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MIGRATION, MODERNIZATION AND HYPERTENSION: Blood Pressure Levels in Four Philippine Communities

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Introduction

Recent research has firmly established hypertension as a key risk factor in coronary heart disease, increasing scientific interest in circumstances surrounding blood pressure dynamics (1-4). In a series of papers, Cassel argues that elevation of blood pressure with age occurs only in modern societies (5-7).

The first of these propositions has gained acceptance. The second, which implicates sociocultural factors more specifically, is being debated vigorously (8-10). The issues have been complicated by conceptual inclarity. Neither Cassel nor his critics have distinguished clearly between comparisons involving lifelong residents of traditional and modern communities, and comparisons of persons who change residence from traditional to modern communities. The former are at risk for the impact of modernization upon blood pressure levels, the latter incur for the consequences of adaptation to a new environment in addition (11).

If psychosocial discontinuity increases hypertension risk, then migrants from traditional to modern communities incur the "double jeopardy" of modernization plus adaptation, and should be at greater risk than sedentary residents of modern communities. While both the foregoing circumstances may operate within a single society and culture, there is a third variable, culture change, which is introduced when migrants choose to relocate to a destination within another culture. To extend

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the language employed above, this would be a "triple jeopardy" situation: modernization, adaptation and culture change would all be implicated.

The 1979 Report of the Working Group on Heart Disease Epidemiology (12) advises migration research on genetically homogeneous population in environments representing contrasting levels of modernization and culture change to resolve the points raised above. Major studies now in progress in Puerto Rico and Honolulu are focused on both intracultural (rural to urban Puerto Rican migrants) and intercultural (trans-Pacific Japanese migrants) changes of residence to destination at a higher level of modernization (13-14).

Filipinos in the Philippines and United States are a third population which offers an opportunity for parallel research. Several pilot studies initiated by the Philippine Heart Center for Asia and Institute of Behavioral Science, University of Colorado, have been completed. These include measurement of blood pressure and prevalence of hypertension in rural and urban Philippine communities (15-17), and cardiovascular disease mortality among Filipinos in Hawaii and California (18-20).

The present paper brings together the results of several blood pressure studies from rural and urban areas of the Philippines. It is one of several manuscripts now in progress which will consolidate and interpret the pilot studies thus far completed. When combined with the forthcoming report on cardiovascular disease mortality, they will provide the basis for more definitive hypothesis testing.

Methods

The four Philippine communities selected for the blood pressure study provide comparative data which have a bearing upon the conceptual issues introduced above. A conservative rural locale and a metropolitan urban center were chosen from Luzon, the oldest site of colonization in the Philippines, with primarily sedentary populations. A progressive rural locale and a metropolitan urban center were also chosen from Mindanao, the most recent site of settlements in the Philippines, with primarily sedentary populations.

The study design is illustrated below:

Figure 1. Predicted Rank Order of Hypertension Prevalence in Sedentary and Migrant Communities

	Sedentary Locations (Luzon)	Migratory Locations (Mindanao)
Rural Locations	Pangasinan Province (0)	Davao Province (2)
Urban Locations	Quezon City (1)	Davao City (3)

The subscript numbers predict comparative levels of hypertension by increasing degree of psychosocial discontinuity, as follows:

0 = absence of psychosocial discontinuity in a rural, sedentary community setting.
1 = modernization within a sedentary urban setting.
2 = adaptation by migrants to a rural community.
3 = modernization and adaptation by migrants to an urban community.

The study will present data on both blood pressure levels and prevalence of hypertension to assess the accuracy of this predictive model.

Study Sites

Since environmental differences are the independent variable utilized as predictors, a brief description of each study site emphasizing its distinguishing characteristics is presented below:

A. The Sedentary Locations

1. Rural Pangasinan

This sedentary agricultural region, producing rice and sugar under the hacienda system since Spanish times, has been historically associated with landlord-tenants and laborers. The most densely settled province of the Ilocos administrative region, with a predominantly Ilocano-speaking adult population, Pangasinan has been the major source of migrants to Manila and Quezon City from the Island of Luzon since 1900 (21).

Within Pangasinan, two coastal municipalities, San Fabian and Lingayen, were sampled by multistage methods, yielding a study population of 8,874 males and 10,191 females. Data were collected by the Research Division, Philippine Heart Center for Asia, as part of a field screening program for rheumatic heart disease, Ischemic heart disease and hypertension (22).

2. Quezon City

While Quezon City, with 957,000 population in 1975, is the suburb within the Metropolitan Manila area manifesting the highest rate of growth since 1960, it is designated "sedentary" for the purpose of this study because the major source of its "immigrant" population has been the central city (Manila proper), i.e., the vast majority of its adult population consists of lifetime metropolitan urbanites who are native Tagalog speakers. Quezon City was established as the national capital in 1936. It is an administrative center with a predominantly white-collar, middle class population, sharing in the greatest concentration of commercial and industrial wealth in the nation.

The metropolitan urban sample was drawn from 16 municipalities, 3,002 persons were surveyed. Of these, 1,139 were males and 1,863 were females. Data,

once again, were collected by the Research Division, Philippine Heart Center for Asia.

B. The Migrant Province

1. Rural Davao Province

On the Island of Mindanao, at the opposite end of the country, a rich reservoir of unoccupied farm land was opened for settlement a half-century ago. However, the bulk of the Cebuano-speaking population of the present provinces of Davao del Sur and Davao del Norte arrived after World War II with 1950-55 representing the peak interval of migration (24). The provinces themselves were not established until 1967. The bulk of immigrants to Mindoro originate from the central provinces of Cebu and Bohol which like Pangasinan are concentration points for rural poverty (21).

Rural Davao represents a high technology farming area where multinational corporations have recently established the most profitable banana and pineapple plantations in Asia. Corporate farms employing industrial labor alternate with homesteaded family farms producing rice, corn and coconut. The mean household income of the administrative region, Southeast Mindanao, in which these provinces are located is second only to that of Metropolitan Manila within the Philippines (24).

The rural Davao sample was evenly divided between the two provinces to the north and south of Davao City: 921 subjects (417 males and 504 females) were drawn from Davao del Sur, and 898 (372 males and 526 females) from Davao del Norte. Data were collected by Davao Research and Planning Foundation, Inc., for the Insitute of Behavioral Science.

2. Davao City

This metropolitan community of one-half million people is the administrative capital of the southern Philippines, with an explosive annual growth rate of 5.5%. Four-fifths of its present population represents post World War II growth. It is an important timber-processing center and contains other heavy industries. Also a relatively wealthy community, it has an urban mean family income second only to that of Manila. Its labor force is more diversified than that of Quezon City with substantial blue collar and small business components. Although predominantly Cebuano-speaking like its hinterland provinces, Davao City is a polyglot community with a substantial minority of immigrants from Luzon.

In Davao City, a city-wide sample frame was employed to select 1,432 individuals. Of these 670 were males and 762 were females. As in the rural Davao provinces, data were collected by Davao Research and Planning Foundation, Inc., for the Institute of Behavioral Science.

Examination

A single casual blood pressure reading taken after five minutes' rest was used in the survey. In Quezon City and Pangasinan, blood pressures were measured using one of four random-zero blood pressure apparatuses (Hawkesley). In Davao Province and Davao City, conventional mercury manometers were employed. Standardization of blood pressure readings and training in measurement were done according to WHO recommended procedures (25). Criteria used for the diagnosis of high blood pressure were also those advised by WHO. Persons with blood pressure greater than 160/95 mm Hg are considered "definite" hypertensives.

Heights and weights were measured to the nearest 0.5 cm. and 0.1 kg. History questionnaires were administered and tabulated for the two urban populations: Davao City and Quezon City. The interview included risk factor data: smoking history, fats and salt consumed in the diet, socioeconomic characteristics and social support. The interviewers utilized by Davao Research and Planning Foundation were trained by Philippine Heart Center personnel to insure comparability of results. All measurements and interview were restricted to persons ages 15 and above.

Results

The results of the four-community study will be presented in three sections: (1) blood pressure comparisons; (2) hypertension prevalence comparisons; (3) associated variables. The hypothesis represented in Figure 1 provides the framework for the discussion.

A. Blood Pressures by Age-Sex and Community

Mean systolic and diastolic blood pressure readings by sex for all four communities appear in Table 1. The direction and significance of differences between communities by type are presented in Table 2. Source tables with detailed age-specific blood pressure readings by sex for all four communities appear in the appendix (A1-A4).

The analysis of mean differences presented in Table 2 produces mixed results. In both the sedentary area (Luzon) and the migratory area (Mindanao), rural mean blood pressure values are higher than urban (panels A-B, Table 2). The diastolic blood pressure differences are all sufficient to attain statistical significance. These interpretations are not affected by age-adjustment (Table 1).

However, blood pressure levels in migrant communities are higher than in sedentary communities (panel C, Table 2). Once again, the diastolic blood pressure values attain a more consistent pattern with greater statistical significance. These interpretations, likewise, are not altered by age-adjustment (Table 1). The pattern of male difference is more uniform than the female pattern.

Table 1. Mean Blood Pressures, Systolic and Diastolic, Age-Adjusted and Unadjusted for Males and Females, Ages 15-74, from Four Philippine Communities: Migrant and Sedentary, Rural and Urban[1].

	Unadjusted				*Age-adjusted*	
	SBP	*SD*	*DBP*	*SD*	*SBP*	*DBP*
A. Sedentary						
1. Rural Pangasinan						
Male	123.41	15.59	28.59	10.26	122.07	78.09
Female	119.95	17.30	76.83	10.97	117.90	75.95
2. Quezon City						
Male	119.06	17.70	77.70	11.51	118.14	77.25
Female	112.55	18.60	72.65	11.51	111.45	72.23
B. Migrant						
1. Rural Davao						
Male	124.45	13.78	04.36	9.44	122.46	82.89
Female	118.15	13.27	81.01	9.39	117.40	80.43
2. Davao City						
Male	124.03	12.00	80.50	12.67	123.49	80.26
Female	117.80	20.05	77.32	13.62	117.99	77.40

[1] Age-adjusted to 1975 population of the Philippines.

The Philippine population is quite young, with a median age of 21.5. Mean blood pressure values in the present study, in which subjects range from 15 to 74 years of age, will be biased in favor of the younger age groups. Since blood pressure differences in younger subjects tend to fall within the subcritical range, they are less interesting in a study focused upon risk of coronary heart disease than the readings for older persons. Also the rank order of means represented by the total population of the four communities may not reflect the status of blood pressures among the older age groups.

These speculations led to a reformulation of age-adjusted date by age groups in Table 3. The SBP and DBP measures for subjects in the 15-24 and 25-44 categories confirm the inferences from Tables 1-2 concerning the rural-urban comparison: the former continue to be higher than the latter. However, the rank order is reversed for subjects in the 45-64 age groups within which the urban readings *tend to be higher than rural.* For age groups 25 and above, *migrant communities continue to have higher readings than sedentary communities.*

The reversal of rank order between rural and urban communities disclosed by the separation and comparison of younger and older age groups results from sharply differentiated patterns of elevation of blood pressure with age in the two types of communities. These patterns are disclosed in Figures 2-3 in which diagrams have

Table 2. Mean Differences in Systolic and Diastolic Blood Pressures Between Communities By Sex With Significance Tests

	Systolic		*Diastolic*	
	Mean Difference	*P*	*Mean Difference*	*P*
A. SEDENTARY LOCATIONS (Luzon)				
Rural – Urban (RP – QC)				
Male	4.35	.001	.89	.05
Female	7.40	.001	4.18	.001
B. MIGRANT LOCATIONS (Mindanao)				
Rural – Urban (RD > DC)				
Male	.42	n.s.	3.86	.001
Female	.35	n.s.	3.69	.001
C. MIGRANT-SEDENTARY COMPARISONS (Mindanao-Luzon)				
Rural – Rural (RD > RP)				
Male	1.04	.10	5.77	.001
Female	1.80	.01	4.18	.001
Rural – Urban (RD > QC)				
Male	5.39	.001	6.66	.001
Female	5.60	.001	8.36	.001
Urban – Rural (DC > RP)				
Male	.62	n.s.	1.91	.001
Female	–2.15	.01	.49	n.s
Urban – Urban (DC > QC)				
Male	4.97	.001	2.60	.001
Female	5.25	.001	4.67	.001

RP – Rural Pangasinan
QC – Quezon City
RD – Rural Davao
DC – Davao City

been constructed from the systolic (Figure 2) and diastolic (Figure 3) data in Table 3.

In both figures, when panels C-D describing urban sites are compared with panels A-B describing rural sites, two important differences emerge:

1) urban readings for ages 15-44 fall below rural readings for the same age groups for both sexes in most cases;
2) urban blood pressures elevate much more sharply between ages 24-44 holds for both sexes.

Table 3. Age-Adjusted Mean Male and Female Systolic and Diastolic Blood Pressures for Selected Age Groups in Four Philippine Communities: Migrant and Sedentary, Rural and Urban

		Male		*Female*	
		SBP	*DBP*	*SBP*	*DBP*
A. Sedentary					
1. *Rural Pangasinan*					
Ages	15-24	117.69	75.26	113.16	76.34
	25-44	122.14	79.14	117.27	76.65
	45-64	127.48	81.70	125.52	80.59
2. *Quezon City*					
Ages	15-24	111.01	72.16	104.59	68.44
	24-44	117.68	78.50	109.28	71.92
	45-64	127.04	83.30	124.81	79.36
B. Migrant					
1. *Rural Davao*					
Ages	15-24	115.49	77.95	112.09	77.34
	25-44	124.28	84.90	117.29	80.84
	45.64	128.69	86.82	125.74	84.49
2. *Davao City*					
Ages	15-24	115.46	74.63	107.70	70.60
	25-44	125.20	81.88	117.29	78.17
	45-64	133.05	87.20	133.68	86.66

[1] Age-adjusted to the Philippine population, 1975

The uniformity of these two patterns for both SBP and DBP causes the urban readings in panels C-D to describe longer lines ascending at steeper angles than those of panels A-B.

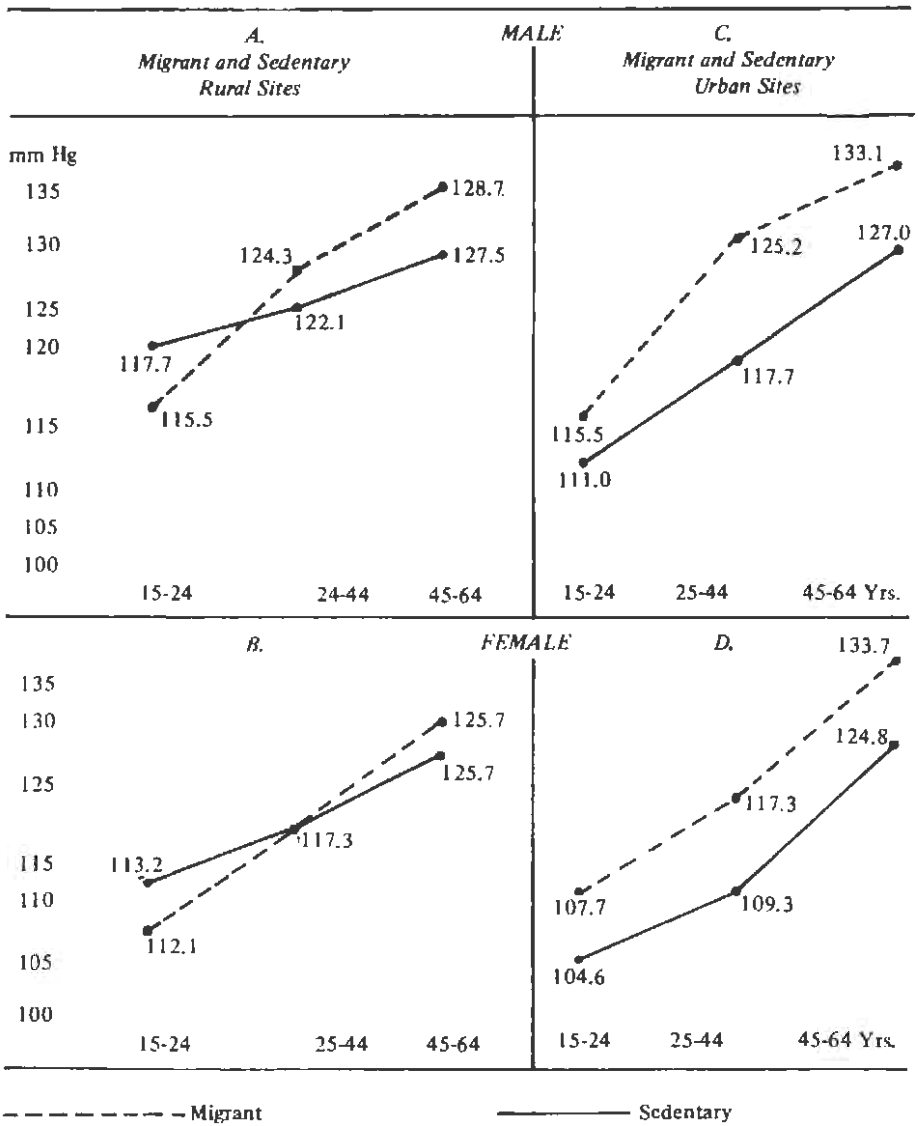
Within each of the four panels of Figures 2-3, a migrant and sedentary community are compared. Once again, two important differences may be noted:

1) the migrant member of each pair of communities disclosed blood pressure readings rising to a higher level than that of its sedentary partner;
2) the urban migrant communities (panels C-D) disclose blood pressures rising to a higher level among persons 45-64 than do rural migrant communities (panels A-B).

As mentioned earlier in the interpretation of data from Tables 1-2, the diastolic patterns (Figure 3) are more completely differentiated between communities than the systolic patterns (Figure 2).

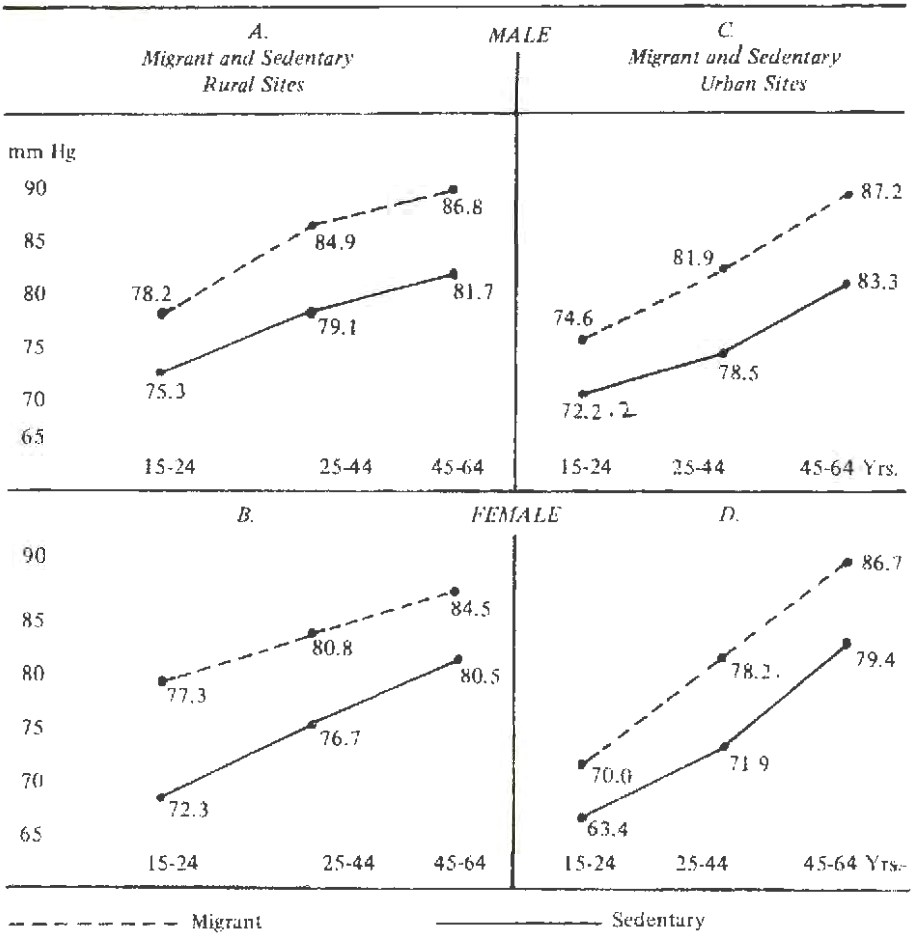
Those two sets of interpretations of the age-adjusted data for specific age-sex groups (Table 3) tend to confirm the assertions presented in Figure 1: urban blood

Figure 2. Age Adjusted Male and Female Systolic Mean Blood Pressures for Selected Age Groups in Migrant and Sedentary Locations: Rural Compared with Urban.



pressures, which are subject to modernization, should be higher than rural; migrant blood pressures, which require adaptation, should be higher than sedentary. Finally, where the two forces interact, migrant urban blood pressures, subject to both modernization and adaptation, should be the highest of all. However, these observa-

Figure 3. Age Adjusted Male and Female Diastolic Mean Blood Pressures for Selected Age Groups in Migrant and Sedentary Locations: Rural Compared with Urban.



tions appear to be true only for the older age groups within the four communities, i.e., persons 45-64. These conclusions await confirmation from the hypertension prevalence data to be reviewed in the following section.

The inferences concerning age patterns would be on firmer ground if supported by other studies. While migrant-sedentary comparisons are lacking from Southeast Asia, urban and rural Chinese blood pressure measures can be secured from two well-known Taiwanese studies (26, 27). In Table 4, the Chinese data have been regrouped to match Table 3, with the following results:

1) urban readings for ages 15-44 fall below rural readings for the same groups for both sexes;

Table 4. Age-Adjusted Mean Male and Female Systolic and Diastolic Blood Pressures for Selected Age Groups by Sex: Rural and Urban Taiwan[1]

	Male		*Female*	
	SBP	*DBP*	*SBP*	*DBP*
Urban Taipei				
Ages 15-24	116.31	69.18	109.00	66.44
25-44	119.64	73.95	113.47	72.05
45-64	130.55	84.21	136.65	82.79
Rural Taiwan				
15-24	123.27	76.00	121.38	78.46
25-44	123.96	79.44	123.44	79.31
45-64	127.64	82.26	135.49	84.49

[1] Age-adjusted to the Philippine population, 1975

2) but urban blood pressures elevate much more sharply between ages 25-44 and 45-64 than do rural blood pressures;
3) finally, urban blood pressures among older persons (45-64) tend to be higher than those found in the rural community.

These conclusions correspond to those provided earlier for the urban and rural Philippine locations.

B. *Hypertension Prevalence by Sex and Community*

The age-adjusted prevalence rates for males and females, ages 50-74, by community are presented in Table 5. Hypertension, as mentioned earlier, is defined as a blood pressure reading in excess of 160/95 mm Hg. The direction and significance of the prevalence rates differences between communities are presented in Table 6.

The rank order of prevalence which is set forth in Table 5 confirms the analysts from Table 3 and Figures 2-3:

1) There is greater prevalence in urban than in rural areas among both sexes;
2) prevalence is greater in the migrant urban than in the sedentary urban location;
3) prevalence is greater in the migrant rural than in the sedentary rural location;
4) the community in which migration and urban life style are combined, Davao City, has the highest prevalence rate encountered in the study.

It is noteworthy that sex differences only appear in the rural locations. In both rural Pangasinan and Davao Province, male hypertension exceeds that of females. In Davao City and Quezon City, rates for both sexes are almost identical.

Table 5. Definite Hypertensives in Four Philippine Communities: Age-Adjusted Rates by Sex for Population Ages 50-74[1] (per 1,000 population)

	Rates
A. SEDENTARY LOCATIONS (Luzon)	
1. Rural Pangasinan	
Male	135.9
Female	123.2
2. Quezon City	
Male	252.0
Female	256.9
B. MIGRANT LOCATIONS (Mindanao)	
1. Rural Davao Province	
Male	189.6
Female	138.8
2. Davao City	
Male	282.7
Female	294.6

[1] Age-adjusted to the 1975 population of the Philippines.

In Table 6, the Mantel-Haenszel relative risk formula has been computed for all pairs of locations, and the significance of differences tested. Within both sedentary (Luzon) and migrant (Mindanao) locations (Panels A-B of Table 6, the excess risk of urban over rural residents proves to be significant. Comparisons of migrant with sedentary communities (Panel C. Table 6) produce similar results: the excess risk of urban over rural residents proves, once again, to be significant. But comparisons of communities of the same type (urban vs. urban, rural vs. rural) did not yield significant results.

The final two comparisons of migrant-sedentary locations (Panel C. Table 6) are worth comment, since they represent the largest and smallest reported differences in relative-risk:

1) the greatest excess of hypertension risk is sustained by the residents of Davao City, the migrant urban location, compared with residents of Pangasinan, the rural sedentary location.
2) the smallest excess of hypertension risk is measured when the residents of Davao City, the migrant urban location, are compared with residents of Quezon City, the sedentary urban location.

The hypertension prevalence data generally confirm the conclusions reached from the examination of the blood pressure levels of persons in the 45-64 age range. The implications of Tables 3 and 6 taken together are as follows:

1) The urban environment is associated with both rapid elevation of blood pressure with age and excessive risk for hypertension among members

Table 6. Relative Risk for Hypertension by Sex in Four Philippine Communities for Population Ages 50-74[1]

	Relative Risk	*P*
A. SEDENTARY LOCATIONS (Luzon)		
Urban – Rural (QC > RP)		
Male	1.75	.001
Female	2.07	.001
B. MIGRANT LOCATIONS (Mindanao)		
Urban > Rural (DC > RD)		
Male	1.52	.10
Female	2.05	.02
C. MIGRANT-SEDENTARY COMPARISONS (Mindanao-Luzon)		
Rural > Rural > (RD > RP)		
Male	1.37	n.s.
Female	1.17	n.s.
Urban > Rural (QC > RD)		
Male	1.28	n.s.
Female	1.77	0.5
Urban > Rural (DC > RP)		
Male	2.08	.001
Female	2.40	.001
Urban > Urban (DC > QC)		
Male	1.19	n.s.
Female	1.16	n.s.

[1]Mantel-Haenszel relative risk formula (28). Probability by Chi-squre.

RP – Rural Pangasinan
QC – Quezon City
RD – Rural Davao
DC – Davao City

of both sexes. This generalization holds for both sedentary and migrant urban locations.

2) Migration appears to interact with the urban environment to intensify the elevation of blood pressure and excessive risk for hypertension. However, differences produced by migration alone do not appear to be sufficient for statistical significance, e.g. rural Davao compared with Pangasinan.

While both modernization and adaptation are associated with elevated blood pressure and hypertension risk, the former operates independently while the latter takes auxiliary role.

C. *Associated Variables*

The etiology of hypertension exemplifies the "linked open systems" model of explanation advocated by Cassel and his associates (29): bio-chemical, physiological, psychosocial and cultural factors are all implicated by contemporary investigators. Explanations ranging from trace minerals in the water supply to the adequacy of social support have found advocates in the recent literature (30-31).

It remains to devise a model tracing the intersystemic linkages between agents at different levels, and to test it empirically. Single factor explanations, such as obesity, still have their advocates; but they are inconsistent with current concepts of etiology. In the absence of a focusing hypothesis, however, commitment to multilevel explanation promotes "broad spectrum" data collection and interview procedures.

Among the factors generally believed to be implicated in elevated blood pressure and hypertension are age and body weight. Both were recorded for all sites in the present study. Within the two cities, a range of items including personal behavior (smoking, dietary factors) and psychosocial factors (education, occupation, social support) was also obtained and analyzed. First, the significance or weight as an explanatory factor will be examined across all four sites. Following this, age and body mass adjusted relationships between SBP and DBP and the other variables will be considered within the two cities where hypertension prevalence was found to be the greatest.

Mean heights and weights by sex for each study site are presented in Table 7 together with age-adjusted figures. All same-sex mean differences in weights between communities were significant at the .005 level with one exception: rural Davao women did not differ in weight from those in Davao City. The table supports the conclusion that both men and women tend to be heavier in urban locations. Age-adjustment increased the urban-rural differences in both sexes by decreasing the rural figures. Detailed age-specific mean heights and weights by sex and community are presented in the appendix (Tables A5-7).

The age-adjusted data by specific age group in Table 8 has been prepared to correspond to the blood pressure levels presented in Table 3. Unlike blood pressure, there is no reversal of urban-rural weight patterns with age. Men and women in the urban samples are heavier than their rural counterparts at each age level in the Table 8 sequence.

Comparison of Table 3 and Table 8 results produces some unexpected observations, however. Although blood pressure elevates with age in both sexes and all study sites (Table 3), *weight does not* (Table 9). Only in Quezon City do we find that persons in the 45-64 age groups have mean weights greater than those who are 25-44. But blood pressure and hypertension levels in Davao City are *higher* than those in Quezon City among persons 45-64 in both sexes. It seems unlikely that

Table 7. Mean Heights and Weights, Age-Adjusted and Unadjusted for Males and Females, Ages 15-74, From Four Philippine Communities: Migrant and Sedentary, Rural and Urban

	Unadjusted Means			*Age-adjusted Means*[1]		
	Height (Cms)	*S.D*	*Weight (Kgs)*	*S.D*	*Height (Cms)*	*Weight (Kgs)*
A. Sedentary						
1. Rural Pangasinan						
Male						
Female						
2. Quezon City						
Male	163.32	7.02	58.46	10.49	163.37	58.18
Female	151.48	6.51	49.93	9.07	151.45	49.59
B. Migrant						
1. Rural Davao						
Male	159.31	7.10	52.11	8.14	158.91	51.33
Female	150.90	6.07	47.60	8.43	150.72	46.98
2. Davao City						
Male	161.66	6.41	53.78	8.91	161.70	53.78
Female	151.44	5.70	47.63	8.54	151.59	47.65

[1] Adjusted to the 1975 population of the Philippines

obesity will explain the prevalence of hypertension found among urban migrants to Davao City.

To assess the possible independent influence of the behavioral variables on blood pressure levels, it is necessary to control for age and body mass. For this purpose, the Quezon City and Davao City study populations were divided by sex. Each group was then separated into scale values of the nine text variables, e.g., four scale values of social support were employed. Mean SBP and DBP levels, adjusted for age and body mass index (weight/height^2 10^4) were them computed for each scale value of the nine variables. Tests for homogeneity of the adjusted means were calculated by analysis of covariance, using the general linear models procedure.

For any associated variable to influence the level of blood pressure in a study population, it is necessary to reject the null hypothesis that all means computed for scale values of that variable could be drawn from the same population. Results for each city and both sexes appear in Table 9, with probability values for homogeneity tests. Seven of the nine variables showed some evidence of relationship to blood pressure ($P \leq .10$). However, only the physiological factors employed as controls, age and BMI, were consistently related to SBP and DBP at a high level of significance in all four groups.

Table 8. Mean Age-Adjusted Heights and Weights for Selected Age Groups, By Sex, for Four Philippine Communities: Migrant and Sedentary, Rural and Urban[1]

	Male		*Female*	
	Height (Cms)	*Weight (Kgs)*	*Height (Cms)*	*Weight (Kgs)*
A. Sedentary				
1. *Rural Pangasinan*				
Ages 15-24				
25-44				
45-64				
2. *Quezon City*				
Ages 15-24	163.77	53.51	151.10	46.73
24-44	163.49	60.37	151.46	50.55
45-64	163.30	62.91	151.28	53.36
B. Migrant				
1. *Rural Davao*				
Ages 15-24	157.58	48.94	150.87	45.81
25-44	160.40	53.42	151.50	49.03
45-64	158.83	52.31	149.75	46.54
2. *Davao City*				
Ages 15-24	161.49	50.67	151.69	44.51
25-44	162.43	55.84	151.60	49.69
45-64	161.06	55.49	150.93	50.24

[1] Age-adjusted to the Philippine population, 1975

There was little consistency across age and sex groups in either city for behavioral variables. Eight homogeneity tests were performed for each (2 BP measures x 2 sexes = 2 cities), nor more than three were significant for specific variables: social support and household income. Three variables disclosed significant departures from homogeneity in only two subgroups: fat consumption, education and occupation.

Behavioral variables were more frequently associated with blood pressure levels in Quezon City than in Davao City, and were more frequently associated with female blood pressures than with male. Conventional risk factor indicators (cigaret smoking, fat consumption) appeared to be less influential than psychosocial variables (social support and income). This could be an artifact of measurement and scaling procedures.

The social support results from both cities (Table 10) represent the most frequent occurrence of statistical significance among the behavioral variables in Table 9. Inverse association of social support with blood pressure can be discerned for both sexes in Quezon City and for males in Davao City. Household income

Unadjusted Means for Systolic and Diastolic Blood Pressure, Age and Body Mass Index By Number of Cigarets Smoked Per Day For Davao City Males and Females

	Cigarets Smoked Per Day			
	None	*01-19*	*21-29*	*30 or more*
A. Males				
SBP	123.40	126.00	135.41	130.75
DBP	80.27	79.09	85.09	83.59
Age	33.08	46.82	47.05	48.71
BMI	3,320.54	3,157.03	3,369.24	3,403.31
N	617	11	22	17
B. Females				
SBP	117.70	117.63	144.33	–
DBP	77.21	81.63	92.67	–
Age	32.72	40.75	58.33	–
BMI	3,141.06	3,410.77	3,288.24	–
N	751	8	3	0

Age and Body Mass Adjusted Means for Systolic and Diastolic Blood Pressure By Number of Cigarets Smoked Per Day For Davao City Males and Females

	Cigarets Smoked Per Day			
	(1) *None*	*(2)* *01-19*	*(3)* *21-29*	*(4)* *30 or more*
A. Males				
SBP	123.85	122.82	129.74	124.05
DBP	80.53	77.68	81.70	79.50
B. Females				
SBP	117.85	110.24	124.94	–
DBP	77.30	77.15	81.51	–

Significance levels:

A. Males
The SBP comparison of Cols. 1-3, has P = < .05; all others are n.s.
The DBP comparisons are n.s.

B. Females
All SBP and DBP intercolumn comparisons are n.s.

(Table 11), while displaying lesser significance, was also inversely associated with blood pressure among both sexes in Quezon City, and among women in Davao. In the Philippines, size of the extended kin group residing nearby (a measure of social support) is positively associated with social class which, in turn, reflects level of income (32-34).

Unadjusted Means for Systolic and Diastolic Blood Pressure, Age and Body Mass Index By Consumption of Foods Containing Saturated Fats and Davao City Males and Females

	Level of Fat Consumption (Score Values)[1]			
	0-2	*3-4*	*5-7*	*8 or more*
A. Males				
SBP	122.87	123.08	125.30	124.90
DBP	78.5	79.78	82.14	81.71
Age	34.88	33.00	35.04	33.40
BMI	3,271.39	3,277.65	3,363.59	3,375.88
N	191	144	173	159
B. Females				
SBP	119.91	116.83	118.32	116.28
DBP	77.33	77.13	78.04	76.70
Age	36.46	32.08	32.60	30.85
BMI	3,081.87	3,102.73	3,201.07	3,181.59
N	172	193	210	187

[1]Score values refer to daily (3), weekly (2), or less frequent (1) consumption of pork/beef, eggs, butter, margarine or fried foods.

Age and Body Mass Adjusted Means for Systolic and Diastolic Blood Pressures by Consumption of Foods Containing Saturated Fats and Davao City Males and Females

	Level of Fat Consumption (Score Values)			
	(1) *0-2*	*(2)* *3-4*	*(3)* *5-7*	*4* *8 or more*
A. Males				
SBP	123.14	124.05	124.47	124.60
DBP	78.82	80.44	81.57	81.40
B. Females				
SBP	117.71	117.70	118.19	117.55
DBP	76.12	77.67	77.92	77.39

Significance levels:

A. Males

All SBP Intercolumn comparisons are n.s. The DBP comparisons of Cols. 1-3 and 1-4 have $P = < .05$

B. Females

All SBP and DBP Intercolumn comparisons are n.s.

Table 9. Statistical Association of Interview Variables with Systolic and Diastolic Blood Pressures Adjusted for Age and Body Mass Index (P Values)

	Davao City				*Quezon City*			
	SBP		*DBP*		*SBP*		*DBP*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Age	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
Body mass Index	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
Residence in city	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Cigaret smoking	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Fat consumption	n.s.	n.s.	.06	n.s.	n.s.	n.s.	n.s.	n.s.
Social support	n.s.	n.s.	n.s.	n.s.	.005	.04	.03	n.s.
Education	n.s.	n.s.	n.s.	n.s.	n.s.	.004	n.s.	.04
Occupation	n.s.	n.s.	n.s.	n.s.	n.s.	.01	n.s.	.07
Income	n.s.	n.s.	.05	n.s.	n.s.	.0001	n.s.	.01

These variables suggest more frequent elevation of blood pressure among the lower class, but the association is based largely on significant associations from Quezon City (Table 9). In Davao, the migrant city, higher social status is more likely to result from upward social mobility. Other studies have related social mobility to an increase in levels of risk factors (35, 36). This may offset the tendency for higher social status to be associated with lower blood pressure in Davao City. At present, however, this is only a hypothesis.

Discussion

The study undertook the comparison of blood pressures and related measurements from four Philippine communities arranged in a 2 x 2 factoral design: urban and rural, migrant and sedentary (Figure 1). It was predicted that blood pressures and hypertension levels would be (1) higher in the urban than rural communities, (2) higher in the migrant than sedentary communities.

Conclusions from intercommunity comparisons are as follows:

1. Between ages 25-44 and 45-64, elevation of blood pressure with age was always greater in urban than in rural study sites. This was true for both SBP and DBP, and for both sexes (Table 3, Figures 2-3).
2. When migrant and sedentary communities were compared (urban with urban and rural with rural), blood pressures of persons 45-64 were always higher in the migrant community. While this was true for both SBP and DBP and for both sexes, the DBP difference were more substantial (Table 3, Figures 2-3).

These conclusions from age-adjusted blood pressure levels were further tested against hypertension prevalence data:

Table 10. Mean Blood Pressure Levels Adjusted for Age and Body Mass by Level of Social Support for Males and Females in Quezon City and Davao City

A. *Quezon City*
Level of Social Support[1]
(Score Value)

	0	*1*	*2*	*3 or more*
A. Males				
SBP	121.33	116.47	117.91	115.96
DBP	79.06	76.28	76.62	76.95
N	312	133	66	54
B. Females				
SBP	113.50	110.56	110.76	107.93
DBP	73.08	72.18	72.86	70.57
N	609	141	59	37

B. *Davao City*
Level of Social Support[1]
(Score Value)

	0	*1*	*2*	*3 or more*
A. Males				
SBP	124.15	123.91	125.02	119.66
DBP	80.53	80.88	80.45	76.80
N	275	251	114	27
B. Females				
SBP	117.50	118.15	117.47	119.53
DBP	77.88	77.42	75.91	76.39
N	315	294	132	21

[1]Score values are assigned for relatives living nearby (1), for frequent visits with relatives (1), regular church attendance (1), and number of association and group memberships (1 + 05).

3. Hypertension prevalence was always greater in urban than in rural study sites for both sexes (Table 5). All possible urban-rural comparison, (4) between migrant and sedentary study sites were made by computing relative risks, and were significant ($P \geqslant .05$) for at least one sex (Table 6).
4. When migrant and sedentary sites of the same type were compared (urban with urban and rural with rural), hypertension was always more prevalent in the migrant community (Table 5). However, relative risks computed for these comparisons (panel C. Table 6), failed to reach statistical significance.

Table 11. Mean Blood Pressures Adjusted for Age and Body Mass by Level of Household Income for Males and Females in Quezon City and Davao City

	A. Quezon City		
	Level of Household Income		
	P000-999	*P1000-1999*	*P2000-*
A. Males			
SBP	120.68	120.46	117.91
DBP	78.44	78.26	77.89
N	153	191	195
B. Females			
SBP	115.43	111.20	109.61
DBP	74.18	72.20	71.67
N	322	292	205

	B. Davao City		
	Level of Household Income		
	P000-999	*P1000-1999*	*P2000-*
A. Males			
SBP	123.26	124.85	123.78
DBP	78.66	81.08	79.93
N	147	145	77
B. Females			
SBP	120.47	117.00	116.82
DBP	77.95	77.66	75.65
N	193	168	81

The urban environment, representing modernization, appears to be sufficient to increase hypertension prevalence significantly in the Philippines without the added factor of migration. Migration, representing the dimension of adaptation to a new environment, does not seem sufficient in itself to increase hypertension prevalence significantly without the assistance of modernization, i.e., an urban environment.

Within the two urban environments, Quezon City and Davao City, age and body mass were closely associated with blood pressure differences; the behavioral variables (personal habits, socioeconomic characteristics) were less clearly associated when age and body mass were controlled. However, both social support and household income showed significant results in a minority of cases tested (Table 9). The relative lack of explanatory power encountered in psychosocial variables, constras-

ted with physiological attributes, has been observed by Reed, McGee and Yano (37) in their recent analysis of urban Japanese data from Hawaii.

A 1978 Iranian study (38) which compared rural villagers with migrants to Teheran and indigenous urbanites from the capital city reached conclusions similar to those presented for the four Philippine communities. Among subjects of both sexes, ages 40-59, both blood pressure and hypertension prevalence were ran. Once again, urban modernization rather than migrant adaptation appears to be the influential variable.

The failure of migrant adaptation to emerge from either the Iranian or Philippine studies as a significant determinant of blood pressure and hypertension differences is not surprising. Neither study described the migration experience or differentiated between migrant and sedentary populations with precision.

The nature of the behavioral changes entailed by migration needs to be elucidated. Length of exposure to the new environment and age at migration, social status of migrants within source and destination communities should be investigated. So too, should possible persistence of rural social organication and employment among migrants in the city as well as changes in primary variables such as diet, physical activity, occupation and social support.

A-1. Systolic and Diastolic Mean Blood Pressures with Standard Deviations and Body Mass Indices by Age Groups for Males, from Rural Pangasinan and Quezon City, Philippines, 1978

				RURAL		
		SBP	*SD*	*DBP*	*SD*	*BMI*
Male Ages:	15-19	115.09	11.57	73.74	8.63	
	20-24	120.26	12.28	77.63	8.73	
	25-29	121.14	11.11	77.91	8.65	
	30-34	121.84	11.34	78.87	9.48	
	40-44	123.63	14.47	80.65	9.80	
	45-49	125.91	16.34	75.95	11.84	
	50-54	126.63	15.28	81.63	10.20	
	55-59	128.32	17.58	81.91	11.41	
	60-64	131.96	19.30	82.63	11.48	
	65-69	136.52	21.78	84.39	12.34	
	70-74	137.75	21.50	83.38	12.30	
				URBAN		
		SBP	*SD*	*DBP*	*SD*	*BMI*
Male Ages:	15-19	109.53	10.24	70.22	8.39	3,165
	20-24	112.92	13.34	74.66	9.60	3,389
	25-29	116.99	13.30	76.90	8.56	3,669
	30-34	115.76	13.22	77.43	9.56	3,690
	35-39	118.39	13.63	79.14	11.06	3,779
	40-44	120.94	15.57	83.26	12.59	3,622
	45-49	124.11	15.96	81.22	10.52	3,794
	50-54	125.40	18.41	82.81	12.43	3,882
	55-59	133.77	25.87	86.10	13.85	3,879
	60-64	127.11	15.88	84.68	10.96	3,878
	65-69	141.35	17.46	80.65	11.80	3,578
	70-74	161.60	26.75	89.40	14.19	3,831

A-2 Systolic and Diastolic Mean Blood Pressures with Standard Deviations and Body Mass Indices by Age Groups for Females, Rural Pangasinan and Quezon City, Philippines, 1978

				RURAL		
		SBP	*SD*	*DBP*	*SD*	*BMI*
Female Ages:	15-19	112.33	10.93	72.78	8.47	
	20-24	114.23	11.12	71.78	9.43	
	25-29	115.93	12.39	75.71	9.69	
	30-34	116.57	13.73	75.94	10.08	
	35-39	117.11	14.96	76.77	10.84	
	40-44	120.99	16.96	79.32	10.71	
	45-49	122.68	17.88	80.13	11.39	
	50-54	123.90	18.24	80.54	11.33	

				RURAL		
		SBP	*SD*	*DBP*	*SD*	*BMI*
	60-64	132.23	21.28	81.39	12.17	
	65-69	133.29	21.41	81.99	12.33	
	70-	135.28	23.30	80.75	11.74	
				URBAN		
		SBP	*SD*	*DBP*	*SD*	*BMI*
Female Ages:	15-19	103.39	9.93	68.22	8.85	3,042.9
	20-24	106.14	14.80	68.74	11.82	3,124.1
	25-29	107.72	12.74	70.90	10.48	3,243.6
	30-34	107.59	14.48	70.40	10.81	3,269.9
	35-39	110.92	12.91	73.53	8.89	3,397.3
	40-44	112.77	17.14	74.20	12.70	3,510.3
	45-49	119.38	17.13	78.15	10.71	3,624.8
	50-54	123.68	22.50	79.45	11.23	3,503.1
	55-59	128.81	19.86	79.64	10.70	3,649.3
	60-64	131.95	21.51	81.15	11.54	3,238.6
	65-69	134.92	29.73	78.00	12.97	3,377.7
	70-	137.96	20.84	75.83	11.93	3,265.4

A-3. Systolic and Diastolic Mean Blood Pressures with Standard Deviations and Mean Body Mass Indices, by Age Groups for Males, Rural Davao Province and Urban Davao City, Philippines 1978

				RURAL		
		SBP	*SD*	*DBP*	*SD*	*BMI*
Male Ages:	15-19	111.39	11.09	75.81	10.11	2,998
	20-24	120.77	14.91	80.72	8.02	3,228
	25-29	123.15	11.40	84.02	7.81	3,341
	30-34	124.19	12.64	84.48	8.20	3,274
	35-39	125-60	14.07	85.46	10.06	3,331
	40-44	125.00	12.60	86.55	9.90	3,362
	45-49	127.92	12.60	86.55	8.83	3,344
	50-54	128.89	16.04	86.99	9.80	3,285
	55-59	129.29	14.47	87.87	8.81	3,291
	60-64	129.17	20.91	86.17	15.78	3,192
	65-69	140.62	20.39	88.75	11.75	3,090
	70-	143.83	24.97	94.50	15.98	3,041
				URBAN		
		SBP	*SD*	*DBP*	*SD*	*BMI*
Male Ages:	15-19	112.22	11.32	72.08	9.68	2,995
	20-24	119.65	10.22	77.94	9.15	3,310

		RURAL				
		SBP	*SD*	*DBP*	*SD*	*BMI*
	25-29	123.58	10.44	80.22	10.06	3,353
	30-34	125.63	10.15	88.33	9.06	3,645
	35-39	125.81	11.66	82.27	11.42	3,494
	40-44	126.92	19.02	83.69	14.29	3,365
	45-49	129.31	19.73	86.59	13.04	3,619
	50-54	130.29	19.58	84.91	14.78	3,431
	55-59	134.80	20.01	87.57	13.17	3,276
	60-64	142.03	26.29	91.06	17.28	3,316
	65-69	138.89	22.97	87.33	13.68	3,454
	70–	137.56	23.42	81.55	15.36	3,401

A-4. Systolic and Diastolic Mean Blood Pressures with Standard Deviations and Mean Body Mass Indices, by Age Groups for Males, Rural Davao Province and Urban Davao City, Philippines 1978

		RURAL				
		SBP	*SD*	*DBP*	*SD*	*BMI*
Female Ages:	15-19	109.97	10.02	76.37	7.68	2,984.6
	20-24	114.82	10.43	78.60	8.47	3,093.0
	25-29	116.12	12.57	78.80	9.16	3,186.7
	30-34	117.33	12.66	81.67	10.75	3,272.4
	35-39	116.86	12.29	81.72	8.06	3,190.5
	40-44	119.90	15.50	82.44	11.23	3,299.6
	45-49	122.72	17.35	83.83	10.85	3,222.8
	50-54	128.98	18.03	86.30	9.68	3,122.5
	55-59	122.76	13.26	82.20	11.69	2,938.0
	60-64	130.09	14.74	85.73	8.10	3,040.2
	65-69	139.00	13.11	88.18	10.94	2,763.3
	70-	131.14	24.52	83.85	13.06	2,559.9
				URBAN		
		SBP	*SD*	*DBP*	*SD*	*BMI*
Female Ages:	15-19	106.39	9.98	76.26	9.17	2,915.6
	20-24	109.28	9.73	71.03	9.03	2,950.9
	25-29	111.28	12.89	73.98	10.95	3,116.7
	30-34	117.16	16.11	77.15	14.28	3,261.8
	35-39	121.18	16.10	80.73	12.88	3,306.0
	40-44	124.20	16.77	84.54	13.08	3,607.9
	45-49	129.27	24.20	84.62	15.38	3,509.4
	50-54	134.78	21.83	85.62	11.79	3,397.2
	55-59	139.39	33.65	88.79	19.92	3,211.3
	60-64	133.71	16.96	89.52	8.02	3,245.9
	65-69	141.80	23.60	90.35	14.31	2,902.3
	70–	158.67	36.10	89.00	7.04	3,066.9

A-5. Mean Heights and Weights, with Standard Deviations, by Age Group, for Males and Females from Quezon City, Philippines, 1978

		MALES				
		Height (Cms)	*SD*	*Weight (Kgs)*	*SD*	*N*
Males Ages:	15-19	163.09	8.15	51.75	9.08	122
	20-24	164.65	6.97	55.79	7.53	82
	25-29	163.49	6.31	60.00	10.91	69
	30-34	162.49	8.01	59.98	10.93	53
	35-39	164.37	5.22	62.08	9.79	44
	40-44	163.73	6.55	59.36	10.87	46
	45-49	162.55	9.11	61.63	7.63	36
	50-54	164.52	5.58	63.94	11.95	52
	55-59	161.68	5.43	62.81	9.87	30
	60-64	164.79	4.17	63.92	8.82	19
	65-69	157.99	4.14	56.54	8.20	17
	70-74	159.23	7.07	61.13	8.26	10
	Total					580
		FEMALES				
Female Ages:	15-19	151.10	6.26	45.99	7.72	175
	20-24	152.68	6.33	47.69	6.61	147
	25-29	152.10	5.18	49.36	7.41	88
	30-34	150.35	6.59	49.24	8.61	70
	35-39	151.37	8.40	51.34	9.92	74
	40-44	151.94	7.18	53.34	10.23	76
	45-49	151.93	8.08	55.01	8.63	73
	50-54	152.55	3.93	53.54	9.74	59
	55-59	150.14	5.39	54.79	10.91	42
	60-64	149.56	4.72	48.39	6.14	20
	65-69	148.17	6.95	50.17	8.68	26
	70-74	149.94	4.69	49.00	12.48	25
	Total					873

A-6. Mean Heights and Weights, with Standard Deviations, by Age Group, for Males and Females from Davao City, Philippines, 1978

		MALES				
		Height (Cms)	*SD*	*Weight (Kgs)*	*SD*	*N*
Male Ages:	15-19	160.46	7.00	48.13	6.70	143
	20-24	162.81	6.05	53.94	7.83	98
	25-29	163.06	5.98	54.76	7.58	88
	30-34	162.24	7.08	57.34	8.90	55
	35-39	162.94	5.66	57.03	8.85	67
	40-44	160.96	6.23	54.18	7.51	36

		MALES				
		Height (Cms)	*SD*	*Weight (Kgs)*	*SD*	*N*
	45-49	161.48	7.15	58.46	10.07	49
	50-54	160.00	6.12	55.00	11.09	35
	55-59	162.10	5.11	53.16	8.77	30
	60-64	160.65	5.96	53.37	9.95	31
	65-69	158.96	5.59	55.00	8.42	18
	70-74	160.52	5.91	54.71	11.42	16
	Total					668
		FEMALES				
Female Ages:	15-19	151.63	5.74	44.26	6.26	160
	20-24	151.77	6.06	44.84	5.92	120
	25-29	151.69	5.36	47.30	7.26	112
	30-34	151.28	5.51	49.40	8.37	75
	35-39	151.62	6.07	50.20	9.30	80
	40-44	151.83	4.92	53.56	9.43	50
	45-49	150.48	6.25	50.83	9.30	46
	50-54	156.05	5.15	51.78	11.07	37
	55-59	150.96	5.78	48.58	9.49	33
	60-64	150.13	5.23	48.80	8.48	21
	65-69	150.11	6.44	44.58	9.41	20
	70-74	146.86	3.34	45.06	6.69	9
	Total					763

A-7. Mean Heights and Weights, with Standard Deviations, by Age Group, for Males and Females from Rural Davao Provinces, Philippines, 1978

		MALES				
		Height (Cms)	*SD*	*Weight (Kgs)*	*SD*	*N*
Males Ages:	15-19	156.47	7.72	47.03	6.93	79
	20-24	159.03	7.01	51.41	8.18	81
	25-29	161.22	7.54	53.95	8.19	87
	30-34	160.13	6.44	52.50	7.26	103
	35-39	159.96	6.30	53.35	7.83	89
	40-44	159.92	7.44	53.85	7.87	98
	45-49	159.60	7.43	56.48	9.08	79
	50-54	159.28	7.10	52.34	8.04	65
	55-59	157.61	5.75	52.03	9.00	31
	60-64	158.17	4.20	50.43	6.93	23
	65-69	156.50	8.23	48.50	6.69	16
	70-74	158.00	7.29	48.17	8.00	12
	Total					763

		Height (Cms)	*SD*	*Weight (Kgs)*	*SD*	*N*
			FEMALES			
Female Ages:	15-19	150.73	6.36	45.03	5.87	118
	20-24	151.06	5.84	46.81	5.32	149
	25-29	151.82	6.24	48.45	7.54	153
	30-34	150.95	6.12	49.50	8.86	133
	35-39	151.38	6.16	48.42	8.65	138
	40-44	151.84	5.43	50.18	9.67	122
	45-49	150.57	5.69	48.56	8.07	95
	50-54	151.06	5.53	47.28	8.11	53
	55-59	149.90	5.58	44.03	5.83	29
	60-64	146.14	6.40	44.63	9.86	22
	65-69	146.82	5.45	40.73	11.61	22
	70-74	145.07	6.58	37.14	5.60	14
	Total					1,048

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Santiago V. Guzman, Discussant

Hypertension being a public health problem needs solution which is preventive in nature. One of the main thrusts in health promotion and disease prevention is an understanding of risk factors i.e., characteristics which increase morbidity and mortality of disease. One such risk factor in hypertension is migration as already discussed by Dr. Cabral.

It might be pertinent to mention at this point that studies on intercultural assessment of the effects of migration among Japanese migrants some years ago. This study involved Japanese from Hiroshima and Nagasaki and Japanese in Honolulu and Japanese in San Francisco where they evaluated the prevalence of coronary artery disease and hypertension in these three groups of population and they found that the prevalence of coronary artery disease was highest in San Francisco and intermediate in Honolulu and lowest in Japan. The same picture was true with hypertension except that they found that hypertension was related to the weight of the individual. In other words, they were able to to explain the degree of rise in blood pressure in San Francisco because the population there were heavier than the population in the other areas.

On the other hand, they had a chance to evaluate the effects of acculturation; the psycho-social and cultural changes in the population and they found that the Japanese who maintained the traditional Japanese culture and associating with more Japanese in San Francisco had the same prevalence rate of coronary artery disease as those in Japan. Whereas those who were assimilated with the American way of life had a very high prevalence of coronary artery disease. In this context, the appearance of hypertension among migrants from rural to urban area may be prevented or minimized if the migrant has social support like being among relatives and friends in the new environment.