PATTERNS OF BLOOD PRESSURE RESPONSE IN MIGRANT AND NONMIGRANT TOKELAUANS

II: PHYSIOLOGICAL AND SOCIO-CULTURAL CORRELATES OF BP RESPONSE

N. S. Altman[1], R. H. Ward[2], I. A. M. Prior[3]

BU-995-M

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[1]Biometrics Unit, Cornell University, Ithaca, N.Y. 14853

[2]Department of Human Genetics, University of Utah, Salt Lake City, UT 84132

[3]Epidemiology Unit, Wellington Hospital, Wellington, New Zealand.

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Abstract

Cardiovascular risk factors were measured on Tokelau Islanders, on the atolls, and several years later on the atolls or in New Zealand (NZ). BP response is computed as the difference between observed postmigration blood pressure (BP) and the BP predicted from a set of concomitants known to be important in the premigrant environment.

The major component of BP change in adults is a consequence of increased obesity in NZ. Despite the marked increase of urinary sodium (UNA), and decrease of urinary potassium (UK) excretion, in NZ, only a very small component of BP response is associated these variables. Other variables associated with response include pulse, serum lipids, serum glucose, and serum uric acid (SUA). Socio-cultural variables which contribute to response include smoking and drinking habits, work and marital status, and contraceptive use.

Despite increased prevalence of cardiovascular risk factors in migrants, the prevalence of heart disease and strokes in both the migrant and nonmigrant populations is low.

Keywords: BP Tokelau migration physiological acculturation

Running Head: Patterns of BP Response II

Introduction

In the preceding paper [1], we defined BP response as the difference between predicted and observed BP in the postmigration time period. A regression model was developed to summarize the relationship between BP and a set of concomitants in the premigration time period. This model was used with the postmigrant values of the concomitants to predict postmigrant BP of both the migrants and nonmigrants. The concomitants were atoll of origin, height, weight, body mass index (weight/height^2), body fat index (a transform of subscapular skinfold), and serum cholesterol. We interpret BP response as the component of BP charge which is not explained by the change of distribution of the concomitants.

In the Tokelauan population, it has already been established that, prior to migration, nonmigrants and migrants had similar values for an array of physiological variables, including BP [2]. After migration, many of these factors differ significantly. In particular, BP of migrants is significantly greater than that of nonmigrants.

Cross-cultural studies of other populations indicate that, in ethnically similar groups, increased levels of BP are associated with acculturation to a Western lifestyle.

The purpose of this investigation is to identify variables which are significantly associated with BP response in Tokelauans, and which may, therefore, suggest which factors underlay the observed increase in BP. We also attempted to determine if response was related to the presence or absence of cardiovascular disease and diabetes, as well as to the use of medications and to abnormal blood lipid levels.

Previous analyses of this data set have concentrated on explaining the cross sectional differences between the two postmigrant populations [3,4]. Due to the scale of the emigration (over half the population now resides in NZ) and increased contact with NZ, the nonmigrants, as well as the migrants, have experienced significant socio-cultural transition since the premigrant survey.

The response model approach differs from previous analyses, in that it allows us to compare how changes in the physical and socio-cultural environment since 1967 have affected both nonmigrants and migrants.

The Michigan Interactive Data Analysis (MIDAS) [5] was used for all analyses in this paper.

Method

Previous work suggested that distinct juvenile and adult patterns of BP and physiological concomitants exist in the Tokelauan population [6]. The age at which the transition from juvenile to adult phase occurs varies with the concomitant, so a uniform cut off of 18 years was selected.

The relationship between BP and the concomitants in the premigrant adults is described in detail in the preceding paper [1]. The major association is between BP and the obesity measures, although in some cases the total variance explained is very small.

Physiological Factors

The additional physiological variables used in this study are listed in Table 1. Most of these variables have been linked to BP in other populations [7-11]. The age distributions of the physiological variables are summarized in Figures 1-4. The univariate association of the these variables with response was summarized in Table 1 using correlations for continuous variables and analysis of variance for categorical variables. If the within atoll correlations were similar, the six-survey correlation was reported; if not, the correlations were reported by atoll.

There are very few correlations between BP response and the physiological variables that are consistent across survey groups. UK is not associated with response in any group. Pulse was positively correlated with response in all groups. The other significant correlations are not consistent across groups.

Because the physiological variables are highly correlated, we used multiple

regression to clarify the major associations with BP response. We first used stepwise regression to select a "best" set of variables for each regression equation; we then combined sets of variables so that the variables used would be consistent within each survey group. Finally, we did a stepwise regression, entering the variables in fixed order. The contributions to R^2 are summarized in Table 2.

Between 8% and 17% of variation in BP response is accounted for by multiple regression on the physiological variables. UNA and UNA/UK make small significant contributions in migrants but not in nonmigrants. Pulse makes the largest contribution in every group but nonmigrant women.

Socio-Cultural Factors

A number of socio-cultural factors have been identified which are associated with BP in other populations [12-18] Table 3 summarizes the significant relationships between BP response and the socio-cultural factors. Religion, parity, and number of live births were also investigated, but were not associated with BP response.

For nonmigrants, usual residence was defined as one of the three Tokelauan atolls or other Pacific Islands. For the migrants, major urban centres of Wellington and Auckland were considered. There is considerable correlation between atoll of origin and place of residence in NZ. Although raw BP is strongly associated with atoll of origin, place of usual residence is not significantly associated with BP response. The length of stay in NZ was positively associated with both SBP and DBP response. Some Tokelauans had travelled to NZ and then returned to Tokelau, or had lived on other Pacific Islands. Among those who had lived away from their home atoll prior to migration to NZ, travel to NZ prior to the current migration, and/or living on other atolls was not associated with BP response. However, there was a positive association of DBP response for men, and SBP response for women, with duration of stay on other Pacific Islands.

Nonmigrants are mostly engaged in traditional non-wage occupations; as a

result, those classified as unemployed are mostly aged, and only a few people in administrative and similar positions have been classified as skilled. In NZ, most Tokelauans work at unskilled jobs, although many of the women work only in the home; one again, those classified as unemployed tend to be older. In both environments, people classified as "workers" or "housewives" have lower BP response than those classified as "unemployed".

Use of alcohol and tobacco were rare in Tokelau during the premigrant time period. In the postmigrant groups, over 50% of the men and about 6% of women drank alcohol, while over 70% of men and over 25% of women smoked tobacco. Nonmigrant male drinkers have elevated DBP response and smokers have lowered SBP response. Among migrants, drinking is associated with elevated BP response, and the response is greater among those who drink more frequently. Women smokers have lower SBP response, but in men, SBP response increases with number of cigarettes smoked per day.

Very few women in either environment use contraceptives. Among nonmigrant women there was no significant relationship between BP response and contraceptive use, but in migrants, DBP response is higher for birth control users, and in particular, for oral contraceptive users.

In both the nonmigrant and migrant populations, divorce is rare. Unmarried people are younger, and widowed people older, than married ones. Since the migrants tend to be young, there are few widowed people in this group. For men in both survey groups, widowers had the lowest BP response and single or divorced men the highest. Among nonmigrant women, married women have the lowest response and divorced the highest, while among migrant women, single women have the lowest response and widows the highest.

To obtain a more comprehensive understanding of how the socioeconomic and physiological variables affect BP response, stepwise regression was performed, using dummy variables for categorical variables. Once a smaller set of factors had been selected, the variables were entered in the regression equation in fixed order so that contributions to R^2 could be compared across dependent variables and survey groups. Table 4 summarizes the results of the ordered regression.

For men, atoll of origin, pulse, drinking habits (yes,no), the ratio of UNA/UK/SUA, and marital status, plus for migrants length of residence in NZ, were found to be the best predictors of response. UNA/UK and SUA were significant for the migrants but not the nonmigrants. Overall, 11% to 15% of variance was explained by these variables. It is interesting to note that length of residence in NZ still makes a significant contribution for men even when the other variables are accounted for. This suggests that the influence of the new environment is not simply a function of exposure to the identified factors. Overall, however, little of the variability in BP response was explained by these variables.

For women, atoll of origin, pulse, serum glucose, SUA, UNA, lipid type, marital status, and for migrants, length of residence in NZ, were found to the best predictors of response. Pulse, SUA and marital status made significant contributions to R^2 for nonmigrants but not for migrants, while plasma glucose and lipid type made significant contributions for migrants but not nonmigrants. Overall, only 7% to 11% of variance was explained by these variables.

Medical Conditions

Many medical conditions are related to BP. These include the various forms of cardiovascular and coronary disease, as well as diabetes. Also, medication for these conditions is known to affect BP. Very few Tokelauans in either environment had histories of cardiovascular or coronary disease. As well, the use of medication for heart conditions, hypertension, or diabetes was rare. Table 5 summarizes the distribution of various medical conditions in the populations, and their association of BP response.

Of those responding positively to the Rose questionnaire (indicative of possible angina [19]) only migrant women had elevated BP response. A few respondents also had effort pain. Of these, the men had elevated BP response, but the women did not.

Among nonmigrants, men with a history of heart attacks or mitral valvular

disease had elevated BP response, but among migrants they had lower BP response. In both groups women who were under medication for high BP or heart condition had elevated BP response.

The distribution of diabetes in the nonmigrant and migrant populations has been discussed elsewhere [20,21]. About 30% of men and women in both survey group were classified as possible, probable or definite diabetics; of these 3 to 5% were classified as definite. Among nonmigrants, response is highest for those classified as probably diabetics and lowest for those classified as definite diabetics. The differences achieve significance only for male SBP response. Among migrant men, there is no difference in response with diabetic status. For women, BP response increases significantly as diabetic status changes from normal to definite. Among nonmigrants, and migrant women, those under medication for diabetes showed no significant differences from the population as a whole; the three migrant men under medication had significantly lower DBP response.

The Tokelau population was classified by lipid type using Rifkind's criterion [22]. While only 6.5% of nonmigrant men and 7.7% of nonmigrant women exhibited type IIA, IIB, or IV lipid profiles, the figures became 25.4% and 16.1% of the total R^2 for migrant men and women respectively. Nonmigrants with abnormal lipid type have response similar to those with normal lipid type. Migrant men with abnormal lipid type have elevated DBP response. Migrant women with abnormal lipid type have elevated SBP response.

Discussion

We have defined response as the difference between observed and predicted BP in the postmigrant environment. BP response approximates the change in BP that is not due solely to changes in the distribution of known concomitants, and in particular, to changes in obesity. Having evaluated the relationship between BP response and a set of physiological and socio-cultural variables, it is of some interest to evaluate the relationship between the same set of variables and "raw" BP. This comparison will indicate the extent to which apparent relationships between these variables and increased BP in the migrant

population is actually a reflection of postmigration changes in the original set of concomitants.

Compared with its association with BP response, a given variable may have a stronger, unchanged, or weaker, association with raw BP. A stronger association with raw BP than response indicates that the association of this variable with raw BP can be accounted for, at least in part, by its association with the "obesity factors". An unchanged association indicates that this variable is independent of the the "obesity factors". A weaker relationship with BP than with response indicates that this variable has a synergistic interaction with the "obesity factors". All three of these situations occur in this data.

Table 6 summarizes the correlation between the physiological variables and raw BP. Comparing with Table 1, several striking differences appear. SUA, glucose, triglycerides and urea nitrogen have significant positive correlations with BP in all sex-survey groups. By contrast, these variables exhibit only weak correlations, or negative correlations, with BP response. UNA and UK have significant negative correlation with BP in several atoll-sex-survey groups, but are correlated with response only for female nonmigrants. This suggests that these factors are associated with BP mainly through their association with obesity.

The association of pulse with raw BP is very similar to its association with BP response, suggesting pulse is independent of weight factors. UNA/UK is associated with raw BP only for migrant men; it is associated with response for all migrants, but is negatively associated with response for nonmigrant women.

If changes in BP are attributed to changes in obesity, then dietary changes following migration are likely to be partly responsible. Migration to New Zealand has resulted in a marked change from the traditional diet of coconuts, breadfruit, fish and little salt. Migrants now have markedly increased consumption of carbohydrates and cholesterol through their changed diet which is now rich in dairy products, sugar, flour plus some meat [23]. Salt use has also increased, as has exposure to tobacco and alcohol. To a much lesser extent these changes have also occurred in Tokelau. It appears that a major component of

dietary change is an increase in caloric consumption leading to the observed increase in obesity. This is in turn has had a marked effect on BP, as well as a number of the physiological variables analysed above. Most of these are not associated with BP response, suggesting that they have little relationship with the rise in BP once the original concomitants are controlled for.

The role of dietary sodium in inducing high BP is controversial. In the Tokelau populations, there has been a dramatic increase in UNA excretion from a mean of about 40 mEq for premigrants to 100 mEq for migrants. Nevertheless, the ratio of UNA/UK, while a significant regressor, predicts only about 2% of the variance of response, if other physiological are controlled for, and somewhat less if drinking habits are also controlled for. However, although the effect is small, it remains significant even when all other concomitants are included in the regression equation.

The socio-cultural variables also differ in their associations with BP response and raw BP. The results for raw BP are in Table 7, while those for BP response are in Table 3. Temporary migrations, length of residence in NZ, work status, and number of live births, are more strongly associated with raw BP than with BP response. These factors are all associated with obesity. Consistent with other studies of smoking and BP [8,14,24], smoking habits was negatively associated with raw BP, but not with BP response, which takes weight into account. The overall level of association of smoking with BP and BP response is small, and becomes non-significant when other variables are included in the analysis.

Usual residence, alcohol use, and contraceptive use, have a stronger relationship with BP response than with raw BP. These represent features of the socio-cultural environment which act synergistically with obesity to increase blood pressure. Of these, the most consistent is the relationship with alcohol. A number of studies have concluded that alcohol consumption is associated with increased BP [25,26]. For nonmigrant Tokelauan males, drinking appears to be negatively associated with BP, but it is positively associated with response.

Similarly, the use of contraceptives may represent a surrogate measure of acculturation factors that increase blood pressure, but which are not associated with the general increase in obesity. The use of contraceptives is not associated

with raw BP in either of the female populations, which contrasts with the association with BP response in migrant women (Table 4). The use of contraceptives of all kinds was associated with higher DBP response (Table 4), as well as with standard SBP and DBP response.

CHD risk and BP have been reported to vary with marital status [17, 25]. In the Tokelau populations, this relationship is stronger for BP response than for raw BP. For all sex-survey groups, single people have the lowest raw BP and widowed, divorced or separated, the highest. The pattern is more complex for BP response.

It is difficult to properly evaluate the relationship between BP changes and disease because coronary and cardiovascular disease are rare among the Tokelau nonmigrant and migrant populations, with no apparent increase in prevalence in NZ. There was, however a slight increase in the numbers responding positively to the Rose questionnaire. More important is the marked increase in NZ of Tokelauans with unusual serum lipid concentrations, (mainly Type II-A and Type IV). These lipid types are associated with increased raw BP and also with BP response. However, as expected, the association is stronger with raw BP since the concomitant influence of increased obesity has not been accounted for.

The prevelance of diabetes is about the same in the nonmigrant and migrant population, about 3% to 5%. The association of raw BP and BP response with diabetic classification is similar for migrants. Both raw BP and response increase with increasing indication of diabetes, but the association is stronger for raw BP. For nonmigrant men, raw BP and response are both lowest in those classified as definite diabetics, and highest in those classified as possible or probable diabetics; the association is stronger for raw BP. For nonmigrant women, raw BP is highest in those classified as definite diabetics and lowest in those classified as normal, while response is highest in those classified as probable diabetics, and lowest in definite diabetics.

Finally, the multiple regression of raw BP on important physiological and socio-cultural variables was performed. The results are in Table 8. It should be noted that in both Tables 5 and 9, length of residence in NZ is significant for men

after the other variables have been accounted for, in the migrant population, although the effect is small. This suggests that migration to NZ and subsequent acculturation has an effect on raising BP that is additional to the influence of the measured variables that have previously entered the analysis. Cassel [27] cites several blood pressure studies in adults in traditional and acculturated societies. In many, but not all, traditional societies, blood pressure is low and does not increase (may even decrease) with age; blood pressure and the correlation of blood pressure with age increase with the degree of acculturation. In the Tokelau populations, temporary migrations to more acculturated environments was not associated with a change in BP response, for nonmigrants. Among migrants, there was some association for those visits which were then followed by migration to NZ. Although the numbers involved in short visits is small, the evidence suggests that there is a small "duration" effect of migration, but that these effects, at least if sustained for less than four years, do not persist upon return to the home environment. The small, but significant, effect of length of residence in NZ on BP response which is not a function of the other physiological and socio-cultural variables, suggests that long term migration and accompanying acculturation has an influence on BP. Whether or not this factor is equivalent to the "acculturation/stress" variables identified by Beaglehole et al (1977) [28] , awaits further analysis.

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TABLE 1
SIGNIFICANT CORRELATIONS OF PHYSIOLOGICAL VARIABLES WITH BP REPONSE

		Pulse	SUA	Glucose	Trig	UNA	UK	UNA/UK	Nitrogen
MALE									
Nonmigrant	SBP response	.28**		-.28*n					
	DBP response	.32*	.22*a	-.34*n					-.13*
Migrant	SBP response	.22*a						.21*a	
		.31**n						.20*f	
	DBP response	.24**	.15*f						
FEMALE									
Nonmigrant	SBP response	.18**						-.17*f	
	DBP response	.26**				-.22**f		-.23*f	
Migrant	SBP response			.20*n	.23*n			.23*a	.12*
	DBP response	.10*		.21*					

**	$p < .01$
*	$.01 < p < .05$
f	Fakaofo
a	Atafu
n	Nukunonu

TABLE 2

R^2 VALUES DERIVED FROM ORDERED MULTIVARIATE REGRESSION OF PHYSIOLOGICAL VARIABLES ON BP RESPONSE. VARIABLES WERE ENTERED IN THE ORDER GIVEN.

		Atoll	Pulse	Glucose	UNA	UK	UNA/UK	SUA	Total
MALE									
Nonmigrant	SBP response	1.5	5.5**	2.6*	1.2			3.0*	13.8*
	DBP response	4.7**	7.5**	2.4*	0.6			1.4	16.6**
Migrant	SBP response	2.4**	3.4**		1.6*		2.5*	1.4*	11.3**
	DBP response	1.1	5.2**		1.5*		1.1	1.7	10.6**
FEMALE									
Nonmigrant	SBP response	2.1*	2.6**	1.5			1.3	1.1	8.6*
	DBP response	1.2	6.2**	0.0			2.0	2.5*	11.9**
Migrant	SBP response	2.9**	0.3	2.9**	2.4*		2.7**		11.2**
	DBP response	2.8*	1.1	2.1	1.3		3.2**		10.5**

** $p < .01$

* $.01 < p < .05$

TABLE 3. SIGNIFICANT ASSOCIATIONS OF SOCIO-CULTURAL VARIABLES AND BP RESPONSE. CONTINUOUS VARIABLES ARE REPRESENTED BY THE CORRELATION COEFFICIENT; CATEGORICAL VARIABLES ARE INDICATED BY THE APPROPRIATE CODE DERIVED FROM THE ANALYSIS OF VARIANCE RESULTS

		Usual Residence	Temporary Migrations	Time in NZ	Work Status	Drink Yes-No	Amount of Alcohol	Smoke Yes-No	No. of Cigarettes	Marital Status	Birth Control
MALE											
Nonmigrant	SBP response				*	+				*	
	DBP response				*			-			
Migrant	SBP response	*	.31**	.14**	*	++	.13*		.14*	*	
	DBP response			.18**			.11*			*	
FEMALE											
Nonmigrant	SBP response									*	
	DBP response									*	
Migrant	SBP response			.13**			.54**	-		*	
	DBP response			.12*		++					+

**	$p < .01$
*	$.01 < p < .05$
-	negative association $.01 < p < .05$
+	positive association $.01 < p < .05$
++	positive association $p < .01$

TABLE 4. R^2 VALUES DERIVED FROM ORDERED MULTIVARIATE REGRESSION OF PHYSIOLOGICAL AND SOCIO-CULTURAL VARIABLES ON BP RESPONSE. VARIABLES WERE ENTERED IN THE ORDER INDICATED.

		Atoll	Pulse	Glucose	Drink	UNA/UK	SUA	UNA	Lipid Type	Marital Status	Time in NZ	Total
MALE												
Nonmigrant	SBP response	1.2	5.2**		2.3*	0.7	0.0			4.6*		14.0**
	DBP response	3.9	6.2**		0.2	0.3	0.0			0.6		11.2**
Migrant	SBP response	2.4	2.1**		4.0**	1.7*	1.0*			2.5**	1.1*	14.8*
	DBP response	0.9	4.6**		1.3*	0.6	1.5*			2.6**	3.4**	14.9
FEMALE												
Nonmigrant	SBP response	2.1	2.2**	0.2			0.5	0.0	0.4	2.3**		7.7*
	DBP response	1.2	5.4**	0.0			1.6*	0.7	0.0	2.1*		11.0**
Migrant	SBP response	2.6	0.0	2.5**			0.1	0.4	0.9	0.8	1.0	8.3*
	DBP response	2.5	0.8	1.0			0.2	0.3	1.2*	0.2	1.1	7.3*

** $p < .01$

* $.01 < p < .05$

TABLE 5. DISTRIBUTION OF SPECIFIC MEDICAL CONDITIONS IN TOKELAUANS IN RELATIONSHIP TO BP RESPONSE. THE NUMBER OF INDIVIDUALS WITH A GIVEN CONDITION IS GIVEN ABOVE. ASSOCIATION WITH BP RESPONSE IS INDICATED BY AN APPROPRIATE NUMBER OF ASTERISKS IN THE ROW BELOW.

	Rose Criterion	Infarction	Other CVD[1]	Diabetes	Lipid Type
MALE					
Nonmigrant (240) #	26	2	19	7	15
SBP response				--	
Migrant (512) #	71	5	10	15	135
DBP response		-	+		+
FEMALE					
Nonmigrant (337) #	41	5	26	79	29
Migrant (421) #	68	3	11	33	71
SPB response			++	+	+
DBP response	+				

1 includes aortic and mitral valvular disease, rheumatic heart disease, strokes and miscellaneous heart disease

++ $p < .01$ positive associatoion

+ $.01 < p < .05$ negative association

- - $p<.01$ negative association

- $.01<p<.05$ negative association

TABLE 6. SIGNIFICANT CORRELATIONS OF PHYSIOLOGICAL VARIABLES WITH RAW BP

		Pulse	SUA	Glucose	Trig	UNA	UK	UNA/UK	Nitrogen
MALE									
Premigrant	SBP		.35**a	.37**f	.22**f		-.22*f		.18**
	DBP	.36**a .26**f	.27**a	.37**f	.18**				.21*a
Nonmigrant	SBP	.13*	.33**a .28*n	.26*a .30**f	.35**f				.33**a
	DBP	.23**	.33**a .31**n	.36**a (-.22n) .23*f	.31**n .35**f				
Migrant	SBP	.25**	.13**	.21**	.22**	-.18*n			.15*f
	DBP	.30*	.16**	.22**	.24**	-.18*n			
FEMALE									
Premigrant	SBP	-.20*n	.27**	.17**f	.32**				.40**n .21**f
	DBP	.20*f	.29**	.15*f	.26**	-.18*f			.28**n
Nonmigrant	SBP	.23*f	.41**a .27*f	.24**	.30**		-.18**f		.24*a
	DBP	.23*a	.30**	.22**f	.30*				.12*
Migrant	SBP		.24**	.34**	.37**		-.21**n -.24**f	.24*f	.28**
	DBP		.21**	.31**	.35**		-.26*n	.26*f	.22*a

** $p < .01$
* $.01 < p < .05$
n Nukunonu
f Fakaofo
a Atafu

TABLE 7. SIGNIFICANT ASSOCIATIONS OF SOCIO-CULTURAL VARIABLES AND BP. CONTINUOUS VARIABLES ARE REPRESENTED BY THE CORRELATION COEFFICIENT; CATEGORICAL VARIABLES ARE INDICATED BY THE APPROPRIATE CODE DERIVED FROM THE ANALYSIS OF VARIANCE RESULTS.

		Temporary Migrations	Time in NZ	Work Status	Drink Yes-No	Amount of Alcohol	Smoke Yes-No	No. of Cigarettes	Marital Status	Birth Control
MALE										
Nonmigrant	SBP			*	--					
	DBP			*			-			
Migrant	SBP	.38*	.16*	*				.17**		
	DBP		.27**					.14*	*	
FEMALE										
Nonmigrant	SBP			*					*	
	DBP			*	-				*	
Migrant	SBP	.36*	.11*	*		.42*	--		*	++
	DBP	.44**	.17**	*			--		*	++

** $p < .01$
* $.01 < p < .05$
- negative association $.01 < p < .05$
-- negative association $p < .01$
++ positive association $p < .01$

TABLE 8. R^2 VALUES DERIVED FROM ORDERED MULTIVARIATE REGRESSION OF PHYSIOLOGICAL AND SOCIO-CULTURAL VARIABLES ON BP RESPONSE. VARIABLES WERE ENTERED IN THE ORDER INDICATED.

		Atoll	Pulse	Glucose	Drink	UNA/UK	SUA	UNA	Lipid Type	Marital Status	Time in NZ	Total
MALE												
Nonmigrant	SBP	1.6	1.0		2.3*	0.1	3.5**			1.1		9.5**
	DBP	12.2	2.9*		0.4	0.0	3.1**			0.5		19.1**
Migrant	SBP	2.0	4.7**		0.0	0.4	3.5**			0.1	1.2	11.9**
	DBP	0.3	8.0**		0.0	0.1	3.6**			0.1	5.9**	18.0**
FEMALE												
Nonmigrant	SBP	1.1	0.3	5.8**			9.8**	0.4	0.2	3.6**		21.7**
	DBP	3.4	2.1*	2.2*			9.5**	0.7	0.0	0.8		18.7**
Migrant	SBP	3.5	0.2	13.9**			5.3**	0.9	1.9*	0.4	0.2	26.8**
	DBP	3.2	0.1	10.3**			3.1**	0.7	2.1**	0.0	1.1	20.6**

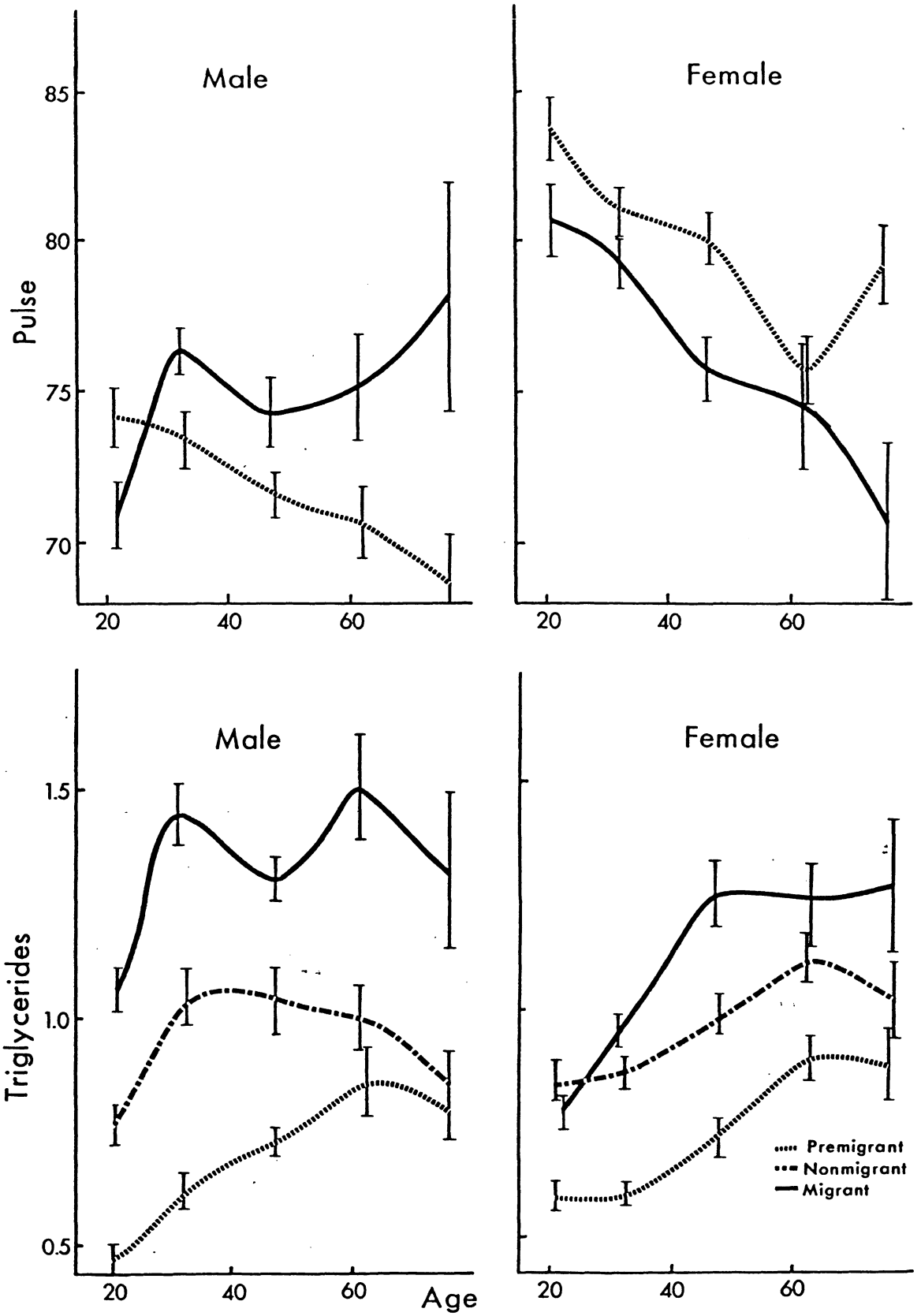

Fig. 1. Plots of pulse and serum triglycerides (mm/l) with age. For pulse, there is no significant difference between premigrants and nonmigrants.

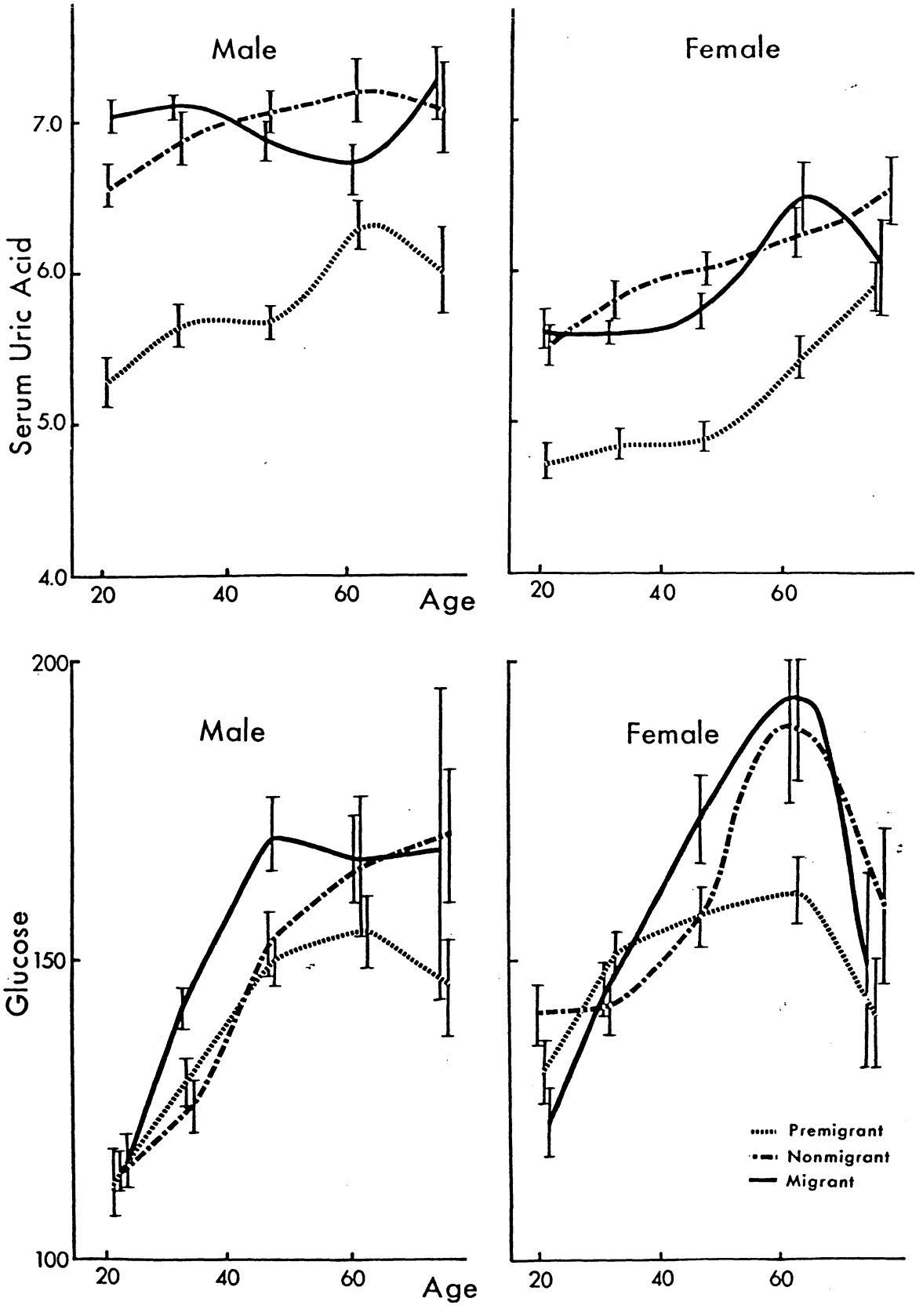

Fig. 2. Plots of serum uric acid (mg/100ml) and plasma glucose (mg%) with age.

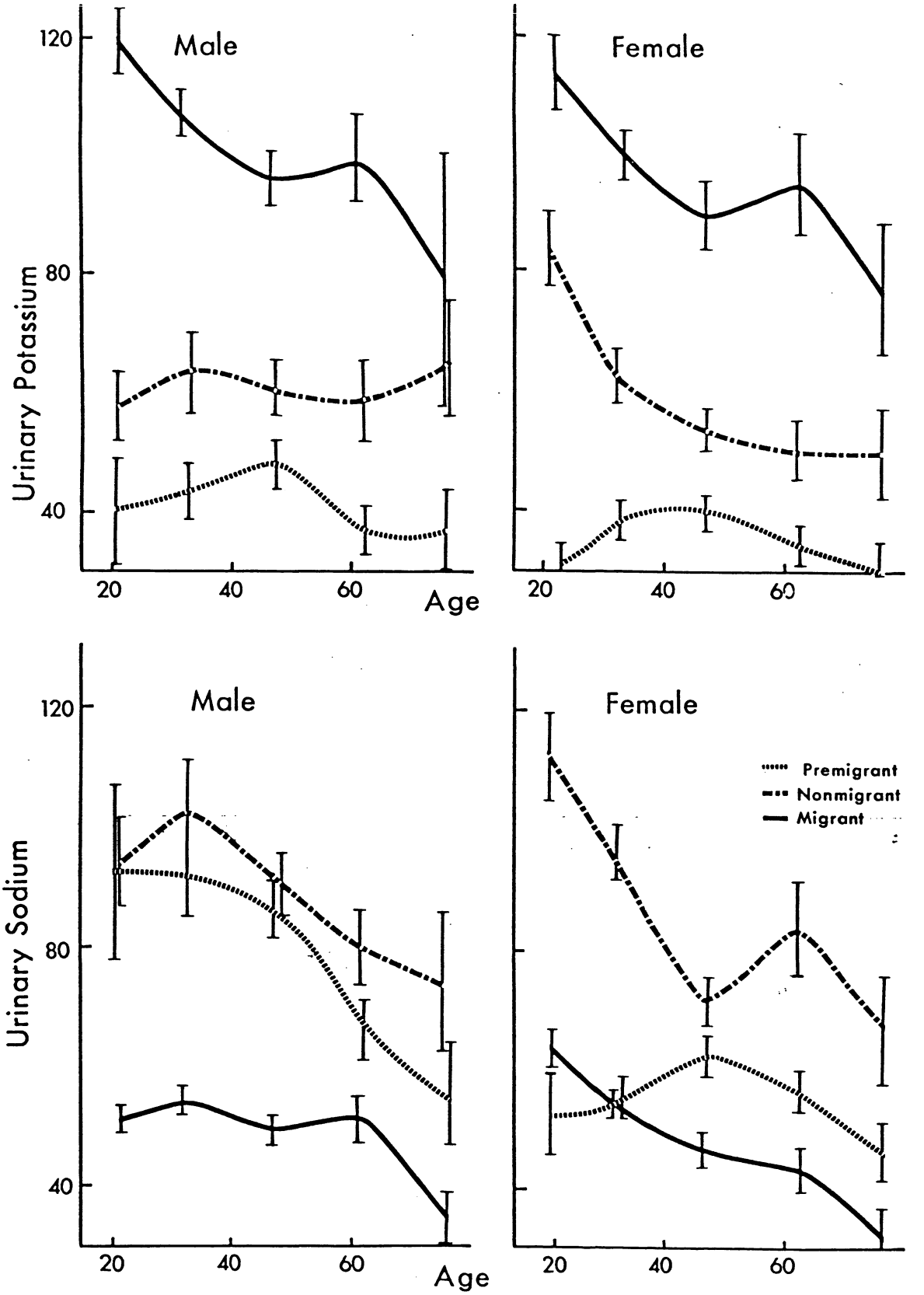

Fig. 3. Plots of urinary potassium (mEq) and urinary sodium (mEq) with age.

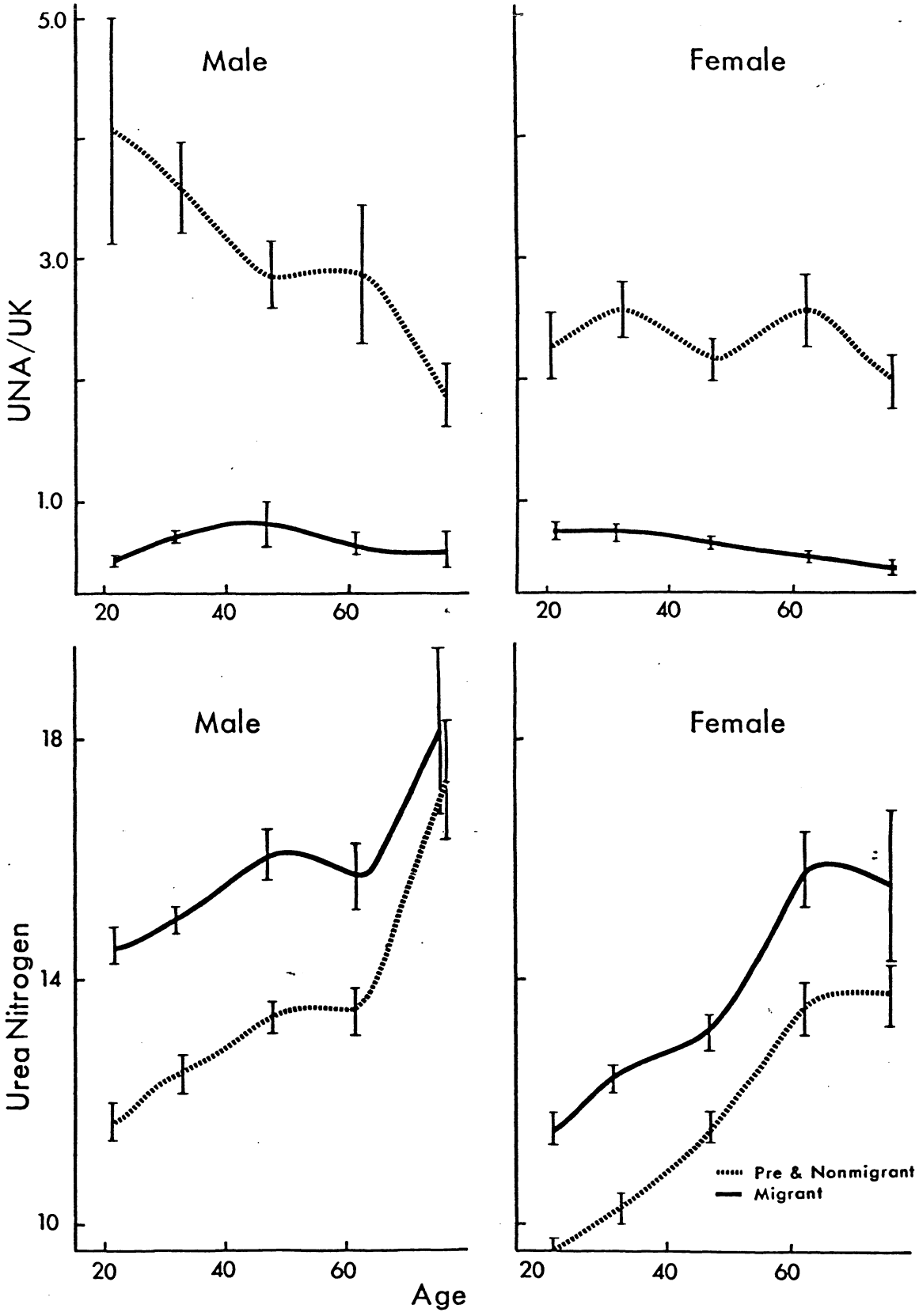

Fig. 4. Plots of ratio of urinary sodium to urinary potassium and urea nitrogen (mg%) with age. There is no significant difference between premigrants and migrants for these variables.