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CePoD Working Paper # 2008-105

Migration, Health and Environment in the Desert Southwest

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May 2008

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Abstract

Although research on place effects and health has focused on racial/ethnic disparities, and to some extent nativity differences, more limited attention is paid to the length of exposure to neighborhoods. Yet, in rapidly growing areas of the country, new arrivals come in large numbers, moving to new neighborhoods and changing the economic, social, and in some cases, physical landscape of their new surroundings. Further complicating this picture is that these new arrivals include both foreign born international migrants and domestic migrants from other parts of the United States. This paper addresses this intersection between studies on place and health and migration and health by analyzing new data for one of the fastest growing cities in the country, Phoenix AZ. We estimate models of self reported health focusing on nativity, migration history (duration) and exposure to the environment of the receiving communities. Preliminary results suggest that neighborhood amenities and problems are associated with self reported health but nativity differences persist. Further, duration in the receiving community is associated with lower reported health even controlling for age, ethnicity and nativity hinting that foreign born immigrants may not be the only individuals subject to an "immigrant paradox" of health.

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Introduction

Many of the prior studies on the relationships between migration and health have focused on the so-called "immigrant paradox," which finds that immigrants to the United States typically have better health status than their native born peers (Hummer et al., 2000). To explain this apparent paradox, several explanations have been proposed: selection of the healthiest individuals into the immigration experience, the acquisition of unhealthy behaviors in the receiving community and even selective return migration. (Abraido-Lanza et al., 1999; Palloni and Arias, 2004).

An under-investigated factor for explaining health trajectories of immigrants is the local environment of receiving communities. While comprehensive frameworks have been developed for studying the decision to migrate, less research has examined specifically where in local communities immigrants choose to live and work, how immigrants change locations over time, and how exposure to different environmental risks and resources in these locations are associated with health outcomes.

The relationship between health trajectories and the local environment is also an under-investigated issue among internal, domestic migrants. Much of the research on migration focuses on international migrants, but the risks, resources, and decision-making processes of international migrants are likely to be very different than those of internal migrants. In rapidly growing areas of the country, such as the urban south, desert southwest, and arid coastal west, large numbers of domestic migrants are transforming communities with just as much impact as international migrants.

In sum, many urban areas of the country are experiencing rapid growth from newcomers both domestic and international. The local environment plays an important role in shaping their health, quality of life, and overall well-being, but there is tremendous variation within urban areas with regards to exposure to environmental risks, resources, and amenities. It is not well understood how characteristics of migrants are associated with their environmental experiences. Environmental experiences are likely to vary by migration type (domestic or international), socioeconomic status, and race and ethnicity. Furthermore, environmental experience, migration patterns, and consequences for health trajectories in the most rapidly growing areas today are likely to be very different from patterns in the past and from more slowly growing regions of the country.

In this paper, we test the contribution of both current environmental exposure and migration history to the well-being of migrants and non-migrants in the Phoenix metropolitan area. Phoenix is an ideal location as it represents one of the fastest growing metropolitan areas in the United States and has attracted many new arrivals from within the U.S. and abroad. We distinguish between domestic and international migrants, and pay close attention to features of the natural and built environment that may explain variations in subgroup difference in well-being. Data for this paper comes from the Phoenix Area Social Survey (PASS), a survey conducted in 2006 that interviewed approximately 800 individuals in the Phoenix metropolitan area.

Background

Immigrants and Migrants. The "immigrant health paradox" has captured the attention of researchers struggling to understand why immigrants to the United States appear to have health

advantages that would not be predicted by their socioeconomic position. There are several possible explanations offered. One is simply that immigration is a selective process. Healthier individuals are those who can muster the strength and resources necessary to undertake international moves. That later generations suffer worse health than the immigrant generation is then explained by this nonrandom selection for migration.

But international migration is not the only type of mobility in the United States and internal migration is also subject to considerable selectivity. Researchers have noted that there is a life course dimension to this migration such that most moves occur in young to middle adulthood as individuals establish their own residences and career mobility trajectories that motivates longer distance moves. The selectivity of internal migrants could play out somewhat differently than international migrants but one might still expect healthier individuals to be the ones most likely to undertake inter-county or interstate moves. Yet, little attention has been given to the health status of these migrants. And, there has been even less attention to incorporating both international and internal migrants in comparative view. If both types of migrants are combined in a study, it is usually to investigate their economic or spatial impact on one another (see Kritz and Gurak, 2001)

Spatial distribution of health. Further complicating the study of the health of migrants is the possibility that location itself influences health. A large body of research is devoted to understanding the role of place on health. Investigations of health disparities often focus on the spatial disadvantages groups may experience. Here too selection functions to separate individuals perhaps isolating those in worse health in worse areas. Or, perhaps some groups are less able to choose locations that have fewer risks or have more amenities and social networks that promote health (Cagney, Browning & Wallace, 2007).

Understanding the role of place on health and well-being must incorporate not only the physical and environmental aspects of the neighborhood but also extend to the social resources and social disorganization that may be present in these neighborhoods (Sampson, Morenoff and Gannon-Rowley, 2002). Researchers frequently point to racial, ethnic and economic segregation as sources of social cohesion but also neighborhood disadvantage (i.e. concentrated poverty, delinquency, etc.). Overall, findings suggest that residential segregation is associated with negative health outcomes for minorities but the "Hispanic" or "immigrant" paradox still persists even in segregated neighborhoods (Lee & Ferraro 2007). But, this is a static model that implies prolonged exposure or segregation based on residential location (LeClere, Rogers and Peters, 1997). Where do migrants fit into this picture? Should we expect all migrants (international and intra-national) to be healthier than their nonmoving counterparts? Do migrants choose locations that are likely to promote worse health than their previous locations? Incorporating measures of residential segregation, concentrated poverty as well as the actual physical environment will be necessary to fully address the extent to which international migrants experience advantaged health outcomes compared to non-migrants and whether this same association between migration and health would apply to domestic migrants moving into this fast growing metropolitan area.

Addressing health among immigrants and migrants: We propose a unique model of place and health that incorporates both type of migration (international and internal) as well as stability of residential location. We consider the possibility that different types of migrants are selected into different types of neighborhoods and that this in turn affects the association of current residential location with health status. We also propose that greater residential mobility within a metropolitan area will be associated with subsequent health. However, we do not propose a priori a directional hypothesis here. This is because we have theoretical guidance that points to

opposite directions. On the one hand, migration type and residential mobility may be associated with disrupted social networks and reduce access to information and support that is beneficial to health (Irwin et al, 2004). On the other hand, residential mobility may reduce prolonged exposure to neighborhood health risks (ex. pollution, noise, etc.) and this in turn may be associated with positive health outcomes. Thus, we employ measures of nativity, duration of residence in the metropolitan area, and detailed sociodemographic and environmental measures of the neighborhoods in models predicting several health outcomes. We model self rated health status among immigrants and domestic migrants in Phoenix with a special focus on duration of residence in Phoenix and reported neighborhood conditions.

In addition to overall self-rated health, we focus on two specific health risks that arise from conditions in the local Phoenix environment: heat stress and breathing problems. Exposure to excessive heat is a risk that is of special concern to individuals living in the desert southwest. Daily maximum temperatures in Phoenix in peak summer months average 104 degrees, and temperatures above 110 degrees are not uncommon. In addition to quality of life issues, there are multiple health consequences of excessive heat exposure. Most serious are heat exhaustion and heat stroke. These conditions occur when the body is unable to regulate temperatures by dissipating excess heat. Although the number of deaths due to heat exposure is relatively small—about 8,000 deaths from 1979 through 2003—this number is greater than the combined total deaths from "hurricanes, lightning, tornadoes, floods, and earthquakes" in the same period (Centers for Disease Control 2007). There is also good reason to believe that excessive heat exposure is an unacknowledged contributor to other causes of death; heat exposure is often not listed as a secondary factor in death certificates (Basu and Samet 2002). The effects of excessive heat have mostly been performed on animals and experimental studies in humans are rare

(Bouchama and Knochel 2002). Analyses of meteorological and hospital admissions or mortality data, however, have found that excessive heat is related to serious health adverse events. Several studies suggest that processes related to myocardial infarction (heart attacks) are positively correlated with temperature (Cui et al. 2005). Excessive heat exposure has also been proposed as a limiting factor in children's development (Riniolo Schmidt 2006). Children's stimulation seeking, attention, social behavior, and interactions with their environment are reduced when exposed to chronic heat stress, and these deficits are likely to prevent healthy cognitive development (Riniolo Schmidt 2006).

Another health risk that is exacerbated by excessive heat is breathing problems and asthma. Asthma affects a large proportion of people in the United States. It is common in children, affecting approximately 6-8% of children (Centers for Disease Control 2007). Yearly, it leads to an estimated 14 million days of missed school (Centers for Disease Control 2007). Symptoms of asthma are worsened by exposure to pollutants, such as sulphur dioxide (SO2), nitrogen oxides (NOx), ozone (O3), carbon monoxide (CO), and small particles 10 μm or less (PM10) (Hwang et al. 2005). Studies show that proximity to freeways and roads with high traffics counts are associated with more asthmatic symptoms (Gordian, Haneuse, and Wakefield 2006). Allergens caused by pollinating plants also worsen asthma symptoms and can trigger severe attacks. Although pollutants, small particles, and pollinators are present across the United States, there is good reason to believe these risks are heightened in high temperatures climates such as the desert southwest. The formation of ground-level ozone, commonly called smog, results from the combination of nitrous oxides, volatile organic compounds, sunlight, and heat (Environmental Protection Agency 2007). Traffic congestion in fast-growing areas, such as Phoenix and Las Vegas, along with extreme summer temperatures, contributes to making these

cities among the top 20 most polluted, in terms of ground-level ozone (American Lung Association, 2007). Pollens from plants are another lung irritant that can trigger asthma attacks (Zhong 2006), and research shows that pollen counts are significantly correlated with temperatures (Stennett and Beggs 2004). Other research shows that higher temperature is correlated with asthma prevalence (Lee et al. 2005). Linking these trends together, some researchers have suggested that global trends in increasing asthma prevalence and incidence may be related to warming and subsequent greater production by pollinators (Beggs and Bambrick 2005).

Data and Methods

The data for this study come from the Phoenix Area Social Survey (PASS), a survey of the Phoenix metropolitan area funded by the National Science Foundation as part of its Long Term Ecological Research (LTER) Network. The LTER program supports intensive research on ecological and environmental processes in 26 sites across the United States. While most of these sties are located in primarily natural areas, two of these research sites—the Central-Arizona Phoenix LTER and the Baltimore Ecosystem Study—were specifically centered in cities. This allows for highly interdisciplinary collaborations across the natural and social sciences to study the urban/environmental interface.

The PASS survey was designed with participation from multiple scientific disciplines, including economics, sociology, demography, ecology, urban planning, anthropology, and others. In April through September 2006, 808 household surveys in 40 neighborhoods across the Phoenix metropolitan area were completed. Sampling was random within eight types of neighborhoods that are of specific theoretical interest to rapidly growing areas in the desert

southwest. Differentiation between urban core, suburbs, and outlying fringe areas is important due to very different ecological environments. The eight neighborhood types, which were defined by geographic placement and Census 2000 block group data, were low income core, low income suburban, middle to high income core, middle income suburban; low to middle income fringe, high income suburban, high income fringe, and retirement community. The PASS focused on a variety of domains, including demographics, environmental perceptions and opinions, environmental values and beliefs, neighborhood cohesion, and neighborhood preferences, perceptions, and satisfaction.

Race/ethnicity, immigrant, and migrant variables. The Phoenix metropolitan area attracts both international and domestic migrants from several sources. For example, between 1995 and 2000, over 60,000 individuals moved to the area from Los Angeles, approximately 30,000 came from Chicago, 22,000 from New York, 18,000 from San Francisco and 12,000 from San Diego (Lewis Mumford Center for Comparative Urban and Regional Research, 2007). In addition, so many foreign born individuals moved to the Phoenix area in recent years that it has been labeled as a "re-emerging" immigrant gateway, a city with historical immigrant settlement that has also seen the growth of its foreign born residents outpace the national average in recent years (Singer, 2004). Many of these are migrants from Latin America (primarily Mexico) although other parts of the world are represented as well. Based on historical settlement patterns in the Phoenix area *and* its recent growth, the area is still predominately composed of native born non-Hispanic White (65.8%) along with a sizable Hispanic minority (25.1%) that is of mixed nativity (39% are foreign born). The remaining population is African American (4%, the vast majority of whom are US born) and Asian (2.7% of which 67% are foreign born). For our preliminary analyses, we focus on the largest groups represented in the PASS survey. We use

demography and migration history information in the survey to create several dummy categories of ethnicity and immigration status: Non-Hispanic US Born, Non-Hispanic foreign-born, Hispanic US Born, and Hispanic foreign-born. Because we are also concerned with processes related to duration of exposure to the Phoenix metropolitan area and environment, we also create a variable representing the number of years living in the Phoenix area.

Health status variables. Although the primary aims of the PASS were not to measure the health status of respondents, some limited health well-being measurement is available. Fortunately, the two domains of health status that have the most detailed measurement in PASS—heat stress and breathing-related illnesses—are the two conditions most likely to be affected by the local Phoenix environment: extremely hot summers and high levels of air pollution in the form ground level ozone (smog) and coarse particulate matter (PM10) such as dust.

Breathing problems were measured with a question that asked, "During the past year, did you or someone in your household experience coughing, wheezing, shortness of breath, chest tightness or phlegm when they did NOT have a cold or respiratory infection?" If the respondent said yes, they were asked how often those symptoms occurred: one time or more than one time. This information is used to create a scale of breathing problems in the household which ranged from 0 (no occurrence) to 2 (two or more occurrences)

Exposure to heat stress was measured by asking, "During last summer, did you or anyone else in your household have symptoms related to heat or high temperatures such as leg cramps, dry mouth, dizziness, fatigue, fainting, rapid heart beat or hallucinations?" If yes, a follow up question asked if this occurred once or more than once. Together, these questions were used to create a scale of heat stress that varied from 0 (no occurrence) to 2 (two or more occurrences).

Finally, self-rated health was assessed with a question that asked, "In general, compared to other people your age, would you say your health is excellent, good, fair, or poor?" This measure ranged from 1 to 4, with higher values being better self-rated health.

Local neighborhood and environment. We include variables for features of respondents' neighborhoods that may mediate relationships between race/ethnicity, migration, and health. Households located closer to parks, with more shade and more plants are expected to be associated with better health outcomes than those with fewer such amenities. Likewise, reported neighborhood problems are likely correlated with worse health reports. Not all typically desirable features, however, may be correlated with better outcomes. Flowering plants, while aesthetic, may also be triggers for asthma and other breathing problems. Respondents were asked their neighborhood preferences for the presence of shade, neighborhood parks, flowering plants, and accessibility to distance to natural areas. They were also asked about their neighborhood satisfaction in these same domains. If a respondent expressed both preferences for and satisfaction with a feature, then we coded them as having an adequate amount of that feature. Otherwise, it was coded 0. Neighborhood problems were coded as 1, if respondents believed them present, and 0 if not present. Respondents reported the presence of four possible neighborhood problems: trash, noise, crowding, and waste sites.

Controls. Several controls are included in the models to guard against spurious associations. In our preliminary models, these controls are largely based on individual respondents including gender, education, and age. Gender is a dichotomous variable, coded 1 for male, and 0 for female. Education is simply coded to range from high school through graduate education (1 to 4). Age is estimated in the models with a quadratic term, to allow for non-linear effects of age on health outcomes. We do have one household level measure at this stage,

household income, and will be able to adjust for other household characteristics, including household size, in subsequent analyses. For the models presented here, household income is coded in a series of dummy variables representing income categories, with an additional category for missing and refused responses. We take this approach, rather than a continuous measure of income, to avoid losing cases due to missing and refused responses.

We also include neighborhood measures from the 2000 Census in order to control for the social and economic context. We created two theoretically distinct indexes. An Ethnicity and Immigration index is a combination of the following measures at the block group level: percent Hispanic, percent speaking English as a second language, percent foreign born, and percent recently arrived to the US (in the last 5 years). A Socioeconomic Status index is a combination of housing value, percent with a college degree or above, percent in poverty, and percent homes that are owner occupied. Because these variables have different metrics, the two indexes are created by standardizing the variables to have mean 0 and standard deviation 0, after which they are summed. Our primary purpose for using these composite indexes is to control for neighborhood social and socioeconomic variations and prevent spurious associations.

To test our hypotheses, we use linear regression models to predict respondents' frequency of breathing problems, frequency of heat stress, and their self-rated health. Our regression models are random effects models that account for the clustered nature of the data, which was collected in 40 neighborhoods. We follow a nested model strategy, in which we first estimate a base model with race/ethnicity, immigrant, and migrant measures and controls. We then introduce measures of respondents' neighborhoods environment in order to test if these factors help to mediate, or explain, subgroup differences.

Results

Table 1 presents descriptive statistics by race/ethnicity and immigration subgroup. Starting with the health outcomes, there are substantial subgroup differences. The frequency of breathing problems is highest for non-Hispanics. This outcome is measured on a scale from 0-2. Non-Hispanic US born and Non-Hispanic foreign born respondents average about 1.0 on this scale, which corresponds to someone experiencing breathing problems once in the past year. Hispanics, in contrast, have lower levels of these problems. Hispanic US born average .9 reported incidences of breathing problems, and foreign-born Hispanics average only .7. This pattern of foreign born Hispanics having better health outcomes is consistent with prior findings in the immigrant paradox literature. With regards to heat stress and overall self-rated health, however, Hispanics have worse outcomes than non-Hispanics. Households of the Hispanic foreign born respondents have the highest frequency of heat stress in this sample (.7 on the 0 to 2 scale), and the respondents themselves have the lowest self-rated health (2.9 on the 1 to 4 scale).

(Table 1)

There are also large differences in the demographic characteristics of the respondents by race/ethnicity and nativity. As expected, the foreign-born have shorter tenure in the Phoenix area than the native born US respondents; many of the native born respondents in the sample were born in Phoenix. Surprisingly, the sample is much less male for the Hispanic foreign born respondents. This is likely due to differential survey response, rather than actual compositional differences in the population. It may be that a greater portion of the male Hispanic foreign born respondents was working or unavailable or unwilling to participate in the PASS survey. Education and income, however, follow patterns consistent with the larger population. Hispanic foreign born respondents have lower education and lower income than others. The Hispanic

foreign born respondents are also much younger than other groups. The non-Hispanic US born respondents are older on average.

There is also large variation in the reports of neighborhood amenities and problems among the groups we compare. First, non-Hispanics born in the United States (mostly whites) tend to be advantaged in terms of neighborhood characteristics. Among Hispanics, the foreign born report more neighborhood problems, including more noise, trash, crowding and waste sites, than US born Hispanics. Based on these patterns, foreign born Hispanics (mostly Mexican origin) appear to face more neighborhood characteristics we would expect to be associated with worse health outcomes.

As expected, there were also substantial differences in the neighborhood and social economic context. Recall that neighborhood social and economic context was measured by two indexes, each constructed as a sum of standardized indicator variables from the 2000 Census. Hispanic foreign born had the highest score on the Ethnicity & Immigration index. This same group also had the lowest score on the Socioeconomic status index.

(Table 2)

Table 1 showed variation by race/ethnicity and immigration subgroups, and our multivariate models test the significance of these association and attempt to explain these relationships through neighborhood environmental factors. For all outcomes, we include our race/ethnicity and nativity groups. We then add our control variables. All further models address the possible role of neighborhood environmental attributes in mediating the relationship between race/ethnicity and nativity and the health outcome being modeled. Table 2 estimates the models for the frequency of breathing problems.

Model 1 of Table 2 predicts breathing problems with only the race/ethnicity/immigration and tenure in Phoenix variables. The results show that Hispanic foreign born respondents have lower breathing problems, yet duration in Phoenix has significant positive association with breathing problems. Although it is rounded to zero, the quadratic term for duration is significant and negative, suggesting that greater duration in Phoenix is associated with breathing problems yet this association decreases over time. Note that this effect holds net of the control for nativity and that the foreign born have shorter durations in Phoenix. It may not be that living in Phoenix longer is associated with worse health but that recent migration (international *and* domestic) is selective of healthier individuals in general. Certainly the rapid growth of the Phoenix area in recent years has acted as a magnet for many economic migrants regardless of their nativity. In model 2, sociodemographic controls are added, yet these significant relationships persist. This suggests that these patterns are not simply explained by factors such as education, income, and age.

In models 3 through 10, measures of the respondents' local neighborhood environment are added. If the coefficients for the race/ethnicity/immigration or Phoenix exposure variables decrease in these models, it is consistent with the premise that these neighborhood environmental factors may partially explain these relationships. None of the environmental variables, however, substantially reduces the magnitude of the Hispanic foreign born or years lived in Phoenix coefficients. Several of the neighborhood variables share relationships with breathing problems: shade is associated with less breathing problems, possibly because shade reduces temperatures that could exacerbate existing breathing difficulties. Parks and flowering plants, however, also are associated with lower levels of problems. This is contrary to expectations that these factors could be associated with higher levels of pollen and other allergens. The negative coefficients,

however, suggest a different interpretation, possibly related to the types of neighborhoods that have parks and flowering plants. Noise and crowding are associated with higher levels of breathing problems. The exact mechanism is not clear, but noisy, high-density neighborhoods may have higher levels of traffic, and subsequently air pollutants from automobiles.

(Table 3)

Table 3 examines the frequency of heat stress. Model 1 shows higher levels of heat stress among both the Hispanic US Born and Hispanic foreign-born. In addition, heat stress is positively associated (with a negative quadratic trend) with years lived in Phoenix. These significant coefficients are slightly diminished with the inclusion of sociodemographic controls in model 2. Additional neighborhood environment variables are added in models 3 through 10. As expected, neighborhood shade and parks are associated with significantly lower levels of heat stress. None of these neighborhood variables, however, substantially reduce the relationships for the race/ethnicity and nativity variables.

(Table 4)

Finally, in Table 4 we examine overall self-rated health. In model 1, Hispanic foreign born respondents have significantly lower health. Unlike the prior two outcomes, however, years lived in Phoenix is not associated with perceived health status. In model 2, when sociodemographic background factors are estimated, the coefficient for Hispanic foreign born is greatly reduced, going from -.26 and significant to -.07 and insignificant. These results suggest that background factors, such as gender, age, education, income, and neighborhood social and economic context explain this coefficient. Later models (models 3 through 10) show that shade is significantly associated with better self-rated health, while problems with neighborhood noise and wastes sites are associated with lower health. It is noteworthy that neighborhood amenities

and problems are associated with this general measure of health even in the presence of controls for education, income, age, and neighborhood status. These neighborhood environmental characteristics could reflect differentials in wealth not accounted for by income alone.

Discussion

The Phoenix metropolitan area provides an excellent venue for studying the relationship between health, place and migration. The area has experienced tremendous growth in the past several years attracting many new residents including international and internal migrants from diverse origins. Although these are complex processes, we begin by comparing self reports of health problems among international and internal migrants and by duration of residence in Phoenix while controlling for the neighborhoods in which they reside.

Our analyses support the importance of incorporating migration (international and internal) as well as residential mobility into analyses of place and health. We find that the "immigrant paradox" in health status is complex and varies according to the specific health outcome examined. With breathing problems, the Latino foreign born has a health advantage, but with heat stress, Latinos both foreign and US born have a health disadvantage. With overall self-rated health, foreign born Latinos have a health disadvantage. In addition, we find that recent migrants to Phoenix have better reported health than those in the area for longer periods of time. In other words, we have some preliminary suggestions that mobility is associated with better health consistent with the expectations that the selection process of migration favors those in better health. This also counters the expectation that migration leads to lower health by disrupting the social networks that enhance or protect health. Although we cannot directly

measure selection or supportive social networks here, our results bolster support for new data collection to focus on these factors.

Our preliminary analyses here will guide us in further research to consider other possible measures of intra-metropolitan mobility and other sources of exposure beyond residential location (e.g., work location, time spent outside the metropolitan area during the year) in explaining the persistent and somewhat paradoxical negative effect of duration of residence in the Phoenix area. Certainly prior research would suggest longer residence would be associated with greater social ties and connectivity that would enhance health status. On the other hand, it is possible that duration of residence in the Phoenix area is associated with lower socioeconomic mobility such that longer term residents are not those who were drawn to the area during its recent economic expansion. Thus, selectivity could once again be at work. We will need to examine differences by age of migrants and their periods of arrival in the Phoenix area to further understand these patterns.

Another possibility for additional research is information collected by other studies within the Central-Arizona Phoenix LTER project. Other scientists have collected data on heat islands, species diversity, soil samples, and traffic patterns. Importantly, the 40 neighborhoods for the PASS study were chosen to be as close as possible to other ecological data collections, thus facilitating spatial linking of social and ecological data sources. These measures will allow us to provide additional information about the neighborhoods in the sample beyond the self reported measures we have included thus far.

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Table 1: Means by Race/Ethnicity & Immigration Subgroups

	Non-Hispanic US Born	Non-Hispanic Foreign Born	Hispanic US Born	Hispanic Foreign Born
Health Outcomes				
Breathing Problems Frequency (0-2)	.95	1.03	.87	.67
Heat Stress Frequency (0-2)	.38	.43	.60	.69
Self-Rated Health (1-4)	3.22	3.37	3.09	2.90
Years Lived in Phoenix	21.85	13.40	23.24	10.76
Male	.46	.40	.40	.24
Age (in years)	50.97	45.03	38.97	36.54
Education (1-4)	2.41	2.66	1.80	1.33
Household Income Categories (proportion)				
HH Income less than 20k	.08	.09	.11	.43
HH Income 20k-40k	.18	.29	.27	.29
HH Income 40k-60k	.15	.09	.27	.16
HH Income 60k-80k	.12	.06	.07	.01
HH Income 80k-100k	.09	.09	.09	.04
HH Income 100k and more	.26	.34	.13	.05
HH Income missing/refused	.13	.06	.06	.02
Neighborhood Environment (proportion reporting attribute or problem):				
Has shade	.64	.63	.51	.64
Has nearby park	.70	.94	.57	.72
Has flowering plants	.73	.66	.64	.66
Problem with trash	.12	.17	.33	.42
Problem with noise	.09	.14	.17	.20
Problem with crowding	.08	.11	.04	.20
Problem with waste sites	.03	.14	.17	.27
Neighborhood Social and Economic Context				
Ethnicity & Immigration Index †	-.90	-.99	1.49	5.90
Socioeconomic Status †	.74	.99	-2.00	-4.30
Sample sizes	612	35	70	83

† Formed by summing indicators that have been standardized to mean 0, standard deviation 1

Table 2: Relationship between breathing problems and individual and environmental factors

	1	2	3	4	5	6	7	8	9	10
Race/Ethnicity & Nativity										
Non-Hispanic Foreign Born†	0.11	0.07	0.08	0.12	0.06	0.06	0.06	0.06	0.04	0.08
	(0.66)	(0.42)	(0.45)	(0.73)	(0.34)	(0.37)	(0.35)	(0.39)	(0.27)	(0.45)
Hispanic US Born†	-0.08	-0.11	-0.12	-0.13	-0.11	-0.13	-0.12	-0.09	-0.14	-0.12
	(-0.64)	(-0.90)	(-0.96)	(-0.98)	(-0.89)	(-1.02)	(-0.94)	(-0.68)	(-1.10)	(-0.93)
Hispanic Foreign Born†	-0.22+	-0.32*	-0.28*	-0.28*	-0.30*	-0.32*	-0.31*	-0.32*	-0.35*	-0.28*
	(-1.92)	(-2.22)	(-2.01)	(-1.99)	(-2.13)	(-2.27)	(-2.18)	(-2.28)	(-2.42)	(-1.99)
Years Lived in Phoenix	0.02**	0.02**	0.02**	0.02**	0.02*	0.02**	0.02**	0.02**	0.02**	0.02**
	(2.97)	(2.71)	(2.89)	(2.74)	(2.42)	(2.66)	(2.66)	(2.87)	(2.63)	(2.69)
Years Lived in Phoenix²	-0.00*	-0.00*	-0.00*	-0.00*	-0.00*	-0.00*	-0.00*	-0.00*	-0.00*	-0.00*
	(-2.51)	(-2.33)	(-2.46)	(-2.37)	(-2.06)	(-2.28)	(-2.29)	(-2.47)	(-2.23)	(-2.29)
Neighborhood Environment										
Has shade			-0.21**							-0.12
			(-2.89)							(-1.50)
Has nearby park				-0.22**						-0.13
				(-2.97)						(-1.63)
Has flowering plants					-0.21**					-0.11
					(-2.73)					(-1.35)
Problem with trash						0.15				-0.00
						(1.55)				(-0.01)
Problem with noise							0.27*			0.13
							(2.48)			(1.04)
Problem with crowding								0.34**		0.21
								(2.80)		(1.58)
Problem with waste sites									0.21	0.08
									(1.44)	(0.50)
Controls										
Nbh. Ethnicity & Immigration Index		-0.02	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
		(-1.09)	(-0.92)	(-1.15)	(-1.04)	(-1.28)	(-1.24)	(-1.09)	(-1.22)	(-1.11)
Nbh. Socioeconomic Status		-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.03	-0.01
		(-1.43)	(-1.13)	(-1.19)	(-1.17)	(-1.27)	(-1.27)	(-1.18)	(-1.43)	(-0.75)
Male		-0.24***	-0.23***	-0.23***	-0.25***	-0.23***	-0.23**	-0.23**	-0.24***	-0.22**
		(-3.42)	(-3.30)	(-3.36)	(-3.53)	(-3.33)	(-3.28)	(-3.27)	(-3.40)	(-3.19)
Age		0.02+	0.03*	0.02*	0.03*	0.02+	0.02+	0.02+	0.02+	0.03*
		(1.89)	(2.07)	(2.02)	(2.08)	(1.81)	(1.80)	(1.85)	(1.80)	(2.05)
Age²		-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+
		(-1.78)	(-1.89)	(-1.88)	(-1.91)	(-1.69)	(-1.66)	(-1.70)	(-1.71)	(-1.82)
Education		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
		(0.59)	(0.53)	(0.61)	(0.56)	(0.65)	(0.61)	(0.48)	(0.68)	(0.52)
HH Income 20k-40k ‡		-0.04	-0.02	-0.03	-0.03	-0.03	-0.03	-0.02	-0.03	-0.01
		(-0.30)	(-0.19)	(-0.27)	(-0.21)	(-0.27)	(-0.22)	(-0.20)	(-0.23)	(-0.04)
HH Income 40k-60k ‡		-0.02	-0.01	-0.02	-0.01	-0.01	-0.01	-0.00	-0.01	0.01
		(-0.15)	(-0.06)	(-0.18)	(-0.05)	(-0.07)	(-0.08)	(-0.03)	(-0.04)	(0.08)
HH Income 60k-80k ‡		-0.18	-0.17	-0.21	-0.17	-0.18	-0.18	-0.16	-0.18	-0.17
		(-1.14)	(-1.10)	(-1.31)	(-1.08)	(-1.15)	(-1.15)	(-1.02)	(-1.12)	(-1.09)
HH Income 80k-100k ‡		-0.14	-0.13	-0.14	-0.12	-0.14	-0.14	-0.11	-0.13	-0.09
		(-0.85)	(-0.76)	(-0.82)	(-0.73)	(-0.85)	(-0.82)	(-0.66)	(-0.77)	(-0.56)
HH Imcome 100k and more ‡		-0.16	-0.14	-0.17	-0.15	-0.15	-0.15	-0.14	-0.15	-0.13
		(-1.09)	(-0.98)	(-1.16)	(-1.00)	(-1.03)	(-1.02)	(-0.95)	(-1.00)	(-0.87)
HH Income missing/refused		-0.26+	-0.24	-0.27+	-0.25	-0.25	-0.25	-0.24	-0.25+	-0.24
		(-1.66)	(-1.57)	(-1.78)	(-1.62)	(-1.60)	(-1.62)	(-1.58)	(-1.65)	(-1.57)
Intercept	0.75***	0.37	0.40	0.48	0.46	0.36	0.35	0.32	0.38	0.46
	(9.52)	(1.16)	(1.27)	(1.51)	(1.44)	(1.12)	(1.11)	(1.01)	(1.20)	(1.46)

+p<.10, *p<.05, **p<.01, ***p<.001, two-tailed tests

† Reference is Non-Hispanic US Born; ‡ reference is HH Income less than 20k

Table 3: Relationship between heat stress and individual and environmental factors

	1	2	3	4	5	6	7	8	9	10
Race/Ethnicity & Nativity										
Non-Hispanic Foreign Born†	0.07	0.04	0.04	0.06	0.04	0.03	0.04	0.04	0.02	0.05
	(0.50)	(0.29)	(0.31)	(0.47)	(0.32)	(0.25)	(0.26)	(0.28)	(0.14)	(0.35)
Hispanic US Born†	0.23*	0.16	0.15	0.15	0.16	0.15	0.15	0.17	0.13	0.13
	(2.37)	(1.51)	(1.47)	(1.45)	(1.50)	(1.40)	(1.49)	(1.59)	(1.28)	(1.24)
Hispanic Foreign Born†	0.34***	0.26*	0.27*	0.27*	0.25*	0.25*	0.26*	0.25*	0.23*	0.26*
	(3.68)	(2.23)	(2.35)	(2.36)	(2.20)	(2.19)	(2.25)	(2.21)	(1.98)	(2.18)
Years Lived in Phoenix	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*
	(2.34)	(2.25)	(2.35)	(2.26)	(2.31)	(2.20)	(2.22)	(2.31)	(2.17)	(2.45)
Years Lived in Phoenix²	-0.00*	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00+	-0.00*
	(-2.20)	(-1.83)	(-1.90)	(-1.85)	(-1.88)	(-1.79)	(-1.81)	(-1.88)	(-1.74)	(-1.99)
Neighborhood Environment										
Has shade			-0.10+							-0.10
			(-1.76)							(-1.59)
Has nearby park				-0.11+						-0.08
				(-1.73)						(-1.29)
Has flowering plants					0.04					0.10
					(0.63)					(1.55)
Problem with trash						0.11				0.04
						(1.35)				(0.42)
Problem with noise							0.10			0.02
							(1.09)			(0.20)
Problem with crowding								0.11		0.05
								(1.16)		(0.50)
Problem with waste sites									0.17	0.13
									(1.47)	(0.98)
Controls										
Nbh. Ethnicity & Immigration Index		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
		(-1.01)	(-0.89)	(-1.04)	(-1.02)	(-1.17)	(-1.07)	(-1.00)	(-1.14)	(-1.12)
Nbh. Socioeconomic Status		-0.03+	-0.02	-0.02+	-0.03+	-0.02+	-0.03+	-0.03+	-0.03+	-0.02
		(-1.80)	(-1.60)	(-1.66)	(-1.86)	(-1.66)	(-1.73)	(-1.69)	(-1.80)	(-1.53)
Male		-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.06
		(-1.28)	(-1.20)	(-1.24)	(-1.25)	(-1.20)	(-1.21)	(-1.21)	(-1.25)	(-1.01)
Age		-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
		(-0.10)	(0.00)	(-0.02)	(-0.14)	(-0.17)	(-0.14)	(-0.12)	(-0.19)	(-0.16)
Age²		-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
		(-0.22)	(-0.28)	(-0.27)	(-0.19)	(-0.14)	(-0.16)	(-0.18)	(-0.14)	(-0.13)
Education		0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.04
		(1.20)	(1.15)	(1.18)	(1.21)	(1.25)	(1.21)	(1.15)	(1.29)	(1.24)
HH Income 20k-40k ‡		-0.08	-0.08	-0.08	-0.09	-0.08	-0.08	-0.08	-0.08	-0.07
		(-0.83)	(-0.76)	(-0.81)	(-0.85)	(-0.80)	(-0.79)	(-0.79)	(-0.75)	(-0.71)
HH Income 40k-60k ‡		-0.02	-0.01	-0.02	-0.02	-0.01	-0.01	-0.01	-0.00	-0.00
		(-0.14)	(-0.09)	(-0.16)	(-0.16)	(-0.07)	(-0.11)	(-0.09)	(-0.03)	(-0.02)
HH Income 60k-80k ‡		-0.18	-0.18	-0.19	-0.18	-0.18	-0.18	-0.17	-0.18	-0.18
		(-1.39)	(-1.37)	(-1.47)	(-1.40)	(-1.40)	(-1.39)	(-1.34)	(-1.37)	(-1.43)
HH Income 80k-100k ‡		0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.03
		(0.15)	(0.20)	(0.17)	(0.12)	(0.14)	(0.16)	(0.22)	(0.22)	(0.24)
HH Imcome 100k and more ‡		-0.03	-0.02	-0.03	-0.03	-0.02	-0.03	-0.02	-0.02	-0.02
		(-0.24)	(-0.17)	(-0.27)	(-0.26)	(-0.19)	(-0.21)	(-0.18)	(-0.16)	(-0.14)
HH Income missing/refused		-0.13	-0.12	-0.14	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13
		(-1.06)	(-1.00)	(-1.12)	(-1.07)	(-1.00)	(-1.03)	(-1.02)	(-1.04)	(-1.02)
Intercept	0.26***	0.37	0.39	0.42	0.35	0.36	0.36	0.35	0.38	0.38
	(4.05)	(1.43)	(1.50)	(1.62)	(1.35)	(1.39)	(1.40)	(1.36)	(1.46)	(1.44)

+p<.10, *p<.05, **p<.01, ***p<.001, two-tailed tests

† Reference is Non-Hispanic US Born; ‡ reference is HH Income less than 20k

Table 4: Relationship between self-rated health and individual and environmental factors

	1	2	3	4	5	6	7	8	9	10
Race/Ethnicity & Nativity										
Non-Hispanic Foreign Born†	0.14	0.15	0.15	0.15	0.15	0.15	0.16	0.15	0.18	0.18
	(1.07)	(1.18)	(1.16)	(1.16)	(1.17)	(1.17)	(1.23)	(1.20)	(1.36)	(1.37)
Hispanic US Born†	-0.10	-0.04	-0.04	-0.04	-0.04	-0.05	-0.04	-0.05	-0.02	-0.03
	(-1.05)	(-0.44)	(-0.41)	(-0.44)	(-0.44)	(-0.46)	(-0.42)	(-0.53)	(-0.19)	(-0.32)
Hispanic Foreign Born†	-0.26**	-0.07	-0.09	-0.07	-0.07	-0.07	-0.07	-0.07	-0.04	-0.06
	(-2.70)	(-0.63)	(-0.83)	(-0.63)	(-0.62)	(-0.64)	(-0.68)	(-0.61)	(-0.37)	(-0.52)
Years Lived in Phoenix	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(-1.18)	(-1.32)	(-1.47)	(-1.32)	(-1.34)	(-1.33)	(-1.27)	(-1.39)	(-1.23)	(-1.58)
Years Lived in Phoenix²	0.00	0.00	0.00+	0.00	0.00+	0.00+	0.00	0.00+	0.00	0.00+
	(1.41)	(1.64)	(1.76)	(1.64)	(1.66)	(1.65)	(1.61)	(1.70)	(1.53)	(1.82)
Neighborhood Environment										
Has shade			0.14*							0.17**
			(2.49)							(2.79)
Has nearby park				0.00						-0.04
				(0.06)						(-0.65)
Has flowering plants					-0.02					-0.07
					(-0.28)					(-1.19)
Problem with trash						0.03				0.15+
						(0.33)				(1.74)
Problem with noise							-0.16+			-0.13
							(-1.93)			(-1.43)
Problem with crowding								-0.11		-0.07
								(-1.19)		(-0.66)
Problem with waste sites									-0.19+	-0.22+
									(-1.73)	(-1.79)
Controls										
Nbh. Ethnicity & Immigration Index		0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01
		(1.15)	(0.99)	(1.15)	(1.15)	(1.10)	(1.24)	(1.15)	(1.30)	(0.99)
Nbh. Socioeconomic Status		0.04**	0.04*	0.04**	0.04**	0.04**	0.04**	0.04**	0.04**	0.04**
		(2.80)	(2.51)	(2.78)	(2.81)	(2.81)	(2.66)	(2.69)	(2.80)	(2.60)
Male		-0.05	-0.05	-0.05	-0.05	-0.04	-0.05	-0.05	-0.05	-0.06
		(-0.85)	(-0.97)	(-0.85)	(-0.86)	(-0.83)	(-0.97)	(-0.92)	(-0.88)	(-1.07)
Age		-0.02*	-0.03**	-0.02*	-0.02*	-0.02*	-0.02*	-0.02*	-0.02*	-0.02*
		(-2.46)	(-2.63)	(-2.46)	(-2.43)	(-2.47)	(-2.38)	(-2.44)	(-2.35)	(-2.45)
Age²		0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
		(2.29)	(2.41)	(2.29)	(2.28)	(2.31)	(2.19)	(2.26)	(2.21)	(2.26)
Education		0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
		(1.50)	(1.56)	(1.50)	(1.49)	(1.51)	(1.48)	(1.56)	(1.39)	(1.52)
HH Income 20k-40k ‡		0.15	0.14	0.15	0.15	0.15	0.14	0.14	0.14	0.13
		(1.52)	(1.43)	(1.51)	(1.52)	(1.52)	(1.45)	(1.47)	(1.42)	(1.31)
HH Income 40k-60k ‡		0.33**	0.32**	0.33**	0.33**	0.33**	0.33**	0.33**	0.32**	0.31**
		(3.11)	(3.05)	(3.11)	(3.12)	(3.13)	(3.06)	(3.06)	(2.97)	(2.95)
HH Income 60k-80k ‡		0.32**	0.31*	0.32**	0.32**	0.32**	0.32**	0.31*	0.31*	0.30*
		(2.58)	(2.54)	(2.58)	(2.59)	(2.58)	(2.59)	(2.53)	(2.56)	(2.46)
HH Income 80k-100k ‡		0.28*	0.27*	0.28*	0.28*	0.28*	0.27*	0.27*	0.27*	0.25+
		(2.14)	(2.08)	(2.14)	(2.15)	(2.14)	(2.13)	(2.06)	(2.05)	(1.94)
HH Imcome 100k and more ‡		0.38***	0.37**	0.38***	0.39***	0.39***	0.38**	0.38**	0.37**	0.36**
		(3.34)	(3.25)	(3.33)	(3.34)	(3.34)	(3.28)	(3.28)	(3.23)	(3.13)
HH Income missing/refused		0.29*	0.28*	0.29*	0.29*	0.29*	0.28*	0.28*	0.29*	0.28*
		(2.40)	(2.32)	(2.40)	(2.41)	(2.41)	(2.37)	(2.35)	(2.38)	(2.30)
Intercept	3.25***	3.47***	3.45***	3.47***	3.48***	3.47***	3.48***	3.49***	3.46***	3.50***
	(48.34)	(14.10)	(14.05)	(13.98)	(14.05)	(14.08)	(14.16)	(14.15)	(14.08)	(14.07)

+p<.10, *p<.05, **p<.01, ***p<.001, two-tailed tests

† Reference is Non-Hispanic US Born; ‡ reference is HH Income less than 20k