Relationship between Pica and Iron Nutrition in Johannesburg Black Adults

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SUMMARY

On direct questioning by a Black staff nurse, 23% of 348 consecutive unselected adult outpatients attending the Johannesburg Non-European Hospital said that they regularly ate earth or ash. The prevalence was higher in the women (33%) than in the men (11%), and in 50 women with minor gynaecological complaints who were interviewed by a Black psychologist, it was 72%. The quantity eaten varied from an occasional tablespoonful to several handfuls a day. In an attempt to define the reasons for the habit a thematic apperception test was used. A strong association with pregnancy was identified, but the explanation for this was not established. Some subjects claimed that the material was eaten for medicinal purposes, while others merely liked the taste. The effect on iron nutrition appeared to be variable, depending on the iron-binding capacity of the soluble iron content of the material consumed.

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The eating of non-food material (pica) has been known to the medical profession since the time of Hippocrates, and has been observed in many different countries.[1,2] The range of substances which might be consumed is wide, and includes earth, clay, pebbles, laundry starch, ice, wall plaster and charcoal. Pica has been observed in both sexes and at all ages, but is particularly common among children and pregnant women. There is some evidence that it is most prevalent among adults when the socio-economic circumstances are poor.

An association between pica and anaemia has long been noted, but the reason for the association is still controversial. It has been suggested that iron deficiency in some way predisposes to pica. In keeping with this view is the experience of several workers that the habit is cured by the administration of iron.[3-5] On the other hand, others believe that the pica is the initial event, and that the ingestion of the foreign material leads to anaemia. Support for this concept is provided by the demonstration that certain clays markedly reduce the absorption of iron.[6] These clays adsorb inorganic iron *in vitro*, but other clays do not do so to any significant extent. The effect of pica on iron nutrition would therefore be expected to depend upon the iron-binding properties of the particular material consumed, which is typically constant for each individual. If pica is not the result of iron deficiency, the reason for its practice by adults is obscure.

There have been several descriptions of adult pica in Central and Southern Africa. David Livingstone discussed at length the eating of earth or clay, especially from the walls of the huts, by the people he encountered during his travels. He observed it among the rich as well as the poor and the slaves, and it could not be ascribed to shortage of food. Gelfand[7] has reported his personal knowledge of the custom in Rhodesia, Zambia, Malawi, Mozambique, Zaire and in the countries further north.

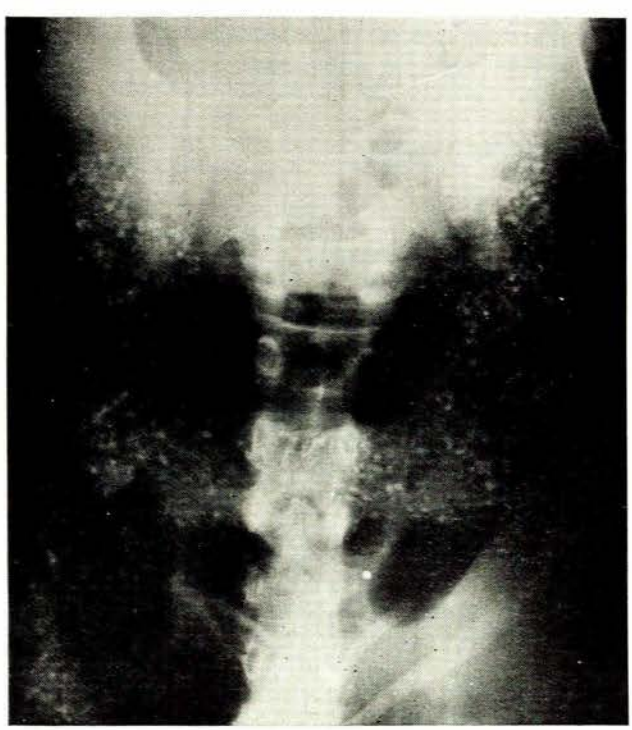

Fig. 1. Plain radiograph of the abdomen of a woman with iron deficiency anaemia who stated that she consumed at least a cupful of earth a day. Radio-opaque material is visible within the bowel.

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Interest in the subject of pica was aroused by two Black women with iron deficiency anaemia which could have been ascribed to their daily consumption of at least a cupful of earth (Fig. 1). In spite of investigation no other cause was uncovered, and after they had been treated with iron and had given up the geophagia, the haemoglobin concentration remained normal during the following three years. On inquiry it seemed that the eating of earth or ash might be a fairly common practice among urban Black adults, and since there did not appear to be any definite information about its prevalence, the present study was undertaken. The relationship (if any) of the habit to iron nutrition in this group was also of interest, as were the reasons behind it.

PATIENTS AND METHODS

Adult Black patients attending the Outpatient Department of the Johannesburg Non-European Hospital were studied. This hospital serves the northern suburbs of Johannesburg, and a high proportion of the patients are employed in domestic service or in commerce.

Preliminary Survey

Three hundred and forty-eight successive unselected outpatients were interviewed by a Black staff nurse. The name, age and sex of each individual were recorded, and if pica was admitted, the nature and quantity of the material eaten was noted, together with the reason for the habit and its frequency and duration.

Motivation in Women

In a second study, 50 women were selected from the gynaecological clinic for more detailed investigation. Individuals with malignant neoplasms, acute infections or 'medical' conditions such as diabetes or cardiac failure were excluded. The group remaining comprised 18 women complaining of infertility, 13 with chronic pelvic infections and 19 with menstrual disorders. Their ages ranged from 19 to 55 years, with a mean of 34,0 years. Two or three women were interviewed individually each day by a Black psychologist using the patient's home language. The patient was not told the purpose of the interview, which was to apply a thematic apperception test. After a brief medical history had been taken, three pictures specially drawn for the study by a Black artist were shown in turn to the patient, who was invited to tell a story about each. The pictures were intended to be sufficiently indefinite so that the subject could respond from her personal experience, rather than simply describe an event unequivocally portrayed. In this way it was hoped to gain insight into both the motivation for the pica and any emotional connotation. It was essential to avoid any mention of pica before obtaining the subject's reaction to the pictures, and not to ask leading questions during the interview. The interviewer therefore used only non-specific prompting such as 'How does she feel?' or 'What do you think she will do after this?'. The stories were written down in full by the interviewer as they were told.

In the first picture a woman is bending in front of a stove. A tray has been pulled out at the bottom of the stove, and she is reaching into the tray with a spoon. In the second picture a woman is scraping between the bricks of a building with a stick, her other hand being placed so as to catch the loosened mortar. In the third picture a pregnant woman is bending down, and possibly scooping earth from the ground with her hand. The pictures were always shown in this order, since only in the third picture was the woman visibly pregnant.

After completing the thematic apperception test the subjects were asked whether they had at any time eaten earth or ash, and if so how much, why they did so, and whether it was related to pregnancy in any way. Finally, blood was taken for haemoglobin estimation.

Iron Absorption Study

Six women who were habitual ash-eaters and 5 who were earth-eaters volunteered for the study. Each was asked to bring a supply of her favourite material. After an overnight fast they were given 10 mg iron as ferrous ascorbate, labelled with 30 μCi ^{59}Fe and dissolved in 50 ml distilled water. Nothing else was ingested for the following 4 hours. That night they fasted again, and the next morning were given a similar dose of ferrous ascorbate, but on this occasion it was labelled with 5 μCi ^{59}Fe and was followed immediately by either 100 g ash or 250 g earth from their own supplies. Fourteen days later a specimen of blood was collected. The haemoglobin concentration, serum iron concentration and iron-binding capacity were estimated, and 10 ml was prepared for differential measurement of radioactivity by the method of Katz *et al.*[9] A Packard Tri-Carb spectrometer was used, and the percentage absorption of each isotope was calculated on the assumption that all the absorbed radioactivity was present in circulating haemoglobin, and that the blood volume was 65 ml/kg.

Soluble Iron Content of Earth and Ash

Seven samples of earth and 2 of ash were investigated. Five grams were incubated in 50 ml 0,1N HCl at 37° for 30 minutes. After centrifugation the concentration of iron in the supernate was determined by the sulphonated bathophenanthroline method.

Chemical Methods

Haemoglobin concentration was determined by the cyanmethaemoglobin method. The serum iron concentration was estimated by a modification of the method of Bothwell and Finch,[10] and the unsaturated iron-binding capacity by the method of Herbert *et al.*[11]

TABLE I. EFFECT OF PICA ON ABSORPTION OF RADIO-IRON

Material eaten	Daily quantity (tablespoonfuls)	Duration of habit (years)	Hb concentration (g/100 ml)	Serum iron concentration (μg/100 ml)	% saturation	% absorbed	
						Control	With ash or earth
Earth	30	10	10,1	25	6	21	11
,,	4	15	9,5	33	8	34	15
,,	5	25	12,3	55	15	12	4
,,	3	(only when pregnant)	14,4	63	20	16	9
,,	5	8	13,9	84	24	4	1
Ash	1	(only when pregnant)	14,4	84	23	9	0
,,	3	10	13,7	64	20	16	1
,,	5	15	13,7	94	25	23	26
,,	15	8	14,9	81	22	13	11
,,	10	11	12,1	88	29	17	13
,,	5	1	13,4	62	15	0	7

RESULTS

Preliminary Survey

Twenty-three per cent of the 348 unselected outpatients admitted to eating either earth or ash. The earth was obtained from neighbouring gardens or from excavated building sites. Red earth was usually preferred, small lumps being chewed, and small stones were often eaten as well. Ash was typically obtained from anthracite heaters or coal stoves, sifted and crushed to a fine powder.

The practice was commoner in females, but 10 of the 151 males ate earth and 8 ash, giving an over-all incidence of 11%. Only 2 males consumed as much as a tablespoonful per day, however, whereas 15 of the 197 women ate at least a tablespoonful a day, and a further 11 as much as 6 tablespoonfuls or more. In 33 other women the quantity was small or the practice intermittent, and here a clear relationship to pregnancy emerged. Eighteen women practised pica only during pregnancy, while others reported that the amount of earth or ash eaten increased when they were pregnant. All told, 29 women ate earth and 30 ash, a combined incidence of 33%.

While a few individuals ate ash for religious reasons, in most the motivation was not very clear. Many said simply that they liked the taste, the smell, the colour or the texture of the earth or ash. Some claimed that the upper gastro-intestinal symptoms of pregnancy were relieved, or the fetus strengthened. A substantial number could not (or would not) give any explanation for the practice.

Motivation in Women

In response to the direct question asked (after the thematic apperception test had been completed), 23 of the 50 women admitted that they had eaten earth, 14 that they had eaten ash and 4 both earth and ash, while only 8 claimed never to have eaten either. However, 6 of the 42 women who admitted to pica had abandoned the practice, 3 of them in childhood; there were thus 36 who could be classed as active. Most notable among these were 2 individuals who said that they consumed a handful, one of earth and the other of ash, several times a day, and another 5 who ate tablespoonful quantities up to four times every day. Tablespoonfuls were eaten once or twice a week by a further 8 subjects, and smaller amounts less frequently by 12. The remaining 9 women practised pica only when pregnant.

The motivation in most cases was not clear from the direct questioning, although the association with pregnancy was obvious. In addition to the 9 who ate earth or ash only while pregnant, there were 5 women who had begun the habit during pregnancy but had then continued after delivery, making 14 subjects in all. Thirteen women said that they ate ash for its medicinal properties; it was claimed to be effective for the relief of heartburn, and by some also for non-specific aches and pains. The remaining 9 offered no explanation other than that the aroma or the taste were enjoyable.

The thematic apperception test provided some additional information, although the intentional ambiguity of the pictures was confirmed by the fact that the majority of the women invented stories which did not include pica. Some of those to whom the pictures did suggest ash- or earth-eating clearly associated the practice with pregnancy. A number of subjects said that the women depicted in the first two pictures were pregnant, although this could not be deduced from the shapes the artist had drawn, and that they were going to eat ash or sand respectively. It seemed particularly significant that this was said by two women who later stated that their own reason for eating ash was medicinal, and not related to pregnancy, and also by two women who claimed never to have eaten either ash or earth. One of the latter said of the first picture . . . 'This is a stove and the woman is cooking. She is taking a coal out of the ash pan. Some people like eating ash. In fact, she is scooping ash out to eat it. She might be pregnant, and just feels like eating ash — very delicious. She is very happy because of the ash she has

been eating: she is satisfied.' The same subject said in response to the second picture . . . 'These are bricks and this woman feels like eating the sand from the bricks. She is scraping a brick in order to get sand. She is pregnant and feels like having sand. It's just an urge because some people yearn for funny things when they are pregnant. She will go into the house, eat the sand she has scraped, and come back when next she feels like having sand. She will stop eating it after the child is born.' Another woman who stated that she herself did not eat earth, but that she lived with people who did, said of the second picture . . . 'She is scraping sand from the wall. It seems as if she's going to eat the sand. If she was in the rural areas I'd say she's eating because everyone does so. Now this is a house of the town type, so she must be pregnant and just feels like having sand. She has just conceived and it rained and now she can't resist the aroma. She'll eat the sand and go away satisfied.'

Apart from the association with pregnancy, the thematic apperception test provided some support for both the other two explanations that had been advanced by the subjects in response to the direct questions. Four women who claimed that they ate ash for therapeutic purposes said that the woman in the first picture was going to eat ash because she had heartburn, or hiccoughs. Two others who said that they liked the taste or the aroma, invented stories with this as the reason why the woman in the picture was eating ash. Finaly, 4 of the women said that the women in the pictures must be mad because of what they appeared to be doing, but the significance of this is debatable.

The woman who ate a handful of ash four times a day had a haemoglobin concentration of 8,7 g/100 ml, and the woman who ate a handful of earth twice a day, 11,2 g/100 ml. In all the others the haemoglobin concentration was 12 g/100 ml or more, the mean figure being 14,6 g/100 ml.

Iron Absorption Study

The results are set out in Table I. All 5 geophagists absorbed less isotope when the labelled iron was ingested with earth ($t = 3{,}65$, $P<0{,}05$), but in only 2 of the 6 ash-eaters was this the case ($t = 1{,}8$, $P>0{,}1$).

Soluble Iron Content of Earth and Ash

The concentrations in the 7 samples of earth varied widely, from 10 μg/g to 480 μg/g. In the 2 samples of ash it was 200 μg/g and 430 μg/g.

DISCUSSION

Because pica has been reported from other parts of Africa, as well as from countries such as the USA,[12,13] Iran,[14] Turkey,[15] South America[3] and India,[1] its occurrence among Johannesburg Black adults was not surprising, but the prevalence found in the present study was unexpectedly high. Among the 50 women with minor gynaecological complaints it was 72%. While this figure may possibly be higher than in the Black female population as a whole, since this was a highly selected group, the incidence of 33% found in the unselected female outpatients may well be an underestimate: if these women had, like the selected 50, completed the thematic apperception test before discussing the subject of pica with a trained psychologist, more of them might conceivably have admitted to the habit than did so in response to simple direct questioning by a staff nurse.

In both the preliminary survey and the detailed inquiry among the selected group, there were some women who said that they ate earth or ash only when they were pregnant, while others increased their intake at such times. In addition, the thematic apperception test revealed that pica and pregnancy were linked in the minds of several women who did not admit this when questioned openly. The association between pica and pregnancy has been known for at least one thousand years. Avicenna stated that the pica of pregnancy differed from other varieties in that its prognosis was better.[1] Livingstone noted that pregnant Black women were particularly prone to eating clay, and Okcuoglu *et al.*[15] made a similar observation in Turkish villagers. Several studies have revealed that the habit of eating clay or laundry starch is extremely common among indigent pregnant women in the southern USA.[12,13] For example, O'Rourke *et al.*[12] interviewed 200 women within a few days of delivery, and 65 admitted that they had eaten clay while pregnant, 23 had eaten starch and 15 had eaten both (total incidence 51%). Six of the women had eaten as much as 100 - 200 g per day, and 7 more than 200 g. The fine white clay of this part of Georgia is highly prized, and is shipped all over the state and sold for consumption by pregnant women. As in the present study, some of these subjects claimed that the clay relieved gastro-intestinal distress. At least in the case of the American women, this appears not unreasonable, since the white clay in question is in fact kaolin! Other women in both studies said that they just liked the taste, and the phenomenon may thus be analogous to the craving for a particular food or condiment which is such a well-known feature of pregnancy.[16]

While the incidence was found to be considerably higher in women, 11% of the 151 male outpatients interviewed by the staff nurse in the present study said that they had eaten earth or ash, although only 2 consumed as much as a tablespoonful a day. Gelfand[7] reported that 31 of 100 Black male inpatients in the Salisbury Native Hospital ate earth, often obtained from antheaps. The usual reason given was that it tasted good; according to Gelfand, antheap earth does taste sweet, and buck frequently lick antheaps. He stated that the incidence of geophagia among Blacks varied considerably from tribe to tribe: for example, it was common among the Kikuyu but rare among the Masai. In some instances the practice might be bound with religious or magical beliefs, and thus not readily discussed with the White man.

Gelfand,[7] and also Weller,[17] pointed out that the distinction between what is a socially acceptable practice and what is regarded as pica varies very much from community to community. The consumption of snails, or thoroughly decayed cheeses, might legitimately be regarded

by some as a perversion of appetite, whereas others would think that it was merely evidence of a cultured palate. In the north of Sweden it was customary during the 19th century to mix earth with the flour when making bread,[1,17] and geophagia was therefore not a manifestation of pica in that community. Very young children will put anything into their mouths: they are discouraged from doing so when their mothers consider the article in question to be unsuitable, and in due course acquire acceptable oral behaviour. Only when a child who is old enough to have learnt what is expected of him persists in the infantile behaviour pattern may the term 'pica' be applied. If clay does not happen to be one of the items which the mother considers should be kept out of the mouth, and its taste is not unpleasant, there is no reason why the child should stop eating it, and under such circumstances clay-eating does not amount to pica.

An association between pica and anaemia has been noted since the time of Hippocrates, who said 'Both men and women who have long had a bad colour, but not in the form of jaundice . . . eat stones and earth and have piles. Those who have a green colour, without decided jaundice, are affected in like manner.'[2] In the 17th century Riverius wrote 'Of the green-sickness, called Chlorosis . . . they have in this Disease . . . a desire of evil meats, and things not ordained for nourishment, as Salt, Spices, Chalk, Coals, Ashes, and the like, which Disease is called Pica Malacia, or strange Longing . . .'[2]

Can iron deficiency cause pica? Since the time of Avicenna it has been believed that the administration of iron preparations will cure the habit.[1] Lanzkowsky[3] cured both the iron deficiency and the pica of young children by administering iron dextran injections, while Catzel[4] stated that sand-eating in 36 children aged 1 - 2 years was cured without exception by iron given orally or by injection. However, Gutelius *et al.*[18] could not establish by means of a double-blind study that it was the iron which was responsible for the improvement in behaviour. They gave iron dextran injections to 16 children and saline injections to another 16, and in both groups the pica was cured. A similar study by McDonald and Marshall[5] confirmed the effectiveness of a placebo in the treatment of pica, but also suggested that iron therapy might be superior. Perhaps the most convincing evidence that pica may sometimes be due to iron deficiency is provided by studies of compulsive ice-eating (pagophagia) in adults. Reynolds *et al.*[19] reported that 23 out of 38 consecutive adults with iron deficiency anaemia consumed at least two tumblers of ice per day by chewing and swallowing small pieces, whereas only 5 - 10% of normal individuals did so. (Perhaps the high incidence in normal subjects can be ascribed to the Californian climate.) On treating the iron deficiency the craving for ice disappeared. This study was uncontrolled, but Coltman[20] found that an injection of iron dextran cured pagophagia within a week, whereas an injection of saline had no effect. Oral iron preparations were as effective as parenteral iron. The 25 subjects in his study (performed in Texas) were all women whose iron deficiency anaemia could be ascribed to menorrhagia, and who had consumed not less than one ordinary refrigerator tray of ice each day for two months or longer. The reason for the craving for ice in these subjects was thought to be the gastro-intestinal epithelial changes which are associated with iron deficiency.

Can pica cause iron deficiency? This has also been believed by many observers. Clay-eating by Negro slaves in the southern USA was considered to lead to anaemia, oedema, hepatosplenomegaly, weakness and death — 'cachexia Africanus'.[1] David Livingstone believed that it caused a haggard appearance, shortness of breath, progressive weakness and pallor. Okcuoglu *et al.*[15] found convincing evidence that the eating of clay was associated with iron deficiency anaemia in Turkish villagers, and Minnich *et al.*[6] showed that this was because the clay adsorbed the dietary iron and rendered it unavailable for absorption. The phenomenon could be demonstrated *in vitro*, and while some clays had little or no binding capacity, others possessed powerful adsorptive properties. It is hardly surprising that the consumption of such material may interfere with the absorption of other metallic cations as well as iron. Potassium deficiency with hypokalaemia and muscle weakness has been ascribed to clay-eating,[21] and zinc deficiency seems to be one component in a complex syndrome of dwarfism, hypogonadism, hepatosplenomegaly and iron deficiency anaemia seen in Iranian,[14] Egyptian[22] and Turkish[15] villagers who eat excessive amounts of clay.

On the other hand, if the clay (or other matter) has little adsorptive capacity, it would not be expected to compromise iron nutrition. In support of this view is the study of O'Rourke *et al.*,[12] who found that the habit of eating even 200 g of either the local white clay or laundry starch every day during pregnancy was not associated with a low haemoglobin concentration in the 200 women they studied. Garretson and Conrad[23] showed that laundry starch did not reduce the absorption of radio-iron in rats, while the habit of eating ice in large quantities can hardly interfere with iron absorption directly since it rapidly melts to water. In the present study the evidence that ash might diminish radio-iron absorption to any significant extent was not convincing, but the particular earths favoured by the 5 women who took part in the absorption study did reduce the absorption of the radioactive tracer. It is, however, difficult to know whether this reflected an inhibition of iron absorption, in view of the finding that significant quantities of soluble iron were released when some earth specimens were incubated in hydrochloric acid. If this also occurred in gastric juice, the lower percentage of ^{59}Fe absorbed might equally well be due to dilution of the isotope, and consumption of such material might improve rather than harm iron nutrition. The effect of pica on the iron nutrition of Johannesburg Black subjects may thus vary from subject to subject depending on the exact nature of the material consumed. It is interesting to note that the two women in the group of 50 whose haemoglobin concentrations were below 12 g/100 ml were the two whose consumption of earth and ash were the heaviest. On the other hand, the mean haemoglobin figure for this group was 14,6 g/100 ml, so that eating the local earths and ashes cannot have a deleterious effect on iron nutrition in the vast majority of individuals.

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