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Hypertension among adults of the Purari delta of the Gulf Province, Papua New Guinea

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SUMMARY

This study, carried out in 1995, found evidence of high blood pressure in a rural population in the Gulf Province of Papua New Guinea. Although the prevalence of obesity as assessed by the body mass index has increased since 1980, blood pressure was not associated with height or weight. Rather, it was associated with fat patterning: increased truncal fatness was associated with greater systolic blood pressure in both males and females. Of the modernization variables examined, the only one associated with blood pressure was type of income, and this for systolic blood pressure among females only. Body mass index was also associated with type of income, this being greatest among the small number of adults with some form of paid employment. Blood pressure showed no association with age, thus conforming to the hypertension pattern seen at early stages of modernization.

Introduction

Although early epidemiological surveys carried out in Papua New Guinea showed adults in rural areas to have universally low blood pressures (1) which failed to rise with advancing age (2-4), urban communities with longer periods of European contact such as Hanuabada showed blood pressures which rose with age (5), while modernizing populations such as the Chimbu in the 1950s showed a greater proportion of younger adults to be hypertensive than older ones (6). More recently, Schall (7) showed the blood pressure of Manus Island males to be greater among urban than rural dwellers, with no such difference for females. While modernization has been cited as one of the major factors associated with this increase in males, factors other than diet and body fatness have not been considered. In this study, the blood pressure of adults in the Purari delta of the Gulf Province is reported and related to body fatness, dietary change and modernization variables including economic status and education.

Methods

The Baroi of the Purari delta have traditionally cultivated palm sago, primarily for subsistence, but also for a limited amount of trade (8). They occupy a land mass of about 380 km^2, of which about 50% has been deemed by them to be suitable for the cultivation of sago palms (9). Their subsistence economy is based on sago, which is cultivated, and fishing, with the growing of root and tree crops being subsidiary activities. In 1980, sago starch supplied 43% of the total dietary energy intake, with sweet potato, taro, fish, coconuts and a variety of other cultivated and hunted and gathered foods supplying the rest (10). Although the idea of trade was with the Baroi before European contact (8) it has not been until more recently that they have undertaken any sort of modernization.

An opportunity sample of 103 individuals of a total population of 334 people above the age of 18 years in Koravake village was obtained during August 1995. Weight, height, arm

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circumference and skinfold thicknesses (biceps, triceps, subscapular, suprailiac, midaxillary, abdominal, forearm and thigh) were measured using standard methods (11,12), and blood pressure was measured in a lying position after 15 minutes rest. Nutritional status was assessed using the body mass index (BMI), arm circumference and triceps skinfold. The BMI was obtained by dividing weight, in kilograms, by height, in metres, squared. Ages were obtained from the village census book by the village census officer. A BMI of 18.5 was used to identify undernourished individuals (13) and 25 to identify obese ones (14). Arm circumference and triceps skinfolds were compared with Frisancho (15) reference values, and cut-offs of a z-score of -1 to identify undernutrition and +1 to identify overnutrition were used. For the blood pressure measurements, cut-offs of 140 mmHg (systolic) and 90 mmHg (diastolic) were used to define hypertension.

Lifestyle questions were identified after discussing important aspects of tradition, change and modernization in this community. These were formalized into the questionnaire format, which was used after pre-testing. Questions included any and most common sources of income, the extent and type of education received, and the extent of urban living, in years. Household food consumption was determined by a short survey of all households. The aim was to determine whether patterns of consumption had changed since 1980, and the method used was identical to the one which I had used in this community at that time. A list of food categories was read out, and the head of the household declared whether or not that food had been consumed by household members during the previous day. This gave an estimate of foods eaten within the household, but not of individual intakes, nor of quantities eaten. Statistical analysis was carried out using the Statistical Package for the Social Sciences for Portable Computer (SPSS PC+). Fisher's exact probability test, analysis of variance and multiple regression analyses were carried out as appropriate.

Results

Table 1 compares the anthropometric status of adults measured in 1995 with similar measurements made in 1980. Whereas mild obesity occurred in only one individual measured in 1980, in the 1995 survey mild obesity was common, with two women

TABLE 1

BODY MASS INDEX, ARM CIRCUMFERENCE AND TRICEPS SKINFOLD OF ADULTS

	1995				1980			
	Males n=53		Females n=50		Males n=27		Females n=24	
	n	%	n	%	n	%	n	%
Body mass index								
<18.5	4	8%	11	22%	7	26%	7	29%
18.5-25	40	75%	32	64%	20	74%	16	67%
>25	9	17%	7	14%	0	0%	1	4%
Arm circumference								
<-1z	1	2%	5	10%	5	18%	5	21%
-1z to +1z	47	89%	39	78%	21	78%	19	79%
>+1z	5	9%	6	12%	1	4%	0	0%
Triceps skinfold								
<-1z	6	11%	8	16%	11	41%	8	33%
-1z to +1z	43	81%	36	72%	16	59%	16	67%
>+1z	4	8%	6	12%	0	0%	0	0%

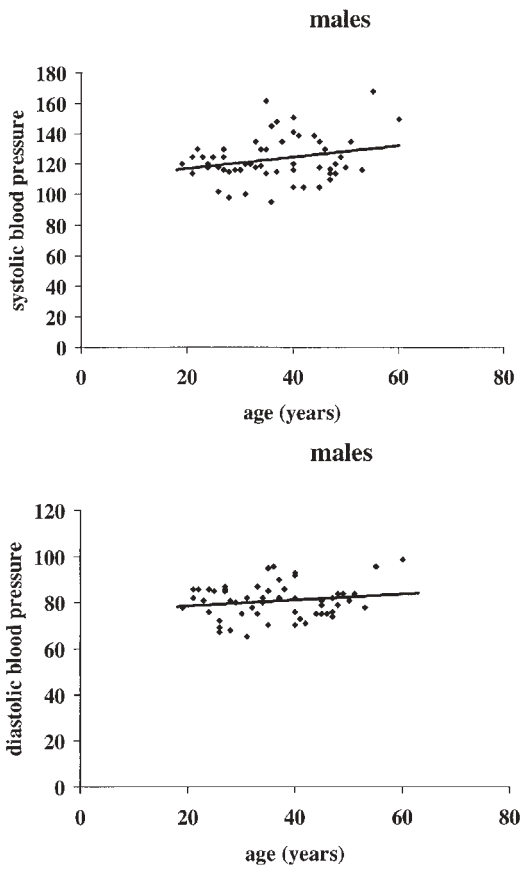

Figure 1. Blood pressure against age: systolic and diastolic blood pressures of males.

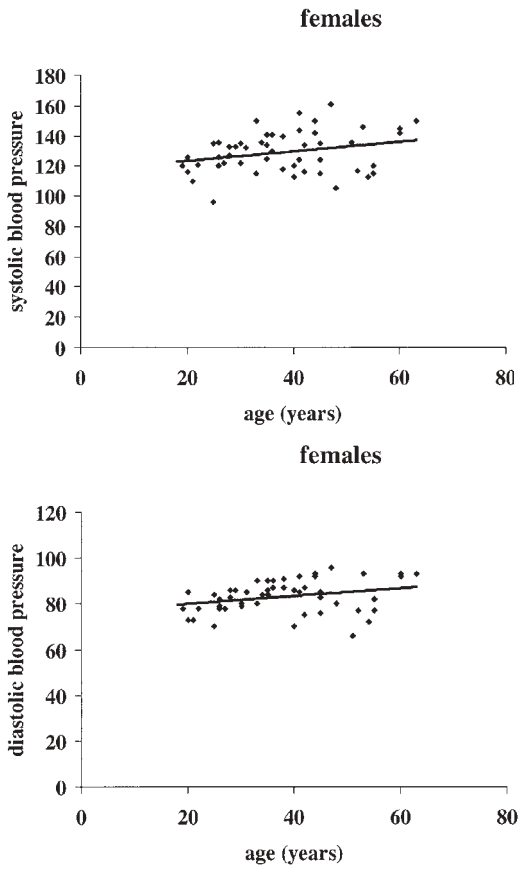

Figure 2. Blood pressure against age: systolic and diastolic blood pressures of females.

showing moderate obesity (BMI>30). In the 1995 survey, low BMI was more common among women than men, although not significantly so. In both sexes there was a greater proportion of the sample with BMI>25 than in 1980, but only significantly so among males (Fisher exact probability test, $p<0.01$). The proportion of males with low arm circumference and triceps skinfold was smaller in 1995 than in 1980 (arm circumference: Fisher exact probability test, $p<0.01$; triceps skinfold: Fisher exact probability test, $p<0.01$). The distribution of BMI across the chosen cut-offs was mirrored by that for triceps skinfold. However, arm circumference distributions across the chosen cut-offs differed, with a lower proportion below the lower cut-off. This suggests that any given value of BMI is associated with greater muscularity and leanness than in the western populations upon which anthropometric reference values are based. Figures 1 and 2 show systolic and diastolic blood pressures by age for males and females respectively. There is a slight, but nonsignificant trend to increasing blood pressure with age for both males and females. Table 2 shows the percentage of adults hypertensive (blood pressure above 140/90 mmHg) in 1995. Although more females (26%) than males (13%) appeared to be moderately hypertensive, the sample size was too small to achieve statistical significance. Two males and one female fell into the definitely hypertensive category - blood pressure being greater than 160/90 (16).

Table 3 shows the proportion of households having consumed different foods and food categories at least once during the previous day, in 1980 and in 1995. Sago firmly remains the staple food, but increased diversity of the

diet is reflected in the greater percentage of households eating crab, prawns, molluscs, fish, green leaves and bananas. However, the increased consumption of western store foods also contributes to this diversity. In the 1980 survey, none of the respondents reported having eaten tinned fish or meat during the previous day. In the 1995 survey, 38% of households reported having eaten these foods in the previous day. Consumption of sugar and rice has also increased enormously. Also associated with blood pressure is whether or not adults have ways in which they can earn money.

Table 4 shows mean weight, height, BMI and systolic and diastolic blood pressure according to whether or not individuals are engaged in a village-based cash enterprise (selling garden foods or betelnut at the market, or selling fish,

TABLE 2

PROPORTION OF ADULTS WITH HYPERTENSION (BLOOD PRESSURE ABOVE 140/90 MMHG)

	Number	% hypertensive
Men		
18-44 years	38	15.8
45 years and older	15	6.7
Total	53	13.2
Women		
18-44 years	31	22.6
45 years and older	19	31.6
Total	50	26.0

TABLE 3

HOUSEHOLD FOOD CONSUMPTION: PROPORTION OF HOUSEHOLDS IN WHICH DIFFERENT FOODS WERE EATEN ON THE PREVIOUS DAY

	1995	1980
Number of households:	47	41
Food		
Sago	100%	100%
Coconut	94%	90%
Banana	74%	46%
Crab, prawns, molluscs	64%	37%
Green leaves	85%	32%
Fish	85%	29%
Cassava	30%	27%
Sugar	70%	39%
Rice	40%	5%
Tinned fish or meat	38%	0%

TABLE 4

AGE, WEIGHT, HEIGHT, BODY MASS INDEX AND BLOOD PRESSURE OF ADULTS ACCORDING TO TYPE OF INCOME

Primary income		Number	Age (years)	Weight (kg)	Height (cm)	BMI	Blood pressure (mmHg) Systolic	Diastolic
Males								
None	Mean	7	46.6	49.6	162.7	18.7	132	91
	(SD)		(18.2)	(8.2)	(6.3)	(2.9)	(31)	(23)
From sale of any combination of: food at market, fish, betelnut, logs, cash crops	Mean	42	34.9	62.4	166.3	22.5	125	86
	(SD)		(11.8)	(8.7)	(5.6)	(2.6)	(13)	(15)
Paid employment or trade store	Mean	4	45.2	68.0	171.6	23.1	128	88
	(SD)		(16.1)	(7.6)	(5.5)	(1.8)	(12)	(13)
One-way analysis of variance	F			8.1	3.2	6.7	0.6	0.3
	p			<0.001	<0.05	<0.01	ns	ns
Females								
None	Mean	4	63.5	37.6	147.9	17.2	119	81
	(SD)		(6.0)	(3.1)	(6.0)	(0.5)	(16)	(20)
From sale of any combination of: food at market, fish, betelnut, logs, cash crops	Mean	42	35.9	51.2	153.6	21.6	124	85
	(SD)		(14.4)	(8.7)	(5.2)	(3.2)	(14)	(13)
Paid employment or trade store	Mean	4	32.8	63.8	157.2	25.8	141	100
	(SD)		(11.8)	(9.5)	(2.5)	(3.9)	(12)	(4)
One-way analysis of variance	F			9.1	3.4	7.5	3.1	2.7
	p			<0.001	<0.05	<0.01	=0.05	=0.08

SD = standard deviation
ns = not statistically significant

logs or cash crops) or are in paid employment or run a trade store with significant turn-over. For both males and females, those who do not have a source of income are lighter, shorter and have lower BMI than those who do have some source of income. The shorter stature of those without any source of income is associated with age in females, but not in males, and is unlikely to be due to recent modernization. The vast majority of individuals are engaged in the sale of foods, logs or cash crops. The minority with either no source of income, or with paid employment, represent extremes of advantage in this community, such that the most poorly nourished are thinner but also shorter, while the most employable individuals are taller than average. There is no difference in systolic and diastolic blood pressure across income categories for the men, while for the women the lower blood pressure of those with no source of income approaches significance.

Three different multiple regression models were applied to the data, relating blood pressure to: 1) modernization variables; 2) anthropometry; and 3) fat patterning. Variables considered in the modernization model were age, duration of education and number of years of town and/or city life. Variables considered in the anthropometry model were age, height and weight. Variables considered in the fat patterning model were age, and biceps, triceps, subscapular, suprailiac, midaxillary, abdominal, forearm and thigh skinfolds. Blood pressure shows no relationships with education or number of years spent living in urban centres, nor with weight and height. However, systolic blood pressure is associated with truncal deposition of fatness in both males (subscapular skinfold, $p=0.02$) and females (subscapular, suprailiac, both $p<0.001$), while diastolic blood pressure is not associated with any of the fatness variables considered. Blood pressure variables show no association with age.

Discussion

Modernization is taking place in many parts of Papua New Guinea, resulting in improved nutritional status in some populations (17) and raised blood pressure in others (7). What is striking about the results of this survey is that there are clear signs that the disorders associated with modernization, obesity and hypertension, are already present in rural Gulf Province. This is probably associated with the dietary change which has taken place over the last 15 years, in which not only has the range of traditional foods eaten increased, but also the extent to which western store foods are consumed. The ability to obtain money by various sources including the sale of foods at market, fishing, logging and cash-cropping has been important in raising people's standard of living, a health-related consequence of this being increased body fatness and hypertension. It is possible that some of the hypertension seen in women may be linked to patterns of employment associated with obtaining cash income, and the use of that income, including quantities of western store foods.

The lack of age dependency of hypertension is similar to that seen among the Chimbu population in the 1950s, at the time of early modernization. Interestingly, blood pressure is not associated with either education or time spent in towns or cities, but it may be that the proportion of the population having lived in urban centres is too small to show any significant relationships with blood pressure. The lack of relationship with education might suggest an informed use of foods that are publicized by the Health Department as being healthy, but this is conjecture.

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