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Do health selection effects last? A comparison of morbidity rates for elderly adult immigrants and US-born elderly persons

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Abstract. This paper uses the Assets and Health Dynamics of the Oldest Old (AHEAD) data set to examine the influence of nativity on the health status, measured by self-reported presence of chronic diseases, of the elderly US-resident population. In particular, age at time of migration is used to examine the potential lingering influence of self-selection for good health among immigrants who entered the USA as adults. Bivariate analyses and logistic regression models are presented. The results of these analyses show that the influence of positive selection for health varies depending on the disease studied. Self-selection for good health is maintained for cancer, heart disease, stroke, and lung disease. This self-selection effect is seen after controlling for socioeconomic factors and health behaviors. While these latter factors are more influential, this study indicates that good health in a population at young ages is maintained throughout the lifespan.

Key words: Elderly, Health, Immigrants, Morbidity, Population survey

Introduction

This paper examines how the health of the elderly foreign-born population in the United States differs from the health of the elderly US-born population. The focus of this study is to consider whether foreign-born persons who migrated to the USA during their adult years have better health than US-born persons.

The interaction between health and migration is complex and the cause-effect relationship is not clear. Does health determine migration, or does migration determine health? That is, if all that is known is that migrants are healthy, this could be because good health was an impetus to migration or because migration 'caused' later good health. There has been little direct study of whether immigrants are healthier than persons from their country of origin who choose not to migrate. Recent research found that immigrants to the USA have lower mortality than persons who remain in sending countries (Swallen 1996). In addition, Marmot, Adelstein and Bulusu's (1984) comparison of Irish, Polish, Italian, Indian, and Caribbean immigrants to England with the population in the country of origin found that for all immigrant groups (except the Irish), male mortality was lower in the immigrants than among those who

remained in the country of origin. This suggests a migration selection effect. In both the English and the American study, the selection effect appeared to be stronger for males than for females.

Health selection should be seen in morbidity as well as mortality. However, there have been very few data sources that include birthplace information that have been analyzed to address the difference in health status on the national level. Surveys that do exist have concentrated on self-reported health. Analyses of both the NHIS (Stephen, Foote, Hendershot & Schoenborn 1994) and by Statistics Canada (Parakulam, Krishnan & Odynak 1992) found that the foreign-born were less likely to report themselves in fair or poor health than were the native-born. These surveys, combined with the mortality findings, demonstrate that the population of adults migrants to the United States is selected for good health.

The question of how long a positive health selection might last has not been well addressed. Parakulam, Krishnan and Odynak (1992) found that once a person had been in Canada 20 years, there was no difference from native-born Canadians in reported health status. However, the Canadian sample consisted of persons under age 65. The age span of most national health surveys has been inadequate for assessing differences in morbidity at advanced ages. This analysis will add to the understanding of the long-term effects of good health; the results presented here describe an extremely elderly population.

The prevalence of disease in a population depends both on the incidence of the disease and the duration of the disease. In addition, if mortality differs between groups, such that one group is more likely to die and the other to live with the disease for a longer time, the prevalence will appear higher in the group that experiences lower mortality. Thus, before considering morbidity prevalence rates in the elderly population, mortality differences must be considered.

Several analyses of mortality of immigrants in the United States indicate that immigrants have lower mortality than US-born persons. Kestenbaum (1986) compiled simple statistics on the influence of birthplace on mortality. He found that persons born outside the United States had lower mortality rates than native-born Americans. Rosenwaike and associates (Rosenwaike 1987; Rosenwaike & Hemstead 1990) examined mortality differentials for foreign-born US-residents, from several countries. They found that disease rates were high among foreign-born adolescents and low at old ages. However, race-specific comparison were not attempted nor were cross-national analyses. Analyses of the National Longitudinal Mortality Survey (NLMS) also demonstrated that foreign-born persons have lower mortality than US-born persons (Rogot, Sorlie, Johnson & Schmitt 1992). Recently, Swallen (1996) used vital statistics of the USA for 1990 and the National Health Inter-

view Survey-National Death Index Linked data to assess current mortality rates for immigrants with US-born persons. She found that immigrants have lower mortality rates than US-born persons of the same sex and rate/ethnicity, but that these rates depend upon age at time of immigration. Persons who enter the USA as working adults have the lowest mortality rates, while persons who enter either as children or in old age have slightly higher mortality rates. Outside of the USA, probably the best examination of the issue was performed by Marmot, Adelstein and Bulusu (1984) in England and Wales. They looked at Irish, Polish, Italian, Indian, and Caribbean immigrants to England, and compared them with the English population, and with persons who remained in the country of origin. Overall, the immigrants had lower death rates that English-born persons, and than persons who remained in the country of origin.

These mortality analyses demonstrate that the foreign-born are not at increased risk of death before age 70. Therefore, even in a cross-sectional study, a decreased prevalence of morbidity among the foreign-born is not attributable to greater death rates, and must measure a real lower incidence of disease. However, actuaries predict that the advantage held by select populations will converge to the non-select population over time (Jordan 1975). Some convergence of mortality rates is seen in analyses of vital statistics (Swallen 1996). This paper asks whether there is also a convergence in morbidity rates at old ages.

Methods

The Assets and Health Dynamics of the Oldest Old (AHEAD) data set, which describes a number of health conditions among approximately 8,000 elderly persons, provides a broad view of chronic disease among the extreme elderly. In the AHEAD data, 9% of the respondents report being foreign-born. This is consistent with the US census data for these age groups. To further understand the relationship between birthplace and health, these foreign-born persons are parsed into three groups that depend on age at time of migration. This division is done to separate persons who come from different areas of the world, and whose migration decisions are driven by separate factors. Using these groups, the breakdown of the AHEAD immigrants age 70 and over shows that 32.1% entered the USA before age 15, 57.4% between ages 16 and 59, and 10.5% at ages 60-plus. This paper focuses on the immigrants who entered the USA between ages 16 and 59. These people would be most likely to be subject to a positive health selection effect, since their migration decision was made during their prime working adult years. Throughout this paper, they will be referred to as adults migrants.

Immigrants, or persons born in countries other than the USA, make up 10% of the elderly (age 65+) population in the USA. In some states, including California, New York and Hawaii, over 20% of the elderly population is foreign-born (Treas 1996). This is a sizable fraction of the population; in comparison, blacks only consist of 8% of the elderly population in the USA. Since this paper examines persons who immigrated to the USA between age 15 and 59, and these persons were age 70 or older in 1993, then the range of possible dates of immigration is from 1908 (for a 100-year old who immigrated at age 15) to 1982 (for a 70-year old who immigrated at 59). In 1908, nearly all immigrants were from Europe, especially Southern and Eastern Europe. In 1982, immigration patterns to the USA were dominated by persons from South America and Asia. Of the adult migrants in this study, 85.5% are white, 8.2% are black, 1.0% are American Indian/Alaskan Nature, 1.4% are Asian and 4.0% are 'Other'. Hispanic ethnicity was determined separately from race; 30.4% of the adult migrants are Hispanic. (Of the whites, 29.9% are Hispanic.)

The AHEAD sample was designed to consist of persons (and households) maintained by persons aged 70 and older. Through the Health and Retirement Survey (HRS) from the University of Michigan, a community-based sample of persons aged 70 and older was drawn. Those living in nursing homes or other long-term care facilities were excluded by design. African Americans, Hispanics (in particular, Mexican-Americans), and Florida residents were over sampled. A more complete description of the sampling design for the HRS is available elsewhere (Juster & Suzman 1995). For those 80 and older, a dual sampling frame was used, with Medicare enrollees from the Master Enrollment File of the Health Care Financing Administration (HCFA) replacing those selected by HRS. To account for this dual sampling frame, weights are used throughout the analyses. The sample therefore consisted of 9,854 persons identified by HRS and 2,058 identified by HCFA. In total, 8,223 persons completed the interview out of 10,228 eligible persons, for a response rate of 80.4%.

Data from the AHEAD survey that is of particular interest for these analyses include the demographic variables and the health and disability variables. The central demographic variables analyzed here is birthplace (USA or non-USA). In addition, age at migration is calculated using either a direct response to the question on age at time of migration or indirect information, consisting of year of migration and year of birth. Other demographic and socioeconomic variables of interest in the survey include age, sex, race (white or non-white), Hispanic ethnicity, urban or rural residence, education (high school graduate or not), and insurance status. Insurance status is treated as a three-category variable in these analyses: uninsured, government insur-

ance (including Medicare and Medicaid), or private insurance. The health behavior variables considered here include smoking, alcohol use, and body mass index (weight/height-squared). Smoking is treated as a three-category variable: never smoked, formerly smoked, and currently smoke. Alcohol use is categorized by the response to the question: did you ever drink alcohol?

In this paper, the dependent variables of interest are self-reported health conditions. The diseases included here are: cancer, lung disease, heart disease, stroke, diabetes, and arthritis. In addition, limitations of activities of daily living (ADLs) are included as a dependent variable. The ADLs included here are: bathing, getting in and out of bed, dressing, eating, walking, and using the toilet. Those who have difficulty or require help with any of these are described as having an ADL limitation.

One small drawback with the AHEAD data is that this survey excludes those persons living in nursing homes, thus excluding a large number of persons with debilitating chronic illnesses. Many previous descriptions of the health of the extremely old population have concentrated on nursing home patients. However, the focus on nursing-home patients can be misleading since, in 1979, only 5% of persons 65 and older resided in nursing homes (Van Nostrand 1979). The proportion institutionalized over age 65 has increased very slightly from 1979 to 1990. Among the US-born in the 1990 one-percent sample of the census, 5.91% of the 65 and over population were institutionalized; among the foreign-born, 5.48% of the 65 and over population was institutionalized. However, the numbers presented in this paper should be understood as the prevalence in the non-institutionalized population. The experience of nursing home patients is likely very different.

Finally, it is important to note that the AHEAD data is based solely on self-report. There are no scientific measures of the presence or absence of disease in this population. The differences found must be emphasized to be between the reported presence or absence of a given condition, and not the medically measured presence or absence of the condition. Cultural differences in reporting many therefore also influence self-reported disease rates.

Cross-tabulations and chi-squared tests were performed to determine the bivariate relationship between a number of factors. A number of factors may confound the relationship between nativity and disease prevalence. Other factors that might account for a relationship between nativity and disease prevalence that were investigated here include: race, ethnicity, sex, age, urban/rural residence, cigarette and alcohol use, body-mass index, health insurance, and education. Logistic regression models were constructed, and odd ratios and measures of significance (*p*-values) are presented. Throughout the paper, results are presented using sample weights.

Results

Table 1 presents the prevalence rates for seven conditions: heart disease, cancer, stroke, lung disease, diabetes, arthritis and the presences of any limitations of activities of daily living (ADLs). Two rates are presented for each condition, one for US-born persons and one for foreign-born persons.

People born in the United States appear more likely to report having some of these health problems than persons born elsewhere. However, the direction of the effect is not always consistent. Cancer, lung disease, heart conditions, and stroke appear to be significantly lower in the foreign-born than in the native-born population. These are the major causes of death in this age group. Diabetes, disability and arthritis are significantly elevated among the foreign-born population. The latter two of these conditions are significant detractors from the quality of life for the elderly. Diabetes is more common among Hispanics, and this may explain the elevated risk of the foreign-born. To address this and other potentially confounding issues, logistic regression models were constructed.

Confounding factors

The simple analysis has been presented above as if birthplace was the lone factor of importance. Potential confounding factors include such things as health behaviors, demographic and socioeconomic factors. These variables are described in the Methods section. A number of factors may be related both to health conditions and to birthplace. These variables are referred to as confounding factors, since they confound the relationship of interest, that between birthplace and health. While some of these variables may measure a direct causal pathway, they will be referred to as confounders, since they confound the relationship of interest.

Table 2 presents information on these confounding factors for the two groups of interest. Both groups contain more females than males; average age is slightly less for US-born (77.3) than for foreign-born (79.2) persons. Neither race nor sex are distributed differently by migrant status. However, foreign-born adult migrants are significantly more likely to be older, Hispanic and to live in urban areas. They are less likely to have a high school diploma. Foreign-born persons, surprisingly, are more likely have non-government insurance than are US-born persons. This finding might not be true for younger immigrants. All persons in these age groups are very likely to have federal health insurance (Medicare). There was no difference between the two groups in Medicare status. In terms of health behaviors, foreign-born adult migrants are less likely to be either smokers or former smokers. There is no difference

Table 1. Proportions and age-sex standardized odds ratios of persons reporting health condition. The odds ratio reports the odds that a foreign-born person who migrated between ages 15 and 59 reports an increased prevalence of the condition compared with a US-born. 1993–94 AHEAD, Wave 1

Health condition	Proportion with condition among US-born (%) (n = 6774)	Proportion with condition among foreign born (%) (n = 379)	Odds ratio
Cancer	14.1	9.9	0.649
Lung disease	11.9	8.0	0.680
Heart condition	31.8	25.5	0.701
Stroke[a]	10.4	8.0	0.668
Diabetes	12.6	15.8	1.385
Arthritis	25.3	29.6	1.190
Any disability[b]	29.3	36.2	1.124

[a] Definite or possible stroke.
[b] Disability measured by any limitations of Activities of Daily Living (ADLs).

in alcohol use between the two groups. Adult migrants also appear to be slightly heavier than US-born persons.

Logistic regression model

When considering the simple relationship between health measures and birthplace, it is necessary to examine whether birthplace is merely a proxy for some other variable. Also, it is important to consider the magnitude and significance of any contribution that birthplace makes to health at old age. Table 2 indicates that the most important confounding factors are: age, ethnicity, residence, education, and smoking status. The other variables will also be included in the logistic models since they have been previously reported as important predictors of the dependent variables. In the logistic regression models presented here, the US-born group is the referent group. The models describe the increase or decrease in risk of the given condition for the adult migrants. An odds ratio of greater than 1.0 indicates that foreign-born adult migrants have an increase in the given condition; an odds ratio of less than 1.0 indicates that foreign-born adult migrants report a decreased prevalence of that condition.

Logistic regression models were created for 7 different health conditions. The conditions of interest include 5 lethal conditions (cancer, heart disease, stroke, lung disease, diabetes) and 2 disabling conditions (arthritis, any ADLs). For each health condition, five models are reported. The simplest model (Model 1) controls only for birthplace, age and sex. Model 2

Table 2. Descriptive summary of demographic factors by birthplace. 1993–94 AHEAD, Wave 1

Variable	US-born (n = 6774)	Foreign-born adult migrants (n = 379)	Statistical significance measure
Sex			
Male	38.0	36.0	$\chi^2 = 0.6$
Female	62.0	64.0	$p = 0.439$
Mean Age	77.3	79.2	$t = 18.3$; $p < 0.001$
Race			
White	87.6	85.5	$\chi^2 = 1.5$
Non-White	12.4	14.5	$p = 0.222$
Ethnicity			
Hispanic	2.2	30.3	$\chi^2 = 810.3$
Non-Hispanic	97.8	69.7	$p = 0.001$
Residence			
Urban	70.7	92.6	$\chi^2 = 85.0$
Rural	29.3	7.0	$p = 0.001$
High school			
Yes	29.6	18.2	$\chi^2 = 22.9$
No	70.4	81.8	$p = 0.001$
Health insurance			
Yes	99.6	98.8	$\chi^2 = 4.6$
No	0.4	1.2	$p = 0.033$
Medicare			
Yes	97.4	96.0	$\chi^2 = 2.0$
No	2.6	3.9	$p = 0.153$
Smoking			
Current	10.0	7.3	
Former	42.2	37.5	$\chi^2 = 8.5$
Never	47.8	55.2	$p = 0.014$
Alcohol use			
Yes	45.2	46.0	$\chi^2 = 0.1$
No	54.8	54.0	$p = 0.733$
Mean Body Mass Index	25.3	25.5	$t = 2.6$; $p = 0.01$

adds demographic characteristics (race, ethnicity and residence). Model 3 adds socioeconomic information (education and insurance status) to Model 1. Model 4 adds health behavior information (smoking status, alcohol use, and BMI) to Model 1. Finally, Model 5 considers the simultaneous effect of all these variables.

Table 3 presents the odd ratios that describe the chance of reporting a diagnosis of cancer (a 'yes' response to the question: "Has a doctor ever told you that you had cancer or a malignant tumor, excluding minor skin cancers?"). The simplest model shows that being older and being male are significantly associated with increased cancer risk. Foreign-born adult migrants, on the other hand, report significantly lower cancer prevalence. This finding could indicate a protective effect of experiencing childhood outside the USA. Whites and urban residents are more likely to report cancer as well. In the socioeconomic model (Model 3), it appears that high school graduates are more likely to report cancer. The health behavior model shows that, interestingly, the three health behaviors included do not appear to affect cancer risk very much. Smoking does appear to elevate cancer risk slightly, but this finding is not statistically significant. One explanation could be that smokers who die of cancer are already dead by age 70. Persons who use alcohol are at elevated risk for developing cancer. Body-mass index also does not show an effect – this is not surprising as cancer is not as associated with obesity as are some other conditions. In fact, the direction of the body-mass index risk is downward. This likely is due to reverse causality since many cancer treatments cause weight loss; hence, persons who are undergoing cancer therapy are likely to be underweight. The complete model shows that the significant predictors for increased cancer risk (among those considered here) are: being US-born, being older, being male, being white, and living in an urban area. White birthplace is not a common consideration in studies of cancer risk factors, it appears that birthplace has a larger influence on cancer than any of the other variables measured. While this effect may be due to such behaviors as diet, controlling for body mass index only reduced the importance of migrant status very slightly.

Table 4 shows the odds ratios associated with heart disease. According to the simple model, age and male sex significantly increase the risk of heart disease; persons who migrated to the USA during adulthood are significantly protected. The demographic model shows that race, ethnicity and residence are also significantly predictive of heart disease. The socioeconomic model shows that education and insurance status do have an effect on risk of heart disease. In fact, having Medicare coverage significantly increases the risk of heart disease. This could be due to reporting bias. Reverse causation could mean those with heart disease make sure to get Medicare. Or, Medicare

Table 3. Logistic regression models for predicting the reported prevalence of *cancer*, presenting odds ratios. 1993–94 AHEAD, Wave 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Birthplace					
USA	1.0	1.0	1.0	1.0	1.0
Adult migrant	0.649**	0.649**	0.661*	0.648**	0.663**
Age (per 5 years)	1.015**	1.015**	1.016**	1.016**	1.018**
Sex					
Male	1.256**	1.250**	1.268**	1.205*	1.222**
Female	1.0	1.0	1.0	1.0	1.0
Race					
White		1.649**			1.550**
Non-White		1.0			1.0
Hispanic					
No		1.0			1.0
Yes		0.911			0.875
Residence					
Urban		1.163*			1.164*
Rural		1.0			1.0
High school					
No			1.0		1.0
Yes			1.133*		1.098
Any insurance					
No			1.0		1.0
Other insurance			3.769		3.252
Medicare			4.545		3.761
Smoker					
Never				1.0	1.0
Former				1.096	1.084
Current				1.117	1.152
Alcohol use					
No				1.0	1.0
Yes				1.118*	1.051
BMI (per kg/m^2)				0.989	0.992

Significance is indicated by p-values: * $0.05 < p \leqslant 0.10$; ** $p \leqslant 0.05$.

Table 4. Logistic regression models for the reported prevalence of *heart disease*, presenting odds ratios. 1993–94 AHEAD, Wave 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Birthplace					
USA	1.0	1.0	1.0	1.0	1.0
Adult migrant	0.701**	0.783*	0.693**	0.711**	0.794*
Age (per 5 years)	1.025**	1.025**	1.025**	1.025**	1.021**
Sex					
Male	1.433**	1.433**	1.417**	1.363**	1.342**
Female	1.0	1.0	1.0	1.0	1.0
Race					
White		1.226**			1.311**
Non-White		1.0			1.0
Hispanic					
No		1.0			1.0
Yes		0.731**			0.672**
Residence					
Urban		0.891**			0.923
Rural		1.0			1.0
High school					
No			1.0		1.0
Yes			0.846**		0.827**
Any insurance					
No			1.0		1.0
Other insurance			0.786		0.853
Medicare			1.307**		1.356**
Smoker					
Never				1.0	1.0
Former				1.344**	1.356**
Current				0.908	0.934
Alcohol use					
No				1.0	1.0
Yes				0.714**	0.598**
BMI (per kg/m^2)				1.001	1.003

Significance is indicated by *p*-values: * $0.05 < p \leqslant 0.10$; ** $p \leqslant 0.05$.

coverage could be a proxy for some 'real' risk factor (diet, occupation, etc.). In addition, persons without a high school education are more likely to report heart problems. The health behavior model also adds some interesting information to the simple model for heart disease. Both being a current smoker and an ever-drinker appear protective for heart disease, but being a former smoker increases the risk for heart disease. Reverse causality again may explain this finding. Once a person has a heart attack, if they survive, they may stop smoking. The final model show that the most important predictors for heart disease in this study were: being older, being male, being white, being non-Hispanic, having less than a high school education, having Medicare, having smoked in the past, and not drinking alcohol. Adult migrants show a borderline protection effect ($p = 0.06$). Looking at the magnitude of the migrant effect, it is as great as sex or race. Again, this demonstrates that adult migrants have different disease risk than persons who were born in the United States, and that these effects are maintained even at extremely old age.

Table 5 presents the odds ratios and confidence intervals for the chance that a doctor has ever told the person they had a stroke. Stroke is an interesting condition to consider since it is elevated in some foreign countries (e.g., Japan) relative to the USA as a cause of death. Thus, we might expect stroke to be elevated among the foreign-born. Both definite and possible strokes, or temporary ischemic attacks, are included as 'strokes' in these models. The simple model shows that age and male sex are associated with increased risk for stroke. Adult migrants again are protected from this disease. According to the health behavior model, current or former smoking increases stroke risk, while drinking decreases the risk. Current smokers have higher risk than do former smokers, who are at higher risk than never-smokers. In the final model, the factors that are associated with increased risk of stroke are: being older, being male, having less than a high school education, being a former or current smoker and not being a drinker. For this condition, controlling for all the demographic, socioeconomic and health behaviors simultaneously removes the effect of migrant status. This is most likely due to the strong correlation between health behaviors, particularly smoking status, and migrant status. Being a migrant does not appear to confer any additional protection, other than that measured by standard health behavior differences.

Table 6 presents the logistic regression models for lung disease. Lung disease is defined in this survey as any chronic lung disease other than asthma. This would include chronic bronchitis, emphysema, tuberculosis, and other lung conditions. In general, one would expect smoking to be most strongly correlated with these diseases. Tuberculosis is currently being 'blamed' on immigrants, but this is likely to be more of a factor in younger age groups (since virtually all these old people, regardless of birthplace, were exposed

Table 5. Logistic regression models for *stroke*, presenting odds ratios. 1993–94 AHEAD, Wave 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Birthplace					
USA	1.0	1.0	1.0	1.0	1.0
Adult migrant	0.668**	0.629**	0.661**	0.710*	0.724
Age (per 5 years)	1.049**	1.049**	1.047**	1.048**	1.045**
Sex					
Male	1.296**	1.296**	1.279**	1.237**	1.227**
Female	1.0	1.0	1.0	1.0	1.0
Race					
White		0.899			1.045
Non-White		1.0			1.0
Hispanic					
No		1.0			1.0
Yes		1.207			1.107
Residence					
Urban		1.036			1.100
Rural		1.0			1.0
High school					
No			1.0		1.0
Yes			0.822**		0.832**
Any insurance					
No			1.0		1.0
Other insurance			1.106		1.083
Medicare			1.212		1.205
Smoker					
Never				1.0	1.0
Former				1.280**	1.273**
Current				1.621**	1.621**
Alcohol use					
No				1.0	1.0
Yes				0.617**	0.611**
BMI (per kg/m^2)				1	0.999

Significance is indicated by *p*-values: * $0.05 < p \leqslant 0.10$; ** $p \leqslant 0.05$.

Table 6. Logistic regression models for reporting the prevalence of *lung disease*, odds ratios. 1993–94 AHEAD, Wave 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Birthplace					
USA	1.0	1.0	1.0	1.0	1.0
Adult migrant	0.680**	0.749	0.674**	0.733	0.814
Age (per 5 years)	0.974**	0.975**	0.974**	0.978**	0.978**
Sex					
Male	1.461**	1.455**	1.450**	1.055	1.036
Female	1.0	1.0	1.0	1.0	1.0
Race					
White		1.822**			1.991**
Non-White		1.0			1.0
Hispanic					
No		1.0			1.0
Yes		0.828			0.750
Residence					
Urban		0.873**			0.866*
Rural		1.0			1.0
High school					
No			1.0		1.0
Yes			0.912		0.869*
Any insurance					
No			1.0		1.0
Other insurance			1.470		1.029
Medicare			1.362		1.073
Smoker					
Never				1.0	1.0
Former				2.996**	3.043**
Current				3.248**	3.373**
Alcohol use					
No				1.0	1.0
Yes				0.756**	0.729**
BMI (per kg/m^2)				0.967**	0.971**

Significance is indicated by p-values: * $0.05 < p \leqslant 0.10$; ** $p \leqslant 0.05$.

to TB in their youth). There is no way to separate these conditions from each other in this data. In the simple model, age is negatively associated with lung disease. This may be due to increased mortality for people with lung disease. To examine this issue, a survey with a wider age distribution would have to be used. Once again, males are at higher risk and adult migrants have significantly lower rates of lung disease. When race, ethnicity and residence are added in the demographic model, the effect of birthplace disappears. Being white is associated with increased risk. In addition, living in an rural area is associated with increased risk of lung disease. Although ethnicity is non-significant, Hispanics appear to report less lung disease. Hispanic ethnicity and urban residence are both more common among adult migrants, and may explain the lack of significance of migrant status in this model. Smoking, never using alcohol, and lower BMI are associated with increased lung disease. Being a current smoker more than triples the odds of lung disease. These health behavior factors also hide the effect of birthplace, although it is still in the direction of increased risk among the US-born. When all factors are considered in the final model, adult migrants do not have significantly different risk than US-born persons. Age retains its inverse relationship – younger persons are more at risk. The other significant predictors of lung disease are: being white, smoking (current or former), never drinking, and having lower BMI. Being a high school graduate is also protective ($p = 0.09$), but no other socioeconomic factors are important. Smoking is the strongest risk factor – current smokers are over 3 times more likely to report lung disease than are never-smokers, and former smokers are almost three times as likely as well. While rural residence appears significant in Model 2, adding information about health behaviors causes this variable to drop out. After smoking, race is the most important risk factor. While birthplace is no longer significant, even when all these factors are controlled for, it still is in the direction of increased risk for the US-born.

One final lethal condition examined here is diabetes. The question in the AHEAD survey asked "Do you have diabetes?" A "don't know" response was considered a no. According to Verbrugge and Patrick (1995), over 80% of diabetics eventually die of heart disease. In the AHEAD data, these two conditions are also correlated. Among diabetics, 43% also report heart disease; while only 30% of non-diabetics report heart disease ($\chi^2 = 65.6$; $p < 0.001$).

Table 7 presents the logistic regression models for diabetes. According to the simple model, this is the one lethal condition that is significantly elevated among the foreign-born adult migrants. As with lung disease, age is negatively associated with diabetes. Sex is not a predictor for diabetes in the simple model. Adding race, ethnicity and residence in the demographic

Table 7. Logistic regression models for the prevalence of *diabetes*, odds ratios. 1993–94 AHEAD, Wave 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Birthplace					
USA	1.0	1.0	1.0	1.0	1.0
Adult migrant	1.385**	1.119	1.118	1.144	1.128
Age (per 5 years)	0.970**	0.969**	0.969**	0.972**	0.972**
Sex					
Male	1.078	1.089	1.092	1.251**	1.259**
Female	1.0	1.0	1.0	1.0	1.0
Race					
White		0.464**	0.462**	0.578**	0.578**
Non-White		1.0	1.0	1.0	1.0
Hispanic					
No		1.0	1.0	1.0	1.0
Yes		1.804**	1.816**	1.558**	1.561**
Residence					
Urban		0.986			1.088
Rural		1.0			1.0
High school					
No			1.0		1.0
Yes			1.031		1.051
Medicare					
No			1.0		1.0
Yes			1.060		1.030
Any insurance					
No			1.0		1.0
Other insurance			1.081		1.080
Medicare			1.146		1.112
Smoker					
Never				1.0	1.0
Former				1.102	1.008
Current				0.791	0.793*
Alcohol use					
No				1.0	1.0
Yes				0.506**	0.500**
BMI (per kg/m^2)				1.087**	1.087**

Significance is indicated by *p*-values: * $0.05 < p \leqslant 0.10$; ** $p \leqslant 0.05$.

model erases significance of the effect of birthplace. Non-whites are twice as likely to suffer from diabetes as are whites; Hispanics also have significantly elevated risk. Since race and ethnicity are highly significant, as expected, and cause birthplace to disappear as an important effect, race and ethnicity are included in the health behavior and socioeconomic models. Both dietary measures included in the health behavior model (alcohol and obesity, as measured in BMI) are significant predictors of increased risk of diabetes. In the final model, birthplace is not significant. The most important predictors for increased diabetes risk are: being younger, being male, being non-white, being Hispanic, never drinking, and having a higher BMI.

Logistic regression models were also created for two chronic conditions – arthritis and the presence or absence of any limitations of ADLs. The results of the regressions for arthritis are reported in Table 8. Unlike the conditions presented previously, arthritis is measured by the act of visiting a doctor for arthritis in the last year. Asking about doctor visits rather than presence of disease may cause an underestimate of disease prevalence, since not all sufferers visit a doctor. In addition, it is likely that factors that predict doctor visits independently from illness, such as insurance, may have a strong influence on these models. According to the simple model, arthritis is increased as expected among older persons and females. Adult migrants are not at elevated risk. Every demographic variable considered, except nativity, appears to be a significant predictor of arthritis. Risk is increased among those who are: older, female, non-white, Hispanic, and rural residents. In the socioeconomic model, both being a high school graduate and being uninsured appear protective. In the final model, the most significant predictors of arthritis are: being older, being female, being non-white, being Hispanic, living in a rural area, being insured, never drinking and being overweight.

In order to address the issue of chronic disabling conditions without the confounder of insurance overwhelming any reported effect, the presence or absence of limitations of ADLs was considered. Results are presented in Table 9. In the simple model, older females are at significantly increased risk for ADLs. Adult migrants are no different from US-born persons. As with arthritis, all of the additional demographic variables are significant. Again, non-whites, Hispanics, and rural residents are at increased risk. In the socioeconomic model, unlike the model for arthritis, insurance status is not an important predictor of disability. Having less than a high school education again indicates increased risk. Smokers, both current and former, are at significantly increased risk for ADLs. In addition, non-drinkers and overweight persons are at increased risk. The final model indicates that birthplace is not an important predictor of disability. The things that are important include:

Table 8. Logistic regression models for *visiting a doctor for arthritis* in the last year, odds ratios. 1993–94 AHEAD, Wave 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Birthplace					
USA	1.0	1.0	1.0	1.0	1.0
Adult migrant	1.190	0.950	1.177	1.148	0.936
Age (per 5 years)	1.018**	1.019**	1.016**	1.026**	1.026**
Sex					
Male	0.638**	0.636**	0.630**	0.648**	0.637**
Female	1.0	1.0	1.0	1.0	1.0
Race					
White		0.480**			0.521**
Non-White		1.0			1.0
Hispanic					
No		1.0			1.0
Yes		2.307**			2.155**
Residence					
Urban		0.827**			0.841**
Rural		1.0			1.0
High school					
No			1.0		1.0
Yes			0.838**		0.925
Any insurance					
No			1.0		1.0
Other insurance			1.688		2.681*
Medicare			1.839		2.931*
Smoker					
Never				1.0	1.0
Former				1.004	1.004
Current				0.980	0.932
Alcohol use					
No				1.0	1.0
Yes				0.810**	0.902*
BMI (per kg/m^2)				1.071**	1.065**

Significance is indicated by p-values: * $0.05 < p \leqslant 0.10$; ** $p \leqslant 0.05$.

Table 9. Logistic regression models for *limitations of ADLs*, odds ratios. 1993–94 AHEAD, Wave 1

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Birthplace					
USA	1.0	1.0	1.0	1.0	1.0
Adult migrant	1.124	1.012	1.101	1.167	1.068
Age (per 5 years)	1.019**	1.110**	1.107**	1.120**	1.120**
Sex					
Male	0.715**	0.716**	0.706**	0.649**	0.669**
Female	1.0	1.0	1.0	1.0	1.0
Race					
White		0.601**			0.765**
Non-White		1.0			1.0
Hispanic					
No		1.0			1.0
Yes		1.618**			1.433**
Residence					
Urban		0.829**			0.873**
Rural		1.0			1.0
High school					
No			1.0		1.0
Yes			0.828**		0.883**
Any insurance					
No			1.0		1.0
Other insurance			0.726		0.923
Medicare			0.615		0.832
Smoker					
Never				1.0	1.0
Former				1.339**	1.350**
Current				1.600**	1.567**
Alcohol use					
No				1.0	1.0
Yes				0.515**	0.545**
BMI (per kg/m^2)				1.064**	1.060**

Significance is indicated by *p*-values: * $0.05 < p \leqslant 0.10$; ** $p \leqslant 0.05$.

being older, female, non-white, Hispanic, a rural resident, a current or former smoker, a never-drinker, and overweight.

Discussion

This study attempts to address the question of whether persons who have good health at young age maintain that advantage at old age. It uses foreign-born persons who migrated to the United States as adults as a group that was positively selected for health at adulthood. When a number of health conditions at old age are considered, it does appear that this group remains in better health than US-born persons. This effect is seen even after controlling for socioeconomic and health behavior differences. Combined with the finding that foreign-born persons are likely to live longer, this indicates that these years of increased longevity are not coupled with an increase in disease. That is, foreign-born persons' increased years of life are, by in large, healthy years. These findings indicate that selection for health at young age is maintained at old age as well.

This study once again also demonstrates the overwhelming importance of socioeconomic factors and health behaviors. Health behaviors were significant predictors of health for every disease considered. Sometimes smoking was important, sometimes alcohol, sometimes BMI, but for every disease, at least one health behavior was influential. Socioeconomic status was almost as ubiquitously influential. Socioeconomic status did not appear important for cancer or diabetes, but for each other disease, under-educated persons were more likely to be affected.

For the most lethal diseases, such as cancer, heart disease, and stroke, there clearly does appear to be a positive health selection. For lung disease, the link is possible, but not assured. For the diseases that are linked with disability, ADLs and arthritis, as well as for diabetes, there is no evidence of a positive health selection for migration. However, it is important to remember that these persons are now many years or decades post-migration. Those individuals who are hardiest at the time of migration may be the most likely to do heavy manual labor, and thus to experience more disability later in life.

The diversity of the findings described above are especially interesting, since they demonstrate the difficulty of assessing 'health' in a population. Disease is multi-faceted, and what influences one disease may not influence another. Or, in fact, the direction of the effect may be reversed. The fact that the positive health selection for migration is not found for every disease is not evidence that it does not occur. Rather, this indicates that perhaps the mechanism of the selection is more closely tied to some diseases than to others. One could imagine that a person who was very healthy at age 25

would be more likely to immigrate to the USA, and to take a heavy labor job. Then, 50 years later, that person might still be less likely to have heart disease, but he would be more likely to have arthritis, due to the stress of his lifetime of strenuous labor. Nutrition could be one method that foreign-born persons use to prolong their good health. That is, not only are adult migrants a more select, less frail population, but they also continue dietary patterns common in their sending countries that enhance their health.

There are at least two other potential explanations for these results. The first would theorize that different results are due to differences in reporting behaviors. The second hypothesis might propose that differences in access to care lead to different disease risk.

It is difficult to address differences in reporting behavior using only this study. Past literature has indicated that lack of insurance coverage leads to delays in disease screening (Ayanian, Kohler, Abe & Epstein 1993; Hopkins 1993; Kassab, Luloff, Kelsey & Smith 1996; Moy, Bartman & Weir 1995); hence, those with insurance are more likely to be aware that they have certain diseases. In these two elderly populations, almost all persons have Medicare insurance. (Persons who immigrated after age 65 are less likely to be covered by Medicare.) Controlling for insurance status, the protective effect of foreign birthplace remained. There may also be cultural differences in the reporting of diseases. However, for lethal conditions such as heart disease or cancer, if they go unreported or undiagnosed, the person is likely to die. Mortality analyses (Kestenbaum 1986; Swallen 1996) indicate that mortality is not higher among the immigrants, so this does not seem a likely explanation. Table 1 shows that adult immigrants are not especially reluctant to report illnesses; they have higher bivariate rates of diabetes, arthritis and disability. Future analyses will concentrate on possible differences in reporting behavior, using the limited physiologic measures available. An analysis of the second wave of the AHEAD data may be one way to address this issue in the future.

Another possible explanation for lower disease rates among adult immigrants is argument that foreign-born persons have less access to medical care, so they are less aware of conditions (under-diagnosed), so they don't report the conditions in the survey. This issue was addressed in several ways. In fact, there is not any evidence that foreign-born adult migrants have less access to medical care. They are less likely to be uninsured than are US-born persons in these age groups. In addition, direct evidence from the AHEAD data set indicates that the foreign-born are not less likely to seek medical care than are the US-born. Foreign-born persons were more likely to report seeing a physician in the last year, and more likely to report being hospitalized in the last year. The US-born were more likely to report using prescription drugs in the last year. None of these differences were statistically significant.

Finally, this study suffers from the cross-sectional design of the data. While this data set will eventually include longitudinal information, that data is not yet available. The main drawback of a cross-sectional study such as this is that the causal ordering cannot be determined. For example, it is impossible to tell if former smokers stopped smoking before or after the onset of a disease. However, excluding the health behavior variables, most of the variables of interest in this survey are not changeable in this manner. Future analyses with the longitudinal component will permit a better examination of the causal ordering, particularly of the health behaviors.

In conclusion, this study points out the importance of considering health at young age when examining health at old age. A group positively selected for health at young age will likely remain positively selected for health at old age. This study has examined adult migrants to the United States. Other groups that might fit this pattern would include studies of veterans of the armed forces and certain professionals. In addition, this study points out the gap between the health of foreign-born adult migrants and US-born persons at old age. Most studies of the elderly do not take birthplace into account during the analyses. While the elderly population is approximately 15% non-white, it is also 10% foreign-born. Every study examines the effect of race, but I am unaware of any other studies of health among the elderly that take birthplace into account. Yet, for heart disease, cancer and stroke, the influence of birthplace was as great (or greater) than that of race.

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