

# Broadening the Perspective of Pica: Literature Review

ELLA P. LACEY, PhD

Tearsheets to Ella P. Lacey, PhD, Assistant Professor, Department of Behavioral and Social Sciences, School of Medicine, and Department of Health Education, Southern Illinois University, Carbondale, IL 62901.

Thomas P. Miale, MD, Department of Pediatrics, Southern Illinois University School of Medicine, reviewed the manuscript for clinical validity.

## Synopsis .....

*Pica is an eating disorder that is manifested by a craving for oral ingestion of a given substance that is unusual in kind and or quantity. It is a long-standing practice that has far reaching implications for prevention and treatment—implications for*

*public health as well as clinical personnel who work in settings where they have the potential for influencing health knowledge, attitudes, and behaviors of their patients. Pica practices also challenge researchers and social scientists whose work encompass development and refinement of models related to nutritional deficiencies.*

*The body of literature on pica is so fragmented that it is difficult to find a precise summary of the knowns and unknowns about the condition. There is little consistency in defining pica, classifying substances ingested, identifying key characteristics of practitioners, recommending treatment, or in projecting outcomes. This review presents a framework for understanding pica as a general practice, summarizes divergent reported hypotheses and conclusions, and illustrates that there is a need for more comprehensive studies of prevalence and incidence and use of deductive as well as inductive research processes.*

**P**ICA IS AN EATING BEHAVIOR that has been documented for centuries. It seems, during various periods and among various groups, to have been emulated, accepted, rejected, denied, policed, or punished, or all of the above. Definitions have been devised, cause and effect models have been postulated, and therapies have been applied, but there has usually been a narrowed "community of solution," one limited to the primary framework of a given academic discipline or clinical specialty.

There are many indications that pica poses health risks associated with malnutrition, sanitation, and personal injury—all among the usual concerns of public health. As a public health problem, it is most timely to examine the issues of concern, provide documentation from the related literature, and offer hypotheses for further study.

## Developing a Framework for Pica

The definitional framework for pica is the first issue of concern. Conflicting definitions in respected sources reveal disparate basic concepts of pica as a behavior. Medical dictionaries are generally quite restrictive in defining pica. Perhaps the most widely used of these restrictive dictionary definitions is Taber's (1), with similar ones provided by Random House (2) and Stedman's (3).

Blakiston's (4) allows a broader range for substances ingested but restricts the description of subjects. Dorland's (5) presents a slightly broader meaning for substances ingested and also allows consideration of a more diverse group as pica practitioners. In contrast, Mosby's Medical and Nursing Dictionary (6) is restrictive in descriptions of both substances ingested and populations of practitioners.

In addition to the problems posed by inconsistent definitions of pica, it is also notable that some general references include no definition or description of pica (7,8). Sources of information for various disciplines offer a wide range of interpretations of pica. Some of these sources do not mention pica (9-12); others provide interpretations that are presented as definitions (13,14). For example, de la Burde and Reames (13) limit pica to "eating plaster or paint." A source (15) for nutrition presents pica as "the desire to ingest bizarre items such as chalk, sand, insects, clay, slate, and so forth." Yet, Crosby (14), a hematologist, suggests the concept of pica ". . . is the compulsive eating of something, usually a single item of food, or ice, or dirt, something within easy reach of the victim," a range which is confirmed in a current hematology textbook (16).

A nutrition reference used by medical practitio-

Label	Common substance	Food or nonfood and frequency of reporting
Pagophagia .....	Ice	Food-related; not frequently reported
Geomelophagia .....	Raw potatoes	
Plumbophagia .....	Lead paint chips	Nonfood; most frequently reported
Geophagia .....	Clay	
Amylophagia .....	Laundry starch	
Cautopyreiophagia .....	Burnt matches	Nonfood; not frequently reported
Tricophagia .....	Hair	
Lithophagia .....	Stones	
Coprophagia .....	Feces	Nonfood; frequently institutional

ners (17) considers pica as the regular and excessive ingestion of food and substances that have no nutritional value and suggests that pica should be treated with intensive, convincing dietary counseling. Another reference (18) that targets a clinical audience describes pica as a folk belief and defines it as the eating of nonnutritional, nonfood items in a compulsive way.

The various definitions and perceptions of pica illustrate disparity in presenting (a) scope of the behavior, whether it encompasses certain patterns of food items as well as nonfood items, (b) mechanisms of action for the behavior, whether it is voluntary and strictly a function of availability and personal taste or whether the behavior is involuntary, as in a compulsion or addiction, and (c) generalizability of the behavior, whether pica is found solely in special populations or whether it also occurs in "normal" populations.

Collectively, it can be surmised that pica is an eating disorder, that it involves satisfaction of a craving by oral ingestion of substances that are unusual in kind (nonfood items) or amount (food items). Of those substances that have been identified as objects of pica, there is general agreement in the literature on labeling assigned to the pica behavior designated as -phagias.

The substances are grouped in the table according to their relationship to food and frequency of appearance in the literature as a form of pica. Pagophagia (ice eating) (19,20) represents a paradox: it is among the most "normal" of substances labeled, yet it is one of the least studied as a unique behavior. Geomelophagia (raw potato eating) is a food pica of uncommon form that has been labeled (21), although not commonly so. Lead ingestion, long acknowledged as a primary source of lead poisoning (22-24), is not labeled as an eating anomaly in the literature; however, as the pathology of plumbism is so frequently discussed,

plumbophagia (lead eating) is adopted for the framework. Geophagia (clay eating) and amylophagia (laundry starch eating) are grouped with plumbophagia because these three problems are given the most attention by researchers as pica concerns (25,26). Cautophreiophagia (eating of burnt matches), tricophagia (hair eating), and lithophagia (stone or plaster eating) (26) are labeled but are less frequently mentioned in the literature as being related to generalized pica practices. As a form of pica, coprophagia (eating of feces) (27) has been studied mainly among the institutionalized mentally retarded.

The box on page 31 has a listing of food, nonfood, and food- and nonfood-related substances that have not been labeled as a -phagia, but have been identified as objects of pica in quantities as great as 9 bunches of celery and 10 liters of ice (28).

There is little reason to doubt that there are many yet-to-be reported substances for each category that are also objects of pica. Although many substances have been reported in the literature, Coleman and coauthors' report (29) of a case of pica involving tomato seeds illustrates the continuing designation of new items as forms of pica. From another perspective, it seems likely that excessive licorice eating, which is of concern as an activator of hypertension (30,31), might be better understood if also classified and analyzed as a form of food pica. Thus, it is hoped that the listings in the tables will provide a context for beginning to identify commonalities and differences of labeled and unlabeled substances ingested by pica practitioners.

### Selected Substances for Selected Groups

Although pica has been described as a worldwide phenomenon (32) and as practiced by both sexes,

## Substances Identified as Objects of Pica That Are Not So Labeled

<i>Nonfood</i>		<i>Food</i>	<i>Food-nonfood</i>
Ashes	Newsprint	Carrots	Baking soda
Balloons	Paper	Celery	Chewing gum
Chalk	Plant leaves	Croutons	Coca leaf
Cigarette butts	Pencil erasers	Licorice	Coffee grounds
Cloth	Plastic	Life savers candy	Oyster shells
Cotton balls	Powder, baby	Milk	Tomato seeds
Crayons	Powder puffs	Parsley	
Detergent	Soap		
Fuzz	String, thread		
Grass	Toilet tissue		
Insects	Twigs		
Lavatory freshners	Wood		
Metal			

all races, and all age groups (33), there are more frequent occurrences of selected substances among selected groups—especially young children, southern or inner-city black women, pregnant women, and retarded people. Editorials on pica appeared in *Lancet* at least twice during the 1970s (34,35). These editorials note that geophagia is a worldwide practice found more commonly in underdeveloped countries and among the (a) poor than the well-to-do, (b) blacks than whites, (c) pregnant than nonpregnant women, and (d) children than adults. The editorial writers conclude that in the United States, geophagia seems to occur in from 27 percent to 75 percent of the various pregnant populations studied, in 17 percent of the white children studied, and in 27 percent of black children studied.

Robischon (36) reported pica prevalence as high as 50 percent in black children and as 34 percent in white children. She compares these reports with her empirical findings of 37 percent pica prevalence in a targeted group of 90 well, black children, age 19 months to 24 months. Frequencies were reported for children who ingested selected substances based on mothers' reports. More than 50 percent of these children, according to Robischon's data, were reported by their mothers to have ingested matches, paper, and ashes. Baby powder, pencil erasers, and thread also had calculations of frequency of ingestion, but were reported to be engaged in by less than half the group.

Halsted (37) summarized findings from research studies that have reported prevalence of pica ranging from 10 percent in young white children in a given clinic to 75 percent in a group of pregnant black women at another site. Halsted indicated that the frequency of the behavior was stable in the range of 25 to 33 percent among young children,

with a higher frequency among black children (37). Black women in low socioeconomic groups were considered by Halsted to have a pica prevalence of approximately 40 to 50 percent, with lower rates in white women. Consequently, Halsted's review shows pica to be a widespread practice, especially among, but not limited to, persons of low socioeconomic status.

Chatterjee and Gettman (38) studied all children reported by Cleveland, OH, hospitals to the Cleveland Board of Health as being lead poisoned during the period 1963–69—a population of 136 children, of whom 117 were black and 19 were white. These authors presented a sociological perspective based on their empirical data as well as on findings from the literature. They concluded that the incidence of lead pica was higher among black children of southern origin due to “permissive socialization of oral behavior.”

Hook, using an ecological perspective, presented pica as an example of a craving of pregnancy that has been extensively investigated (39). Hook's study involved a personal interview with each of 250 women who had recently delivered a liveborn infant at either of two hospitals during a 2-month period of 1975. Ice cream was reported by Hook as the item most frequently craved (18.4 percent). Nonnutritive items, including ice and river bank chalk, were reported by only 1.6 percent of the study's participants. He contrasted data on the 250 women of his study with an earlier study of 300 black women in Tuskegee, AL. In the earlier study, clay was reported as a craving by 43 percent of the 55 women. Hook noted differences in findings in the two studies but speculated that geographic, cultural, or biological factors may be causes for these differences.

Vermeer and Frate presented a geographic study of geophagia in a southern rural black community

(40). The researchers located the sources of clays that had been reported as eaten; they analyzed the potassium content of those clays. In addition, they conducted a field survey of 500 randomized households. Findings included the observation that no adolescent male or adult male reported practicing geophagia. Reported geophagia prevalence was cited as 16 percent among children and 57 percent among women, with 28 percent of the pregnant and postpartum women reporting geophagia as a practice. There was also 17 percent of the pregnant and postpartum women who reported other forms of pica, such as laundry starch, powdered milk, or baking soda.

Standard references used by obstetricians-gynecologists include several considerations of pica. Studies of special interest have appeared in journals of these medical specialists during the period 1968 to 1982. Keith and coworkers reported amylophagia in 987 pregnant women who were under their clinical care at Cook County Hospital in Chicago (25). Significant findings included an incidence of starch eating that was significantly higher in black than white women. Severe anemia occurred more often among starch eaters; women with adequate hemoglobin levels were 2½ times as likely to not be starch eaters than those with inadequate hemoglobin. Of the starch eaters, 27 percent reported having eaten clay in childhood. In multiparous women, starch eating in a particular pregnancy was not correlated with a history of starch eating.

In a study of 861 high-risk, pregnant adolescents in Galveston, TX (41), it was found that 28 percent had a history of pica for clay or soil, laundry starch, and refrigerator frost. Among the mentally retarded, the relatively common occurrence of pica is reported to be positively correlated with degree of retardation (42). One study found an institutional incidence of 9 percent (43), while another found 26 percent (42), with coprophagia accounting for nearly 20 percent of the pica in the latter study.

### Effects of Pica

Although it is established that pica is a behavior found in varying degrees among various segments of the world's population, researchers differ markedly about the potential effects of the behavior. Such disparity seems to be related to the specific pica of focus, the population, and in some cases, the setting of study. It seems to be relatively easy for some researchers to classify a food or food-related pica as harmless, to attribute its emotional basis to pregnant women, and to belittle the effects

in a general population study even though researchers and practitioners from other disciplines almost simultaneously present strongly conflicting evidence in other literature.

Radiologists Maravilla and Berk (44) used a sample of convenience to study the clay-eating behavior of nine radiographic technologists at an urban southwestern hospital. Based on their research and clinical interpretations, they concluded that volume and content of the pica substances are the major problems of concern and that ingestion of small amounts "is a harmless habit." In their clinical judgments, Maravilla and Berk present four pica-related effects as meriting concern about pica practices: (a) inherent toxicity of substances, as occurs in lead intoxication and, undoubtedly, some other nonfood substances; (b) obstructive physiological impacts, as has been demonstrated with geophagia, tricophagia, and lithophagia; (c) excessive calories, as might occur with amylophagia or any high calorie substance; and (d) caloric deprivation, as might occur with pagophagia or any other substance that is low or empty in calories but filling in capacity. Maravilla and Berk's review strongly suggests that the effects of pica are sufficient to support a broadened concern about the health effects of substances ingested by pica practitioners.

Analysis of clays reported eaten in a southern black community led Vermeer and Frate (40) to observe that "geophagia contributes relatively little to daily potassium intake." Their overall conclusion was that geophagia represented "a common custom stemming from deeply imbedded cultural traditions and attitudes . . . the practice has little deleterious effect." Their conclusions have been adopted by the popular media (45-47), with no acknowledgment that ethnographic studies as well as clinical reports have presented findings that differ from those conclusions (32,48,49).

Gudson and Tunca presented a case study of a 20-year-old female patient who came to a medical center emergency room complaining of acute abdominal pains (48). No concern was reported about this patient's eating behaviors until radiographs revealed barium in her descending colon. Upon query, the patient admitted having eaten clay that had been shipped to her. Further, the patient admitted that she had not taken prescribed vitamins or iron due to distaste for the prescriptions. Enemas were administered and the patient was relieved; she was discharged on the fifth day. One day later the patient was readmitted and delivered healthy twins. Gudson and Tunca concluded that

this case was not unusual based on geophagia alone, but noted that threatened abruptio placenta was a possibility. They recommended that differential diagnosis of such presenting problems should include probable and significant possibilities related to pica.

Key and coworkers (49) described a 31-year-old multigravida woman who presented with weakness, pain, nausea, vomiting, fever, rigors, and lack of bowel movements for 2 weeks. The patient reported having eaten an estimated 200 grams to 300 grams of clay daily during present and previous pregnancies. The patient was considered critically ill on admission and died within minutes of admission. The authors presented this case as "the first case of maternal death from a complication of geophagia" (49). These authors presented a synthesis of observations related to pica and concluded on the basis of their collective studies that geophagia is "not an innocuous symptom or habit and must be handled aggressively."

### **Mechanisms of Causation**

Specific mechanisms have often been associated with particular forms of pica. In a literature review, Bothwell (50) observed that iron deficiency, worldwide, is the most common cause of anemia and presents major health problems. He suggested that iron deficiency results from a disturbance of iron balance and that the upset in balance may come from inadequate diet or increased iron losses or from a combination of these factors. Bothwell also concluded that iron deficiency anemia is three times more common in clay eaters; clay and starch absorb iron and prevent its absorption by the body. It is Bothwell's contention that pica would be diagnosed more frequently if physicians elicited more information.

Vyas and Chandra (51), assessing impacts of iron deficiency, stated that "abnormal eating behavior may either be the cause or the effect of iron deficiency." However, they acknowledge that "iron therapy has been observed to accelerate the cessation of these generally self-limited aberrations of behavior."

Dallman and Reeves considered implications of erythrocyte protoporphyrin levels on lead toxicity and iron deficiency (52). They hypothesize that "there is a strong association between lead toxicity and iron deficiency that appears to be due to a shared mechanism for intestinal absorption of lead and iron," but they do not infer the association of lead toxicity with pica.

In a review of geophagia, Halsted (37) presented a historical overview of pica. He referenced recordings of clay eating for medicinal purposes as long ago as 10 B.C.; clay eating as pica is traced to approximately 1000 A.D. Halsted also noted the attention given pica in the 16th, 17th, and 18th centuries. He concluded that geophagia leads to anemia, speculating that the "cation exchange of clay inhibits iron absorption and perhaps the absorption of zinc, potassium, and mercury."

Talkington and coworkers (26) reported on an experimental study of 32 persons for whom they analyzed the effect of laundry starch and clay on iron absorption. Their major research hypothesis focused on whether clay or laundry starch ingestion contributed significantly to the development of iron deficiency anemia by impairing iron absorption. They concluded from their findings that (a) ingestion of 30 to 60 grams of starch just prior to ingestion of ferrous salt did not significantly impair absorption; (b) severe iron deficiency anemia during pregnancy was promptly corrected by a modest daily dose of oral iron, even when the patient continued to eat an average of 70 grams of starch per day; (c) individual differences according to person and time were noted regarding absorption rate; (d) starch contributed to iron deficiency, at least by its nature of caloric content; and (e) differences were observed in effect according to source and type of clay.

A review of lead poisoning and its relationship to pica is based on data from New York City Department of Health (53). Guinee raised concern that pica might be the "earliest addiction," but he cautions about the difficulty of data gathering due to "differing standards for defining a 'case'." He posed the eradication of substandard housing as the solution to lead poisoning.

Lackey, a dietician, reviewed the literature on pica and presented her findings at a national workshop (54). She listed various hypotheses of causation for pica and presented them as a comprehensive range of theories—theories related to psychological phenomena, cultural basis, sensory drive, physiological reasons, nutritional needs, and microbiological medium. Lackey stated that no single theory is adequate but speculated that the cultural basis and physiological reasons theories might, when combined, provide understanding.

Hall (55) reviewed the literature on U.S. findings on pica, but emphasized circumstances in Great Britain. Hall's review focused on toxic materials as pica substances, and he concluded that (a) pregnant women often show dietary fads, and deficiency of

iron or folate may result; (b) pregnant women may consume unusual foods in large quantities, but this is generally harmless unless toxic substances are consumed that may worsen anemia; and (c) the history of consumption of fad foods and unusual substances may be difficult to elicit, but should be carefully checked in cases of refractory anemia in pregnancy. Hall recommends as treatment that the toxic substance be withheld.

Robischon (36) presented developmental theory as a basis for understanding pica behaviors of young children. She concluded that pica results from a developmental behavioral lag that is specific to hand-mouth development.

## Conclusions and Recommendations

There is considerable rationale for health professionals to develop methods of discussing potential pica behaviors in clinical assessments. However, there are numerous unresolved hypotheses and conflicting recommendations regarding pica. Some of the most obvious disagreements are (a) whether pica should be defined only in a restrictive manner encompassing selected substances and selected populations (1,18), or whether the definition should be broadened to include food and nonfood items (20, 56); (b) whether pica is a problem with considerable historical background (32,56), or whether recent literature records the first death (49); (c) whether pica is simply a noncompromising habit and compatible with good health (40,44), or whether forms of pica may be primary or secondary health threats (14,33). When one considers reported pica prevalence and documented impacts of pica, even though it is often encountered in special populations and reported in limited studies, further investigation of pica seems warranted.

Mechanisms of causation for pica should be researched and reported. Studies should be conducted that emerge from designs that are deductive and assess pica as a general condition as well as designs that are inductive and assess the various forms of pica. Whereas there is evidence that physiological, psychological, and sociological explanations each provide some understanding of pica, no single explanation is likely to provide sufficient rationale for all the behaviors associated with pica practices.

Although it appears obvious that there may be different mechanisms that cause longing for a familiar food such as ice cream versus those that cause craving for a nonfood item such as clay, the differences are not nearly so distinguishable when

the cravings are restricted to either food items or nonfood items as separate groups. Further, when the longing is for a "normal" amount of a usual item, the behavior is unquestioned. However, when the longing changes to craving and when satiation is not easily attainable, the behavior raises concern. Issues related to pica as a craving, its application as an addictive process, and its amelioration by iron therapy are suggestive of the need to study pica as a generalizable mechanism related perhaps to addictions. Relationships should be explored for the potential of improving understanding of other addictions such as cigarettes, alcohol, or illicit drugs.

Therapies for pica should be explored systematically to determine the appropriateness and effectiveness of pharmacological responses as well as less invasive therapies. More rationale should be provided before adoption of punitive therapies even as simple as withholding substances and certainly before more aggressive actions such as physical restraint.

Available documentation, although lacking in comprehensiveness, is sufficient to suggest that pica continues to be a health problem that deserves the attention of socially and culturally sensitive researchers. There is an obvious need to provide operational definitions of various forms of pica. For research clarity as well as for clinical and community applications, it seems imperative that more attention should be given to population descriptors, kind and volume of substances ingested, period(s) of vulnerability, and frequency of the behavior.

Pica appears to be a complex behavior that requires deliberate study rather than application of *ex post facto* single cause theories. Although such theories may motivate any given study of pica, it should be apparent that any single cause model will likely offer only a limited explanation of such diverse practices as have been described in the literature through case reports, research studies, and literature reviews of various clinical and applied disciplines.

## References.....

1. Taber's cyclopedia medical dictionary. Ed. 13. F. A. Davis, Co., Philadelphia, 1985.
2. Random House dictionary of the English language. Random House, New York, 1981.
3. Stedman's medical dictionary. Ed. 24, illustrated. Williams & Wilkins, Baltimore, 1982.
4. Blakiston's new gold medical dictionary. Ed. 4. McGraw-Hill, New York, 1979.

5. Dorland's illustrated medical dictionary. Ed. 26. W. B. Saunders, Philadelphia, 1981.
6. Mosby's medical and nursing dictionary. C. V. Mosby, St. Louis, 1983.
7. Melloni's illustrated medical dictionary. Williams & Wilkins, Baltimore, 1979.
8. Dictionary of medical syndromes. Ed. 2. W. B. Saunders, Philadelphia, 1981.
9. Caliendo, M. A.: Nutrition and preventive health care. McMillan, New York, 1981.
10. Dobbins, J.: Maternal nutrition in pregnancy—eating for two? Academic Press, New York, 1981.
11. Pitkin, R. M., and Zlatnik, F. J.: Obstetrics and gynecology. Year Book Medical Publishers, Chicago, 1983.
12. Willson, J. R., and Carrington, E. R.: Obstetrics and gynecology. C. V. Mosby, St. Louis, 1983.
13. de la Burde, B., and Reames, R.: Prevention of pica, the major cause of lead poisoning in children. *Am J Public Health* 63: 737-743 (1973).
14. Crosby, W. H.: Pica: a compulsion caused by iron deficiency. *Br J Hematol* 34: 341-342 (1976).
15. Burton, B. T.: Human nutrition. McGraw-Hill, New York, 1976, pp. 41, 136, 184, 251-272.
16. Duffy, T. P.: Iron deficiency. *In* Fundamentals of clinical hematology. Ed. 2, edited by J. L. Spivak. Harper and Row, Philadelphia, 1980, pp. 17-26.
17. Mehan, C. S.: Revolution in OB: pregnancy nutrition. *In* Nutrition and medical practice, edited by L. Baroness, Y. Cable, D. I. MacDonald, and G. Christakis. AVI Publishing, Westport, CT, 1981, pp. 34-35.
18. Eckstein, E. F.: Food, people and nutrition. AVI Publishing, Westport, CT, 1980, p. 322.
19. Reynolds, R. D., et al.: Pagophagia and iron deficiency anemia. *Ann Intern Med* 69: 435-440 (1968).
20. Coltman, C. A., Jr.: Pagophagia and iron lack. *JAMA* 207: 513-516, Jan. 20, 1969.
21. Johnson, B. E., and Stephens, R. L.: Geomelophagia—an unusual pica in iron-deficiency anemia. *Am J Med* 73: 931-932 (1982).
22. Anderson, C. L., Morton, R. F., and Green, L. W.: Community health. C. V. Mosby, St. Louis, 1978, pp. 216-217.
23. Benson, E. R., and McDevitt, J. Q.: Community health and nursing practice. Prentice Hall, Englewood Cliffs, NJ, 1976, pp. 167-170.
24. Annett, J. L., and Mahaffey, K.: Blood lead levels for persons 6 months-74 years, United States, 1976-80. *Vital Health Stat* [11], No. 233, National Center for Health Statistics, Hyattsville, MD, 1984.
25. Keith, L., Evenhouse, H., and Webster, A.: Amylophagia during pregnancy. *Obstet Gynecol* 32: 415-418 (1968).
26. Talkington, K. M., Gant, N. F., Jr., Scott, D. E., and Pritchard, J. A.: Effect of ingestion of starch and some clays on iron absorption. *Am J Obstet Gynecol* 198: 262-267 (1969).
27. Foxx, R. M., and Martin, E. D.: Treatment of scavenging behavior (coprophagy and pica) by overcorrection. *Behav Res Ther* 13: 153-162 (1975).
28. Crosby, W. H.: Pica. *JAMA* 235: 2765, June 21, 1976.
29. Coleman, D. L., Greenberg, C. S., and Ries, C. A.: Iron deficiency anemia and pica for tomato seeds. *N Engl J Med* 304: 848, Apr. 2, 1981.
30. Conn, J. W., Rouner, D. R., and Cohen, E. L.: Licorice-induced pseudoaldosteronism. *JAMA* 205: 492-496, Aug. 12, 1968.
31. O'Donnell, J. O.: Advances in hypertension research. *Res Resources Reporter* 8: 1-6 (1984).
32. Laufer, B.: Geophagy. *Field Museum of Natural History* 18: 101-198 (1930).
33. Zamula, E.: The curious compulsion called pica. *FDA Consumer* 19: 29-32 (1985-86).
34. Editorial: Clay eating. *Lancet* No. 8090: 614-615, Sept. 16, 1978.
35. Editorial: Earth-eating and anemia. *Lancet* No. 7651: 826, Apr. 18, 1970.
36. Robischon, P.: Pica practice and other hand-mouth behavior and children's developmental level. *Nurs Res* 20: 4-16 (1971).
37. Halsted, J. A.: Geophagia in man: its nature and nutritional effects. *Am J Clin Nutr* 21: 1384-1393 (1968).
38. Chatterjee, P., and Gettman, J. H.: Lead poisoning: sub-cultural as a facilitating agent? *Am J Clin Nutr* 25: 324-330 (1972).
39. Hook, E. B.: Dietary cravings and aversions during pregnancy. *Am J Clin Nutr* 31: 1355-1362 (1978).
40. Vermeer, D. E., and Frate, D. A.: Geophagia in rural Mississippi: environmental and cultural contexts and nutritional implications. *Am J Clin Nutr* 32: 3129-3135 (1978).
41. McGannity, W. J., et al.: Pregnancy in the adolescent. *Am J Obstet Gynecol* 103: 773-788 (1969).
42. Danford, D. E., and Huber, A. M.: Pica among mentally retarded adults. *Am J Ment Defic* 87: 141-146 (1982).
43. McAlpine, C., and Singh, N. N.: Pica in institutionalized mentally retarded persons. *J Ment Defic Res* 30: 1971-1978 (1986).
44. Maravilla, A. M., and Berk, R. N.: The radiographic diagnosis of pica. *Am J Gastroenterol* 70: 94-99 (1978).
45. Huffman, A.: It's hard to quit the habit, Mississippi dirt eaters say. Jackson (MS) *Clarion-Ledger*, Dec. 13, 1983, p. 7.
46. Meet the folks who love to eat dirt. *Weekly World News*, Mar. 13, 1984, p. 1.
47. Tiede, T.: To some food is an earthly delight: where's the beef? *Marion, IL, Daily Republican*, Apr. 18, 1984, p. 3.
48. Gudson, G. P., Jr., and Tunca, C.: Pica and mimicking abruptio placenta (a case report). *Obstet Gynecol* 43: 197-199 (1974).
49. Key, T. C., Jr., Horger, E. D., III, and Miller, J. M., Jr.: Geophagia as a cause of maternal death. *Obstet Gynecol* 60: 525-526 (1981).
50. Bothwell, T. H.: Iron deficiency. *Med J Aust* 2: 433-438 (1972).
51. Vyas, D., and Chandra, R. K.: Functional implications of iron deficiency. *In* Iron nutrition in infancy and childhood, edited by A. Stekel. Nestle, Veney/Raven Press, New York, 1984, pp. 45-59.
52. Dallman, P. R., and Reeves, J. D.: Laboratory diagnosis of iron deficiency. *In* Iron nutrition in infancy and childhood, edited by A. Stekel. Nestle, Veney/Raven Press, New York, 1984, pp. 11-44.
53. Guinee, V. J.: Pica and lead poisoning. *Nutr Review* 29: 267-269 (1971).
54. Lackey, C. J.: Prevalence of pica in pregnancy. *In* Alternative dietary practices and nutritional abuses in pregnancy: proceedings of a workshop. National Academy Press, Washington, DC, 1982.
55. Hall, M. H.: Blood and neoplastic disease. *Br Med J* 2: 661-663 (1974).
56. Annett, B., and Lagercrantz, S.: Geophagical customs. *Studia Ethnographica Upsaliensa* 17: 1-84 (1958).