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Autism in Children with Congenital Rubella[1]

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In the course of studying the behavioral characteristics of 243 preschool children with congenital rubella, we identified the syndrome of autism in 10 children and a partial syndrome of autism in an additional 8. These findings are discussed against the background of the behavioral investigations of rubella children. The methodology of our psychiatric study and the criteria for a diagnosis of autism are presented. The incidence of autism is considered with regard to the prevalence of other psychiatric disorders in this group and the physical status of the children. Two case histories of autistic rubella children are given and their behavioral characteristics are contrasted with nonautistic rubella children with matching sensory and other defects. The prevalence rate is compared with that found in two epidemiological studies and also with the rate indicated by other centers studying rubella children. Etiological implications of these findings are discussed. It is argued that these data support the concept of organic causation of the syndrome of autism.

In the wake of the rubella epidemic that swept the United States in 1964, an estimated 20,000 to 30,000 children were born with congenital malformations. The severity of this epidemic and its sequelae prompted a number of institutions, such as Johns Hopkins (Hardy, 1970; Hardy, Monif, & Sever, 1966) and Baylor University (Desmond, Wilson, Melnick, Singer, Zion, Rudolph, Pineda, & Ziai, 1967; Desmond, Wilson, Verniaud, Melnick, & Rawls, 1970), to initiate major studies of the rubella children. At New York University Medical Center, a multidisciplinary Rubella Birth Defect Evaluation Project was set up to deal with problems of diagnosis and provision of services for children with physical handicaps (Cooper & Krugman, 1966). In cooperation with this project, the

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author undertook in 1967 a behavioral study to determine the psychological and psychiatric consequences of congenital rubella, in terms of both the youngsters and their families.

Early studies of maternal rubella described a limited number of congenital effects, notably cataracts, heart defect, and deafness (Gregg, 1941; Swan, Tostevin, Moore, Mayo, & Black, 1943). Recent reports, however, have emphasized that the fetal infection, often continuing into infancy, may produce a much wider range of impairments than had been recognized (Cooper & Krugman, 1967). For example, the Baylor study (Desmond et al., 1967) noted a diversity of neurological abnormalities in 81 of 100 patients at some time between birth and 1 year of age. Abnormalities included lethargy, full fontanel, irritability, an increase of protein and persistence of virus in the cerebrospinal fluid, and pathological changes in central nervous system (CNS) structures. A high incidence of CNS dysfunction is also reported by the Johns Hopkins investigators (Hardy et al., 1966).

Data on the behavioral sequelae of congenital rubella remain scant. There have been two main currents of thought on the behavior of rubella children. Some investigators have found that these children do not exhibit difficult behavior, and that apart from intellectual limitations they have no special psychological features in common (Kirman, 1955; Bindon, 1957; Sheridan, 1964). A 25-year followup of Gregg's (1941) original patients reported that most of them had made "good socioeconomic adjustments" and concluded that "the developmental potential of many patients had been assessed erroneously during the preschool period" (Menser, Dods, & Harley, 1967). However, the report did not include an organized developmental assessment of these patients as children.

Other investigators have noted significant behavioral sequelae in some rubella children. In a study of 16 children aged 3 to 4 years at the Lexington School for the Deaf, Levine (1951) noted that three youngsters "appeared to combine infantile characteristics, defective mentality, inappropriate emotional responsiveness and queer motor mannerisms." Following the 1951 rubella epidemic in Sweden, a longitudinal study found that children whose mothers were infected during the second month of pregnancy had a higher incidence of unreadiness for school than did the controls and other rubella subgroups (Lundstrom & Ahnsjo, 1962).

Specific references to autism in rubella children were fragmentary before the 1964 epidemic. For example, Rimland (1964) mentions one case treated in the Netherlands by D. Arn Van Krevelen. But the new studies clearly suggest that autistic behavior is one of the possibilities to which the clinician must be alerted in dealing with rubella children. In the Baylor series, of the 64 children surviving

at age 18 months, "8 appeared autistic, isolated, and out of communication with the environment. Two actively rejected (by screaming, crying, back arching) any attempts at communication or contact" (Desmond et al., 1970). The report does not discuss the criteria of autism or provide behavioral details. Another recent study of one multihandicapped rubella baby concludes that the child "fulfills most of the behavioral criteria Rimland lists as 'necessary but not sufficient' for the diagnosis of infantile autism" (Freedman, Fox-Kolenda, & Brown, 1970).

On the other hand, Wing (1969) compared a large number of behavioral items in different groups of children, one of which was largely rubella: (a) autistic, speaking; (b) autistic, nonspeaking; (c) normal; (d) Down's syndrome; (e) receptive aphasia; (f) executive aphasia; (g) partially blind and partially deaf. Of the 15 deaf-blind children, 12 had been identified as having congenital rubella. Wing notes that the partially blind/partially deaf children as a group did not avoid physical contact and had less attachment to objects as contrasted with the autistic children.

Our behavioral study of 243 children with congenital rubella revealed a much higher prevalence of behavioral disturbances than one would normally expect (Chess, 1970). This was particularly striking in regard to autism. We identified 10 of the children as autistic in their total behavioral adaptation. These children presented a picture of autism corresponding in most respects to Kanner's classical criteria for infantile autism. An additional eight children showed a significant number of signs of autistic behavior. In these cases the term "partial syndrome of autism" was employed.

These prevalence figures are obviously very high when compared with the expectancy of autism in the general population. A 1964 British survey of children in Middlesex aged 8 to 10 years found that 4.5 per 10,000 children were autistic. Of these, 2.1 per 10,000 showed behavior "closest to that of Kanner's syndrome" whereas the other 2.4 showed autistic behavior but with less motor abnormality (Lotter, 1966).

In a survey of Wisconsin children by Treffert (1970), the classical infantile autism group showed a prevalence figure of 0.7 per 10,000, whereas the total child schizophrenia group, including autism, accounted for 3.1 per 10,000. In striking contrast, the prevalence rate in our rubella children would correspond to 412 per 10,000 for the core syndrome of autism and 329 for the partial syndrome, yielding a combined figure of 741 per 10,000.

We recognize that the diagnosis of autism requires rigorous justification. The condition is often loosely defined and overdiagnosed. Its etiology continues to be in dispute. Before defining our own diagnostic criteria, we will briefly describe our sample and method of investigation.

SAMPLE

We gathered behavioral data on 243 children (80% of an original sample) who had definitely been affected by rubella *in utero.* The study began when the children were approximately 2½ to 3 years of age. As of June 1970, most of the group (225, or 93%) were between 5 and 6 years old. There were 124 boys and 119 girls.

Their families represented diverse ethnic and socioeconomic backgrounds. One third of the children were either black (15%) or Puerto Rican (18%), and the remaining two-thirds were of white, non-Puerto Rican parentage. Major occupational categories of the fathers were: unskilled and semiskilled, 22%; skilled, 35%; clerical and sales, 19%; professional, 18%. Three-fourths of the mothers were classified as housewives; 7%, unskilled and semiskilled workers; 4%, clerical and sales; 7%, professionals.

The physical status of the children is presented in Table 1. The major defects are visual, hearing, neurological, and cardiac. Only one of every five children was without such defects while more than half had at least two areas of defect. Neurological status has been divided into hard signs, such as spasticity, and soft signs, such as clumsiness of gait.

Table 1
Physical Status

Physical status	Number	Percent
Number of defects		
Well (no defects)	50	20.6
One area of defect	62	25.5
Two areas of defect	47	19.3
Three areas of defect	45	18.5
Four areas of defect	39	16.1
Total	243	100.0
Type of defect		
Visual defects	80	32.9
Hearing defects	177	72.8
Neurological defects (hard signs)	107	44.0
Neurological defects (soft signs)	59	24.3
Cardiac defects	85	35.0

Note.—[N = 243].

METHOD

Psychiatric diagnoses of these children were based on three sets of observations:

1. Retrospective behavioral descriptions obtained from parents.
2. Direct examination of the children in a playroom (except for a number who were seen at home or at Willowbrook State School).
3. Review of behavioral descriptions obtained from schools or from previous medical examinations of the child.

Whenever possible, the child was seen alone by the examiner; if separation anxiety or physical frailty seemed likely to interfere with observation of a significant range of the patient's behavioral capacities, one or both parents were present in the playroom. The youngster was offered an opportunity to play with a variety of materials that were suitable for preschool children and that presented possibilities for both quiet and active occupation. The level, content, and characteristics of the child's play, verbalizations, and affective relatedness were recorded. All diagnoses were reviewed by this writer as the principal investigator.

The psychiatric diagnoses are shown in Table 2. Nearly one half of the children were designated as "without psychiatric disturbance." Reactive behavior disorder, due to external circumstances such as poor handling of a particular child, was identified in 37 (15.2%) of the children. The largest category of behavior deviance was mental retardation—91 children, or 37% of the sample. Since a general population of children would be expected to include about 3% of retardates, 34% of this series may be attributed to fetal rubella. Only 5 children were classified as having chronic brain syndrome, with or without mental retardation. It should be explained that this diagnosis was made according to behavioral rather than neuropathological criteria, that is, behavioral deviations that are a direct result of cerebral dysfunction. As the Baylor study indicates, if the diagnosis of chronic brain damage were to be based on the presence of chronic brain infection, this diagnosis would have to be applied to the great majority of cases of congenital rubella.

As Table 2 indicates, double diagnoses were used. Thus, some children were classified under both mental retardation and autism where these conditions coexisted. It will be noted that autism was identified in nine children with various degrees of mental retardation and in one child without mental retardation. Partial syndrome of autism was identified in one unretarded child, two retarded children, and one child with chronic brain syndrome and mental retardation.

Table 2
Psychiatric Diagnoses of Individual Children

Diagnosis	Number	Percent
No psychiatric disorder	118	48.6
Reactive behavior disorder	30	12.3
Chronic brain syndrome without mental retardation	2	0.8
Chronic brain syndrome with mental retardation	3	1.2
Mental retardation, unspecified	1	0.4
Mental retardation, borderline	7	2.9
Mental retardation, mild	7	2.9
Mental retardation, moderate	13	5.4
Mental retardation, severe	26	10.7
Mental retardation, profound	11	4.5
Autism	1	0.4
Partial syndrome of autism	1	0.4
Reactive behavior disorder + chronic brain syndrome with mental retardation	2	0.8
Reactive behavior disorder + mental retardation, borderline	2	0.8
Reactive behavior disorder + mental retardation, moderate	2	0.8
Reactive behavior disorder + mental retardation, severe	1	0.4
Mental retardation, unspecified + autism	2	0.8
Mental retardation, borderline + autism	2	0.8
Mental retardation, severe + autism	3	1.2
Mental retardation, moderate + autism	1	0.4
Mental retardation, profound + autism	1	0.4
Mental retardation, unspecified + partial syndrome of autism	3	1.2
Mental retardation, moderate + partial syndrome of autism	3	1.2
Chronic brain syndrome with mental retardation + partial syndrome of autism	1	0.4
Total	243	99.7

Note.—[N = 243].

Discussion

Since these figures suggest the possibility that autism has been confused with mental retardation—a not uncommon occurrence—it is appropriate to note that a recent study of 52 retarded children (Chess & Hassibi, 1970) did not yield a single case of autism. Indeed, a major conclusion of this study was a warning against the assumption that certain behavioral expressions in retarded children, such as stereotypy and repetitiveness, are necessarily signs of autism.

The major criteria for our diagnosis of autism derive from Kanner's classical description of children with disturbances of affective contact. Kanner delineated a group of children who from birth gave little evidence of ability to relate to people. Their verbal utterances were monotonously repetitive and did not convey meaning to others, though the children had good rote memory. They displayed an obsessive desire for maintaining sameness. While their capacity for spontaneous activity was limited, they could relate to objects and play happily with them for hours. Among other characteristic behaviors was the failure of such youngsters to look directly at people; they gazed to the side or focused beyond; they did not make visual contact with the eyes of the individual attempting to gain their attention. (The youngsters described by Kanner did not have sensory defect, their intelligence levels were generally normal, and there were no significant neurological findings.)

In the three decades since Kanner's original paper, concepts of autism have proliferated. The main trends are conveniently reviewed by Rutter (1968). Various investigators have pursued Kanner's description in different directions. Some have advanced a psychogenic hypothesis, and others have focused on organic etiology. Some view autism as a variety of mental subnormality, whereas others claim that autistic children are basically of normal intelligence. The research returns are not all in; therefore, nobody can claim a monopoly of insight. But the basic behavioral features depicted by Kanner have stood the test of time, especially the "extreme autistic aloneness," language abnormalities, stereotypic relations to the environment. The lack of affective human contact remains the primary sign.

Sensory Defects

Since our sample included so many children who were retarded and had multiple sensory disabilities, we had to be particularly careful to differentiate between children whose "aloneness" directly reflected these handicaps and those whose affective contact was inherently disturbed. One cannot judge by peculiar

mannerisms or ritualistic behaviors, since these may be exhibited by children who are simply retarded and by both autistic and nonautistic children with sensory lack. Generally it is assumed that mannerisms causing excitation of nerve endings, such as the photic stimulation of eyeball pressing or the vestibular stimulation of head shaking and of lying with head down, do not necessarily represent an actual preference for nonhuman over human relatedness. Given a choice, our nonautistic children prefer people to things.

It may be argued that the isolating effect of living in a world with muted light and muted or absent sound can play a part in creating interpersonal distance. Whether this is to be considered stress is unclear. Experimental deprivation of sensory experience in sensorially normal individuals has been stressful to the point of creating hallucinations. This finding, however, cannot be mechanically applied to our rubella children. The issue here is not that of going from a world of stimuli to one deprived of sight and sound, but of having from birth experienced less stimuli than the child with normal visual or auditory function. Where visual remediation (cataract removal plus glasses) or auditory support (hearing aids) has been provided, one notes a dramatic contrast in reports on autistic and nonautistic children. The latter, after a period of getting used to the devices, respond by spontaneously putting on glasses and hearing aids on arising in the morning, and removing them only on going to bed. When a battery wears out in a hearing aid, the child removes the device during the day, and this is often the first signal a parent has that the hearing aid isn't working. The autistic child, however, does not respond in this fashion. With him it is particularly difficult to test the degree of hearing impairment and to determine to what degree remediation is effective.

Another significant difference between the autistic and nonautistic rubella children with sensory defects is the use they make of alternative, relatively intact modes of experiencing. Nonautistic youngsters whose only sensory lack is hearing are very alert to their surroundings through their other senses, especially exhibiting visual alertness and appropriate responsiveness. Visually impaired children have similarly shown auditory and tactile responsiveness. Children with multiple handicaps may also be markedly responsive, not only through residual sensory capacity, but also through seeking of affectionate bodily contact. Some are shy, some slow to warm up, some perhaps wary; but one is impressed by their readiness to respond to appropriately selected and carefully timed overtures. In contrast, the autistic children neither explore alternative sensory modalities nor manifest appropriate responsiveness. They form a distinct group whose distance from people cannot be adequately explained by the degree or combination of visual and auditory loss, nor by the degree of retardation where

Table 3
Comparison of Defects with Affective Disorders

Defect	Autism	Partial autism	No affective disorder
Visual only	0	0	4
Hearing only	0	1	83
Retardation only	0	0	4
Visual + hearing	1	0	12
Visual + retardation	0	0	6
Hearing + retardation	4	3	19
Hearing + visual + retardation	5	4	45

this also exists. Moreover, whether retarded or not, their affective behaviors do not resemble those of children of their obtained mental age—in fact, there is no mental age for which the behaviors are appropriate.

The presence of sensory and cognitive defect does not in itself account for the number of rubella children who fulfill the criteria for autism. As Table 3 shows, children with similar defects, whether single or multiple, may or may not have an affective disorder. Nor does the degree of defect necessarily determine the affective contact achieved by the children. A severely retarded 3-year-old with severe hearing impairment may gurgle and kick in pleased response to being tickled. Yet a mildly retarded autistic 3-year-old with moderate hearing loss may endlessly manipulate the pieces of a puzzle, but acknowledge the presence of people only by poking at their eyes with a toy.

Communication

In the area of communication, also, the autistic children were different. In our study the autistic youngsters differed basically from the other sensorially impaired children in that they did not have a repertoire of gestures; they did not point; they did not pantomime; they were often absorbed in activities such as hand and head movements, sucking fingers, sucking clothes, and walking in circles.

Our other rubella children with profound hearing and visual loss also could not speak, but were able to communicate through gestures. They acted out, they pointed, they entered into a meaningful dialogue. Quite often they were extremely persistent about making sure that the other person had really understood what they wanted to express. Their whole body seemed to expect

tensely the right sign or action from the listener that would indicate comprehension; if they had doubts, they often repeated their gestures spontaneously.

Whereas parents of the autistic children talked about their child's inability to respond affectively—they often qualified their kisses as "mechanical"—the parents of nonautistic sensorially damaged youngsters said that, although the children could not talk, they were very affectionate and they and the parents derived mutual joy from this affection. Many of these children showed through meaningful actions their awareness of parents' likes and dislikes. Their level of sensitivity and compassion was often considered finer than that of older siblings.

The following two vignettes from psychiatric interviews are typical of rubella children judged to be autistic.

> Steven is 5 years 8 months. Physically he appears to be his stated age. He has a cataract in his left eye plus right eye rubella retinopathy. There is some question about the presence and degree of hearing loss. He functions at borderline intelligence. Steven did not respond to verbal or physical overtures by the examiner and had to be carried into the playroom by the psychologist, who had completed a testing session with him shortly before. The boy gave no sign of recognition or response to the psychologist, nor to his father, with whom he had been walking about in the other room. In the playroom Steven spontaneously reached for the nameplate pinned to the examiner's coat. When the examiner removed the nameplate and held it behind her, then dropped it into her pocket, Steven sought it in both places. He seemed unaware of the examiner and did not look directly at her. He then removed the toy cooking utensils from a compartment of the toy cabinet, placed them in the next compartment, and attempted to climb into the cubby hole. His motor control was good.
>
> Carried repeatedly to the play table, he finally attended to the form board, and quickly placed the 10 pieces in their recessed spaces. Although he made errors with several of the pieces, these were errors for which there was some basis—he tried to put a star into a triangular recess, a rectangle into a square—and he quickly corrected the error. The child then returned to his attempt to get the nameplate, looking first at its original position, then seeking it in the pocket where he had last seen it. At no time did he utter a word or sound, nor did he respond to his name or any verbal direction.
>
> Mark is a healthy appearing, chubby boy who appears to be of appropriate size for his age of 4 years 8 months. He has severe deafness and bilateral retinopathy and functions on a severely retarded level. His parents have described his ritualistic behavior and failure to communicate either by speech or gesture. He was first seen in the playroom, where he had run directly on entering the examiner's office. His mother explained that he had seen the psychologist there and had apparently remembered the blocks. When the examiner walked into the playroom, Mark was engrossed with bringing one block into position with another. He made almost continuous noises with his tongue protruding between his lips, producing a sound like an unending "Bronx cheer." When called loudly, he made no response. When his arm and leg were patted, he made no response. The examiner tried to lift Mark's bowed head by placing a hand under his chin, but the child resisted and would not look up. Mark paid no attention when a fire truck was put in front of him, but when the examiner reached down with a duck puppet, the boy immediately put his hand in the duck's beak for a fleeting moment. During the period of observation, when left alone, Mark did nothing but repetitively oppose the end of one block to the end of another. All this time he continued to make the noise with his lips and tongue. There was no change in facial expression.

Family Stress

It is of interest to examine the autistic rubella child in relation to his family, both in terms of his impact on their style of life and the attitudes they display toward him. In our study group, proportionately more children with autism caused family stress than did those without autism. An autistic child was more likely to alter the family's mode of life and effect their approach to training. Less than one-third of the autistic children were handled in a flexible and appropriate manner, as compared with one-half of the affectively normal though physically handicapped children. Overpermissiveness was the most pronounced characteristic of inappropriate handling. At this stage we can only offer data correlations, without attempting a conclusive judgment as to which factors were causative and which were derivative. Our conjecture is that the contrasting handling derives from the autistic child's behavior, and is not itself the cause of the behavior.

The two groups of families hold strikingly different opinions about the services available for their children. Such services were considered inadequate by 39% of the families with an autistic child, as against 17% of families with a nonautistic youngster. This difference in evaluation may be attributed to two circumstances:

1. Physical defects are visible, their nature can be clearly stated, and

remedial measures are specific. Autistic behavior can be puzzling, and professionals are divided both as to cause and remediation. Hence, parents of autistic children may be referred to inappropriate facilities with disappointing results.

2. Facilities for autistic children are not equipped to deal with youngsters having sensory loss, while those services ready to take the deaf or visually impaired child cannot handle such youngsters if they are also autistic.

Therefore, the family judgment accurately reflects the shortage of facilities for the rubella child who is both autistic and physically defective.

Despite the greater problems facing the families of autistic rubella children, there is no evidence that these children were more rejected. Nor were they viewed less realistically in terms of their physical handicaps. Of these families, 78% accurately identified their children's physical defects, as compared with 83% of the other families. There is thus no significant difference between the two groups in the perception or denial of the physical consequences of congenital rubella.

Maternal attitudes toward these children can, of course, be most complicated. The child's defect is directly due to an illness of the mother, "passed on," so to speak. In many cases an offer of abortion had been refused by the mother. This background clearly creates the possibility that the mother will have irrational feelings of guilt and manifest contradictory rejection and overprotection. The hypothesis of the "schizophrenogenic" mother had to be considered.

The mothers of the autistic children, however, did not differ as a group from the mothers of the nonautistic children. In one instance, on a repeat observation of an autistic youngster 2 years after the initial visit, the younger brother, age 18 months, was present. As the little one behaved in an outgoing, highly related way, the mother remarked, "You have no idea how much pleasure I get from him." She had earlier remarked about her rubella child, "It is very hard to keep trying to make a relationship with a child who doesn't know you exist."

Etiology

The high prevalence of autism in this series of 243 children with congenital rubella inevitably raises the vexed question of the etiology of childhood autism. Our study did not attempt to probe this question, and the present report does not intend to offer a conclusive judgment. Nevertheless, there is an inescapable implication in the data. Our findings would appear to support the argument in favor of an organic etiology as against other lines of inquiry.

On the negative side, we found no evidence to support the psychogenic hypothesis, including the postulate of a schizophrenogenic mother or "refrigerator parents." Nor did genetic components appear implicated, though we made no systematic genetic search. The diversity of families in the sample argues against the possibility that vulnerability to autism is greater in certain socioeconomic groups than in others. The striking individual differences among the retarded children in the group contradicts the speculation that autism is simply a variety of mental subnormality. Any sensory defect in itself cannot explain the autism, in view of the pronounced differences between children with similar handicaps.

The common denominator in our sample is that all the children were at risk for prenatal invasion of the CNS by rubella virus. It seems reasonable to speculate that the common component in our autistic children is brain damage.

This hypothesis is in keeping with the findings of the Baylor University study (Desmond, et al., 1967; 1970). In this most detailed investigation of the neurological aftermath of congenital rubella, 8 of the 64 children surviving at 18 months were characterized as autistic. This ratio of autistic to nonautistic rubella children is even higher than in our series. The Baylor study found a wide range of CNS damage in rubella children. The Johns Hopkins group reported CNS dysfunction in 8 of 33 patients. Rubella virus was recovered from the spinal fluid and brain tissue of several rubella children who died (Hardy, Monif & Sever, 1966). Our findings are consistent with other current studies that have made neurological assessments of autistic nonrubella children. A survey of 25 autistic children in Western Australia noted that 21 (or 84%) showed some evidence of encephalopathy, and 13 (56%) had unequivocal evidence of organic brain disease (Gubbay, Lobascher, & Kingerlee, 1970). The diagnosis of autism was made according to the "nine point" guide of Creak (1961). All 25 children were retarded.

In Bender's series of 50 autistic children, 28 (or 56%) had organic disorders; and 10 of these 28 had congenital defects (Bender, 1970). Yet even this may not tell the whole story, since Bender notes that the early histories were inadequate for 10 children without apparent organicity and that "The lack of such a history, of course, is not conclusive that some pathology might have existed during pregnancy, birth, or early infancy, either unknown to the parents or not reported by them." Intelligence among the 50 children was low.

In our series, the existence of congenital disorder is unequivocally established. The exact mechanism by which organic damage manifests itself behaviorally as autism remains to be determined. But the association between congenital rubella and autism is striking. One is led to wonder to what extent this

link was ignored in the past, especially before the 1964 epidemic made pediatricians and child psychiatrists more aware of the sequelae of rubella.

Certainly it would appear, in view of our findings, that clinicians dealing with autistic behavior in children should routinely inquire whether the mother had rubella during her pregnancy.

Summary

In a behavioral study of 243 children with congenital rubella a high prevalence of behavioral disturbances was found. Ten children were diagnosed as autistic and an additional eight were found to show partial syndrome of autism. These findings are considered in relationship to the psychiatric picture of the group as a whole and also in comparison to prevalence data from other studies. The autistic rubella children were also compared with the nonautistic rubella children with matched physical impairment. Our findings would appear to support the argument in favor of an organic etiology as against other lines of inquiry.

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