primary care research. The task of the 1980s is to refine and expand some of these research tools, to facilitate collaboration between investigators, and to uncover new information about those areas that define this new specialty.

References

1. World Health Organization: Manual of the international statistical classification of diseases, injuries, and causes of death. Geneva, 1967.
2. World Organization of National Colleges, Academies, and Academic Association of General Practitioners/Family Physicians (WONCA): An international glossary for primary care. J Fam Pract 13: 671-681 (1981).
3. World Organization of National Colleges, Academies, and Academic Associations of General Practitioners/Family Physicians (WONCA): Report of the classification committee. Oxford University Press, London, England, 1979.
4. North American Primary Care Research Group: NAPCRG-1: process code for primary care: international field trial version developed by the ad hoc committee for process coding. Richmond, Va., 1981.
5. National Center for Health Statistics: The National Ambulatory Medical Care Survey: sympton classification. DHEW Publication No. (HRA) 75-1337. Hyattsville, Md., 1974.
6. National Center for Health Statistics: The National Ambulatory Medical Survey: 1973. DHEW Publication No. (HRA) 76-1772. Hyattsville, Md., 1975.
7. Schneider, D., Appleton, L., and McLemore, T.: A reason for visit classification for ambulatory care. Vital and Health Statistics, Series 2, No. 78. DHEW Publication No. (PHS) 79-1352. National Center for Health Statistics, Hyattsville, Md., February 1979.
8. World Health Organization: Reason for contact with primary health care services: a model classification. Preliminary report of a World Health Organization working party. Geneva, Sept. 12, 1980.
9. World Health Organization: Ninth revision, international classification of diseases. Manual of the international statistical classification of diseases, injuries, and causes of death. Geneva, 1977.
10. World Organization of National Colleges, Academies, and Academic Associations of General Practitioners/Family Physicians (WONCA): ICHPPC-2 defined: international classification of health problems in primary care, third edition. Prepared by the classification committee. Oxford University Press, Oxford, England, 1983.
11. Finkel, A. J., et al., editors: Physicians' current procedural terminology. American Medical Association, Chicago, 1977, 4th ed.
12. World Health Organization: International classification of impairments, disabilities, and handicaps. A manual of classification relating to the consequences of disease. Geneva, Switzerland, 1980.
13. National Center for Health Statistics: Clearinghouse on health indexes: bibliography on health indexes. Office of Health Research, Statistics and Technology. Hyattsville, Md., 1983, issue 1.

Blood Pressure and Heart Rate Changes in Children When They Read Aloud in School

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SYNOPSIS

The 52 children in the study were recruited from two fifth grade classes in Baltimore city. The blood pressures and heart rates were recorded both at rest and while they read aloud in a classroom setting. A computerized monitoring system was used to measure blood pressures.

Rapid and highly significant increases in blood pressure and heart rate were observed when the children read aloud. A total of 84 measurements of 312 systolic and diastolic readings were not within the 95th percentile of normal pressure for the child's age and sex.

The data indicate that a routine school task, that is, reading aloud, may have significant effects on the cardiovascular system. These findings are discussed in terms of previously unexamined links between certain childhood school experiences and potential problems with adult hypertension.

HYPERTENSION IS THE MOST PREVALENT cardiovascular disease in the United States today. At least one of seven living Americans will be diagnosed as hypertensive within his or her lifetime (*1*). The importance of blood pressure (BP) measurement in children and adolescents is becoming increasingly apparent (*2,3*). Research with adolescents has shown that elevated BP can have significant effects on mortality and morbidity (*4*), and the condition may be associated with race and socioeconomic status (*5,6*). A number of researchers have suggested a relationship between important psychosocial factors in children and blood pressure (*7–10*).

Links between years of schooling, a major determinant of psychosocial development and achievement throughout life, and BP are just beginning to be examined. Reviewing demographic data, Moriyama and coworkers found that the incidence of hypertension was almost three times higher in adults with less than 5 years of education than for those with at least 1 year of college (*11*). This effect was independent of race, sex, and income level. Thus it seems possible that decisions to drop out of school 30 to 40 years before the appearance of chronic hypertension were associated with increased risk of this disease. Unfortunately, there is little prospective data to help clarify this retrospective finding. Micozzi (*12*), however, recently reported a relationship between academic standing and blood pressure in students attending a private school in the Philippines. The school's classes were stratified according to academic performance. He found that hypertension was more frequent in students in the lower than those in the higher achievement classes. Micozzi implied that low academic standing caused emotional changes in children that led to elevations in blood pressure.

Our recent research has led us to suspect that there may be a direct link between the school environment and blood pressure that stems from a routine school task, namely, reading. Our suspicions are based upon a series of studies in which we observed major BP increases in response to reading or speaking aloud (*13–19*).

By using a recently available computerized monitoring system we observed that the simple act of speaking, or reading aloud, produces rapid and significant elevations in BP in both hypertensive and normotensive persons (*13–17*). In adults, the magnitude of pressure increases was directly linked to the rate of reading, with more rapid reading producing greater changes (*19*). Several other important variables were found to influence these changes. Of clinical interest is the significant positive correlation in adults between baseline pressure and the magnitude of increase during speech, with higher resting pressures associated with greater increases while speaking (*14,16*). Status differences also affected the magnitude of the increases. Subjects exposed to a higher status experimenter showed greater BP increases while speaking than those exposed to an equal status experimenter (*18*).

In a study of 38 children ranging in age from 9 to 16 years, we observed significant increases in blood pressure and heart rate (HR) while they read aloud (*15*). These data were collected in the relatively nonthreatening environment of an investigator's home. No attempt was made to stratify the children according to academic standing or demographic criteria such as age, race, and sex.

The present study was designed to increase our information about an additional factor affecting blood pressure in children that also may be involved in the development of hypertension. The cardiovascular effects of reading aloud were examined with respect to several variables implicated as determinants of hypertension: race, sex, age, obesity, speed of speech, and academic standing.

Methods

Subjects were recruited from two fifth grade classes at a Baltimore public school located in a racially mixed, inner city area. Each student was given a consent form to be signed by his or her parent or legal guardian, and only students who returned signed forms were permitted to participate in the study. Fifty-two fifth graders took part: 11 black males, 10 black females, 19 white males, and 12 white females. The average age was 10.1 years. To alleviate anxiety, the students were introduced to the study in a general classroom lecture about the heart, BP, and hypertension, during which the Dinamap 845 was demonstrated. This automated blood pressure device inflates at preset intervals and measures and records mean arterial, systolic, and diastolic BP and heart rate (*20,21*). The reliability of this device has been established via correlation with intra-arterial blood pressure recordings ($r = .98$). Calibration of the instrument used in this study was checked on the day of the study according to the manufacturer's standards.

The study was conducted in a corner of an open classroom. Students were called, two at a time, to a table at the back of the room. BP was measured automatically and recorded by one of three white, female investigators (S.T., C.P., and S.H.). Both students were seated and the Dinamap 845 was attached to one student's arm. One student was tested while the other observed the procedure. The setting was chosen to minimize any apprehension students might have, while still approximating as much as possible the usual classroom environment. The student was asked to rest quietly for the first 2 minutes, then read aloud from a class textbook for 2 minutes, softly enough so as not to disturb classmates, and then rest quietly again for 2 minutes. Systolic (SBP), diastolic (DBP), and mean arterial (MAP) blood pressures and HR were measured at 1-minute intervals for 6 minutes. The number of words read during the reading period was recorded. The text used for reading was an alternate social studies book used by other sections of the same grade level, but unfamiliar to these students.

At the conclusion of the series, the second student was tested while the first watched. Height and weight of each subject were measured with a standard upright scale and recorded after participation in the study, and a ponderal index (PI) was calculated. The IQs of the participants were subsequently obtained from school records.

Results

Average ponderal indices (in pounds per inch) and their standard deviations for each race-sex group are presented in table 1. A two-way analysis of variance for the effects of race and sex on PI was performed (table 2). The PI of blacks (1.56) was significantly higher than the PI of whites (1.40), and the PI of boys (1.52) was significantly higher than that of girls (1.39). There was not, however, a significant interaction between race and sex.

Table 3 presents mean blood pressure and heart rate levels for each race-sex group for each period.

Table 1. Average ponderal indices (weight to height) for each race–sex group

Race and sex	*Number*	*Ponderal index (lbs per inch)*	*SD*
Black males	11	1.69	.42
Black females	10	1.42	.22
White males	19	1.42	.27
White females	12	1.36	.16
Total	52	1.46	...

Table 2. Analysis of variance for effects of race and sex on ponderal index

Source	*Sum of squares*	*Degrees of freedom*	*Mean rquare*	*F value*
Sex	.34697	1	.34697	[1] 4.48
Race	.35608	1	.35608	[1] 4.50
Sex × race	.13156	1	.13156	1.70
Error	3.79829	49	...	...

[1] $P < .05$.

Table 3. Average blood pressure and heart rate level for each race–sex group during each period [1]

Cardiac measure	*Pre-reading rest*	*During reading*	*Post-reading rest*
Systolic blood pressure (mm Hg):			
Black males	125.3	132.2	121.6
Black females	117.4	118.2	112.8
White males	115.8	123.7	111.8
White females	116.8	124.4	114.1
Average	118.8	124.6	115.1
Diastolic blood pressure (mm Hg):			
Black males	71.8	85.3	70.6
Black females	68.6	73.4	65.0
White males	67.0	75.6	66.2
White females	69.6	77.9	65.2
Average	69.2	78.0	66.8
Mean arterial pressure (mm Hg):			
Black males	90.35	101.8	87.2
Black females	85.0	90.4	81.2
White males	82.5	91.4	83.9
White females	85.2	94.2	83.7
Average	85.76	94.4	84.0
Heart rate (beats per minute):			
Black males	91.8	101.0	91.6
Black females	80.1	91.2	82.4
White males	90.8	102.4	94.0
White females	88.75	96.6	88.6
Average	87.9	97.8	89.2

[1] Each period is the average of 2 measurements per subject.

In all cases, BP and HR were higher during the reading period than during the two (pre- and post-reading) resting periods.

A $2 \times 2 \times 3 \times 2$ analysis of covariance with repeated measures was used to examine the significance of the differences in MAP between the two sexes, the two races, the three periods (rest, read, rest), and the 2 minutes within each period. The first two factors are grouping variables and the second two are repeated measures. Thus, each subject is classified according to race and sex, and there are six measures of the cardiovascular variables for each subject: period 1 (rest prereading) minute 1 and minute 2; period 2 (during reading) minute 1 and minute 2; period 3 (rest postreading) minute 1 and minute 2. Parallel analyses for the three other

Table 4. Analysis of variance

Cardiac measure and source	*Sum of squares*	*df*	*Mean square*	*F*	*P<*
Systolic blood pressure (mm Hg):					
Race	0.4	1	0.4	.001	.98
Sex	77.5	1	77.5	.13	.72
Race × sex	1106.1	1	1106.1	1.86	.18
Covariate (ponderal index)	8505.9	1	8505.9	14.28	.001
Error	27993.3	47	595.6	...	...
Period	4531.3	2	2265.6	40.1	.001
Period × race	214.5	2	107.3	1.90	.16
Period × sex	177.2	2	88.6	1.57	.22
Period × race × sex	105.9	2	53.0	.94	.40
Minute	221.2	1	221.2	6.14	.02
	rc = 19.42				
Diastolic blood pressure (mm Hg):					
Race	14.2	1	14.2	.04	.84
Sex	.8	1	.8	.002	.96
Race × sex	496.5	1	496.5	1.42	.24
Covariate (ponderal index)	5223.7	1	5223.7	14.92	.001
Error	16450.8	47	350.0	...	...
Period	6890.6	2	3445.3	144.44	.001
Period × race	7.0	2	3.5	.15	.87
Period × sex	255.1	2	127.5	5.35	.006
Period × race × sex	231.8	2	165.9	6.95	.002
Minute	124.8	1	124.8	4.68	.04
	rc = 15.21				
Mean arterial pressure (mm Hg):					
Race	1.9	1	2.0	.005	.95
Sex	5.0	1	5.0	.01	.92
Race × sex	746.7	1	746.7	1.86	.18
Covariate (ponderal index)	5211.7	1	5211.7	12.97	.001
Error	18880.1	47	401.7	...	...
Period	6039.9	2	3019.9	73.9	.001
Period × race	170.5	2	85.2	2.08	.13
Period × sex	111.7	2	55.9	1.37	.26
Period × race × sex	238.8	2	119.4	2.92	.06
Minute	321.4	1	321.4	9.52	.003
Heart rate (beats per minute):					
Race	593.7	1	593.7	.80	.38
Sex	4427.8	1	4427.8	5.99	.02
Race × sex	811.3	1	811.3	1.10	.30
Covariate (ponderal index)	484.8	1	484.8	.66	.42
Error	34752.6	47			
Period	5749.9	2	2875.0	81.94	.001
Period × race	9.0	2	4.5	.13	.88
Period × sex	12.5	2	6.2	.18	.84
Period × race × sex	133.5	2	66.7	1.90	.16
Minute	35.2	1	35.2	1.84	.18
	rc = 0.000				

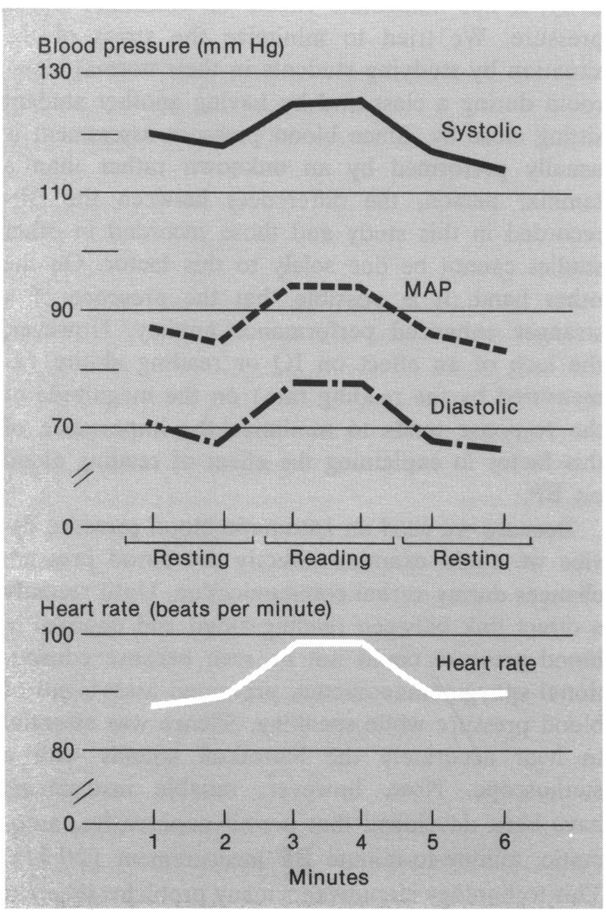
NOTE: rc = correlation of ponderal index with cardiac measure.

cardiovascular variables were performed. Since PI was significantly correlated with the three BP measurements ($P < .0001$), it was used as a covariate. Table 4 includes the analyses of covariance for MAP, SBP DBP, and HR.

When the effect of the three periods was examined, there were significant differences among the means for the three periods for all four measures ($P < .001$). Further examination with simple effects tests showed higher levels of MAP, SBP, DBP, and HR while reading aloud compared with both the pre- and postreading rest periods. There were not significant differences between the resting periods. SBP, DBP, and MAP in the first minute of the periods were significantly higher than in the second. Average BP and HR levels for each minute and period are shown in the chart.

With PI as a covariate, there were no significant differences between the races or the sexes for MAP, SBP, DBP, and HR. Furthermore, race and sex did not interact significantly for any of these measures.

Average systolic, diastolic, mean arterial pressures (MAP), and heart rate levels for each minute and period



Resting BP and HR and change in these measures from resting to reading were examined in relation to IQ. There were no significant correlations between IQ and any cardiac measure either at rest or reading (resting: MAP $r = .00$, SBP $r = -.05$, DBP $r = .01$, HR $r = .10$; reading: MAP $r = -.02$, SBP $r = -.01$, DBP $r = -.05$, HR $r = .14$). Additionally, words read per minute were not significantly correlated with MAP, SBP, DBP, or HR levels while reading. (MAP $r = -.10$, SBP $r = .19$, DBP $r = 0.02$, HR $r = -.05$).

A total of 312 systolic and diastolic BPs were recorded for the entire population, 6 on each of 52 children. According to normative criteria established by the National Heart, Lung, and Blood Institute's Task Force on Blood Pressure Control in Children (*2*), 84 measurements were not within the 95th percentile of normal pressure for the child's age and sex. The norms are for girls > 128/85 or < 90/55; for boys > 132/86 or < 90/56. Thirty-one of the diastolic and 53 of the systolic pressures were outside these ranges. Of the 77 measures that were found to be higher than standard criteria, 48 were observed during the 2 minutes of reading. The other 29 were observed during the 4 minutes of pre- and postreading periods. Seven diastolic measures were lower than the 95th percentile; all of these occurred in the pre- and postreading resting periods. As shown in table 5, a majority of the elevated systolic and diastolic blood pressures occurred in

Table 5. Number of blood pressure readings occurring outside the 95th percentile for age and sex of the child

Category and period	*Systolic*	*Diastolic*
Less than 95th percentile:		
Prereading rest	0	3
During reading	0	0
Postreading rest	0	4
1–10 mm Hg above 95th percentile:		
Prereading rest	6	2
During reading	16	13
Postreading rest	4	0
11–20 mm Hg above 95th percentile:		
Prereading rest	7	2
During reading	6	4
Postreading rest	1	1
21–30 mm Hg above 95th percentile:		
Prereading rest	3	0
During reading	8	1
Postreading rest	2	1
Subtotals above 95th percentile:		
Prereading rest	16	4
During reading	30	18
Postreading rest	7	2

the reading phase, indicating that reading aloud was accompanied by blood pressure elevations that could be considered significant.

Discussion

This study confirms and extends our previous observations that significant increases in BP and HR can occur in children when they read aloud. Both resting and reading BPs differed significantly between the race-sex groups. However, although black males tended to have higher BP, they also weighed more for a given height. Therefore, when ponderal index was controlled, differences between the races or sexes for either resting or reading BPs were not statistically significant. Our previous studies have shown a direct relationship between resting blood pressure and increases in blood pressure during reading (*14,16*). Thus, it is also not surprising that there were larger changes in BP in response to reading for the black males, whose resting BP was also higher than the other race-sex groups. Both the differences in raw BP measurements among the race-sex groups and the disappearance of these differences when indices of obesity are controlled are similar to those reported by Harris and coworkers (*22*).

BP and HR were not correlated with the child's IQ or reading speed, a measure of reading ability. One reason for the lack of correlation may be the low variance in words per minute achieved by these students. The mean number of words per minute observed was 186.3, with a standard deviation of 45.3. In other studies, we have seen that rapid reading leads to significantly greater increases in BP than slower reading (*19*), and thus reading speed would not appear to have significant influence on the overall effects observed in this study.

Although the lack of a correlation between IQ and BP seems to be at variance with Micozzi's study, the two investigations are not directly comparable. Micozzi examined the frequency of hypertension among students in several classes that were stratified according to academic performance, but he did not relate individual performance to BPs in these classes. In contrast, we studied fifth graders of varying IQ and reading ability in two classes. Micozzi defined hypertension as pressure above the 90th percentile for sex and age among the 1,340 students studied. Thus, by definition 134 students were classified as hypertensive for DBP and the same number for SBP. In our study we did not identify hypertensive children; rather, we examined correlations between BP and IQ.

We recorded a total of 312 measures of both systolic and diastolic pressures. Fifty-three systolic and 31 diastolic were outside the 95th percentile standards of the National Heart, Lung, and Blood Institute's criteria for children of comparable race-sex and age groups. A significant majority of these extreme deviations were recorded during reading. The NHLBI's normative criteria were established by assessing blood pressure in children while they were quiet and at rest. The criteria cannot be directly compared with the pressures observed in this study, but such standards help to assess the overall impact of the school setting and the effect of a reading task on blood pressure. Some of the readings we observed were extraordinarily high. For example, one student had an average resting BP of 169/105, which increased to a reading BP of 174/126, and a second student had a resting BP of 140/86 and a reading pressure of 156/102. This suggests that there may be an important link between a routine school task, such as reading, and BP levels previously considered clinically significant. For students with high resting BP levels, reading out loud will lead to further increases.

Although reading aloud is a routine school activity, it has immediate effects on children's blood pressure. We tried to minimize the stress of the situation by studying students in their normal classroom during a class and by having another student sitting close by. Since blood pressure assessment is usually performed by an unknown rather than a familiar person, the differences between the BPs recorded in this study and those recorded in other studies cannot be due solely to this factor. On the other hand, it is possible that the presence of a stranger enhanced performance anxiety. However, the lack of an effect on IQ or reading ability (as measured by the reading rate) on the magnitude of the response tends to minimize the importance of this factor in explaining the effect of reading aloud on BP.

Because we used an automatic blood pressure device we could examine directly the blood pressure changes during verbal communication. Until recently a direct link between reading aloud and changes in blood pressure could not be seen because conventional sphygmomanometers prevented assessment of blood pressure while speaking. Silence was essential to hear accurately the Korotkoff sounds with a stethoscope. Now, however, reliable instruments have been developed that permit noninvasive, automatic, minute-to-minute BP measurement (*20,21*). This technology circumvents many problems inherent in previous recording techniques, and it allows regular, periodic recording of BP and HR during speech.

In comparing the resting levels of BP in this study with those obtained in a recent study in which another automated BP monitor was used, it is interesting to note that our BP data were considerably higher for both races and sexes. The average BPs of 10-year-olds in the Los Angeles basin reported by Harris and co-workers (*22*) follow:

Cardiac measure	*Blacks*	*Whites*
Boys		
Systolic blood pressure	105.2	104.4
Diastolic blood pressure	67.7	63.8
Girls		
Systolic blood pressure	105.4	104.7
Diastolic blood pressure	65.9	64.4

It is not clear why there are such large differences in the SBPs between those we obtained in Baltimore and those Harris and coworkers recorded. At least four hypotheses could help to explain these differences. The higher resting BPs recorded in Baltimore may be a consequence of differences between the recording devices, the effects of the urban setting, the classroom environment itself, or the social strata of the children in the sample. Our population came from a racially mixed, blue-collar urban area. The social strata of the California population was not described. Differences in the experimental milieu itself may also account for the higher rates. We recorded blood pressure in the classroom itself, while in the California study BP was recorded in a separate room within the school. It may be that these nonspecific characteristics of blood pressure assessment have important effects on resting blood pressure that have not been previously recognized.

Our data indicate that reading aloud has important cardiovascular effects both in and out of the classroom. In a previous study of an adult population, we examined the effects of reading aloud and reading silently; only reading aloud produced major BP changes. This observation indicates that cardiac changes in adults are due to mediating variables other than the cognitive demands of reading (*19*). This issue needs further elucidation in children.

BP is often given insufficient consideration in both medical and behavioral studies of children. The data from the present study suggest that much more needs to be known about baseline BP and about changes during routine educational tasks required of children. In that sense the data presented in this study suggest a new conceptual path for examining psychophysiological correlates of some routine aspects of educational practice. Based upon these data we suggest that a routine school task, reading aloud, has stronger effects on the cardiovascular system than has been heretofore recognized. Specific educational strategies should be investigated to evaluate their relative effects on the cardiovascular system. Certainly the differential effects on the cardiovascular system of reading in different situations to teachers, classmates, and other audiences requires careful investigation.

References

1. U.S. Department of Health, Education, and Welfare: Fact sheet. National High Blood Pressure Education Program, DHEW Publication No. (NIH) 76–632, Washington, D.C., 1976.
2. Report of the task force on blood pressure control in children. Pediatrics 59 (suppl.): 797–820 (1977).
3. McLain, L. G.: Hypertension in childhood: a review. Am Heart J 92: 634–647 (1976).
4. Heyden, S., Bartel, A. G., Hames, C. G., and McDonough, S. R. Elevated blood pressure levels in adolescents, Evans County, Georgia. JAMA 209: 1683–1689 (1969).
5. Langford, H. G., Watson, R. L., and Douglas, B. H.: Factors affecting blood pressure in population groups. Trans Assoc Am Physicians 81: 135–146 (1968).
6. Kotchen, J. M., Kotchen, T. A., Schwertman, N. C., and Kuller, L. H.: Blood pressure distributions of urban adolescents. J Epidemiol 99: 315–324 (1974).
7. Buck, C., and Stenn, P.: Personality factors and blood pressure in children. J Psychosom Res 23: 13–15 (1979).
8. Insel, P., Fraser, G., Phillips, R., and Williams, P.: Psychosocial factors and blood pressure in children. J Psychosom Res 25: 505–511 (1981).
9. Kron, J. M., et al.: Personality and casual blood pressure in school age children. J Psychosom Res 24: 75–77 (1980).
10. Lawler, K. A., Allen, M. T., and Critcher, E. C.: Standard responses to the coronary prone behavior pattern in children. J Behav Med 4: 203–215 (1981).
11. Moriyama, I. M., Krueger, D. E., and Stamler, J.: Cardiovascular diseases in the United States. Vital and Health Statistics Monographs, Harvard University Press, Cambridge, Mass. 1971.
12. Micozzi, M. S.: Childhood hypertension and academic standings in the Philippines. Am J Public Health 70: 530–532 (1980).
13. Lynch, J. J., et al.: Human speech and blood pressure. J Nerv Ment Dis 168: 526–534 (1980).
14. Lynch, J. J., et al.: The effects of talking on blood pressure of hypertensive and normotensive individuals. Psychosom Med 43: 25–33 (1981).
15. Lynch, J. J., et al.: Blood pressure changes while talking. Israeli J Med Sci 18: 575–579 (1982).
16. Lynch, J. J., et al.: Interpersonal aspects of blood pressure control. J Nerv Ment Dis 170: 143–153 (1982).

17. Malinow, K. L., et al.: Automated blood pressure recording: the phenomenon of blood pressure elevation during speech. Angiology 33: 474–479 (1982).
18. Long, J. M., et al.: The effect of status on blood pressure during verbal communication. J Behav Med 5: 165–172 (1982).
19. Friedmann, E., et al.: The effects of normal and rapid speech on blood pressure. Psychosom Med 44: 545–553 (1982).
20. Ramsey, M.: Noninvasive automatic determination of mean arterial pressure. Med Biol Eng Comput 17: 11–18 (1979).
21. Yelderman, M., and Ream, A. D.: Indirect measurement of mean blood pressure in the anesthetized patient. Anesthesiology 50: 253–256 (1979).
22. Harris, R. D., et al.: The child-adolescent blood pressure study: 1. Distribution of blood pressure levels in Seventh-Day Adventist (SDA) and non-SDA children. Am J Public Health 71: 1342–1349 (1981).

Factors Affecting the Use of Surgical Physician Assistants

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SYNOPSIS

The actual use of surgical physician assistants in 1979 and the expected use of them in 1984 by 552 general hospitals in the United States with 400 or more beds was assessed by means of a questionnaire mailed to the hospitals' surgical department chairmen. The influence of geographic and institutional variables upon this use was determined by multiple regression analysis.

The most important determinants of actual use were the complexity of surgical care in the institution and its geographic location. Institutions with more complex surgical care and those located outside of the West were more likely to have used surgical physician assistants in 1979. Important determinants of the expected use of surgical physician assistants in 1984 appeared to be the complexity of surgical care and the degree of reliance upon foreign medical graduates (FMGs) in the surgical housestaff training program within the institution. Those surgical department chairmen in hospitals with a greater concentration of FMGs on their surgical housestaffs in 1979 anticipated a greater future role for surgical physician assistants.

THE DEVELOPMENT OF THE PHYSICIAN ASSISTANT profession in the United States during the past 15 years received its major impetus from the shortage of physicians in primary care in rural areas (*1*). Now major U.S. medical institutions are increasingly using physician assistants in the care of surgical patients (*2–4*). Because it is generally accepted that the present supply of surgeons is adequate, or possibly even in excess of needs, and since the projected supply also appears to be more than adequate (*5–7*), interest is growing in exploring alternative approaches for meeting the continually growing need for surgical housestaff manpower to help deliver care in teaching centers. This is a need that has become more severe as the complexity and intensity of surgical patient care in major referral centers has increased. Furthermore, because the future supply of foreign medical graduates (FMGs), who account for 24 percent of all surgical housestaff, is uncertain at best, interest is growing in the use of the surgical physician assistant to reduce the reliance upon FMGs (*8*).

To obtain a better understanding of these trends, a national survey of surgical departments in major U.S. hospitals was undertaken (*9*). In this survey, 774 surgical physician assistants were identified in 165 of the 552 hospitals with 400 beds or more participating in the study. The surgical department