First, as of December 31, 2002, current contact with UFW cancer cases was 87.6%, while it was somewhat higher (96.1%) among California Hispanic cases. Incomplete follow-up underestimates survival and therefore may contribute to the lower UFW observed survival rates for some cancer sites including colorectal cancer. Interestingly, non-Hodgkin's lymphoma observed survival among UFW members may also be underestimated, and thus the survival benefit would actually be greater than estimated in the current model. Second, returning to Mexico for cancer diagnosis, treatment, or death may result in uncaptured UFW cancer cases. Given greater health care costs and language barriers, farmworkers may be more likely to use Mexico's medical system. In a

study of current agricultural workers in California, 18% of respondents who had ever visited a doctor or clinic went to Mexico for the medical care.[1] If UFW members were diagnosed and treated for cancer in Mexico more often than other California Hispanics, then UFW members may not have been captured by CCR, presumably received lower quality cancer care and experienced poorer survival. In this scenario, our findings may actually be overly optimistic. Third, socioeconomic status, access to health care, quality of care, and treatment are all known to affect cancer survival. Data quantifying these factors were limited or unavailable in the CCR database at the time of linkage with the UFW roster. Particularly, the cancer registry lacks information on specific treatment details including compliance, treating physician's specialty, residual disease after treatment, and type of chemotherapy. Due to the lack of specificity in treatment data, it was excluded from the current analysis. Therefore, potential confounding related to disparities in socioeconomic status, health care access, and treatment may contribute to differences in observed survival rates between the 2 study populations. Finally, the small number of UFW cancers diagnosed for some cancer sites may have limited our ability to detect observed survival differences, particularly among the female population.

Despite these limitations, the current study offers the first comparison of observed cancer-specific survival rates between ethnically similar farming and nonfarming populations in California. In our analysis, cancer survival was comparable between UFW and California Hispanic populations for most cancer sites. Survival deficits were detected in the univariate analysis among UFW men when compared to California Hispanic men for all cancer sites combined and colorectal cancer. While these differences did not persist in the multivariate model, it is important to note that UFW men are diagnosed at an older age and more advanced disease stage than the general California Hispanic population. This is particularly important for colorectal cancer, which is a highly preventable disease when individuals participate in routine screening procedures. Public health efforts to reduce this disparity and address existing barriers to cancer screening are necessary in California's Hispanic farm-working populations. Superior observed survival among male UFW members after non-Hodgkin's lymphoma diagnosis remains an anomaly and requires subtype-specific investigations with larger case numbers to confirm these findings.

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