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Prevalence of elevated blood pressure in students attending a college oral health program

Physical evaluation of dental patients prior to treatment can reveal signs and symptoms of diagnosed and undiagnosed disease. This cross-sectional study examined the prevalence of elevated blood pressure readings in a group of college students attending an annual oral health program. The data were collected at the annual session on one day in three consecutive years. While the risk of hypertension increases with age, unless the blood pressure is recorded in all adult patients, a significant number of occult high blood pressure readings may go undetected. Since untreated hypertension can cause morbidity and mortality in some patients, the recording of the blood pressure for all adult patients is indicated. The results of this study revealed that 56 of 416 (13.4%) college students with recorded blood pressure values had elevated blood pressure readings within the ranges of mild to severe elevations. Male gender was associated with elevated readings (x^2 = 18.57, $p < 0.001$). Self-reported high blood pressure was associated with age differences, current care by a physician, and medication use. Routine recording of blood pressure is essential for the comprehensive evaluation of adult dental patients, regardless of age. Inconsistent application of physical evaluation principles based on age and disease-related abnormalities may exclude younger individuals at risk for occult disease and associated morbidity. Screening for blood pressure elevation, even in younger adult groups not usually associated with hypertensive disease, can identify individuals needing further medical evaluation.

Physical evaluation of dental patients is a critical first step in the preparation for dental treatment. Signs and symptoms of medical illnesses can have an impact on oral health, dental treatment, and medications used in dental care, as well as on the patient's ability to withstand dental procedures. Modifications to dental treatment are often necessary for individuals with medical complications. Efficacious treatment of dental patients therefore requires that many sources of patient health information be synthesized so that quality care can be achieved.

Previously diagnosed medical conditions and obvious symptoms of recognizable disease are easily documented. However, careful initial physical evaluation of dental patients may reveal important signs of undiagnosed medical diseases. Recognition of these signs and symptoms should lead to a physician referral for definitive diagnosis and treatment prior to dental care. These measures can decrease the chance of medical emergencies during dental care.[1,2]

As the population of dental patients ages, so does the likelihood of chronic disease, numbers of medications, and medical frailty. However, medical illnesses requiring treatment and dental care modification are present in younger patients as well. It is therefore imperative that all dental patients have a complete physical evaluation prior to dental treatment.[1,2] Use of screening procedures can easily identify patients at risk for systemic illnesses such as hypertension.

Hypertension is one of the most common chronic conditions of adulthood. Hypertension can be characterized by isolated elevation of either diastolic or systolic pressure, or both. Blood pressure represents the force of arterial blood flow against the arterial wall. Five factors determine blood pressure: cardiac output, peripheral vascular resistance, total blood volume, blood viscosity, and arterial wall compliance.[3] Cardiac output and peripheral vascular resistance are the most important factors affecting blood pressure.

Longstanding elevations above normal in either diastolic or systolic pressure, or both, can contribute to significant morbidity and mortality. The majority of individuals with elevated blood pressure values have essential hypertension which is of unknown etiology.[4,5] Essential hypertension can lead to cardiovascular disease and increased risk of death. Spontaneous cerebral vascular accident, myocardial infarction, left ventricular hypertrophy, and renal disease are consequences of untreated hypertension.[6] Approximately 5% of patients have elevated blood pressure levels that are related to other medical conditions.

In 1993, the Fifth Joint National Committee Report classified ranges of normal and elevated blood pressure according to both diastolic and systolic values.[7] Table 1 outlines the stages of hypertension.

In a national study of blood pressure in the US from 1976-80, the National Health and Nutrition Examination Survey (NHANES II), it was estimated that 25.1 million non-

Table 1. Adult Blood Pressure Classification.*

Category	Systolic (mm Hg)	Diastolic (mm Hg)
Normal	less than 130	less than 85
High normal	130-139	85-89
Hypertension		
Stage I (mild)	140-159	90-99
Stage II (moderate)	160-179	100-109
Stage III (severe)	180-209	110-119
Stage IV (v. severe)	≥ 210	≥ 120

*Adapted from: Report of the Fifth Joint National Committee on detection, evaluation, and treatment of high blood pressure, 1993.

Table 2. Hypertension Prevalence by Age, NHANES III, 1988-1991.

Age (yrs)	% Hypertensive+
18-29	4
30-39	11
40-49	21
50-59	44
60-69	54
70-79	64
80+	65

+ Hypertension = 140/90 or greater (average of 3 readings) on single occasion or antihypertensive drug use.
* National Health and Nutrition Examination Survey III (1988-1991), National Center for Health Statistics. See reference #8.

institutionalized adults aged 18 to 74 had definitive hypertension.[7] Another 17.1 million adults had borderline hypertension. While the majority of cases occur in individuals over the age of 50, in that study, 2.0% of 18- to 24-year-olds and 6.6% of 25- to 34-year-olds were found to be hypertensive. More recently, Phase I of NHANES III has estimated that 4% of 18- to 29-year-olds and 11% of individuals in their third decade may be hypertensive (Table 2).[8] The data from NHANES II may have underestimated prevalence due to a definitional criterion change which includes systolic pressure elevations in hypertension established by the Joint National Committee in 1993.[7,9] The prevalence of elevated blood pressure increases with age, and it affects greater numbers of African-Americans than Caucasians. Males are more likely to be affected as young adults, while females show a higher prevalence in old age.[10]

Patients with untreated chronic medical illness who undergo dental treatment may be at greater risk for emergent medical events. Dental treatment may evoke anxiety and stress in some individuals. If a patient has a compromised cardiovascular system due to undiagnosed hypertension or other disease, cardiovascular or cerebrovascular events may be precipitated by the stress of the dental treatment. Use of screening procedures such as blood pressure measurement can detect elevations requiring further evaluation. Medical emergencies can occur without warning signs or without detection of underlying risk. Through screening procedures, patient evaluations can provide the best preparation. Younger patients who are at risk for medical illness have added years of risk of medical complications, if their disease is not identified.

Therefore, to determine the prevalence of diagnosed and undiagnosed elevated levels of blood pressure among a younger group of dental patients, we examined the records of patients attending an annual oral health program for college students at a private Midwestern school of dentistry during one session in each of three years.

Methods

In service to the community and in preparation for regional boards, the fourth-year class at Case Western Reserve University School of Dentistry annually sponsors a single-session fee-free oral examination for students of local colleges and universities. When appropriate, a dental prophylaxis and radiographic survey were completed. The college oral health program session was held outside normal clinical hours on a Saturday morning and was supervised by full- and part-time faculty of the School of Dentistry.

All participants completed initial intake records required for becoming a patient of the School of Dentistry. This included consent for examination, radiographic survey, and treatment. The patients' demographic information and health history were recorded on an abbreviated medical history form. The patients were asked if they currently have or if they ever had had any of the medical illnesses listed on the medical history form. Medications, hospitalizations, physician name and 'phone number, as well as vital signs were recorded on this form. The objective measurement of BP was completed by means of either an aneroid or mercury sphygmomanometer for a one-time measurement made according to the manufacturer's recommendations. Abnormal recordings of vital signs were rechecked and verified by a faculty member.

The objective measurement of blood pressure was compared with self-reported blood pressure. We analyzed demographic variables to determine differences in the presence of high blood pressure. The data were analyzed by means of the SPSS software for Windows (version 7.5, 1996). Categorical variables were compared by the chi-square statistic or Fisher's exact test. Alpha was set at $p = 0.05$. Age was collapsed into five groupings for cate-

Table 3. Rate of Positive Self-report to Medical Information (n = 479).

Medical Problem	Positive Responses		Missing Responses
Drug allergy	93	(19.5%)	3
Bleeding history	2	(0.4%)	-
Diabetes	3	(0.6%)	1
Hepatitis	18	(3.8%)	2
High blood pressure (self-report)	13	(2.8%)	11
Past history hospitalization	163	(34.0%)	-
Current medical care	39	(8.1%)	-
Take medications	116	(24.2%)	-
Rheumatic fever/heart disease	13	(2.7%)	1
Seizure disorder	3	(0.6%)	-
Sexually transmitted disease	8	(1.7%)	3
Prosthetic joints	0	-	

gorical analysis: 18-29 years, 30-39 years, 40-49 years, 50-60 years, and over 60 years.

The convenience sample included 479 students from colleges and universities within a 20-mile radius of the School of Dentistry who had completed the health history and admission records forms. The study included participants from three discrete annual sessions. Participants were notified of the session through flyers posted in campus centers and residence halls of the institutions.

Results

The results of the study showed that the average age of participants was 25.96 ± 6.42 years, with an age range from 18 to 64. Only 22 individuals were over the age of 40 years, and 80.8% of the sample was under 30 years of age. There were 248 females (51.8%) and 231 males (48.2%) who participated. Table 3 lists the rate of positive responses to key medical information questions. Of the 116 (24.2%) individuals taking medications, 52 were females on birth control pills. Thirty-four percent (n = 163) of the group had been hospitalized at least once.

Thirteen (2.8%) individuals stated that they had a history of high blood pressure, and of those, three had elevated readings. A total of 56 (13.5%) individuals had clinically elevated blood pressure readings (≥ 140/≥ 90). Therefore, 53 subjects had elevated readings which were previously undetected. The mean age of those with elevated blood pressure readings was 27.8 ± 8.67 years. Six individuals over the age of 40 years had an elevated reading. Thirty-eight of the 56 students (67.9%) with high blood pressure readings were under 30 years of age. Additionally, 53 individuals (16.1%) under 30 years of age had BP values in the high-normal range. Overall, 64 individuals had BP readings in the high-normal range (130-139/85-89).

Gender was associated with elevated blood pressure readings, with 20.7% of males (43/208) and 6.3% of females (13/208) having elevated readings ($x^2 = 18.57$, $p < 0.001$). The elevated blood pressure recordings by category are shown in Table 4.

Self-reported history of high blood pressure revealed a trend for association with objectively determined elevated blood pressure. The self-reported high blood pressure was associated with age, current medical care, and medications (Tables 5, 6).

It is unfortunate that blood pressure recordings were not made for 63 individuals who participated in the oral health screening days over the three annual sessions. Fifty-five of those missing BP values occurred during the first annual session and were attributed to a protocol change during the first session. The additional missing values from the following two years were either not recorded or recorded incompletely.

Table 4. Classification of Blood Pressure Readings among Participants.

Blood Pressure Classification	n*	Percent
Normal	296	71.2
High normal	64	15.4
Mild hypertension (stage I)	49	11.8
Moderate hypertension (stage II)	6	1.4
Severe hypertension (stage III)	1	0.2
Very severe hypertension (stage IV)	0	-

* 63 cases missing.

Discussion

Treating patients with undiagnosed medical conditions presents potential risk to the patient and increases the chance of untoward events while the patient is undergoing dental care. Dental procedures which induce anxiety may place patients with untreated illnesses at further risk.[11] Anxiety associated with dental procedures has been shown to increase blood pressure levels.[11-13]

Although transient elevations in blood pressure, such as "white coat" anxiety-induced elevation, were once thought to be inconsequential, recent information has linked this occurrence to cardiovascular abnormalities.[14,15] Patients experiencing this type of blood pressure elevation may

have abnormalities of left ventricular function and of the large arteries similar to those found in patients diagnosed with hypertension.[14,15] It is possible that undiagnosed patients with anxiety and elevated blood pressure values could be at risk of the consequences of hypertensive disease similar to an uncontrolled known hypertensive patient.

While older patients may be more likely to have multiple medical illnesses, younger patients may also have significant undiagnosed diseases, which places them at risk for the sequelae of disease, including hypertension.

It is imperative that all dental patients have a comprehensive medical history review which includes vital signs documentation, review of major organ systems, record of major illnesses, hospitalizations, surgeries, and medications, as well as a complete oral evaluation. Routine updating of the information should be performed at regular intervals. Inconsistent application of physical evaluation based on age criteria and disease-related abnormalities may exclude significantly diseased younger individuals at risk for disease-associated morbidity.

This review of the blood pressure readings of 416 adults currently in college identified 56 individuals with a single-day recording of an elevated blood pressure reading (≥ 140/≥ 90). Three of these individuals stated that they had a history of high blood pressure. Over 13% of the participants had clinically elevated blood pressure readings. This is in a group of individuals who may be least likely to be suspected of having hypertension. Ninety-five percent of those individuals had no idea that they may have high blood pressure. Likewise, the degree of control in the three known hypertensive patients with elevated readings may have been inadequate. It is important to note that the diagnosis of hypertension is not made upon the finding of elevated readings on a single occasion. The clinical diagnosis of high blood pressure is made after elevated blood pressure measurements are confirmed at two or more subsequent visits, or with the use of antihypertensive drug therapy.[4]

Table 5. Association of Self-reported Blood Pressure Readings (Chi-square).

Variable:	Self-reported High Blood Pressure Yes	No
Objective Blood Pressure (n = 405)*		
BP ≥ 140/≥ 90	3	48
Normal BP	6	348
		Chi-square = 3.59, p = 0.058
		**74 cases missing*
Current Physician's Care (n = 468)*		
Physician's care	8	30
No Physician Care	5	425
		Chi-square = 51.15, p < 0.001
		**11 cases missing*
Medication Use (n = 468)*		
Uses medication	8	106
No medication	5	349
		Chi-square = 10.03, p = 0.002
		**11 cases missing*
Age (n = 462)*		
18-29 yrs	8	364
30-39 yrs	1	68
40-49 yrs	3	14
50-59 yrs	1	1
> 60 yrs	0	2
		Chi-square = 31.09, p < 0.001
		**17 cases missing*

The value of screening procedures such as blood pressure recording can identify those individuals in need of referral and treatment, thus supporting health promotion.[16] Hypertension screening in dental patients has been advocated for many years as a valuable service in identifying patients in need of treatment.[17,18] The National Heart and Lung Institute promoted an educational program to inform the public and the professional community about the values of hypertension screening. The American Medical Association as well, concerned about low screening and detection, recommended that all patients must have their blood pressures taken routinely by all physicians, dentists, and other health personnel. Commenting on this recommendation, Lynch states, "There is no reason in modern dentistry why the dentist should not be thoroughly familiar with the patient's blood pressure, and in most instances, the most accurate way to be familiar is to take the pressure in the dental office. Patients with undetected hypertension may account for an occasional sudden death in the dental office."[19] Routine blood pressure measurement has been shown to be a valuable method of medical case finding.[20] Relying on symptoms for hypertension detection is unreliable,

Table 6. Association of Objective Blood Pressure Readings (Chi-square).

Variable:	Objective Blood Pressure Measurement Elevated (≥ 140/≥ 90)	Normal Values
Gender (n = 416)*		
Male	43	165
Female	13	195
		Chi-square = 18.57, p < 0.001
		**63 cases missing*
Medication Use (n = 416)*		
Uses medication	8	90
No Medication	48	270
		Fisher's Exact Test, p = 0.051
		**63 cases missing*

since individuals with significant cardiovascular compromise secondary to hypertensive disease may remain symptom-free despite long-term elevated BP readings.[5,21,22]

In a more recent study of 1588 dentists, it was reported that use of a written medical history was common; however, few dentists routinely recorded blood pressure and other vital signs unless the patient had a history of hypertension or cardiovascular disease.[23] Since these disorders are more prevalent with increasing age, dental patients under the age of 30 may not be suspected to be at risk. Perhaps it is the expected yield on screening that may discourage routine screening of all adult patients in the dental office. Because of the potential for long-term morbidity associated with hypertension, screening for such disease should remain the standard of care.

Because the blood pressure values were recorded once on a single occasion, definitive diagnosis of hypertension is not possible. It is possible that the occurrence rates could represent an overestimation of the actual prevalence of hypertension in this sample. The overall prevalence rate of this sample was 13.4%, which can be compared with the NHANES III data from Table 2. It is important to note that the NHANES BP protocol included the making of three separate BP measurements *per* individual at one appointment. In the present study, one measurement was made at the visit *per* patient. If the result was abnormal, the measurement was rechecked at that time. The difference in methodology may contribute to the variation seen between the results of this study and the national data for individuals of similar age. However, the NHANES data provide a reference against which the present study's information may be reviewed. The results suggest that further investigation of the blood pressure measurement in college students may be warranted.

Other considerations in this study include the possible confounding of the findings by age in this diverse student sample. While the age range was from 18 to 64 years, when the mean age of the sample (25.96 ± 6.4 yrs) and the mean age of the group with elevated blood pressure readings (27.8 ± 8.67 yrs) were compared, age appears minimally to distinguish between the normotensive and elevated blood pressure groups. Additionally, self-reported medical history information should be viewed with caution. There were instances of both false-positive and false-negative reports when self-reported high blood pressure was compared with objective measurement. Verification of the medical history with objective measures and physician input can clarify information necessary for safe and efficacious dental treatment of patients. These findings would also suggest areas for greater emphasis in the dental school curriculum, and in quality assurance activities to document protocols and behaviors supporting improved compliance with standard procedures for physical evaluation.

The results of blood pressure screening in this self-selected convenience sample must be viewed with caution. The college students participating in this program may represent a highly select group that is exceptional among all college students. However, it does emphasize that additional study and health screening in college students may be indicated. In general, it would suggest the importance of screening adult patients of all ages for elevations in blood pressure.

Conclusions

A significant number of elevated blood pressure readings were recorded in this sample of younger adults not usually associated with hypertensive disease. Male gender was associated with elevated readings, while self-reported high blood pressure was associated with age, current medical care, and medication use. Hypertension is not characterized by overt observable signs and symptoms, yet it can be a significant contributor to cardiovascular and cerebrovascular events. The identification of 53 previously unknown patients at risk for the diagnosis of hypertension in a group least likely to be suspected of the disease supports mandatory screening of adults of all ages. Additional study would be interesting to document the routine recording of blood pressures in adults of all ages, as well as the nature and scope of BP recordings.

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