

# Familial aggregation of blood pressure in 558 adopted children

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Blood pressure was measured in each member of 398 French-Canadian families with at least one adopted child of the same ethnic origin. Measurements were made at home by a nurse, usually with the subject seated. One comparison per family between parents and randomly chosen index children was made, using age- and sex-adjusted scores. The correlation in blood pressure scores between parents and natural children was highly significant ( $P < 0.001$ ), at 10.2% for systolic and 13.7% for diastolic, in 140 homes with at least one natural child, but the correlation between parents and adopted children was nonsignificant, at 0.81% and 1.0%, in 398 homes with at least one adopted child. The correlation between pairs of natural children was significant ( $P < 0.05$ ), at 7.84% for systolic and 8.41% for diastolic, in 80 homes with more than one natural child but nonsignificant, at 0.49% and 1.69%, respectively, for pairs of adopted children in 138 families with more than one adopted child. It is concluded that heredity explains most of the familial resemblance of blood pressure in children.

On a mesuré la tension artérielle de tous les membres de 398 familles canadiennes-françaises ayant au moins un enfant adopté de même origine ethnique. Les déterminations ont été faites à domicile par une infirmière, le sujet étant généralement assise. On a fait une comparaison par famille entre les parents et un enfant représentatif choisi au hasard, en utilisant des cotes ajustées pour l'âge et le sexe. La corrélation des cotes de tension artérielle entre les parents et les enfants naturels a été hautement significative ( $P < 0.001$ ), à 10.2% pour la pression systolique et 13.7% pour la diastolique, dans 140 foyers ayant au moins un enfant naturel, mais la corrélation entre les parents et les enfants adoptés n'a pas été significative, à 0.81% et 1.0%, dans 398 foyers ayant au moins

un enfant adopté. La corrélation entre des paires d'enfants naturels a été significative ( $P < 0.05$ ), à 7.84% pour la systolique et 8.41% pour la diastolique, dans 80 foyers ayant plus d'un enfant naturel mais elle a été nonsignificative, à 0.49% et 1.69%, respectivement, pour des paires d'enfants adoptés, dans 138 foyers ayant plus d'un enfant adopté. On conclut que l'hérédité explique la plupart des ressemblances familiales entre les tensions artérielles chez les enfants.

The Montreal Adoption Survey was undertaken in 1972 as a cross-sectional study of French-Canadian families in the Montreal area with at least one adopted child of the same ethnic origin, with the purpose of discriminating between the genetic and the environmental components of the familial resemblance of cardiovascular risk factors such as elevated systolic and diastolic blood pressure, pulse rate, body weight and weight/height ratio. Natural children living in these adoptive homes served as controls.

Parent-child and child-child correlations have shown that the familial aggregation of body weight and weight/height ratio is determined virtually only by genetic factors.<sup>1</sup> The blood pressure data from 398 adoptive families are presented here in detail: preliminary reports have appeared.<sup>1-3</sup>

## Methods

A local adoption agency provided a list of 398 French-Canadian families

with at least one adopted child of the same ethnic background living in that family for at least 1 year. A total of 558 adopted and 256 natural children aged 1 to 21, as well as 376 fathers and 398 mothers, were examined by a nurse during a home visit. Six fathers taking antihypertensive drugs and 16 who were absent during the visit were not included. All visits took place at least 1 hour after supper on a weekday evening between 1972 and 1974. The majority of the families who accepted this visit had adopted a child within the last 10 years, with the consequence that, on the average, the adopted children were younger than the natural children (Fig. 1). At least one natural child was present in 140 families.

Blood pressure was measured with a standard mercury sphygmomanometer fitted with a constant deflation valve. Cuffs of appropriate width were used for children. The points at which the first-phase and fourth-phase Korotkoff sounds were heard were recorded as the systolic and diastolic pressures, respectively. Except for children too young to sit still, who lay supine, readings were made in the sitting position. Two measurements per person were made in the following sequence: parents first, fathers being first on even days and mothers on odd days; then the children, in a sequence counterbalanced with respect to status (natural or adopted) and randomized for children of each status. The two readings were averaged to yield single values for the systolic and the diastolic pressures.

Values in millimetres of mercury were converted into age- and sex-adjusted standard deviation unit scores, where a unit was the reading for an individual minus the mean pressure for his age and sex group, divided by the standard deviation for that group. Three-year age groups were formed for boys and for girls, and 10-year age groups for fathers and for mothers. The mean blood pressures of the adopted children did not differ from those for the natural children within each age group; therefore the readings for all of the children were validly pooled to form these age groups.

In each family the father's and mother's scores were averaged to yield a "midparent" score. In families with more than one adopted child the index child was chosen at random; the same

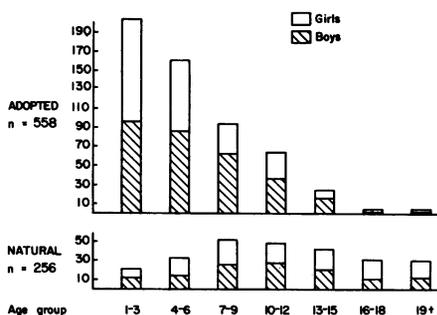


FIG. 1—Frequency distribution of 814 children according to 3-year age groups, sex and status (adopted or natural), in 398 French-Canadian families in the Montreal area having at least one adopted child of the same ethnic origin.

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procedure was used in families with more than one natural child for selecting an index child. The Pearson's  $r$  correlation coefficient was computed, making one comparison per family ( $X =$  midparent score,  $Y =$  index child). This coefficient was squared to yield the determination coefficient  $R^2$ , which expresses the proportion of the variance of the children's pressure that is "explained" by that of the parents. For Figs. 4 and 5,  $R^2$  was multiplied by 100 to yield percentages. The research hypothesis that  $\rho \neq 0$  was tested bilaterally by calculating the  $t$  and  $P$  values for  $r$ .

Child-child correlations were calculated by choosing randomly a pair of natural children or a pair of adopted children in homes with more than one child of the same status. There were 80 homes with more than one natural child and 138 homes with more than one adopted child.

## Results

Median blood pressures for parents and children are shown in Figs. 2 and 3, respectively.

The correlation between the midparent pressure unit scores and those of the natural children (Fig. 4) was relatively small but highly significant and positive: 10.2% for systolic and 13.7% for diastolic ( $P < 0.001$ ). In contrast, the correlation between the midparent scores and those of the adopted children was small and non-significant: 0.81% for systolic and 1.0% for diastolic.

The correlation between scores for pairs of natural children in the same

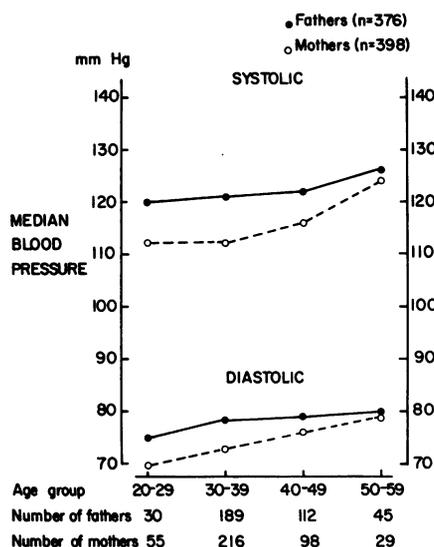


FIG. 2—Median blood pressures, first-phase systolic and fourth-phase diastolic, of the 774 adoptive parents, according to 10-year age groups.

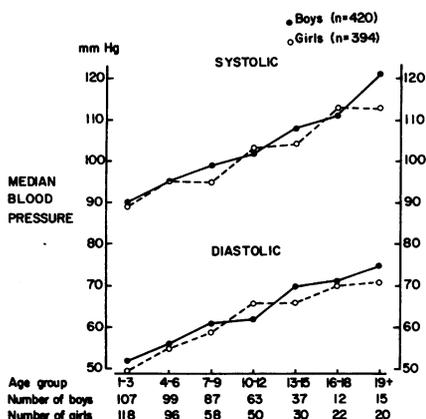


FIG. 3—Median blood pressures of the 814 children. Within each age group the blood pressures of the natural children did not differ from those of the adopted children. The mean blood pressures of the boys were not significantly different from those of the girls.

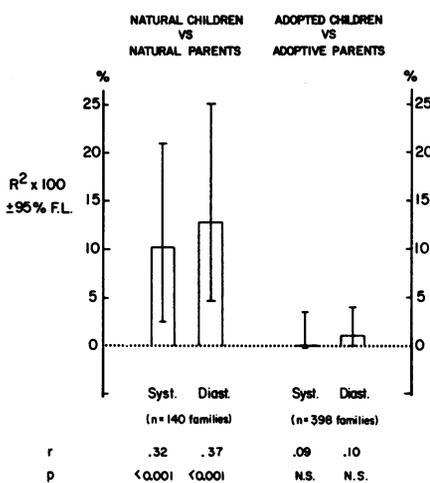


FIG. 4—The square of the correlation coefficient ( $R^2$ )  $\times 100$  is shown by the column's height and accompanied by the 95% fiducial limit, indicating the proportion of the variance of children's blood pressure that is explained by that of the parents. One comparison per family was made between the midparent blood pressure score and that of a randomly chosen index child.

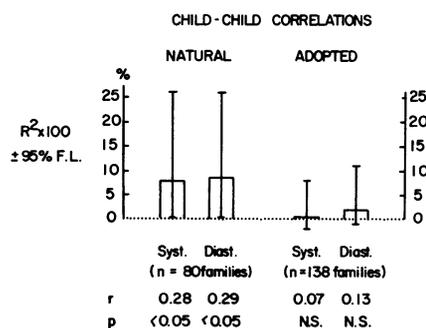


FIG. 5—Correlation between pairs of natural children in families with more than one sibling, and between pairs of adopted children in families with more than one adopted child. In families with more than two children of the same status the pair was randomly chosen.

family (Fig. 5) was significant and positive: 7.84% for systolic and 8.41% for diastolic ( $P < 0.05$ ). The correlation between scores for pairs of adopted children was small and nonsignificant: 0.49% for systolic and 1.69% for diastolic.

## Discussion

The findings from our data are clear-cut: the blood pressure of natural children resembles, to a small but significant degree, that of their natural parents and that of their brothers and sisters. This is not the case for adopted children, who show no significant aggregation either with their adoptive parents or with their adoptive brothers and sisters, with whom they share the same home environment.

The conclusion that heredity explains virtually all of this familial resemblance might be weakened by the fact that our adopted population was younger than the group of natural siblings. However, the correlation coefficients for each age subgroup did not show significant differences with the overall correlation, nor did they show a significant trend with increasing age of the children.

This makes it improbable that the gathering of a substantial number of adopted teenagers would alter our conclusions; nevertheless, we are presently trying to complete our adopted population with older individuals, so that the duration of exposure to family customs might be more comparable.

Our data for natural children confirm those of Zinner, Levy and Kass,<sup>4</sup> and our data for adopted children strongly suggest that the sharing of the home environment does not contribute significantly to the familial aggregation of blood pressure in children.

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## References

1. BIRON P, MONGEAU JG, BERTRAND D: Familial aggregation of blood pressure and body weight in adopted and natural children. *Clin Res* 23: 1A, 1975
2. Idem: Familial aggregation of blood pressure in adopted and natural children. *Circulation* (suppl 3) 49: 106, 1974
3. MONGEAU JG, BIRON P: Familial aggregation of blood pressure. *Clin Res* 22: 759A, 1974
4. ZINNER SH, LEVY PS, KASS EH: Familial aggregation of blood pressure in childhood. *N Engl J Med* 284: 401, 1971