# MIGRATION AND THE RISK OF DYING

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Geographic differences in the risk of dying have been well demonstrated for middle-aged whites in the United States (1-7). Death rates are low in the Great Plains area generally and high near the East Coast of the U.S., with the middle-aged men in the highest-rate areas having twice the risk of those in the lowest-rate areas. While various hypotheses have been suggested to account for factors responsible for these differences, the evidence to support these hypotheses is generally tenuous.

In a prior study (6), we have shown that: If it were possible to identify the factors responsible for the low rates for all causes of death in the four lowest-rate areas (having a population exceeding one million) and if these factors could be applied to the U.S. over-all, then for those under age 65 alone there would be 100,000 fewer deaths per year.

While our concern is deaths from all causes, we at the Ecology Field Station of the Heart Disease Control Program are even more concerned with the cardiovascular-renal diseases, including coronary heart disease.

#### HYPOTHESES

The question has been raised as to whether the differences in death rates could be due to migration patterns (5). Stated more specifically, one hypothesis suggests that low death rates in North Dakota, Nebraska and other Great Plains areas are observed because men with heart disease and other chronic ailments move away, presumably to "retirement" States.

Our objective is to focus on this and other questions related to migration and ecological patterns. For example, does migration of itself affect the risk of dying? Is the risk of dying related to the area in which one is born? What differences in mortality are observed for different migration streams?

#### MATERIALS AND METHODS

Deaths of the native-born were tabulated by State of birth and by State of usual residence, by age, sex and race for middle-aged individuals. By arrangements made with the National Center for Health Statistics (NCHS) tabulations were obtained for coronary heart disease deaths in 1950 and for all deaths and 17 cause categories, 1959-1961. The age groups selected were those used by the Bureau of the Census in its State of birth and lifetime migration reports (8-10). Some rates were calculated by NCHS and some by our Program.

All rates presented are for middle-aged native-born whites, by sex. Age-specific death rates for age groups 45-64, 35-74, and 40-69 are all age-adjusted by the direct method by tenyear age groups to the total U.S. population in these age groups in 1950.

In any study of morbidity or mortality rates, consideration must be given as to whether the population accepted as the "population at risk" is identified with reasonable accuracy. In this study, several factors are pertinent.

a. The population is estimated from the 25-percent sample enumeration. The resulting sample error is generally quite small for all those living in a specific State of birth or for all lifetime migrants to or from a State. For specific streams of migration sample error is somewhat greater. Probably more important is the systematic bias which may easily arise from such sampling; for example, the U.S. population of white males, age 65-74, as calculated from the 25-percent sample is approximately two percent less than the complete enumeration (11). In the age group 45-64 this difference is generally less than one percent.

b. In the 1960 Census, those with no indication of nativity were classified as native-born (10) but they obviously could not be classified as to State of birth. This group together with a miscellaneous group were proportionately much more numerous in the population than on death certificates. This introduced a bias in the conventional calculation of death rates, --for age groups 45 to 74 probably one to three percent higher. \* Comparisons of rates are presented in such a way that errors should be negligible, generally not more than two percent. \*\*

\*For Alaska, Nevada and Rhode Island the rates may be about four percent higher than "true" rates, and for the District of Columbia, about seven percent.

\*\*To study the magnitude of the bias, the rates of whites residing in their State of birth and of residents not born in the State were adjusted, by age and sex. Both population and deaths with

#### AGE, SEX AND CAUSE OF DEATH

Death rates for middle-aged whites residing in their State of birth are almost identical to those residing in States other than State of birth (Figure 1). The native-born whites who





are residing in States other than State of birth at the time of the census enumeration are defined by the Bureau of the Census as "lifetime migrants" (10) and for convenience are hereafter frequently referred to as merely "migrants". A native-born decedent whose residence at time of death is not his State of birth is similarly classified as a lifetime migrant.

The category, "residents of State of birth" at time of census enumeration or at death, includes those who have never moved; but it also includes intra-state migrants and those who have moved across State lines and then returned to

State of birth or nativity not specified (or classified as "other") were proportionately distributed to the specific categories. One of the larger differences as a result of adjustment is a comparison of Nebraska with California: The Nebraskans born in the State have unadjusted rates 14.5 percent lower than the California-born, as compared with 12.6 percent lower, derived from adjusted rates. For many comparisons, such as Missouri with New York, the result is essentially the same (within one-half percent), whether adjusted or unadjusted rates are used.

For rates of those who have moved out of their State of birth, no practical adjustment procedure has yet been developed. Therefore, no formal adjustment factors are used in the presentation of rates in this paper for either group. re-establish residence in their State of birth prior to census or death; this group may be called "non-migrants".

Our operational definitions thus are obviously more limited than those which need to be used in a general theory of the effects of migration on health or of migration (12).

In order to observe more clearly the slight differences that are recorded, we may arbitrarily accept the age-sex-specific rates for those residing in their State of birth as unity, calculate the ratios of the lifetime migrants to the "nonmigrants", and plot them on a scale to magnify the differences (Figure 2).

# Figure 2--RATIO OF DEATH RATES OF WHITES: "LIFE-TIME MIGRANTS" <u>divided</u> by "RESIDING STATE OF BIRTH", ALL CAUSES, BY AGE AND SEX, 1959-1961



For all causes of deaths, the rates for male migrants are about four percent higher than for those residing in State of birth, whereas females show a mixed pattern of rates. For the cardiovascular-renal causes, male migrants tend to have a rate nominally higher, and female migrants nominally lower, than those residing in their State of birth (Figure 3).

The ratios vary somewhat by cause showing migrants' rates for hypertension and hypertensive heart disease to be about ten percent lower than rates for "non-migrants" (Figure 4). The ratios show higher migrant rates for lung cancer, accidental and violent causes and chronic respiratory diseases than for those living in State of birth. The high migrant rate for chronic respiratory diseases (chronic bronchitis, emphysema, asthma, and other non-specific chronic respiratory diseases) is due in part to the high rate of migrants in Arizona. But even if this group were excluded, the ratio would still remain Figure 3--RATIO OF DEATH RATES OF WHITES: "LIFE-TIME MIGRANTS" <u>divided by</u> "RESIDING STATE OF BIRTH", CVR DISEASES, BY AGE AND SEX, 1959-1961



Figure 4--RATIO OF DEATH RATES OF WHITES AGE 35-74: "LIFETIME MIGRANTS" <u>divided by</u> "RESIDING STATE OF BIRTH", SELECTED CAUSES OF DEATH, BY SEX, 1959-1961



high. The high ratio for "accidental and violent" causes for white females is due largely to the low rates for those residing in their State of birth; the death rates of migrants are only about 10 points higher, producing a very high ratio. Even so, accidents and violence (and to a lesser extent, malignant neoplasms) are largely responsible for the elevated all-causes ratios for white females, age 35-54 (Figure 2).

# BY STATE

We may consider the specific hypothesis that the Dakotas and Nebraska have low death rates because the men with chronic ailments move away; or the more general hypothesis that all differences in death rates are due to selective migration. Comparison of death rates by State of birth without regard to residence would be a test of these hypotheses. If the more general hypothesis is true, we would expect no difference in rates between states. These calculations are presented for males 45-64 for cardiovascular-renal causes and show a pattern of death rates very similar to those tabulated by State of residence (Table 1), the product moment correlation being +0.91.

For all causes of death, a similar parallel is obtained, with a correlation of +0.88 in death rates by State of residence with rates by State of birth. (For these and all subsequent correlations, n = 46 States, with Alaska, Hawaii, Nevada and Wyoming excluded because of small numbers in one of the following categories: "residing in State of birth" or "residing in States other than State of birth" or "residing in States other than State of birth"--that is with one standard deviation of random error exceeding seven percent, for white males, age 45-64, CVR diseases.) These are obviously not independent correlations, but they do test the hypothesis proposed.

In order to avoid such dependence, rates have also been calculated by State for those residing in State of birth and for those whose State of residence is "other States" (Table 2). Those living in States other than State of birth obviously moved away at some time after birth and in this setting are viewed as out-migrants. The correlation between these two variables is +0.80.

The six States with the highest rates for those residing in State of birth have rates approximately as high for those born in the State who have moved on to other States (Figure 5). The six States with the lowest rates for those residing in State of birth also had among the lowest rates for those who had moved to other States.

Table 1--CARDIOVASCULAR-RENAL (CVR) DISEASES DEATH RATES BY STATE OF RESIDENCE AND BY STATE OF BIRTH, NATIVE WHITE MALES, AGE 45-64, 1959-1961

Table	2CVI	R DISI	LASES	DEAT	H RATES	BY	STATE	OF
BIR	CH BY I	PLACE	OF U	SUAL	RESIDENC	œ,	WHITE	MALES,
AGE	45-64	. 1959	9-196	1				

	State of	State of		Place of usual residence		
State	residence	birth	State of birth	State of birth	Other states	
UNITED STATES	836.0	836.0	UNITED STATES	829.4	847.9	
NEW ENGLAND			NEW ENGLAND			
Maine	876.1	855.0	Maine	857.1	851.3	
New Hampshire	866.0	882.1	New Hampshire	904.4	856.2	
Vermont	783.3	817.3	Vermont	748.0	881.5	
Massachusette	914 2	916 1	Massachusetts	921.1	904.4	
Rhede Teland	992 7	958 5	Rhode Island	983.2	918.0	
Connecticut	818 0	845 7	Connecticut	810.8	920.6	
MIDDIE ATTANT	010.0	043.7	MIDDLE ATLANTIC		1	
New York	021 6	027 0	New York	931.8	916.3	
New IOIK New Iongow	0/2 5	92/.0	New Jersey	941.4	916.3	
New Jersey Persey	942.5	934.5	Pennsylvania	924.2	928.2	
	925.0	923.4	SOUTH ATLANTIC			
Dolemento	4 070	1006 7	Delavare	987.0	1039.0	
Deraware	0/9.4	1004.7	Maryl and	961.3	946.6	
Maryiano Dista of Columbia	952.1	958.5	Dist. of Columbia	1148.2	864.7	
Dist. Or Columbia	1008.3	939.8	Vireinia	866.9	963.2	
Virginia Nonte Mandada	803./	899.0	West Virginia	826.4	859.2	
West Virginia	843.8	840.4	North Carelina	912.7	878.3	
North Carolina	921.3	904.0	South Ceroline	1037.7	963.6	
South Carolina	1005.6	1015.2		024 6	916.2	
Georgia	917.1	921.7	Blende	939 1	773.0	
Florida	865.6	824.7	PLUILUA Dicitua	030.1	//3.0	
EAST NORTH CENTRAL			Chie	020 7	970 0	
Ohio	836.4	850.8	Unite	035.7	999 5	
Indiana	832.7	854.5	Indiana	802.0	825.6	
Illinois	900.4	868.9	11110918 Michigan	072.0	975 6	
Michigan	820.8	827.5	Michigan	746 6	845 5	
Wisconsin	752.1	776.5		/40.0	043.5	
EAST SOUTH CENTRAL			HAST SOUTH GENTRAL	761 9	952 1	
Kentucky	784.5	802.0	Kentucky	755 2	055.1	
Tennessee	761.1	804.7	1ennessee	753.2	002.3	
Alabama	796.7	800.9	Algound	750.0	910.2	
Mississippi	757.4	779.4	LINCE NODEL OFFERAL	130.3	015.2	
WEST NORTH CENTRAL			WEST NORTH CENTRAL	690.2	769.0	
Minnesota	708.2	714.8	Tomo	701 0	817.4	
Iowa	720.8	758.2	Tant	745 5	847.4	
Missouri	767.8	793.6	Missouri North Dekete	620 4	698.3	
North Dakota	672.4	667.3	North Dakota	621 6	710.8	
South D <b>akota</b>	692.0	675.4	Nobroche	622 7	757 1	
Nebraska	658.4	697.9	Nediaska	6/2 2	770 3	
Kansas	690.1	713.4	kaliset Lidon cornel odyned i t	042.3	110.5	
WEST SOUTH CENTRAL			WEST SUUTH CERTERL	700 3	763.0	
Arkanses	732.0	736.7		988 6	827.2	
Louisiana	903.8	871.0		621 5	771 9	
Oklahoma	711.2	715.1	UKI AROMA	727 6	778 0	
Texas	756.4	740.4		/2/.0	//0.0	
MOUNTAIN			Montono	000 5	701 3	
Montana	770.4	827.7	Montana	600.0	702 9	
Idaho	681.8	662.1		605.6	736 3	
Wyoming	707.3	694.1	Wyoning Coloredo	641 2	797 2	
Colerade	684.5	727.5	Coloisa	691 7	771 1	
New Mexico	571.8	608.8	NEW MEXICO	502 2	764 1	
Arizona	797.1	688.4	Ar1zona	202.2	907 1	
Utah	642.5	705.6	UCAh	029.9		
Nevada	1007.4	809.7	Nevada	/02.9	642.8	
PACIFIC			PACIFIC	605.0	701 9	
Washington	791.8	691.8	Washington	082.9	/01.3	
Oregon	766.6	705.4	Oregon	002./	//0./	
California	823.3	735.9	California	/29.1	700.1	
Alaska	705.6	611.7	Alaska	209./	/24.9	
Hawaii	977.8	1034.3	Havaii	1183.9	0,0.0	



# Figure 5--CVR DISEASES DEATH RATES BY STATE OF BIRTH BY PLACE OF USUAL RESIDENCE, STATES WITH HIGHEST AND LOWEST BATES, WHITE MALES, 45-64, 1959-1961

The death rates for those living in State of birth, or "non-migrants," show a consistently high correlation with out-migrants, for each sex separately, for all causes and coronary heart disease, as well as for the CVR diseases (Table 3).

Those residents not born in a State who moved into and became residents of a State prior to death may be thought of as in-migrants. Rates for this group also show a rather high correlation with non-migrants."

Out-migrants also show substantial correlations with in-migrants. While somewhat lower, they are all statistically significant at the .01 level. Loosely speaking, those who spend the early portion of their lives in a State show some tendency toward having death rates similar to those who spend the latter part of their lives in the State.

## WEST NORTH CENTRAL

The West North Central States generally have low death rates, and this is particularly true for the "non-migrants" in this area, those residing in State of birth. But what about the death rates of those born in these States who migrate to various other parts of the United States when compared as in-migrants to various areas? Those age 35-74 who moved to East Coast States, had a death rate about 20 percent lower than those born in their respective East Coast States (Figure 6).

The migrants from each of the West North Central States to each division of the East Coast States (New England, Middle Atlantic and South Atlantic) had lower rates than did those born there, for all causes and for coronary heart disease as well as for CVR diseases--in spite of

- Table 3--CORRELATION COEFFICIENTS OF DEATH RATES OF LIFETIME MIGRANTS AND RESIDENTS OF STATE OF BIRTH FOR SELECTED CAUSES AND BY SEX, MIDDLE-AGED WHITES, 1959-1961 and 1950
  - x = "Non-migrants": Living in State of birth (or born in State of residence).
  - y = Out-migrants: Born in State but living elsewhere (or lifetime migrants to other States).
  - z = In-migrants: Residents not born in State (or lifetime migrants moving into the State).
  - n = 46 States, excluded are Alaska, Hawaii, Newada, Wyoming and District of Columbia.

	r <sub>xy</sub>	* <sub>xz</sub>	r <sub>yz</sub>
Year, age, cause	"Non-	"Non-	Out-
and sex	migrants"	migrants"	migrants
	with out-	with in-	with in-
	migrants	migrants	migrants
1959-1961.			
age 45-64			
All causes	75	(0)	10
Male	./5	.60	.40
Female	.76	.65	.40
CVR			
Male	.80	.70	.48
Female	.73	.68	.45
Coronary heart			
di sease			
Mole	75	. 80	. 50
Remain	.72	.64	. 44
realize			
1950, age 40-69			
Coronary heart			
disease			
Male	.82	.79	.67
Female	.60	.77	.66
1959-61,age 35-74			
AII Causes Mole	. 81	.72	.58
110 L C			
1959-61.age 65-74			
All causes			
Male	.75	.74	.63

small numbers and resulting random error. (A partial exception is the Missouri-born.) Thus, the people moving from the northern part of the Great Plains to the East Coast had death rates intermediate between their State of birth and their State of residence.

Those born in the West North Central States who moved to States in other parts of the country, who thus became in-migrants, show a more mixed pattern of rates, similar to or slightly higher than the "non-migrant" rates in the various geographic divisions of States to which they have moved. Figure 6--RATIO OF CVR DISEASES DEATH RATES: "IN-MIGRANTS FROM WEST NORTH CENTRAL STATES" <u>div-</u> <u>ided by</u> "NON-MIGRANTS", BY GEOGRAPHIC DIVISION OF RESIDENCE BY SEX, AGE 35-74, 1959-1961



### TO RETIREMENT AREAS

Out-migrants, age 45-64, from the Northeast to Florida have slightly lower death rates, for CVR as well as all causes, than those remaining in the Northeast, but have slightly higher rates than those residents born in Florida. Rates for migrants from other areas present a mixed pattern.

Out-migrants to Florida, age 65-74, have particularly low death rates for this age group (Figure 7), either in comparison with those born in Florida or with "non-migrants", --those who remained in their State of birth. Most pronounced are the rates for those from the Northeast and East North Central States--for males approximately 23 percent and for females 37 percent below the rate of the "non-migrants".

Female migrants to Florida, age 65-74, thus show a pattern of low rates even more clearly than do males (Figure 8) and females, age 55-64, also present evidence of low rates. However, these patterns of low rates for whites do not apply to nonwhite migrants to Florida.









White female migrants to Arizona had slightly lower rates than did those remaining in their State of birth, for all causes as well as CVR causes, but middle-aged male migrants had rates very slightly higher than did those remaining in their State of birth.

Migrants to California in 1959-1961 definitely had higher rates than those born in California--10 to 15 percent higher for the CVR diseases. The rates for those migrating to California from most areas were higher than for those remaining in their State of residence, except for the East Coast. Migrants from the latter had death rates nominally lower than the rates for those remaining along the East Coast, but they still had the highest rates among those migrating to California.

Migrants to California, age 65-74, had patterns very similar to those for age 45-64, which is in marked contrast to the data for Florida.

Since the health status of individuals in different streams of migration and in different age-sex groups may be different, no conclusions should be drawn about the relative merits of various retirement areas.

# TO INDUSTRIAL AREAS

Another major wave of migration has been to the Middle Atlantic States, and the migrant death rates are similar to the high rates for those born in these States. They thus tend to be slightly higher than rates of those remaining in their State of birth (Figure 9).

Those from the West North Central States have CVR death rates 15 to 20 percent higher than those remaining in their State of birth, but these rates are still 5 to 20 percent lower than the rate for those born in the Middle Atlantic States (for ages 45-64 and 65-74, by sex).

Migrants to the East North Central States present a similar but less pronounced pattern of higher rates than for those remaining in their State of birth--except that migrants from the Northeast had rates slightly lower than those remaining in the Northeast.

#### DISCUSSION

Standard vital statistics procedures have been used to tabulate and calculate the rates and ratios presented. The presence of both random and systematic error has been recognized. In addition, one may speculate: Possibly the informant for the death certificate may sometimes not know the State of birth and assume it to be the State in which the decedent was last residing-while the informant to the census enumerator will report otherwise. An alternate possibility is that the individual while living may wish to be classified as born in the State even though he was actually born elsewhere. (This latter line of thought is suggested by data for nonwhites in New York State.)

To achieve an adequate comprehension of the meaning inherent in the comparisons is particularly difficult. The comparisons of U.S. totals for lifetime migrants with those born in State of residence are in part geographic comparisons, because in some sections of the country the population consists largely of the population born there. Within geographic divisions of States there also is a degree of heterogeneity New Jersey, for example, has many inmigrants, while Pennsylvania's population was largely born there.

State data also may lack homogeneity--as is shown by the Omaha metropolitan State economic area: Of the population, all ages, born in Nebraska, approximately 20 percent lives in the Omaha area, but of those who have moved into Nebraska almost 40 percent lives in the Omaha area (13). In-migrants to Nebraska have a death rate 21 percent higher than those born in the State (native white males age 45-64). If migrants to a metropolitan area experience the high mortality observed for the metropolitan area as a whole, then the application of indirect methods of adjustment suggest that the difference in rate would be not more than 14 percent, and possibly considerably less.

Similarly, a substantial portion of the outmigrants from rural Nebraska has moved to metropolitan areas (14). Thus, it would be reasonable to expect Nebraska out-migrants to have a higher death rate than those remaining in the State, as is shown in Table 2.

The low Florida rates for migrants of retirement age suggest several possibilities: Those moving to Florida for retirement (a) are, as a group, in better health than those who remain in their home communities, to be near relatives, friends, a family physician, hospital, and other resources known to them; (b) have a higher socio-economic status, with its accompanying lower risk of dying, as inferred from studies in metropolitan areas in the U.S. (15-17); (c) are in some instances likely to return north either when a chronic illness sets in or when a spouse dies, or (d) may be younger, --that is, may be individuals age 65-69 to a substantially greater extent than individuals age 65-74 generally. An alternative hypothesis is that there is

## Figure 9--CVR DISEASES DEATH RATES OF OUT-MIGRANTS TO MIDDLE ATLANTIC STATES AND "NON-MIGRANTS", BY GEOGRAPHIC DIVISION OF BIRTH, MALES, AGE 45-64, 1959-1961



something inherent in Florida living for those of retirement age which reduces their risk of dying, but which does not appreciably affect those prior to retirement.

A hypothesis within the realm of possibility is that a higher proportion of migrants generally will be aggressive "Type A" individuals (who have higher coronary rates) as defined by Friedman and associates (18), as compared with those who remain in their State of birth--more generally the "Type B" person.

Syme and associates have well demonstrated higher rates for those with high cultural mobility (19). If both of these characteristics are present to a substantially greater extent in migrants than in those remaining in their State of birth, then the migrant mortality rates would be expected to be higher than present tabulations indicate. On the other hand, some individuals (such as ministers, teachers, construction workers, etc.) migrate in order to remain in the same type of work.

Further, the educational level of lifetime

migrants to large metropolitan areas generally is much higher than for those born in State of residence, but for those in the Pacific States, migrants consistently have lower educational achievement levels (20). Migrants to California have higher rates in relation to the rates for the California-born than would be anticipated from the experience for other parts of the country. One may speculate that this is related to their lower educational levels, particularly in view of the relationship observed for selected urban areas between socio-economic status and death rates (15-17).

While lifetime migrants generally have death rates slightly higher than those remaining in their State of birth, these differences are negligible compared to the high rates for migrants from abroad, or the foreign-born, in 1900 (as compared with native whites then) (21). In the U.S., Norwegian and Swedish-born middle-aged males have much higher death rates than those who remained in Norway and Sweden (22).

### SUMMARY

1. Lifetime migrants--those living at time of death in a State different than State of birth-appear to have slightly higher death rates than do those living in State of birth.

2. Migration generally has tended toward metropolitan areas, which on the average have higher death rates than do non-metropolitan areas.

3. Available evidence does not support the hypothesis that geographic differences in death rates are primarily due to migration.

4. Lifetime migrants to Florida from the Northeast and North Central regions who are of retirement age have particularly low death rates. The pattern of rates suggests the possibility that selective migration in some way plays an important role.

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