CHILDREN WHO EAT NOXIOUS SUBSTANCES

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Interest in pica has been growing in recent years, largely because of the number of children who acquire lead poisoning. Pica, the habitual ingestion of noxious substances, has been found to be more common than previously supposed, particularly among children of low-income families. Greenberg and his associates (1958) have described the close relation of lead poisoning to pica and suggested that an inquiry into pica be part of the well-baby examination, and that a test for lead poisoning be given to all children reported to have pica. Harrison (1956) found that most cases of childhood lead poisoning occur in children aged fifteen to thirty-six months, who live in the slums. He believes that young children normally explore their environment by mouth and that the ingestion of lead occurs by chance and only because old paint and paint embedded in old plaster are readily available to children who live in dilapidated old houses. He suggests that the harmful effects of pica can be controlled by slum clearance. This hypothesis has been supported by Griggs, who indicated in a personal communication that he found pica to be less prevalent in low-income children who had moved to new housing projects.

Cooper (1957) investigated the presence of pica in children over six months of age who were brought for child health services to a

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Baltimore clinic. Pica was present in 98 of 784 children she investigated, an over-all incidence of 21.9 per cent. The incidence was higher among Negro than white children. She found that the habit was characteristically established in the second year of life and usually disappeared spontaneously by four or five years. When she compared the characteristics of children with and without pica, she found no difference in I.Q. Children in the pica group, however, were somewhat more neurotic, and much more likely to be ill, physically defective, or have feeding problems. She believed poor nutrition to be the underlying cause of pica and postulated the ingestion of lead as incidental to the child’s need for substances found in plaster.

Kanner (1957) described pica as mostly encountered in malnourished, poorly supervised, and otherwise neglected children. In a series of 30 cases, all from low-grade homes, half of the children were severely retarded and almost all were of lower than average intelligence. He suggested that lack of affection had possibly forced the children to derive satisfaction from overeating miscellaneous substances when real food was not available or where general inanition might have driven some to stuff themselves.

Lourie et al. (1958) describe pica in some children as a deficiency disease related to a lack of satisfaction of oral dependency needs. In other children, oral gratification is used to alleviate anxiety.

Thus, we see pica described as part of normal development, as due to nutritional lacks, and as characteristic of retarded and emotionally deprived children.

An unusual opportunity to gain insight into the origin of pica was presented during a longitudinal study of the development of premature infants. In this study, which we have reported elsewhere (Freedman et al., 1960), more than 500 premature infants have been followed since birth by means of periodic neurological, psychological, and physical examinations, and by the systematic collection of social information. The population is homogeneous, almost all coming from families of very low socioeconomic status. Most of the children are Negro, though white and Puerto Rican children are also included. All of the children had first been examined a few hours after birth, and since then at regular intervals. At each examination, social, psychological, neurological, and pediatric information was recorded on data sheets and punched on IBM cards.
The focus of our study is the detection of brain injury and its relation to neonatal history. We became interested in pica only because lead poisoning resulting from the ingestion of paint in plaster was a fairly frequent cause of brain injury and of death in children on the Pediatric Service of the Kings County Hospital. These children were drawn from the same socioeconomic group as the majority of our premature infants. Since it was important for us to identify any possible cause of brain damage in our premature population, it became necessary to take pica into account. Therefore, when the premature child was seen at two and a half years of age and a complete battery of examinations was administered, an inquiry was made as to whether the child habitually ate any objects other than food.

In an analysis of the causes of morbidity in a population, the validity of the conclusion is greatly enhanced by the availability of dependable premorbid information and by the existence of a control or comparison group, on whom similar information is available. It is one of the very great contributions of a longitudinal study that independent observations are made and recorded over a period of time; moreover, when a new line of inquiry suggests itself, it becomes possible to review the information which has previously been gathered without reference to the present problem.

Our study of premature infants presented such an opportunity. In this paper we present data relating to pica and its possible origins in a group of 272 children born prematurely.

Present Procedure

All children were returned for observation when they were between thirty and thirty-three months old. All subjects were single births and had weighed less than 2100 grams at birth. Each child was examined by the psychologist and the pediatrician, and the mother was interviewed by the social worker. In the interview, the mother was asked about the child’s ability to feed himself, his use of a bottle, and whether the child had any feeding problems. She was then asked whether she had ever seen the child eating dirt, plaster, or any object other than food. If the mother described the child as having occasionally or accidentally eaten a foreign substance, the child was not considered to have pica. Only if the mother reported that the child habitually and with intent ate and swallowed substances other than food did
we describe the child as having pica. Of 272 children, 59 (21.7%) had pica. This percentage is almost identical with that reported by Cooper. Substances eaten included paint, plaster, garbage, paper, dirt, matches, tobacco, starch, and feces. Most of the children ate more than one substance, and many were reported as eating “anything.”

Pica was found in all three ethnic groups, but was least prevalent among the Puerto Rican children. The incidence was slightly higher among Negro children as compared to white. In all three ethnic groups, pica was more often found among girls than among boys, although the difference between the sexes was not statistically significant.

**TABLE I**

**INCIDENCE OF PICA IN PREMATURE CHILDREN**

Aged 30 to 33 months (single births only)

<table>
<thead>
<tr>
<th></th>
<th>Negro Male</th>
<th>Negro Female</th>
<th>White Male</th>
<th>White Female</th>
<th>Puerto Rican Male</th>
<th>Puerto Rican Female</th>
<th>All male</th>
<th>All female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>92</td>
<td>124</td>
<td>11</td>
<td>22</td>
<td>9</td>
<td>14</td>
<td>112</td>
<td>160</td>
<td>272</td>
</tr>
<tr>
<td>Percent with pica</td>
<td>18%</td>
<td>25.8%</td>
<td>18.2%</td>
<td>22.7%</td>
<td>0%</td>
<td>21.4%</td>
<td>16.9%</td>
<td>25%</td>
<td>21.7%</td>
</tr>
</tbody>
</table>

All the children who ate plaster or paint were given laboratory tests for lead poisoning; six of the fifty-nine, all Negro children, were found to have lead poisoning. Of these one was brain damaged.

For purposes of comparison, we matched each of the children with pica, whom we will call the experimental group, with the next-born study child of the same sex and ethnic group who did not have pica, the controls. Data on physical, emotional, psychological, neurological, and social status, collected for the longitudinal study on prematurity, were collated separately for the experimental and control group, and differences between the two groups were statistically compared.

**FINDINGS**

Since we found no important difference between the three ethnic groups and since the Negro population was the largest and most homogeneous, our discussion will be confined largely to the forty-nine Negro children with pica and a comparison group of forty-nine Negro children without pica.

**Neonatal Insults**

In this small population we found no statistical evidence that ex-
treme prematurity, high serum bilirubin levels, high weight loss, or extreme hypoxia as isolated insults in the neonatal period were more characteristic of the experimental than of the control group.

However, when we constructed a risk group of those with the following characteristics: birth weight of less than 1250 grams, neonatal hypoxia, loss of more than 12 per cent of body weight, and high peak serum bilirubin levels, we found that eighteen of the experimental group and twelve of the control group were in the risk category. The differences were in the expected direction, but were not statistically significant.

Social Class and Characteristics

Our population has previously been described as belonging to the lowest socioeconomic class in New York City (Wortis et al., 1961). Characteristically, the mothers were born in the rural south and were migrants to New York. Most of the mothers had completed eight years of school and worked as factory or domestic workers, one third were unmarried. Most of the fathers were also unskilled workers from the south. Almost all of the children lived in crowded homes located in a segregated slum area.

Our pica group rated somewhat lower in social status than the control group. In an index of family disorganization and stress at the time of the child's birth, the mean for the experimental group was lower than for the controls. These differences between the experimental and control groups in social class and family disorganization were not statistically significant when compared by the use of the t test, though in the male the differences approached significance.

| TABLE II |
| --- | --- | --- |
| **Premature Negro Children With and Without Pica** |
| Mothers' Social Status | Mean Score |  | Total |
|  | 0 = worst score | 4 = best score |  |
| Pica | Female | 1.81 | 1.73 |
| No pica | Male | 2.12 | 1.71 |

Comparison of the two groups of mothers in regard to education,
age, place of birth, and length of time in New York City disclosed no
differences between the two groups.

Status at L Year

When the children were between twelve and fifteen months old, they had been given the Cattell Test of infant intelligence and had been scored for motor development using items from the Gesell Test. The experimental group rated lower than the controls in motor development (D.Q.). On the Cattell Test, the mean scores of the experimental group, both male and female, were lower than the controls. In the Cattell Test, the difference between the two groups was statistically significant at the 5 per cent level, using the chi² test.

TABLE III

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pica</td>
<td>85.2</td>
<td>94.0</td>
<td>91.4</td>
</tr>
<tr>
<td>No pica</td>
<td>97.5</td>
<td>103.6</td>
<td>101.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Male*</th>
<th>Female*</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pica</td>
<td>84.0</td>
<td>96.6</td>
<td>93.1</td>
</tr>
<tr>
<td>No pica</td>
<td>93.2</td>
<td>100.1</td>
<td>97.8</td>
</tr>
</tbody>
</table>

*Chi square=3 P=.05

Status at Two and a Half Years

At two and a half the children again received psychological, pediatric, and social ratings. At this age we found no significant differences between the two groups in mean height or weight. Intelligence was again measured by the Cattell Test of infant development, and the experimental group again had lower mean scores, although the difference was not statistically significant.

A composite score was constructed in which the child was rated for the presence of deviant behavior. This combined score included the following items: eating difficulties other than pica, sleep disturbance, absence of bladder and bowel control, rocking, and bad temper. A greater degree of deviant behavior was shown by the experimental
group. The difference between the groups was statistically significant at less than the .05 level, using the analysis of variance.

A composite score was also constructed which rated the quality of care the child received and the family organization at this age. Included in this rating were family intactness, the number of caretakers responsible for the child, the presence of social pathology in the home, and maternal rejection of the child. Our pica group rated lower in quality of care, the males especially appearing to live in worse social situations. The difference in scores in the males was statistically significant at the .05 level when measured by the t test.

Rating scores, based on the mother's description of the child, showed no difference between the experimental and control group in a rating of "neurotic behavior" and "adjustment," which were derived from Frances Graham's Scales (Graham, 1958). However, six of the pica group scored as "brain damaged" in the score as compared to one in the control group.

**TABLE IV**

**MEAN SCORES OF CHILDREN WITH AND WITHOUT PICA AT TWO AND A HALF YEARS**

<table>
<thead>
<tr>
<th></th>
<th>I.Q. (Cattell Infant Intelligence Test)</th>
<th>Score of Deviant Behavior (0 = best 5 = worst)</th>
<th>Score of Family Organization and Quality of Care (0 = best score 5 = worst)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male*</td>
<td>Female*</td>
<td>Total*</td>
</tr>
<tr>
<td>Pica</td>
<td>78.6</td>
<td>91.8</td>
<td>87.2</td>
</tr>
<tr>
<td>No pica</td>
<td>83.8</td>
<td>96.8</td>
<td>92.2</td>
</tr>
</tbody>
</table>

*P = less than .05

At the two-and-a-half-year examination, all children were scored in relation to presence or absence of brain damage. Children with no
evidence of brain damage or soft signs only were scored 0 or 1. Children with hard signs of neurological damage, i.e., motor difficulty probably or certainly of central origin, were scored as 2 (probable brain damage) and 3 (brain damage). The scores of three children were deferred pending tests of hearing or vision. Thirty-seven of the experimental group and forty-seven of the controls had scores of 0 or 1. Four children had scores of 2 (probable brain damage) all of whom had pica, and seven had scores of 3 (brain damage) six of whom had pica. Only one child in the control group was described as brain damaged. This severely damaged child with spastic cerebral palsy was described as chewing but not swallowing paper.

Since the number of brain-damaged children was so high in our experimental group, we decided to review the brain-damage scores of all children whom we had seen at two and a half years. We found that in the 272 premature children who had been examined, 39 had brain damage. Twelve of these were in our experimental group.

Using the t test to compare the mean scores of brain damage in children with and without pica, we found a highly significant difference (p = less than .01) between the two groups, the children with pica being much more likely to be brain damaged.

Maternal Attitude

It should be noted that in the interview at two and a half years, the problem of pica was almost never raised by the mother herself, even though she was given a chance to express concern about the child’s eating habits before we asked about pica. Characteristically, the mother thought that eating dirt or plaster was normal behavior in children of this age and that the child would outgrow it as he became older. Cooper (1957), whose population closely resembled our own, found the same maternal attitude. Indeed, in our score of maternal anxiety, the mothers of the experimental group showed somewhat less anxiety with regard to the child than the controls, although the experimental group contained almost all the severely damaged children and more of those with behavioral anomalies.

In the poor social situation in which these families lived, it was apparent that children were often without adequate adult supervision and control. Children were often left in the care of older siblings or with indifferent adults. Some children were openly rejected. One of
the mothers of the experimental group had been previously known to us as a completely rejecting mother who had made attempts to rid herself of the child. This little boy, who was the one child described as eating feces, died of a head injury shortly after our interview at two and a half years.

**Discussion**

Our material suggests that pica in a two-and-a-half-year-old child may derive from a combination of biological and social causes. Such a child belongs to a social group where there is almost uniformly poor housing, where close supervision of childhood activities is difficult to achieve, and where there is apparently no strong cultural taboo about the dangers of indiscriminate eating. In addition, the child with pica has more disadvantages than his peers in almost every comparison we were able to make. Not all the differences were of statistical significance, but all were in the same direction. The neonatal course was more stressful, the social status was lower, and at one year intellectual and motor development was slower. At two and a half the family situation was worse and the child with pica was slower intellectually. The behavior of the child with pica was more likely to be deviant in many ways; he was more often reported to show body rocking or to have a bad temper, sleeping difficulties, or food problems other than pica. Finally, there was greater likelihood of finding signs of severe brain damage which antedated the development of pica.

Infants normally explore their environment by conveying objects to the mouth. Exploration by mouth increases sharply when the infant begins to crawl and new objects become available. When the hands are released from locomotion and the child is moving around freely, the control of pica is primarily dependent upon the amount of supervision and direction he receives. The infant learns the difference between food and not-food, between permitted-eating and not-permitted-eating through teaching and admonition. "No!" "Don't touch!" "Spit it out!" "Dirty!" These simple commands directed at teaching the child to discriminate are usually repeated over and over again by the concerned mother. The child is taught to discriminate, and the rejection of non-edible substances begins as learned behavior, based largely on the continuity and persistence of maternal teaching. This kind of teaching is obviously lacking in our group.
However, other factors than maternal control and concern are operative. An inner process of growth and maturation is going on which also reduces the child's interest in the exclusively oral exploration of the environment. As he grows, the child no longer relies entirely on satisfactions derived by mouth, but responds more to sounds and to visual stimuli. He begins to manipulate objects, to engage in imitative play, and to use his progressing motor abilities to explore the environment. He increases his ability to discriminate size, colors, texture, and taste. This process of internal growth does not have a uniform pace. The normal sequence and rate of biological maturation are not identical in all children. The rate of motor and intellectual growth is obviously slow in some children and accelerated in others. Development may also be delayed by injury to the brain which impairs the child's ability to see, hear, or respond to tactile stimuli, or to move in his environment. Emotional disturbance, whether due to brain damage or to environmental influences, in the form of nonaffectional relations to adults, or anxiety and apprehension due to other stresses, may fix the child in an infantile pattern of behavior and establish a continuing need for oral gratification of a primitive kind. It is possible that in this social group the need for nutritional supplement may indeed be a factor in the child.

Finally, the interrelation and combination of social and biological factors again raises the question, often raised before, whether the brain-injured child is more reactive to noxious environment than others. It may be that such a child has a lowered emotional threshold as a result of cerebral disorganization and in consequence is more affected by environmental stresses.

**Conclusion**

In a group of 272 children of low social class, born prematurely, the incidence of pica was determined. Data on neonatal difficulties which might predispose to brain damage and on the rate of motor and mental development, the physical and neurological status, the child's behavior and the socioeconomic situation both before and at the time information on pica was elicited, were available on these children.

The child manifesting pica tended to suffer more neonatal insults and to be slower in motor and mental development, to show more neurological defects, to have more deviant behavior, and to have
poorer living conditions than did a control group from the same premature population who did not have pica. These differences between the pica and control group were present both prior to and at the time of the development of pica. Some of these differences were shown to be statistically significant. A relationship of pica to previously existing brain damage is apparent.

It appears that the occurrence of pica is not related to one factor only but is the result of a combination of social and biological factors. The question is again raised whether the child with brain damage may be more reactive to a noxious environment.

**Schematic Description of Pica As a Behavioral Anomaly in Children**

The following stages in the child's development are not isolated and separate from each other but overlap and may be coexistent. The age is given as an approximation of the time when new stages of development appear.

**Age Six Months to One Year**

Indiscriminate sucking and mouthing of objects is normal infant behavior. The infant reaches out, grasps, and conveys objects to his mouth. When he starts to walk, his environment is extended, objects become more available for mouthing, and his hands are free to bring objects to his mouth. Mouthed objects may be food or nonfood (pica). The ingestion of noxious objects is normal infant behavior.

**Age One Year to Two Years**

Pica ceases as a result of *learned behavior*. Through repeated admonition, the infant is taught to reject objects other than food.

Pica ceases as the child's *biological development* progresses. Oral exploration of environment decreases, and responses to visual and verbal clues increase as the organism develops.

**Age Two Years to Three Years**

Pica ceases as child's perceptual acuity increases. Differences are perceived between objects: food and nonfood. The development of vision, taste, hearing, and touch is involved.

Pica persists where development has been interfered with and where the factors previously described have not operated. Deficiencies in one or all aspects of development may be involved. The young child with pica may be untaught, may have difficulty in learning, may have
poor perception, or may be emotionally disturbed. All of these developmental lags may be environmentally determined or the result of brain injury.

REFERENCES

GRIGGS, R. Personal communication.