

# The Effect of Residential Mobility on Registration Rates of a Population Served by a Neighborhood Health Center

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THE DIFFICULTIES encountered in estimating registration rates for families eligible for the service of a community health center have been pointed out in a paper by Salber and co-authors describing the characteristics of patients registered at the Martha M. Eliot Health Center in Bos-

ton, Mass. (1). Ideally, specific point prevalence registration rates would be determined for subgroups at successive points in time. For example, for the 15th day of each successive month, we might wish to know the proportion of families that were registered among all white Aid to

Families of Dependent Children (AFDC) families currently residing in the service area and having at least one preschool child. If there were no movement of population in or out of the area, a baseline census enumeration could serve as a population register. As each family registered, an

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entry to this effect would be duly recorded. At any point in time, we could determine what proportion of the aforementioned white AFDC families had already registered. The denominator population for any given subgroup would, over time, always be composed of precisely the same families.

Residential mobility in the Martha M. Eliot Health Center catchment area was found, however, to be rather high, and the characteristics (for example, AFDC status) of even residentially stable families fluctuated over time. Mobile families may possibly have a markedly different cumulative registration experience from that of more residentially stable families.

The previous study of registration differentials had required estimates of the registration prevalence for various subpopulations as of August 15, 1968, the first anniversary of the inauguration of registration. In the absence of a communitywide prevalence survey for that date, reliance was placed on two less satisfactory indicators of the center's penetration, namely, the proportion of the originally enumerated cohort that was registered by August 15, 1968, and the ratio of registrations during the year to the number of eligible families at the beginning of the year.

1. The proportion of the originally enumerated cohort that was registered by any given anniversary would only rarely equal the desired prevalence figure for that date since, for this equality to hold, a specific set of relations has to exist between the sizes of the nonmigrant, in-migrant, and out-migrant groups and the registration rates in the three groups. If the migrant groups are very

small as compared with the non-migrant group, the maximum potential error is rather small. If, however, there has been substantial movement of the population, the error could, under certain circumstances, be appreciable.

2. The ratio of registrations during the year to the number of eligible families at the beginning of the year is, in most instances, likely to be a substantial overestimate because some portion of the registrants would have moved from the catchment area by the end of the year, thereby causing an inflated numerator. In practice, the type of selective net out-migration required to compensate for the inflated numerator would be unlikely to occur.

To obtain a better understanding of the effects of mobility on

Public Health. The center is a combined program of the Boston Hospital for Women and the Children's Hospital Medical Center and serves approximately 2,000 women and 6,000 children from 2,070 homes. It is located in a low-income housing project in northern Jamaica Plain but serves an additional population from outside the housing project. One-third of the eligible households, containing approximately 40 percent of the area's children, reside in the housing project. We restricted our study of mobility to the housing project because of the availability of Boston Housing Authority records for those housing units and the unavailability of records for other housing units.

Analysis of quarterly reports

**Table 1. Percentage distribution of white and black families moving into and out of housing project, July 1967-June 1968, by presence of children under 21 years and receipt of Aid for Dependent Children**

Children under 21 and AFDC status	Families moving in (N=220)		Families moving out (N=217) <sup>1</sup>	
	White	Black	White	Black
With children under 21:				
Family on AFDC.....	6.4	58.6	15.1	15.6
Family not on AFDC.....	2.3	17.7	15.6	13.3
No children under 21.....	4.5	10.5	34.9	4.6
Total.....	13.2	86.8	65.9	34.1

<sup>1</sup>2 families, 1 white and 1 black, are included in the total but are omitted from the body of the table because the ages of the children were unknown.

our penetration indicators, we undertook a study of in-migration and out-migration from a portion of the catchment area.

The Martha M. Eliot Health Center is funded by the Maternal and Child Health Services (formerly the Children's Bureau) of the Department of Health, Education, and Welfare, through the Massachusetts Department of

of the Boston Housing Authority revealed that the ratio of families moving into an apartment during the year to the total number of apartments was 19 percent. The mobility pattern of black families, however, differed considerably from that of white families. Of the 220 families that had moved into the project between July 1967 and June 1968, 87

percent were black; of the 217 families that had moved out of the project during the same period, only 34 percent were black. A larger proportion of the families moving into the project had children than of the families moving out. Similarly, a larger proportion of the families moving into the project were receiving Aid to Families of Dependent Children (AFDC) than of the families moving out (table 1).

The head of the household was under 30 years in the majority of black families that had moved into the housing project during the study year; the ages of the heads of households in the white group were fairly evenly distributed. While, in 53 percent of the families moving in, the heads of the households were younger than 30, in only 23 percent of the families moving out, were the heads this young (table 2).

It became obvious from these migration differentials that our penetration indicators were subject to rather severe biases. In order to examine these biases more directly, the registration records had to be linked with the mobility records. A linkage study was therefore conducted for a sample of housing units from the housing project.

## Methodology

There are 1,152 apartments in the housing project. Of these, 22 had been converted to other uses by the time of the study, including those used for the Martha M. Eliot Health Center. The remaining 1,130 apartments were listed in locational order. A 20 percent systematic random sample was drawn, giving a total of 226 apartments for study.

Then, for each apartment

**Table 2. Percentage distribution of white and black families moving into and out of housing project, July 1967–June 1968, by age group of head of household**

Age group of head of household	Families moving in (N=220)		Families moving out (N=217)	
	White	Black	White	Black
Under 30.....	3.6	49.5	8.3	14.7
30-44.....	5.5	24.5	18.4	13.4
45-64.....	1.4	8.6	13.4	3.2
65 and over.....	2.7	4.1	25.8	2.8

drawn, separate cards were made up, on which were recorded the apartment number and address, dates and length of occupancy by families during the study year (Aug. 1, 1967, through July 31, 1968), race and sex of the head of the household, age of the youngest child, number of children under 21, eligibility of the family for services of the center, where the family had moved from and where they moved to, and its AFDC status. (Eligibility was defined in terms of the granting agency and was restricted to families with women in their reproductive period or with children under 21 years.) From the records of the Martha M. Eliot Health Center, the center's identification number for the family and the date of registration were added.

## Results

The 226 apartments in our sample housed 264 families during the year—36 apartments had successively two families and one apartment had three. Fifty-nine (26.1 percent) of the apartments were vacant from 1 to 33 weeks; the total vacancy period for all apartments during the year was 605 weeks. One hundred sixty-seven apartments had no vacant periods. The 226 apartments

were occupied 11,147 weeks of a possible 11,752, an occupancy rate of 94.9 percent. Twenty-three percent of the families that moved transferred to other apartments in the project.

*Characteristics of families.* Sixty-one percent of the 264 families were black and 39 percent white; 70 percent were eligible for care at the Martha Eliot Center. Sixty-five percent of the families with children under 21 were on Aid to Families of Dependent Children. Seventeen percent of the eligible families had five or more children; in 61 percent of the families with children, the youngest child was less than 6 years old. Seventy percent of the 184 families eligible for services at the Martha M. Eliot Health Center were registered at the center; 60 percent of the eligible families registered during the study period. Since registration was restricted to families with children under 21 or with women in their reproductive years, the bulk of our report concerns the 184 families in the sample that were eligible for service under criteria established by the funding agency.

*Mobility of eligible families.* Of the 184 eligible families, 109 lived in the housing project at the same address throughout the study year and are arbitrarily la-

beled *A* families. The breakdown of all eligible families by mobility status was as follows:

Mobility category	Families
<i>A</i> Nonmovers.....	109
<i>B</i> Immigrants:	
<i>B</i> <sub>1</sub> Moved from outside housing project to sample apartment.....	35
<i>B</i> <sub>2</sub> Moved from inside housing project to sample apartment.....	9
<i>C</i> Outmigrants:	
<i>C</i> <sub>1</sub> Moved outside housing project from sample apartment.....	22
<i>C</i> <sub>2</sub> Moved to nonsample housing project apartment from sample apartment.....	9
Total.....	184

On August 1, 1967, families eligible for service at the health center occupied 140 of the sample apartments. During the next 12 months, 31 of these families, the *C* families, moved out of these apartments. Movement from the sample apartments did not occur at an even rate throughout the year. During the first quarter, 14 families—45.2 percent—left; during the second, seven families—22.6 percent; during the third, five families—16.1 percent; and during the last quarter, another five families left.

*Registration patterns of families.* The patterns of registration of the 109 eligible families that lived in the housing project for

**Table 4. Interval between first opportunity to register and date of registration of eligible families that had lived in sample apartments only part of the study year**

Weeks between first opportunity to register and registration	Weeks of occupancy between Aug. 1, 1967, and July 31, 1968				Total
	0-13	14-26	27-39	40-52	
<i>B</i> families:					
0-13.....	1	3	7	3	14
14-26.....	0	0	2	2	4
27-39.....	0	0	1	0	1
40-52.....	0	0	0	0	0
Did not register by end of study period.....	3	6	5	2	16
Total.....	4	9	15	7	35
<i>C</i> families:					
0-13.....	2	2	1	0	5
14-26.....	0	0	1	1	2
27-39.....	0	0	0	0	0
40-52.....	0	0	0	0	0
Did not register before moving out of housing project.....	9	2	1	3	15
Total.....	11	4	3	4	22

NOTE: 9 *B* families and 9 *C* families that had transferred to other apartments within the housing project are excluded from this table.

the entire year under study were analyzed according to race, AFDC status, age of the youngest child, and number of children in the family (table 3).

Seventy-three of these 109 families were registered by the end of the first year of the center's operation, a rate of 67 percent. Although white families were a little slower to register than black families, by the end of

the study year the registration of both groups was an identical 67 percent.

AFDC families in the project registered at slightly higher rates than families not on AFDC (72 percent compared with 67 percent).

Registration was markedly influenced by the size of the family and the age of the youngest child. (These two factors are interrelated.) Families with more children registered at a more rapid rate than families with fewer children, and those with very young children registered at a more rapid rate than those with older children.

The *B* and *C* families did not have the same amount of time in which to register as the *A* families, since the *B* families were not living in the sample apartments at the beginning of the study year and the *C* families were not there at the end. Nine of the *B* families, however, had been living in the housing project in other apartments and were transferred during the year into the study

**Table 3. Cumulative percentage distribution of 109 families that lived in housing project throughout study year, Aug. 1, 1967–July 31, 1968, by quarter of registration at Martha M. Eliot Health Center**

Characteristics of families	Number of families	End of 1st quarter	End of 2d quarter	End of 3d quarter	End of study year
<i>Race:</i>					
Black.....	87	32.2	56.3	62.1	66.7
White.....	21	33.3	42.9	57.1	66.7
<i>AFDC status:</i>					
On AFDC.....	61	36.1	62.3	67.2	72.1
Not on AFDC.....	43	30.2	46.5	60.5	67.4
<i>Age of youngest child:</i>					
0-5 years.....	65	41.5	70.8	78.5	83.1
6-11 years.....	18	33.3	50.0	66.7	72.2
12 years and over.....	31	9.5	14.3	19.0	28.6
<i>Number of children:</i>					
1.....	21	19.0	23.8	23.8	33.3
2-4.....	60	36.7	61.7	71.7	76.7
5 or more.....	23	39.1	69.6	82.6	87.0

NOTE: 5 of the 109 families had no children; 1 was of "other" race.

apartments. Thirty-five *B* families moved into the project from outside. Similarly, although 31 *C* families were not living in the study apartments at the end of the year, nine of them still lived in the housing project, having transferred to other apartments. Twenty-two *C* families had moved outside the housing project.

Registration rates are presented only for the *B* and *C* families that had moved into or out of the project. Families that had transferred within it were not included in our calculation of rates. Registration for the *B* families (the families moving in) was 54.3 percent and for *C* families (those that moved out), 31.8 percent (table 4).

Of the 31 families moving in with at least 13 weeks left to register before the end of the study year, 41.9 percent registered during their first 13 weeks of residence. The comparable 13-week figure for those families that lived in the project for the entire year was 32.1 percent. While this difference of 10 percentage points is not statistically significant, it is nevertheless suggestive. It could be due to the younger age of the children in families moving into the project or the fact that these families had no previously established tie to a source of medical care. *C* families registered at a somewhat lower rate than the other groups of families either because the children were older or because they anticipated their forthcoming moves.

In another measure of health center penetration, a family-weeks concept is used—the proportion of the total potential coverage actually realized. To compute this measure, we characterized each apartment by the number of weeks it was occupied

**Table 5. Number of families in sample apartments eligible to register for service and number registered during study year, by mobility category**

Mobility category	Eligible families in sample apartments—		Eligible families registered during study year—	
	Beginning of year	End of year	While living in sample apartment	Living in sample apartment end of year
<i>A</i> .....	109	109	73	73
<i>B</i> <sub>1</sub> .....		35	19	19
<i>B</i> <sub>2</sub> .....		9	2	18
<i>C</i> <sub>1</sub> .....	22		7	
<i>C</i> <sub>2</sub> .....	9		13	
Total.....	140	153	104	100
Adjustment <sup>1</sup> .....			+1.5	-1.5
Adjusted total.....			105.5	98.5

<sup>1</sup>6 of the *B*<sub>2</sub> families (the families that had transferred into a sample apartment from another apartment in the housing project) were registered before moving. Only 3 of the *C*<sub>2</sub> families (families that had transferred from a sample apartment to a nonsample apartment) had registered before moving. Since the expected values of these 2 figures must be equal, the adjustment of 1.5 makes each of them equal to 4.5, which is the average of their values in our sample.

by eligible families. We summed these measures, the total being an aggregate of the weeks of occupancy by eligible families, or 7,546 family-weeks.

Each apartment was also characterized according to the number of weeks in which it was occupied by eligible families before their registration at the Martha M. Eliot Health Center—1,570 family-weeks. The entire occupancy of the families that had not registered by the end of the study period was counted—2,685 family-weeks.

The ratio of the unregistered aggregate (1,570 + 2,685, that is, 4,255 family-weeks) to the total family-weeks was the percentage of family-weeks during the year not covered by registration—56.4 percent. Thus, 43.6 percent of the potential coverage was achieved, a measure which reflects not only the length of the interval between the first opportunity a family had to register and the actual date of registration but also the volume of migration as well. Normally, the higher the

mobility rates, the lower the percentage of potential coverage achieved. While we may usually prefer, for analytical purposes, to separate the promptness of registration from the rate of migration, the composite rate can be useful descriptively.

*Registration point prevalence.* Table 5 provides the information required to calculate various estimates of the proportion of families registered among the eligible ones living in the housing project at the end of the first year of the health center's operation. Using only data from the sample of apartments, we find:

1. The ratio of the "adjusted estimated number of families residing in the housing project at year's end that had registered" to the "total estimated number of eligible families residing in the housing project at the year's end."

$$\frac{5 \times 98.5}{5 \times 153} = 64.4 \text{ percent}$$

2. The registration rate within the cohort of *A* families, that is,

those families occupying a sample apartment at the beginning of the study year and not moving during the year.

$$\frac{73}{109} = 66.9 \text{ percent}$$

Since the foregoing estimates are based exclusively on the sample of apartments, they are subject to considerable variance. Greater precision can be achieved by combining information from the baseline area census and from the center's registration records with the sample data.

In a previous paper (1), Salber and co-authors had reported that, according to the baseline census enumeration, 714 eligible families were residing in the housing project at the beginning of the year. There were 621 registrations during the year by families that lived in the housing project at the time of registration. The registration ratio was thus:

$$\frac{621}{714} = 0.870$$

We shall use this ratio as the basis for an estimate of year-end point prevalence. The numerator of the ratio includes families that were no longer residing in the housing project at the end of the year. The adjusted estimates from the sample show that, of the 105.5 families which had registered while occupying a sample apartment, 98.5 were still living in the project at the end of the year. The seven  $C_1$  families that had moved from the project subsequent to registration are responsible for the difference between 105.5 and 98.5. The numerator of the registration ratio should be reduced by a factor of  $98.5 \div 105.5$ .

The denominator of the registration ratio fails to reflect any

net change between the beginning and end of the year in the number of eligible families residing in the housing project. In our study, 44 eligible families moved into sample apartments and 31 eligible families moved out, leading to an increase from 140 eligible families at the beginning of the year to 153 eligible families at the end. The denominator of the registration ratio should thus be inflated by a factor of  $153 \div 140$ .

The correction factor is:

$$\frac{98.5 \div 105.5}{153 \div 140} = 0.854$$

The registration ratio of 0.870 would thus, in the present instance, need to be reduced by about 15 percent to provide an estimate of the registration prevalence at the end of the study year. Reducing the registration ratio by the correction factor, the prevalence estimate is 74.3 percent, as compared with the estimate of 64.4 percent based exclusively on the sample of apartments.

## Discussion

In spite of a rather appreciable rate of mobility in the housing project population, the registration ratio needed to be reduced by only 15 percent to provide an estimate of the year-end registration prevalence. The requisite correction would frequently be much greater.

Our analysis deals exclusively with the aggregate figures for a geographic area. As was suggested by the data concerning migration differentials according to race, age of the head of the household, and AFDC status, changes during the year in the size of particular subpopulations can be extremely large. The

correction necessary to convert a subpopulation-specific registration ratio into a point prevalence rate would thus tend to be far more consequential than the correction appropriate for the total population.

As the interval between the baseline enumeration and the point in time for which prevalence is to be estimated increases, the correction factor is likely to depart further from unity. Similarly, as the period during which registrations are accumulated grows longer, the departure from unity is likely to increase. If the present study had covered a 2-year period, the numerator of the registration ratio would certainly have required a far greater reduction than it did for the single year.

The size of the correction is, of course, subject to fortuitous circumstances. In the present analysis, the proportion of  $C_1$  families which had been registered before they moved was rather small, in part because of an accident of timing. As we indicated earlier, nearly half of the  $C$  families moved during August, September, and October of 1967; there was thus less than 3 months of exposure to the risk of registration for such families. If the period of high residential mobility had not followed so closely the opening of the health center, outmigration of families after registration would have been far more common and the required correction would have been far more substantial.

It is apparent that it would be dangerous to apply to another situation the particular correction calculated from our data. We would recommend, however, that other health center investigators randomly select a relatively small cohort of housing units within

their catchment areas and prospectively follow the occupancy histories of these units in terms of the tenants' eligibility for services, their demographic characteristics, registration for services, and health services utilization

patterns. We view this approach to the complications arising from residential mobility as being more efficient and edifying than the alternative periodic prevalence surveys of independent samples of families.

#### REFERENCE

- (1) Salber, E. J., Feldman, J. J., Offenbacher, H., and Williams, S.: Characteristics of patients registered for service at a neighborhood health center. *Am J Public Health* 60: 2273-2283, December 1970.

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**FELDMAN, JACOB J. (Harvard University School of Public Health), SALBER, EVA J., and JOHNSON, HELEN:** *The effect of residential mobility on registration rates of a population served by a neighborhood health center. HSMHA Health Reports, Vol. 86, September 1971, pp. 803-809.*

Difficulties arise in estimating the proportion of families residing in a defined target area that are registered for services at a health center. Even if a baseline census enumeration and registration records are available, residential mobility greatly complicates the estimation of registration point prevalence. The out-migration of families that have registered and changes in the size and composition of the target population need to be taken into account.

The investigation described was undertaken to evaluate, for one particular situation, the amount of bias which migration differentials might introduce. Incidentally, some light was thrown on possible methods for assessing the impact of residential mobility on the estimation of registration rates.

A systematic random sample of apartments within a housing project was selected. For a 12-month period, the occupancy history, in terms of eligibility and registration for health center services, was recorded for each apartment. These data made it possible to delineate cumulative registra-

tion curves for various subgroups of the population. Outreach penetration could thereby be assessed for the different subgroups at various durations of time from the inauguration of services. Penetration differentials could be viewed in terms of the promptness of registration during different intervals and of the eventual proportion of the population that was covered.

A summary measure useful in comparing cumulative penetration curves for different situations involves the computation of the percentage of family-weeks covered by registration among all potentially covered family-weeks.

In the present instance, the ratio of registrations to the baseline population was about 20 percent higher than the estimated year-end registration point prevalence. The degree of overstatement would be greater in situations with higher residential mobility rates and longer study periods. Furthermore, the amount of distortion was undoubtedly far greater for certain subpopulations than it was for the population as a whole.