Effects of Migration on Cancer Incidence and Resources for Prevention and Treatment in Florida

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Synopsis ....

Migration adds a complex dimension to the task of those who plan and allocate resources for health care. The authors offer a methodology for estimating the contribution of migration to the incidence of cancer, allow for age- and sex-specific cancer risks, and estimate, by county, the impact of recent migration on the annual incidence of cancer in Florida. Cancer and migration data were used to develop estimates of the number of cancer cases for Florida counties that were attributable to recent migrants. A net gain and loss ratio was calculated for new cancer cases in 1980 resulting from the 1975-80 migration pattern.

Florida data was used because that State has one of the highest crude cancer incidence rates in the nation, is one of the most populous States, and has a population growth from migration rather than from natural increase. Preliminary findings on the relationship between cancer health services resources and net cancer rates from migration are discussed. County cancer health services resources had a strong positive relationship to population size, but the impact of migration on cancer incidence was in a curvilinear relationship to population size.

MIGRATION IS A DYNAMIC PHENOMENON with a profound effect on health care delivery.

As a result, the task of planning for and allocating health care resources in localities with significant migration cannot be performed effectively without being able to estimate the effect of migrants' health status on specific health care resources. To address this problem, we explored the impact of immigration and emigration on the delivery of cancer-related health services in Florida counties.

The relationship of migration and health services delivery involves two separate ideas. One, people's health is viewed as the cumulative result of their residential history. The cultural and environmental factors associated with where they came from have shaped their health. Two, the quality of a person's health can be a major factor in that person's decision to migrate. Some researchers have found that migration is selective for health, that is, migrants tend to be healthy people *(1-3)*. Others, however, have found a weak association between migration and health *(4)* and higher disease risks among migrants *(5, 6)*. Most studies of migration and cancer are attempts to explain apparently different rates of cancer between migrants and nonmigrants. Those studies support etiologic hypotheses of differential rates of exposure to various risk factors *(7)*. Although most studies focus on international migration, interstate and intrastate migration studies have a similar theoretical framework.

Studies investigating the effects of migration and health suffer from several inherent difficulties. The first difficulty centers on the migrant's length of residence in a community *(4, 7)*. How long does a person reside in a community before that person's health problems are no longer considered part of the impact of migration? Cancers of various latency periods may manifest themselves in a receiving community, but may have developed following exposure in a sending community. Because environmental and occupational conditions differ from place to place, exposure to risk factors may change during several previous residences *(4)*. Time in place of residence and age when migration occurs are important in determining the specific risk factors affecting cancer among migrants.

A second difficulty is that migration is often selective by age, socioeconomic status, race, sex, and health and is not representative of the general population in the sending community *(8)*. Estimates of cancer rates of migrants, based on cancer rates in the sending community, can be inaccurate *(9, 10)*.

In this study, cancer and migration data were used to develop estimates of the number of cancer cases attributable to recent migrants for Florida counties, and the cancer cases among migrants were related to cancer treatment resources. Florida has one of the highest crude cancer incidence rates in the nation, is one of the most populous States, and has population growth from migration rather than from natural increase *(6, 7)*. Data for Florida provide an opportunity to explore the effects of migration on cancer rates and the availability of resources for health services. While the study has limitations, it provides some definition to an otherwise more obscured picture.

Florida is particularly vulnerable to the impact of migration on cancer rates because of high immigration and more specifically the great influx of the elderly. Between 1970 and 1980 the population increased by 43.5 percent, trailing only Nevada and Arizona in growth. A small proportion of this growth rate was attributed to natural increase, 8 percent in the period 1975–80, with 92 percent from net migration. Net migration during the 1970s totaled almost 3 million additional persons and is expected to account for all of Florida's growth by 1990.

Florida's population growth during the period 1979–81 was affected by an influx of Haitian and Cuban refugees and entrants. About 200,000 documented and undocumented migrants entered the country through Florida. About half of the Mariel boatlift entrants settled in Dade County *(11, 12)*. The health status of the Cuban migrants was higher than that of the Haitians, who formed a smaller proportion of immigrants. Among the Cubans, the most severe health problems on entry were nutritional deficiencies, intestinal parasites, high-risk pregnancies, and mental illness *(13)*.

The most dramatic demographic change in Florida's population was in its age structure. The median age in 1950 was 30.9 years, similar to the general population. By 1980, the median age was 34.7 years, compared with 30.0 years for the nation. The age shift was a result of high rates of immigration of older persons *(14)*. Florida's elderly population grew by 61 percent in the period 1950–80 and 71 percent in 1970–80. The elderly were more than 17 percent of the State's population in 1980, about 1.7 million persons. The State with the next highest percentage of elderly that year was Arkansas, with 13.9 percent. Only 14 percent of the elderly in Florida were born in the State, compared with the national average of 86 percent of the elderly residing in their State of birth.

The effect of elderly immigration is compounded by their concentration within particular regions. At least 15 Florida counties have more than 20 percent of the population 65 years and older. Six of those counties have a 25 percent or greater share; more than 30 percent of the populations of Charlotte, Pasco, and Manatee Counties are elderly. The heaviest concentrations of elderly are on the west coast and on the eastern "Gold Coast," Dade, Broward, and Palm Beach Counties, one of the largest concentrations of elderly in the nation *(15, 16)*. As a result of a disproportionate share of elderly persons, Florida has the highest crude death rate and one of the highest crude cancer incidence rates in the nation (unpublished report, "Crude Cancer Incidence Rates for States, DC, and PR, 1988," Edward Trapido, University of Miami, School of Medicine, Sylvester Comprehensive Cancer Center, Miami, FL, 1991).

Epidemiologic data indicate that the crude incidence rate of cancer increases beginning with 65 years of age; about half of all cancer cases diagnosed nationwide are among persons in this age category *(17)*. For 1981, about two-thirds of all cancer cases diagnosed in Florida were among persons 65 years or older *(18)*.

Data from the Surveillance, Epidemiology, and End Results (SEER) Program, supported by the National Cancer Institute, indicate that about half of all cancer cases in the country occur among persons in this age range. SEER is the closest equivalent of a national cancer registry system and collects cancer incidence data from 12 nationally representative regions.

To respond adequately to the increasing numbers of cancer cases, health planners in Florida need to be able to estimate the impact of migration on the cancer health care load. Migration and cancer cases both are expected to continue to climb throughout the decade.

Methodology

To calculate the impact of migration on the incidence of cancer in Florida, we used a procedure that takes into consideration the age and sex composition of migration as well as the number of migrants. Three data sources were used in making the calculations. First, information from the Florida Cancer Data System for the period 1981–83 was used in estimating cancer among immigrants and emigrants for each Florida county. The data set contains reports on the diagnoses of new cancer cases by county of residence and functions as the statewide tumor registry. Second, 1980 Census summary data for county populations by age groups and sex were used to estimate the age and sex of migrants and nonmigrants. Third, the census county-level migration data were used to estimate the age and sex of immigrants and emigrants by county. The data were combined in estimating the incidence of cancer among migrants in and out of each Florida county while accounting for age and sex differences among migrants and in cancer rates.

Assumptions. Three assumptions were made for the purpose of data analysis.

1. The 1980 incidence of cancer by age and sex equals the average annual incidence of cancer for the period 1981–83 by age and sex. This assumption permits combining the 1980 population data with the 1981–83 cancer incidence data.
2. Immigrants and emigrants experience different risks of cancer. The differences persist for age groups and sex. This assumption is based on the logical premise that immigrants are subject to the cancer risk of their community of origin, the sending community, and that emigrants are subject to the cancer risk of the community they left.
3. Emigrants and nonmigrants are subject to the same cancer risk for age group and sex because they are from the same community of origin.

Technical procedures. Although the migration data file had counts of the 1980 resident population by age group and sex, it represented a sample, rather than census estimates. Therefore, the census data for population counts was preferred. However, the census summary data tape (STF 3) showed age by 10-year groups for ages 35–84 years. The 5-year age group counts of population were estimated by deriving the proportion in each 5-year interval from the migration data file and applying those proportions to the census 10-year interval counts. In summary, the census 10-year intervals were apportioned into 5-year intervals, based on the migration data file, which was in 5-year intervals. All calculations were applied to separate sex categories. A similar procedure was used to calculate immigration, emigration, and nonmigration rates. Rates and proportions of immigration, emigration, and nonmigration were derived from the migration data file and applied to the census population counts to derive the counts of immigration, emigration, and nonmigrating populations used with the cancer estimation procedure described subsequently. Estimation was by county on an age group- and sex-specific basis. Estimates were rounded by age group and sex categories, resulting in small discrepancies among the summed figures. For example, cancer cases among immigrants and nonmigrants may not sum exactly to total 1980 cancers.

'The largest counties have 3.5 times the number of net cancer cases as the medium-sized counties, but 4.4 times as many cancer resources.'

Calculations. All calculations were on an age group- and sex-specific basis. Totals sum counts of age group and sex. Age was in 5-year-age groups from birth to 4 years up to 85 years and older. Based on the assumptions and technical procedures discussed, the following calculations were made.

1. Florida age- and sex-specific cancer incidence rates were derived by dividing age-specific annual averages of numbers of State cancer cases in the period 1981–83 by the 1980 age-specific population counts.
2. Immigrant cancer rates were estimated for each county by multiplying age- and sex-specific counts of immigrants (those who were not residents of the county in 1975, but were in 1980) by the corresponding age- and sex-specific incidence rates of cancer for Florida. (National incidence rates for cancer by age and sex were not available. As Florida was the only sizable State making such rates available, the rates for Florida by age and sex were used to estimate the number of cancers occurring among immigrants.)
3. To derive the numbers of cancer cases among nonmigrants, defined as those persons residing in the county in both 1975 and 1980, the estimated number of cancer cases among immigrants was subtracted from the estimated number of total cancer cases in the county, for each category of age and sex. The county incidence rates among nonmigrants was computed by dividing the number of county nonmigrant cancer cases by the county counts of nonmigrants for each age and sex category.

County	ACS [1]	Hospice	UOA [2]	Oncologist	Radiation therapist [3]	Enterostomal therapist [4]	Hospital: Large [5]	Hospital: Small [6]	Tumor program [7]	Cobalt units [8]
Alachua	0	1	1	2	5	4	2	3	1	2
Baker	0	0	0	0	0	0	1	0	0	0
Bay	1	0	0	0	0	0	3	0	0	0
Bradford	0	0	0	0	0	0	1	0	0	0
Brevard	1	1	2	2	0	2	4	1	0	0
Broward	1	3	2	8	8	15	12	8	0	3
Calhoun	0	0	0	0	0	0	1	0	0	0
Charlotte	1	0	1	2	1	1	3	0	0	0
Baker	0	0	0	0	0	0	2	0	0	0
Clay	0	0	0	0	0	0	2	0	0	0
Collier	1	0	2	1	1	1	0	1	1	1
Columbia	0	0	0	0	0	1	2	1	0	0
Dade	1	1	2	22	11	20	23	16	3	1
De Soto	0	0	0	0	0	0	1	0	0	0
Dixie	0	0	0	0	0	0	0	0	0	0
Duval	0	3	1	3	4	7	8	5	3	2
Escambia	1	2	0	2	3	1	4	3	3	0
Flager	0	0	0	0	0	0	1	0	0	0
Franklin	0	0	0	0	0	0	1	0	0	0
Gadsden	0	0	0	0	0	0	1	0	0	0
Gilcrist	0	0	0	0	0	0	0	0	0	0
Glades	0	0	0	0	0	0	0	0	0	0
Gulf	0	0	0	0	0	0	1	0	0	0
Hamilton	0	0	0	0	0	0	1	0	0	0
Hardee	0	0	0	0	0	0	1	0	0	0
Henry	0	0	0	0	0	0	1	0	0	0
Hernando	0	0	0	0	0	0	1	0	0	0
Highlands	0	0	1	0	0	2	2	0	0	0
Hillsborough	1	1	1	2	6	8	11	4	2	2
Holmes	0	0	0	0	0	0	1	0	0	0
Indian River	1	0	1	1	0	1	2	0	0	0
Jackson	1	0	0	0	0	0	2	0	0	0
Jefferson	0	0	0	0	0	0	0	0	0	0
Lafayette	0	0	0	0	0	0	0	0	0	0

[1] ACS = American Cancer Society field office (may serve several counties).
[2] UOA = chapter of the United Ostomy Association, which provides support for patients with artificially created openings of the urinary or gastro-intestinal tract.
[3] Certified by the American Board of Radiology.
[4] Cares for patients with ostomy.
[5] 300 or more beds.

4. Cancer cases among migrants, those residing in the county in 1975 but not in 1980, were estimated by multiplying the age- and sex-specific counts of emigrants by the age- and sex-specific incidence rates among nonmigrants.

5. Net cancer cases for each county were computed by subtracting the numbers of cancer cases among emigrants from those for immigrants.

6. A gain and loss (GL) ratio of cancer cases for each county was calculated by dividing the total number of cancer cases by that total minus the net number of cancer cases for each county. The resulting ratio was multiplied by 100 to express it as a percentage. A ratio of 100 would indicate that cancer cases gained through immigration were offset exactly by those lost through emigration. A ratio exceeding 100 would indicate the percentage of cases was more than the so-called expected, which is those that would have occurred if no migration had occurred. A ratio less than 100 would indicate the percentage of cases was less than the expected number, as a result of the migration pattern of the county.

Cancer resources. Information on cancer resources was obtained from data prepared by the University of Miami, School of Medicine, Sylvester Comprehensive Cancer Center, for the American Cancer Society *(19)*.

Table 1 shows nine categories of cancer treatment resources available in each of the 67 Florida counties for 1980. The county resource categories were American Cancer Society (ACS) field office, hospice, United Ostomy Association (UOA) chapter, oncologist, radiation therapist, enterostomal therapist, large hospital (300 or more beds), small hospital (fewer than 300 beds), tumor program, and hospital radiology department with a cobalt unit.

A simplified, rough accounting of county cancer treatment resources and efforts may be obtained by in Florida counties, by type of resource, 1980

County	ACS [1]	Hospice	UOA [2]	Oncologist	Radiation therapist [3]	Enterostomal therapist [4]	Hospital		Tumor program [7]	Cobalt units [8]
							Large [5]	Small [6]		
Lake	1	0	1	0	0	1	5	0	0	0
Lee	1	0	1	0	1	1	2	2	0	1
Leon	1	2	0	2	0	5	1	1	1	1
Levy	0	0	0	0	0	0	1	0	0	0
Liberty	0	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	1	0	0	0
Manatee	1	0	0	1	2	4	1	1	0	0
Marion	1	1	1	1	1	1	2	0	2	0
Martin	1	1	1	0	0	0	0	1	0	0
Monroe	1	0	0	0	0	0	4	0	1	0
Nassau	0	0	0	0	0	0	1	0	0	0
Okaloosa	0	0	0	0	0	3	5	0	0	0
Okeechobee	1	0	0	0	0	0	1	0	0	0
Orange	1	1	1	1	1	4	6	3	0	1
Osceola	1	0	0	0	1	0	3	0	0	0
Palm Beach	1	3	1	3	2	11	9	4	0	1
Pasco	1	1	2	1	1	2	4	1	0	0
Pinellas	1	1	3	6	5	19	12	8	1	5
Polk	1	1	1	1	1	2	5	2	0	2
Putnam	0	0	0	0	0	0	1	0	0	0
St. Johns	0	0	0	0	0	0	2	0	0	0
St. Lucie	0	0	0	0	1	0	1	0	0	0
Santa Rosa	0	0	0	0	0	0	2	0	0	0
Sarasota	1	1	2	4	2	2	2	1	0	1
Seminole	0	0	1	1	0	2	1	0	0	0
Sumter	0	0	0	0	0	0	0	0	0	0
Suwanee	0	0	0	0	0	0	1	0	0	0
Taylor	0	0	0	0	0	0	1	0	0	0
Union	0	0	0	0	0	0	1	0	0	0
Volusia	1	1	1	2	2	5	7	1	1	1
Wakulla	0	0	0	0	0	0	0	0	0	0
Walton	0	0	0	0	0	0	1	0	0	0
Washington	0	0	0	0	0	0	1	0	0	0

[6] Fewer than 300 beds.

[7] Programs approved by the American College of Surgeons for cancer treatment in hospitals.

[8] Hospital departments of radiology equipped with cobalt units for radiation therapy.

summing each county's number of resources. A measure with greater precision is being developed. The present index gives an indication of the correspondence between general levels of resources and net cancer cases resulting from migration.

Results

Table 2 shows the counties in order of population size with their estimated number of new cancer cases in 1980, the number of net cancer cases resulting from recent migration, the gain and loss ratio, and the cancer resources index. This discussion focuses on summary statistics for these variables as displayed in tables 3 and 4. County information in table 2 is referenced throughout this report.

Table 3 shows correlations for the variables of interest. There were substantial correlations among county population size, the numbers of new and net cancer cases in 1980, and cancer resources. In brief, larger counties had more new cancer cases, but more resources. The correlation between population size and net cancers resulting from migration was moderate, a ratio of 0.753. The large population counties were Dade with Miami, Broward with Fort Lauderdale, Pinellas with St. Petersburg, Hillsborough with Tampa, Palm Beach with West Palm Beach, Duval with Jacksonville, Orange with

> *'The finding of the association between population size and excessive numbers of cases of cancer may be indicative of migration toward areas with extensive treatment facilities. The effect of migration is greater on medium-sized counties...'*

Table 2. Florida counties in order of increasing population size, with their estimated number of new cancer cases, number of net cancer cases resulting from recent migration, cancer case gain and loss ratio, and cancer resources index, 1980

County	Population [1]	New cancer cases	Net cancer cases	Gain and loss ratio	Cancer resources index
Lafayette	4.0	10	0	100.00	0
Liberty	4.3	10	−3	76.92	0
Gilchrist	5.8	21	−5	80.77	0
Glades	6.0	10	−4	71.43	0
Franklin	7.7	41	−6	87.23	1
Dixie	7.8	30	−5	85.71	0
Hamilton	8.8	23	0	100.00	1
Calhoun	9.3	36	−1	97.30	1
Union	10.2	31	−9	77.50	1
Gulf	10.7	44	−5	89.80	1
Jefferson	10.7	21	−1	95.45	0
Wakulla	10.9	31	−4	88.57	0
Flagler	10.9	69	−15	82.14	1
Washington	14.5	47	−3	94.00	1
Holmes	14.7	36	−3	92.31	1
Madison	14.9	45	−4	91.84	1
Baker	15.3	30	−1	96.77	1
Taylor	16.5	59	0	100.00	1
Henry	18.6	54	−12	81.82	1
De Soto	19.0	70	1	101.45	1
Hardee	19.4	55	−7	88.71	1
Levy	19.9	78	−4	95.12	1
Bradford	20.0	53	−7	88.33	1
Okeechobee	20.3	115	−13	89.84	2
Walton	21.3	73	−2	97.33	1
Suwanee	22.3	78	−3	96.30	1
Sumter	24.3	79	3	103.95	0
Nassau	32.9	93	−13	87.74	1
Columbia	35.4	91	−3	96.81	4
Jackson	39.2	108	−9	92.31	3
Gadsden	41.6	153	−12	92.73	1
Hernando	44.5	368	7	101.94	1
Highlands	47.5	318	22	107.43	5
Osceola	49.3	294	−10	96.71	5
Putnam	50.5	168	23	115.86	1
St. Johns	51.3	233	13	105.91	2
Citrus	54.7	315	69	128.05	2
Santa Rosa	56.0	171	−15	91.94	2
Charlotte	58.5	438	72	119.67	9
Indian River	59.9	345	23	107.14	6
Monroe	63.2	242	−18	93.08	6
Martin	64.0	421	41	110.79	4
Clay	67.1	152	10	107.04	2
Collier	86.0	545	−4	99.27	9
St. Lucie	87.2	443	30	107.26	2
Bay	97.7	381	−28	93.15	4
Lake	104.9	534	89	120.00	8
Okaloosa	109.9	255	6	102.41	8
Marion	122.5	614	51	109.06	10
Manatee	148.4	856	116	115.68	10
Leon	148.7	395	−8	98.01	14
Alachua	151.3	359	3	100.84	22
Seminole	179.8	420	129	144.33	5
Pasco	193.6	1,495	202	115.62	13
Sarasota	202.3	1,593	152	110.55	16
Lee	205.3	1,291	119	110.15	9
Escambia	233.8	808	−16	98.06	19
Volusia	258.8	1,710	78	104.78	22
Brevard	273.0	1,024	94	110.11	13
Polk	321.7	1,189	81	107.31	16
Orange	471.0	1,581	73	104.84	19
Duval	571.0	1,884	−11	99.42	36
Palm Beach	576.9	3,872	292	108.16	35
Hillsborough	647.0	2,486	54	102.22	38
Pinellas	728.5	4,560	492	112.09	61
Broward	1,018.2	5,515	605	112.32	60
Dade	1,625.8	7,080	281	104.13	100

[1] Population size is shown in thousands.

Orlando, and Polk with Lakeland. The large population counties tended to have the largest numbers of net cancer cases, but not all counties fit the general pattern. Large population counties with large numbers of net cancer cases were Broward with 605, Pinellas with 492, Palm Beach with 292, and Dade with 281.

Small population counties had the lowest numbers of net cancer cases, such as Lafayette with none, Liberty with minus 3, and Gilchrist with minus 5. Some large population counties that did not fit the pattern were Duval with minus 11 and Escambia with minus 16. Manatee County with 116, a mid-sized county, had an atypically large number of net cancer cases. The gain and loss ratio correlated weakly with population size (0.294) and the resources index (0.280).

Table 4 provides some clarification of these relationships. Small counties, defined as those with less than 50,000 population, averaged 92 percent of the new cancers in 1980 that they would have experienced in the absence of migration in the period 1975–80. Small counties comprised half of all Florida counties. In aggregate, they had a drastic effect on the correlation between the gain and loss ratio and other variables. These correlations were weakened because the smaller counties experienced a lower than expected increase in cancer cases. Examples were Liberty with 76.92, Gilchrist with 80.77, Glades with 71.43, and Franklin with 87.23. Liberty experienced 77 percent of the cancers in 1980 that it would have had if it had been a closed population, with no migration in the period 1975–80.

For most counties in this size category, the net emigration of cancer cases was 10. However, six counties lost more than 10 cases. Only four counties of less than 50,000 population gained new

Table 3. Pearson product moment correlation of variables for all Florida counties, circa 1980

	Population [1]	New cancer cases	Net cancer cases	Gain and loss ratio	Cancer resources index
New cancer cases	0.969	. . .	. . .	. . .	. . .
Net cancer cases	0.753	0.863	. . .	. . .	. . .
Gain to loss ratio	0.294	0.320	0.473	. . .	. . .
Cancer resources index	0.978	0.966	0.764	0.28	. . .
Means	145.5	687.3	44.6	99.9	9.3
Standard deviation	267.5	1,309.5	110.4	12.4	17.0
Minimum	4.0	10	– 28	71.4	0
Maximum	1,625.8	7,080	605	144.3	100

[1] Population size is shown in thousands.

cancer cases in 1980 as a result of migration, and these were likely to be large counties. Most notable was Highlands, which experienced 7 percent more cancer cases in 1980 owing to its net migration pattern.

Averaging the GL ratio of counties with populations larger than 50,000 showed a gain in the number of cancer cases in 1980 owing to migration. The highest relative gain was shown by counties in the 100,000 to 200,000 population category. These eight counties had 13 percent more cancer cases on average than expected because of migration. Standing out in the 100,000 to 200,000 category were Seminole with a gain of 44 percent in cancer cases owing to migration and Lake with a 20 percent gain. Seminole was notable for its very low cancer resources. The two largest Florida counties, Dade with a GL ratio of 104.13 and Broward with 112.32, were affected proportionately less by migration.

The other counties with populations of more than 50,000 averaged 6 percent more cancer cases owing to migration. Citrus with a GL ratio of 128.05 and Charlotte with 119.67 were counties in the 50,000 to 100,000 population size category that stood out in cancer gain, with gains in the 20 percent or more range owing to recent migration. Citrus, in particular, had limited cancer resources.

Conclusion

As with any estimating procedure, the technique employed to estimate cancer case prevalence attributable to immigration, emigration, and nonmigration required choosing among alternative assumptions. The critical assumptions that were made for this analysis were that immigrants and emigrants for a particular county had different age- and sex-specific cancer risks, and that emigrants and nonmigrants for the same county had the same age-

Table 4. Variables for Florida counties, grouped by population size, circa 1980

Size	Number of counties	New cancer cases	Net cancer cases	Gain and loss ratio	Cancer resources index
Less than 50,000	34	78.6	– 3.9	91.9	1.2
50,000–100,000	12	321.2	18.0	106.6	4.1
100,000–200,000	8	616.0	73.5	113.2	11.2
200,000–500,000	7	1,313.7	83.0	106.5	16.3
500 and more	6	4,232.8	289.2	106.4	55.0

and sex-specific cancer risks. Findings on the association between migration's effect on cancer incidence and cancer resources, although preliminary and tentative, were informative to our understanding of the complex relationships between migration and health, and especially migration and cancer.

While county cancer resources had a strong positive relationship to county population sizes, migration's contribution to the incidence of cancer had a curvilinear relationship to county population size. That is, counties with small populations, fewer than 50,000, on average had reduced demand for cancer resources because of migration. While counties of more than 50,000 in population on average had increased demand for cancer resources because of migration, migration contributed most to resource demand in moderately large counties, those of 100,000 to 200,000 population.

These findings, tentative for several reasons, provide direction to future and ongoing research. First, for the analysis we used estimates of cancer cases in general. Since some types of cancer demand more treatment resources than others, estimates of migration's effects on particular classes of cancers would be more insightful when discussing resources. Second, the resources measurement admittedly is crude. Future work not only requires resources to be measured with more precision, but needs to allow for shared resources among counties.

The finding of the association between population size and excessive numbers of cases of cancer may be indicative of migration toward areas with extensive treatment facilities or where health care resources are plentiful *(20)*. The effect of migration was greater on medium-sized counties, such as Lake and Manatee with populations in the 100,000 to 200,000 range, than on the largest counties, such as Palm Beach and Dade with 500,000 or more. The largest counties had 3.5 times the number of net cancer cases that the medium-sized counties had, but 4.4 times as many cancer resources. Regardless of the distribution discrepancy, health planners should be aware of this relationship in planning for prevention and treatment facilities.

References

1. Marmot, M. G., Adelstein, A. M., and Bulusu, L.: Lessons from the study of immigrant mortality. Lancet No. 8392: 1455–1457, June 30, 1984.
2. Stenhouse, N. S., and McCall, M. G.: Differential mortality from cardiovascular disease in migrants from England and Wales, Scotland and Italy, and native-born Australians. J Chron Dis 23: 423–431 (1970).
3. Shai, D.: Cancer mortality in Cuba and among Cuban-born in the United States: 1979–81. Public Health Rep 106: 68–73, January-February 1991.
4. Kasl, S. V., and Berkman, L.: Health consequences of the experience of migration. Annu Rev Public Health 4: 69–90 (1983).
5. Stanhope, J. M., and Prior, I. A. M.: The Tokelau Island migrant study: prevalence of various conditions before migration. Int J Epidemiol 5: 256–266 (1976).
6. Stanhope, J. M., Sampson, V. M., and Prior, I. A. M.: The Tokelau Island migrant study: serum lipid concentrations in two environments. J Chron Dis 34: 45–55 (1981).
7. Haenszel, W.: Migrant studies. *In* Cancer epidemiology and prevention, edited by D. Schottenfeld and J.F. Fraumeni, Jr. W.B. Saunders Co., Philadelphia, PA, 1982, pp. 194–207.
8. Ritchey, P. N.: Explanations of migration. Annu Rev Sociol 2: 363–404 (1976).
9. Staszewski, J.: Cancer of the upper alimentary tract and larynx in Poland and Polish-born Americans. Br J Cancer 29: 390–399 (1974).
10. Warshauer, M. E., Silverman, D. T., Schottenfeld, D., and Pollack, E. S.: Stomach and colorectal cancers in Puerto Rican-born residents of New York City. J Natl Cancer Inst 76: 591–595 (1986).
11. Lieberman, L. S.: The impact of Cuban and Haitian refugees on state services: focus on health services problems in cross-cultural contexts. Report for Star Grant Project DSRT No. 81-66 and 81-67, University of Florida, Department of Anthropology, Gainsville, FL, September 1982.
12. McCoy, C. B., and Gonzalez, D.: Cuban immigration and immigrants in Florida and the United States: implications for immigration policy. Monograph No. 3, University of Florida, Bureau of Economic and Business Research, Gainsville, FL, November 1985.
13. Shpiner, G. M., and Lewis, R. G.: Cuban and Haitian refugee problems, needs, and issues, and their impact on health and related human service delivery in Dade County, Florida: a key informant assessment. A Report of the FAU-FIU Joint Center for Environmental and Urban Problems, Florida International University, Miami, FL, April 1981.
14. Smith, S. K.: Florida in the 20th century: a survey of demographic change. Business and Economic Dimensions 18: 2–8 (1982).
15. McCoy, H. V., et al.: The control of cancer in Florida. Florida J Public Health 3: 5–7 (1991).
16. McCoy, C. B., Khoury, E. L., and Anwyl, R. S.: Cancer incidence among Florida's elderly. Paper presented at annual meeting, Southern Sociological Society, Louisville, KY, March 21–25, 1990.
17. Yancik, R.: Frame of reference: old age as the context for the prevention and treatment of cancer. *In* "Perspectives on prevention and treatment of cancer in the elderly," R. Yancik, et al., editors. Raven Press, New York, NY, 1983, pp. 5–17.
18. McCoy, C. B., et. al.: Encyclopedia of cancer in Florida, 1981–83. American Cancer Society, Florida Division, Tampa, FL, 1986.
19. Comprehensive Cancer Center, University of Miami School of Medicine: Cancer control resources. Prepared for the American Cancer Society, the State of Florida, and the Florida Cancer Control and Research Advisory Board. American Cancer Society, Florida Division, Inc., Miami, FL, July 1984.
20. Martinez, I.: Cancer in Puerto Rico. Central Cancer Registry, Cancer Control Program, Department of Health, Commonwealth of Puerto Rico, San Juan, PR, 1988.