A Comparison of Selected Cleft Palate Children and Their Siblings on the Variables of Intelligence, Hearing Loss, and Visual-Perceptual-Motor Abilities

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The first investigation of the intellectual functioning of cleft palate children was conducted by Wolstadt (*23*) in 1931. This study suggested that the intelligence of cleft palate children is within normal limits. Subsequent studies (*7, 9, 10, 11, 16, 18*) have also reported normal intelligence for the cleft palate groups they examined, although statistically significant differences in intelligence quotients (IQ) were found between cleft palate and non-cleft palate children. The higher IQ scores favored the non-cleft palate groups.

Lewis (*7*) and Ruess (*16*), have compared the intelligence of cleft palate children with that of their siblings. Lewis (*9*) found a significant difference between a cleft palate group and a sibling group on the Stanford-Binet Intelligence Scale with higher scores reported for the sibling group. Ruess (16) reported a significant difference in Wechsler Intelligence Scale for Children (WISC) Verbal and Full Scale IQ's, but not in Performance IQ's for the two groups. The higher intelligence quotients favored the sibling group. Neither of the studies which included siblings as control subjects have reported audiometric information for either group. Hearing status would seem an important consideration since Means and Irwin (10) found a significant difference between Stanford-Binet IQ's for normal hearing cleft palate children and cleft palate children with poor hearing.

In addition to studying overall differences in verbal and performance IQ's on intelligence tests, obtaining specific information concerning under-

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lying visual-perceptual-motor problems would seem advisable. This consideration is cogent to the concomitant problems of cleft palate children since Tisza et al. (*19*) found that children born with oral-facial deformities showed some difficulty in the structuralization of certain perceptual-motor gestalten. A comparison of children without cleft conditions failed to show similar distortions of geometric figure drawings. Tisza et al. (*19*) have reported observations that suggest important areas of investigation concerning difficulties in perceptual organization that may not appear in overall IQ scores of cleft palate children.

The purpose of the present investigation was to examine the effect of hearing loss on the verbal and performance IQ's of selected cleft palate children and their siblings. Specifically, the following question were posed:

1. Are there differences in cleft palate children and their siblings with respect to verbal and performance IQ, verbal comprehension and perceptual organization with no consideration of hearing loss?
2. Are there differences in poorer hearing cleft palate children and their normal hearing siblings with respect to the variables of IQ, verbal comprehension and perceptual organization?
3. Are there differences in normal hearing cleft palate children and their normal hearing siblings on the variables of IQ, verbal comprehension and perceptual organization?
4. What are the differences between the poor hearing and good hearing cleft palate children with respect to verbal and performance IQ, verbal comprehension and perceptual organization?
5. Are there differences between the siblings of good hearing and poor hearing cleft palate children on the variables of verbal and performance IQ, verbal comprehension and perceptual organization factors?

Subjects

Our cleft palate sample differs from the general population of cleft palate children since children with full scale WISC IQ's below 80 were excluded from the study. This selected sample was obtained to clarify differences in verbal and performance IQ's and to study visual-perceptual-motor abilities of children operating within a normally graded school situation. The sample and the results obtained in this study must be considered in view of the selection procedure and generalizations to the overall population should obviously be restricted.

There were 18 males and 8 females in the cleft palate group. This sample contained cleft lip and palate and cleft palate only subjects, but no cleft lip only subjects. The sibling group included 13 males and 13 females. Twenty five pairs were white; one pair was black. The mean chronological age of the cleft palate children was 10.5 (S.D. 3.2) years, while the mean chronological age of their sibling was 10.6 (S.D. 2.7) years. The age range in both groups was from 5 to 15 years. the sibling

pairs differed in chronological age by no more than six years. Comparisons of each variable could be accomplished since each test item was arranged and scored according to standard score values for each age group. Seventy five percent of the children in this study attended school in a metropolitan area; and the remaining 25% attended school in a rural area.

Methods

The 26 pairs of children were examined employing a test battery which included the Peabody Picture Vocabulary Test (PPVT) (*3*), the Wechsler Intelligence Scale for Children (WISC) (*21*), Cohen's Verbal Comprehension Factor (VC) (*2*) and Cohen's Perceptual Organization Factor (PO) (*2*).

The VC factor (*2*) is an average of WISC Information, Comprehension, Similarities and Vocabulary subtest scores. This factor purports to measure the same verbal abilities over age and to partial out the effects of general intelligence. The PO factor (*2*) is an average of Block Design and Object Assembly subtest scores and purports to measure visual-perceptual-motor abilities.

Socio-economic status was determined through the use of Hollingshead's Two Factor Index of Social Position (*8*). In addition, the choice of the sibling pairs from both urban and rural communities assumed a control upon clusters of subjects from one or another grouping.

Each subject was given a pure tone air conduction hearing test. Criterion for inclusion in the poor hearing cleft palate group was an average decibel (dB) loss in the speech frequencies (250, to 2000 Hz) of 20 dB (re: ISO 1964 Standards) or more in the better ear. Criterion for inclusion in the normal hearing cleft palate group was an average hearing loss of less than 20 dB in the better ear. A total loss of hearing in one ear was not a consideration for inclusion in the group with poor hearing. All siblings met the normal hearing criterion.

Results

Analysis of the present data included five comparisons of the subject groups. Three comparisons were made between the cleft palate children and their siblings (intra-familial), and two comparisons were made between groups based upon the hearing status of the cleft palate child (inter-familial).

A test of difference (t test) for matched groups was used for the intra-familial comparisons. Erlenmeyer-Kimling and Jarvik (*5*) have pointed out that paired series of subjects are correlated variables. In addition, correlation coefficients of .50 are reported in studies investigating the mental abilities of siblings. Further, Edwards (*4*) states that the t test for paired observations should be used where paired scores are correlated variables (p. 216).

In order to answer the first question posed in the study, data in Table 1

TABLE 1. Comparison of the total cleft palate group vs. total sibling group (26 pairs) on the variables of IQ, verbal comprehension factor, and perceptual organization factor with no consideration of hearing loss

	Cleft Palate Group (N=26)		Sibling Group (N=26)		
	Mean	S.D.	Mean	S.D.	t
Age in Months	126.31	38.27	126.89	32.40	-.10
Peabody IQ	98.81	19.05	104.58	19.90	-2.25 *
WISC Verbal IQ	98.66	13.72	105.39	16.81	-3.28 *
WISC Performance IQ	106.04	13.02	105.24	13.38	.34
WISC Full Scale IQ	102.58	12.68	105.81	14.84	1.85 *
Verbal Comprehension Factor	9.91	2.21	10.89	2.89	-2.44 *
Perceptual Organization Factor	10.77	2.35	10.12	2.63	.11

* Significant at .05 level

are organized to show differences between the cleft palate children and their siblings, regardless of hearing status, on the variables of verbal IQ, performance IQ, verbal comprehension and perceptual organization.

The results indicate a significant difference between groups in verbal intelligence as measured by the PPVT and WISC verbal tests as well as in verbal comprehension as measured by the VC factor. The differences favor the sibling group. There are no significant differences between groups in performance IQ, or in perceptual organization.

The data in Table 2 is organized to show differences between poor hearing cleft palate children and their normal hearing siblings on the IQ variables, verbal comprehension and perceptual organization in answer to the second question posed in the study. In response to the third question raised, the data shown in Table 3 concerns differences in IQ variables, verbal comprehension and perceptual organization between normal hearing cleft palate children and their normal hearing siblings.

The results presented in Tables 2 and 3 indicate that receptive verbal ability as measured by the PPVT is significantly worse for the poor hearing cleft palate children than for their siblings. No significant difference in receptive verbal ability between the normal hearing cleft palate children and their siblings was found. A significant difference in WISC Verbal IQ is noted for both the poor hearing and normal hearing cleft palate groups as compared with their respective sibling groups. Verbal comprehension is significantly worse for the poor hearing cleft palate group in comparison to its sibling group.

In addition, no differences were found between the cleft palate group

TABLE 2. Comparison of cleft palate children with 20 dB or greater hearing loss vs. their normal hearing siblings on the variables of IQ, verbal comprehension factor, and perceptual organization factor

	Cleft Palate Group (N=9)		Sibling Group (N=9)		
	Mean	S.D.	Mean	S.D.	t
Age in Months	129.67	31.31	131.89	24.94	.23
Peabody IQ	85.89	21.13	97.56	19.25	-3.32 *
WISC Verbal IQ	96.34	15.10	103.23	16.77	-2.63 *
WISC Performance IQ	99.67	10.23	96.67	11.14	.74
WISC Full Scale IQ	97.89	12.90	100.12	13.76	.87
Verbal Comprehension Factor	9.12	2.37	10.39	2.96	-2.93 *
Perceptual Organization Factor	9.56	2.22	8.78	2.14	.78

* Significant at .05 level

and the sibling group on Performance IQ, or the PO factor regardless of the hearing status of the cleft palate child.

The fourth and fifth questions posed in this investigation were designed to seek answers to the questions concerning differences between the good and poor hearing cleft palate children and between the siblings of the good and poor hearing cleft palate children with respect to the variables of verbal and performance IQ, and verbal comprehension, and perceptual organization.

In Tables 4 and 5 the data are organized so that comparisons are inter-familial rather than intra-familial. There were no significant differences in socio-economic status between family groups.

The data included in Table 4 indicates a significant difference between groups in verbal ability as measured by the PPVT, and a definite trend toward differences in performance ability as indicated by the scores for the WISC Performance IQ and the PO factor. The greater mean scores favored the better hearing cleft palate group.

The data presented in Table 5 indicates no significant differences between the groups in verbal ability as measured by the PPVT, WISC Verbal IQ or the VC factor. Differences do occur, however, in Performance IQ and perceptual organization, and the scores are significantly higher for the siblings of the better hearing cleft palate children.

Discussion

In general, the results of several studies (*6, 7, 9, 11*) have suggested that there are differences between verbal and performance abilities of cleft

TABLE 3. Comparison of cleft palate children with less than 20 dB hearing loss vs. their normal hearing of siblings on the variables of IQ, verbal comprehension factor, and perceptual organization factor

	Cleft Palate Group (N=17)		Sibling Group (N=17)		
	Mean	S.D.	Mean	S.D.	t
Age in Months	124.53	42.29	124.24	36.16	.04
Peabody IQ	104.12	14.88	108.30	19.77	-1.01
WISC Verbal IQ	99.89	13.26	106.53	17.24	-2.32 *
WISC Performance IQ	109.42	13.33	109.77	12.43	-.11
WISC Full Scale IQ	105.06	12.20	108.83	14.88	-1.60
Verbal Comprehension	10.33	2.07	11.15	2.91	-1.43
Perceptual Organization Factor	11.42	2.21	11.74	2.30	-.62
Metropolitan Achievement Test	4.47	3.50	4.94	3.51	-.78

* Significant at .05 level

TABLE 4. Comparison of poor hearing cleft palate children vs. good hearing cleft palate children on the variables of IQ, verbal comprehension factor, and perceptual organization factor

	Poor Hearing Cleft Palate Group (N=9)		Good Hearing Cleft Palate Group (N=17)		
	Mean	S.D.	Mean	S.D.	t
Age in Months	129.67	31.30	124.53	42.29	.31
Peabody IQ	85.88	21.12	104.11	14.87	-2.56 **
WISC Verbal IQ	96.33	15.09	99.88	13.25	.61
WISC Performance IQ	99.66	10.22	109.41	13.32	-1.91 *
WISC Full Scale IQ	97.88	12.89	105.05	12.19	-1.39
Verbal Comprehension Factor	9.111	2.36	10.32	2.06	-1.35
Perceptual Organization Factor	9.55	2.21	11.41	2.20	-2.04 *
Socio-economic Status	52.56	21.80	44.47	14.87	1.12

** Significant at .05 level

* Significant at .10 level

TABLE 5. Comparison of siblings of the poor hearing cleft palate children vs. siblings of the good hearing cleft palate children on the variables of IQ, verbal comprehension factor, and perceptual organization factor

	Siblings of Cleft Palate With Poor Hearing (N=9)		Siblings of Cleft Palate With Good Hearing (N=17)		
	Mean	S.D.	Mean	S.D.	t
Age in Months	131.89	24.93	124.23	36.15	.56
Peabody IQ	97.55	19.24	108.29	19.76	-1.32
Verbal IQ	103.22	16.76	106.52	17.23	.46
Performance IQ	96.66	11.13	109.76	12.42	-2.64 *
Full Scale IQ	100.11	13.75	108.82	14.87	-1.45
Verbal Comprehension Factor	10.38	2.95	11.14	2.90	.63
Perceptual Organization Factor	8.77	2.13	11.73	2.29	-3.20 *
Socio-economic Status	52.56	21.80	44.47	14.87	1.12

* Significant at .05 level

palate subjects. Ruess' study (*15*) of cleft palate subjects and their siblings indicated a deficit in verbal intelligence but not in performance intelligence for the cleft group.

Our data contained in Table 1 are directly comparable to the results obtained with the cleft palate subject in Ruess' (*16*) study. The differences between the present study and that of Ruess may be seen in Table 2 where groups were divided according to audiometric status of the cleft palate child and where both intra-familial comparisons are made.

A further conclusion which can be drawn from the data in Tables 1, 2, and 3 is that the cleft palate child has no consistent pattern of visual-perceptual-motor problems concomitant with the cleft palate condition alone. Goodstein (*7*) found a significant difference in performance IQ as well as in verbal IQ between a cleft palate group and control group. This may well reflect a higher incidence of mental retardation in his cleft palate sample than in the control group.

Smith and McWilliams (*16*) and Tisza et al. (*19*) also suggested the presence of visual-perceptual-motor deficits in their respective studies. Smith and McWilliams (*17*) reported data from scores on the Illinois Test of Psycholinguistic Abilities (ITPA) which indicated that the cleft palate subjects they studied, as a group, were less skilled in the visual channel than in the auditory channel. This finding is not easily explained if the only involvement of cleft palate children is lowered verbal ability which may be partially explained by a fluctuating hearing loss. Results presented

in Tables 4 and 5 may help explain the similarity of our findings and those of Smith and McWilliams (*17*) and Tisza, et al. (*19*) since the data in Tables 1, 2, and 3 of the present study would suggest no visual-perceptual-motor involvement concomitant with the cleft palate condition when comparisons are intra-familial.

The results of the portion of this study comparing the nine poor hearing cleft palate children to the 17 normal hearing cleft palate children indicated no difference in WISC Verbal Intelligence or Verbal Comprehension. There were, however, significant differences in WISC performance IQ, and perceptual organization. These results suggest that verbal abilities of cleft palate children, exclusive of those involving reception, are not dramatically different regardless of the present status of their hearing. These results must be considered in view of the selection procedure and the overall intelligence of the present sample of children.

Further, while a visual-perceptual-motor deficit does not appear to be a consequence of the cleft palate condition alone, the data suggest that significant differences in visual-perceptual-motor abilities do occur between subgroups of cleft palate children and that these differences appear when the children are subdivided on the basis of hearing sensitivity. Smith and McWilliams (*17*), although not specifically subdividing children on the basis of present hearing status, found similar patterns of perceptual-motor deficits with their cleft palate subjects.

Another finding in this study (Table 5), indicated that differences in visual-perceptual-motor abilities appear not only between the normal hearing and the poor hearing cleft palate children, but also appear between their respective siblings. In addition, there is no accompanying significant difference in WISC Verbal IQ to suggest an over-all factor of lowered intelligence.

The comparisons of the poor hearing cleft palate children with the normal hearing cleft palate children presented in Table 4 support earlier studies (*9, 10*) which reported a reduction in Stanford-Binet IQ's for the poorer hearing group. The initial interpretation of these earlier studies would be that since the Stanford-Binet is heavily weighted with verbal items the poor hearing cleft palate children score lower than do the normal hearing cleft palate children because of Verbal deficits resulting from a hearing loss. On the basis of the findings of the present study, however, one might speculate that the Stanford-Binet IQ's of the poor hearing cleft palate group may have been lowered by relatively poorer performance abilities. Smith and McWilliams (*17*) hypothesis regarding visual-perceptual-motor involvement in cleft palate children is also supported by the present findings.

Since both the cleft palate and sibling groups were divided on the basis of the severity of the hearing loss of the cleft palate child, the differences in visual-perceptual-motor abilities would not be the predicted outcome. One might more reasonably predict differences in verbal IQ between the

cleft palate groups, but no differences in performance IQ of the cleft palate groups, and no differences between the siblings of the two groups. Since our findings are contradictory to the predicted "common sense" outcome, but are to some extent suggested by earlier studies (*9, 10, 17*), further investigation of the etiology and natural history of the hearing loss in cleft palate children is needed. Further, more information is needed about the relationship of the hearing loss in cleft palate children and the visual-perceptual-motor deficits noted in those samples. Since the visual-perceptual-motor differences also appeared between sibling groups in this study, further genetic studies of the families of cleft palate children would seem to be indicated.

The fact that this group of children ranged in age from 5 to 15 years of age may suggest another kind of aural pathology, since the hearing loss most commonly associated with cleft palate condition ordinarily disappears with age (*11, 14*). Eustachian tube and palatal muscle dysfunction have been found to be important coexisting condition of hearing loss among cleft palate children (*1, 13, 14*). Recent studies by Paradise and Bluestone (*13*) and Bluestone and Wittel (*1*) have added experimental support to clinical evidence of Eustachian tube malfunction in cleft palate infants. It may be that cleft palate, visual-perceptual-motor deficits, Eustachian tube malfunction and persisting hearing loss may all result from the same overall genetic abnormality with the cleft palate being the most obvious manifestation.

Summary

An investigation of intellectual function, hearing loss, and visual-perceptual-motor abilities of 26 selected cleft palate children and their siblings was undertaken. Five separate analyses of the data were completed. The first analysis incorporated the usual comparison of the cleft palate group with the sibling groups. The other four comparisons were made according to the severity of hearing impairment of the cleft palate child.

The first comparison confirmed the results of past studies (*7, 9, 11, 16*), i.e., a significant difference was found between the cleft palate group and the sibling group on verbal measures. In addition, Ruess' (*16*) findings of no difference in performance IQ between cleft palate group and sibling group was confirmed.

Results of the other four comparisons suggested that there is a significant depression in WISC Verbal IQ associated with the cleft palate condition even when hearing sensitivity is within normal limits. This may reflect to some extent the effect of early fluctuating hearing loss so common with young cleft palate children. The present level of hearing impairment may also be a contributing factor to lowered verbal IQ scores. Differences in hearing seem to be reflected mainly in receptive verbal ability and verbal comprehension rather than in a difference in verbal intelligence. Therefore, although hearing status does seem to affect some

selected verbal abilities, the consistent verbal deficit reported in this study lends support to the ideas of Phillips and Harrison (14) and Smith and McWilliams (*17*). That is, the language of cleft palate children is depressed by a combination of negative factors—the physical abnormality itself, with its resulting poor speech, parental attitudes, and the lack of environmental stimulation. In addition, while poor hearing may contribute somewhat to the lowering of verbal skills, it does not appear to be the primary or only factor contributing to the lowered verbal skills of cleft palate children.

Results of this study suggest visual-perceptual-motor involvement of the sibling in the family as well as the cleft palate child. In other words, the cleft palate condition may, in some cases, be only one manifestation of a broad range of involvements which may be of familial origin.

Since the findings of differences in visual-perceptual-motor abilities between families occurred when the children were grouped on the basis of severity of hearing loss of the cleft child, the relationship between the cause of persisting hearing loss and visual-perceptual-motor deficit should be investigated along with a more thorough psycho-social evaluation of the family of the cleft palate child.

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