

Blood Pressure Measurements in Israeli Arab Children and Adolescents

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Abstract

Background: Hypertension is one of the most prevalent vascular diseases in the adult population. It is an important determinant of atherosclerosis in adolescents and young adults. There is to date no information on blood pressure in children of the Israeli Arab population.

Objectives: To study blood pressure in Israeli Arab children and adolescents.

Methods: Blood pressure measurements were taken in the supine position in 4,488 Israeli Arab children and adolescents of both sexes aged 6–17 years. Height and weight were also determined. Correlation was investigated between systolic and diastolic blood pressure, body mass index, gender, and age.

Results: The systolic and diastolic blood pressures were similar in both sexes for all age groups up to 14 years of age. Systolic blood pressure was significantly ($P < 0.001$) higher in males aged 15–17 years (120 ± 13 vs. 111 ± 12 mmHg, 123 ± 13 vs. 113 ± 14.0 mmHg, and 123 ± 18 vs. 111 ± 14 mmHg, respectively). Diastolic blood pressure was higher in males aged 15–17, with a statistically significant difference for age 17 only (75 ± 12 vs. 69 ± 13 mmHg). Blood pressure was elevated in 322 students in the initial screening (7.17%), with a decrease to 2.18% when this group was rescreened 2 weeks later. The systolic blood pressure in our group is higher than that in Jewish Israeli children of Asian and North African origin, and in American children. It is similar to the systolic blood pressure of European children and Jewish children born in Israel. The diastolic blood pressure in our group is higher than that in all groups of Israeli Jewish children and American children of different ethnic groups.

Conclusions: Israeli Arab children and adolescents have higher blood pressure levels than their Israeli Jewish counterparts. Further studies are required to confirm this observation.

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Hypertension is one of the most prevalent vascular diseases. It is the principal cause of stroke, cardiac failure, heart attack and renal failure in adults [1], and appears to

play a role in adolescents by converting early atherosclerotic lesions to more advanced ones [2]. Racial differences have been found in the prevalence and severity of essential hypertension [3], but it is not yet known whether children of these populations are also at increased risk for hypertension.

Blood pressure levels among Jewish children in Israel have been studied, yet different studies of the same age groups have revealed dissimilar findings [4–6]. This was attributed to the different ethnic groups in Israel.

The Arab population in Israel represents a unique minority, with a lifestyle different to that practiced by the Jewish population [7]. To our knowledge, blood pressure in this population has not been studied extensively in children. We therefore conducted a study in Arab school-age children to evaluate the blood pressure level in this population.

Methods

Taibe, an Israeli Arab town of approximately 24,000 residents, is located 20 miles northeast of Tel Aviv. Children and adolescents attending its 13 elementary and secondary schools were selected as the target population for this study. A total of 4,488 students participated in the study, reflecting 97.5% of the total school population.

Blood pressure and body measurements were taken by a pediatrician and 15 nurses who are residents of Taibe or work in one of two pediatric medical centers — the Schneider Children's Medical Center and Sapir Medical Center (both affiliated to Tel Aviv University). Before the survey, all examiners were given two special training sessions on blood pressure measurement and were tested in the procedure.

Blood pressure was measured in the right arm during the morning hours, using a regular mercury gravity sphygmomanometer after the subject had been in a supine position for at least 5 minutes. Cuff sizes varied from 7.5x19 to 13x26 cm, to cover at least two-thirds of the length of the upper arm. The cuff was rapidly inflated to approximately 20–30 mmHg above the point at which the radial pulse disappeared, and then released slowly at a rate of about 3 mm/second. Systolic blood pressure is based

on the appearance of Korotkoff phase I, and diastolic blood pressure on Korotkoff phase IV at a precision of 2 mmHg. Three measurements were taken with 5 minute intervals between measurements, and the average of the three readings was considered the mean BP.

Children who exhibited high blood pressure equal to or higher than percentile 95% of the standard reported by the Task Force 1977 [8] were examined by a pediatrician and had their blood pressure measured once more during the same session. Children who continued to exhibit high blood pressure were examined again 2 weeks later.

All measurements were taken in the schools' health education halls during the morning sessions from April to June 1993. Body height (cm) and weight (kg) were measured on a vertical and balance scale, respectively, with the subjects wearing indoor clothes and without shoes. Body mass index was calculated as weight/cubic height. For statistical analysis, Student's *t*-test was used for comparison between groups.

Results

A total of 4,488 students (2,284 boys and 2,204 girls) were examined during the study period. Table 1 shows the mean and standard deviation of SBP and DBP according to age and gender. Systolic and diastolic pressure during early childhood were similar in males and females. However, from age 15 to 17 years, DBP was higher in males than in females and a statistically significant difference ($P < 0.008$) was found for age 17 (75 ± 12 vs. 69 ± 13 mmHg, respectively). SBP was significantly ($P < 0.0001$) higher in males than in females at age 15 to 17 (120 ± 13 vs. 111 ± 12 mmHg, 123 ± 13 vs. 113 ± 14 mmHg, and 123 ± 18 vs. 111 ± 14 mmHg, respectively).

Figure 1 depicts blood pressure versus body mass index (Quetelet Index) in males and females. Males with body mass index above 18 exhibited higher SBP than fe-

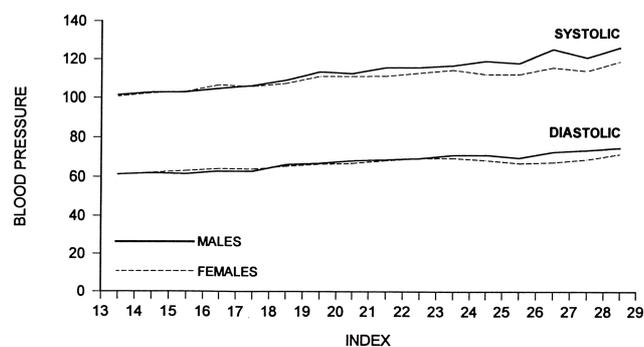


Figure 1. Systolic and diastolic blood pressure by body mass index and sex

Table 2. Prevalence of significant hypertension in 4,488 Arab children and adolescents in blood pressure screening

Screening	Total number	% of original cohort	Elevated systolic or diastolic blood pressure, or both			
			Boys		Girls	
			No.	% of original cohort	No.	% of original cohort
First visit	322	7.17	171	7.48	151	6.85
Rescreening	98	2.18	48	2.1	50	2.27

males and a higher DBP was found in males with index above 23. However, these were not statistically different.

The prevalence of elevated blood pressure was determined from the number of children with elevated blood pressure at both the first and second visit [Table 2]. Elevated blood pressure was found at the first visit in 322 students (7.17%) and in only 98 students at the second visit (2.18%).

Discussion

The cross-section design of this study provided an opportunity to investigate blood pressure in an Israeli Arab population of children and adolescents, and to compare the mean blood pressure levels with those of other studies. We compared our findings with those of the Task Force 1987 (which provided reference values of blood pressure derived from nine studies conducted within a similar period and with approximately 70,000 children) [9], with those of six European studies with a total number of 28,043 children [10], and with those found in Israeli Jewish children of the same age [5,6].

Although the levels of SBP found in Israeli Arab children are similar to those of the European children [10] and the Jewish children who were born in Israel [5], they are significantly higher than those reported by Zadik et al. [6] who examined Israeli children of Asian and North African origin ($P > 0.0001$). They are also significantly higher than the pooled means published in recent years by the Task Force [9] on American children of different ethnic origin ($P > 0.0001$) [Figure 2]. The SBP measurements were also higher than those found in the Bogalusa Heart Study [11] and the Houston study [12].

Table 1. Systolic and diastolic (phase IV) blood pressure by age

Age (yr)	No. of boys	No. of girls	Systolic BP		Diastolic BP	
			Mean \pm SD (mmHg)		Mean \pm SD (mmHg)	
			Boys	Girls	Boys	Girls
6	231	213	100 \pm 11	99 \pm 11	61 \pm 9	61 \pm 9
7	230	194	104 \pm 10	103 \pm 11	62 \pm 8	63 \pm 9
8	246	238	104 \pm 11	105 \pm 10	62 \pm 9	64 \pm 8
9	218	211	106 \pm 12	106 \pm 11	63 \pm 9	64 \pm 8
10	232	259	106 \pm 11	106 \pm 12	63 \pm 0	63 \pm 9
11	256	239	105 \pm 11	109 \pm 13	63 \pm 10	64 \pm 0
12	260	219	108 \pm 12	109 \pm 13	65 \pm 10	65 \pm 10
13	238	209	111 \pm 13	110 \pm 12	66 \pm 9	67 \pm 10
14	87	85	116 \pm 13	115 \pm 11	70 \pm 9	73 \pm 8
15	107	119	120 \pm 13*	111 \pm 12	71 \pm 9	69 \pm 10
16	119	127	123 \pm 13*	113 \pm 14	72 \pm 11	70 \pm 10
17	60	91	123 \pm 18*	111 \pm 14	75 \pm 12*	69 \pm 13

* $P < 0.001$ vs. SBP values in girls of the same age.

* $P < 0.008$ vs. DBP values in girls of the same age.

SBP = systolic blood pressure
DBP = diastolic blood pressure

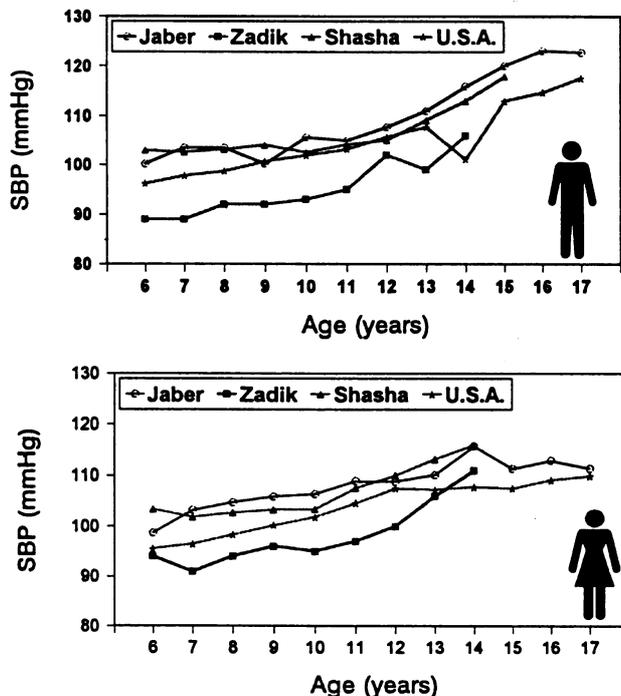


Figure 2A. Systolic blood pressure in Arab, Jewish and American children and adolescents

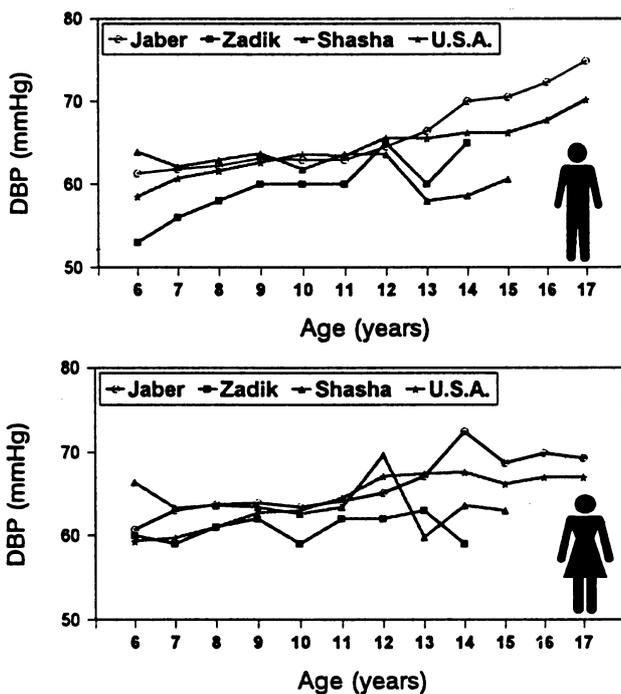


Figure 2B. Diastolic blood pressure in Arab, Jewish and American children and adolescents. [Refs. 5,6,9]

The DBP in our study is higher than the pooled means of the Task Force 1987 ($P>0.01$) [9], higher than those found in Israeli children who were born in Israel [5] ($P>0.002$), and markedly higher than those found in Jew-

ish children and adolescents of oriental descent [6] ($P>0.0001$) [Figure 2B].

In our study we measured BP in the supine position, which is routine practice in our hospital, as opposed to the sitting position in most other studies. We believe that in healthy children the differences in BP measurements between the supine and sitting position are minor and would not have affected the results of the study.

It should be noted that a comparison of diastolic blood pressure across these studies was difficult since different criteria were employed. We used the fourth Korotkoff sound for all ages, as was done in most of the studies, including that of Zadik et al. [6].

Some investigators recommend that an average of two or more consecutive blood pressure measurements be used to estimate blood pressure in children [13,14], while others advise the mean of three readings on separate days [15].

Taller children have higher blood pressures than do shorter children of the same age, and obese children have higher blood pressures than lean children [16,17]. It has been shown that Israeli children of Oriental origin are shorter and thinner than those of European origin [18]. This may explain, at least in part, the relatively lower blood pressure found by Zadik et al. [6] who examined children of Oriental descent [Figure 2].

Although we can speculate that from an anthropometric point of view Arabs could be similar to Jews of Oriental origin, our study shows a difference in blood pressure measurements between these two groups, namely SBP and DBP were higher in Arabs than in Jewish children of Oriental origin. Since our study did not include a control group of Jewish children of different ethnic origins, we could not compare the body mass index in Arab versus Jewish children. Moreover, there may be additional contributing factors to these differences, such as genetic, environmental, and socioeconomic.

The high prevalence of students — 7.17% — with elevated blood pressure in the first screening was expected. With repeated measurements, blood pressure readings fell as a result of adjustment of the child to the procedure. After rescreening, significantly high readings persisted in only 2.18%. This prevalence is higher than that found in junior high school children in St. Paul and Minneapolis in the USA, which was lower than 5% on the first screening and decreased to 1% in the second screening [19].

In our study we examined BP in a large Arab town. Unlike small villages, the population of this town (24,000 inhabitants at the time of the study) seems to represent a heterogeneous group of Israeli Arabs, although the question regarding the extent to which this population is representative of other Israeli Arab children was not determined.

It is of interest to compare our results with those of other studies conducted in Arab children and adolescents. Unfortunately, few studies have measured BP levels in this population. In one study [20], the prevalence of hy-

hypertension was found to be similar to that of the general Israeli population (26.7%). This study was conducted on 412 subjects, most of them adults. Further studies on children and young adults in Arab populations are needed.

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