
Case

Alexia is a 13-year-old girl. She is physically healthy and good at school and gets along well with her parents. She reports having friends and is hanging out with them frequently, whereas her mother describes concerns about Alexia being a loner socially. Alexia's mother brought her in for a consultation because over the past 2 months, Alexia has often locked herself in her room for periods of time and overall has seemed withdrawn and depressed. Upon direct conversation with Alexia, she admits retreating into her room but denies feeling lonely or dysphoric. She describes that she retreats into her room when she feels the urge to eat eye shadow. She seems embarrassed to explain the process, but after some prompting, she reports buying several compacts of eye shadow daily in the local drug store. She has a preference for a specific brand, in particular for the taste of the brands' gray color. While putting on eye makeup about 3 months ago, some makeup dropped onto Alexia's lips. She liked the taste and consistency so much that she continued eating it.

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Because her worried mother now watches her more closely, Alexia often tries to withstand the strong urge to eat eye shadow, but always gives in to her cravings after a few hours. Although Alexia has not told anyone about her makeup consumption, she assumes that no one she knows shares the habit. Having disclosed her information during the consultation, she reports feeling ashamed. She believes that people would think she were crazy. On the other side, she worries that the eye shadow could harm her health.

Symptom Presentation

Alexia is a typical example of an adolescent with the feeding and eating disorder pica. Other than in individuals with quantitative feeding and eating disorders such as anorexia nervosa, bulimia nervosa, and binge eating disorder that are characterized by eating too much or too little, individuals suffering from the qualitative feeding and eating disorder pica regularly crave and intentionally consume nonnutritive, nonfood items (American Psychological Association [APA], 2013). They usually do not have any aversion to food in general. The range of possible items consumed is vast, including earth, clay, hair, paint, cigarette butts, laundry starch, paper, chalk, and feces. As Young (2011) points out, the substances are often dry or even powdery. When reading

online first-person accounts (e.g., Humhoney, 2010), individuals are usually very specific about cravings (e.g., consistency and the composition of the item, where it is acquired, or how it smells and feels). They might favor a specific type of laundry starch that has just the right consistency, or crave a specific kind of clay after it has been baked for the right duration to adjust its dampness. Very little is known about the amount of substances usually consumed, probably due to difference in individual and substance. For earth eating (called *geophagy*), the typical amount consumed seems to be 25–45 g daily, depending on the substance's consistency and the population (e.g., schoolchildren, Geissler, Mwaniki, Thiong'o, & Friis, 1997; pregnant women, Luoba et al., 2005). Individuals with pica experience strong cravings toward the substance they consume. Just like Alexia, they usually feel a strong urge to consume the substance, and even when they try to withstand it, they usually give in.

For children suffering from pica, it might be even harder than for adults to control their urges as inhibition mechanisms might not yet be fully developed. There is no data comparing the prevalence of consumption of different pica substances, particularly for children and adolescents. Most of the prevalence data for children was collected in areas where geophagy was the most common pica substance (e.g., Nchito, Geissler, Mubila, Friis, & Olsen, 2004). Other studies found plaster or paint chips (De la Burd e & Reames, 1973; Marchi & Cohen, 1990) to be prevalent. In addition to those findings, other substances listed in previous versions of the Diagnostic and Statistical Manual of Mental Disorder that are particularly typical for infants include string, hair, and cloth, while outdoor substances comprise animal feces, stones, and insects (APA, 1987).

Looking at the abovementioned online first-person account and others, it seems that many individuals suffering from pica know about the medical consequences their disorder consumption can create. Some individuals notice problems with their digestion or skin, but cannot stop eating their desired items. Up to a certain age, however, children may not be cognitively able link possible consequences to their pica or might

not even notice them. Thus, treatment of pica in children could pose a great challenge if they are not able to recognize the negative implications their behavior has.

Individuals who struggle with pica often hide their cravings and consumption from their family and friends because they feel embarrassed. Young (2011) reported after analyzing posts found in an online discussion group about cornstarch pica: individuals may secretly order large amounts of their craved item on the Internet (e.g., pencils, starch, baby powder) or sneak outside to taste the earth from the nearby forest after the rain. Everyday items like toilet paper or tissues might also be consumed, only raising the suspicion of the family members when consumed in huge amounts. Sometimes, the location of the acquired item is chosen to conceal their behavior, such as stripes of wallpaper behind a cupboard might be ripped off so that the missing wallpaper is less likely to be noticed than in other areas. Particularly children and adolescents may hide it for fear of sanctions or closer surveillance.

Like Alexia, many individuals are unlikely to report their pica behaviors without specific inquiry, as they do not consider it worth reporting or feel embarrassed (Rose, Porcerelli, & Neale, 2000). In a recent study, in- and outpatient patients being treated for eating disorders or weight loss were specifically asked about pica eating behaviors. Of those reporting such eating habits, some stated they were embarrassed, and that until this interview, no one had inquired about such behavior (Delaney et al., 2014).

History of the Diagnosis of Pica in the Diagnostic and Statistical Manual of Mental Disorders

Before inclusion in the Diagnostic and Statistical Manual of Mental Disorders (DSM), in the medical context, pica first appeared in 1563: Geophagy was described in a medical book in pregnant women and in children (Rose et al., 2000). Prior to the twentieth century, pica was usually not seen as an independent disorder (Hakim-Larson, Voelker, Thomas, & Reinstein, 1997), but had

commonly been subsumed under other diagnoses such as anorexia nervosa, bulimia, and rumination (for a more extensive historical review of the diagnosis, see Parry-Jones & Parry-Jones, 1994).

Pica first appeared in the DSM with the release of the third edition of the DSM (DSM-III) by the APA (1980). Found in the “Infancy, Childhood and Adolescence Disorders” section at that time, the diagnostic criteria for pica included the repeated consumption of a nonnutritive substance that was not due to another mental or a physical disorder (e.g., infantile autism or Kleine-Levin syndrome). The eating habit had to exist over a period of at least 1 month. The usual age of onset reported was 12–24 months, with the disorder rarely persisting into adolescence or adulthood. Some predisposing factors were listed, including mental retardation, mineral deficiencies, and family-related issues (e.g., neglect or poor supervision). The listed complications associated with the disorder were lead poisoning and intestinal obstruction.

In the revision of the DSM-III (DSM-III-R; APA, 1987), the diagnostic criteria remained the same, as did the category, then called “disorders usually first evident in infancy, childhood, or adolescence.” Mineral deficiencies and family-related issues were not listed as predisposing factors. The DSM-III-R categorized three populations with pica cases that today still represent the groups of individuals in which pica is most prevalent (see “Epidemiology and Course”): young infants, individuals with mental retardation, and pregnant women.

The fourth edition of the DSM (DSM-IV; APA, 1994) added some complexity to the diagnostic criteria of pica by requiring that the eating habit being inappropriate to the individual’s developmental level and not a part of a culturally supported practice. The latter has been reported frequently, including in a report by Abraham and Parsons (1996) that found women in tropical latitudes engaged in geophagy around their pregnancy because they believed the soil to increase fertility. Sensitivity to culture practice has been criticized repeatedly. For example, Paniagua (2000) posits that such an emphasis on cultural variables is uncommon for the DSM and argues

that the exclusion of a great number of individuals with pica behavior might result in a failure to detect individuals with severe and life-threatening conditions. For the first time, the DSM allowed for comorbid diagnosis of pica with other mental disorders if the pica was severe enough to warrant clinical attention. The DSM-IV also listed typically consumed items, varying with the age of the individual concerned. Compared to the earlier versions of the DSM, a more detailed description of the course and complications of the disorder had been added, but the limited knowledge about the disorder has also been emphasized. Also, pica was included as a disorder seen in adults for the first time, having been moved from the “Feeding and Eating Disorder of Infancy or Early Childhood” section to the “Eating Disorder” section as an example of “Other Eating Disorders.” In the text revision of DSM-IV (DSM-IV-TR; APA, 2000), the diagnostic criteria did not change, and only descriptions of associated disorders and prevalence data for a subgroup of adults with mental retardation were added.

Current DSM-5 Diagnostic Criteria

In the DSM-5 (APA, 2013), pica moved as a full syndrome, not only as an example of “Other Eating Disorders,” to a new combined category “Feeding and Eating Disorders.” Also, some specifications were made to clarify the diagnostic criteria. First, the substances consumed in pica are now specified as “nonfood” in criterion A. Therefore, nonnutritive substances regarded as foods or beverages are no longer items warranting a pica diagnosis. Examples of such substances which raised discussion in the past are “diet” beverages that have no calories and therefore no nutritional value. Also, ice intended for eating (e.g., ice cubes or crushed ice) no longer warrant a diagnosis of pica even if consumed in unusually large amounts. Cornstarch, uncooked rice, and other food items usually in need of processing prior to consumption are now excluded from the diagnosis as well, but were considered pica substances before. However, ice and starch not meant for eating, e.g., frost scraped from the

interior of a freezer and laundry starch, still count as pica items.

Although criterion B has not changed, there are new specifications in the “diagnostic features,” describing that pica should only be diagnosed in individuals at least 2 years of age. Any behavior similar to pica before 2 years of age may represent developmentally appropriate mouthing of objects, sometimes leading to inadvertent ingestion. Specifying this age limit is in line with the criteria in the International Classification of Diseases 10th version (ICD-10; World Health Organization, 1992).

Criterion C added the provision that in order to confer a diagnosis of pica, the eating behavior should not be part of a socially normative practice (see description of culturally supported practice in DSM-IV). In addition, criterion D specifies that the pica diagnosis should be given in the context of another mental disorder or medical condition only if needing additional clinical attention. The term medical condition also includes pregnancy. The craving of unusual food items can be common in pregnancy, to the extent that in some regions, a woman may be considered pregnant if she starts to show pica behavior (Hunter, 1993). Thus, the necessity for additional clinical attention needed before adding a pica diagnosis might prevent stigmatization and pathologization of whole subpopulations.

Examining Alexia’s case from the beginning of the chapter, she meets the DSM-5 diagnostic criteria for pica: She describes frequent consumption of eye shadow, clearly a nonnutritive, nonfood substance, over a period of more than 1 month (A). She is an otherwise mentally and physically healthy adolescent (D), so the eating of eye shadow is inappropriate to her developmental level (B). She lives in an urban, US family, where the consumption of makeup or any of the main components of her eye shadow is neither a culturally nor a socially normative practice (C).

Epidemiology and Course

To our knowledge, there are no community-based prevalence studies of DSM-5 pica. There are only a few studies that report prevalence of pica among

representative populations of children, dating back to 1942 (Dickins & Ford, 1942) and most recently 2004 (Nchito et al., 2004). Of course, comparability and generalizability of these data is limited due to different diagnostic criteria used. However, throughout the literature, children are one of the three major populations presenting with pica, along with pregnant women and individuals with intellectual or developmental disabilities. Rose et al. (2000) summarized that pica seems to be most common in underdeveloped areas (e.g., rural African populations; Young, 2011) with low socioeconomic status, in women (especially pregnant women), and in children, with prevalence rates generally decreasing with age.

Epidemiological studies in youth were mainly conducted in the USA and in different regions of Africa, yielding prevalence rates ranging from 1.7% for children in upstate New York counties (Marchi & Cohen, 1990) to a considerable 74.4% in children in Zambia (Nchito et al., 2004). However, these studies have to be interpreted with caution. Several studies conducted in the USA employed criteria different from those of the DSM (e.g., consumption of two or more nonfood substances (Marchi & Cohen, 1990)), specific subgroups (e.g., children being treated for sickle cell disease (Ivascu et al., 2001), children currently treated in clinics (Millican, Layman, Lourie, Takahashi, & Dublin, 1962)), or age ranges including toddlers whose behavior was still developmentally appropriate and thus would not meet DSM criteria for pica (e.g., De la Burde & Reames, 1973; Marchi & Cohen, 1990). Young (2011) summarized in her review of the literature that highest prevalence rates for children are found in African countries and in the US regions with low socioeconomic status. The studies in African populations show that children mostly engage in geophagy, while studies conducted in other countries (mainly in the USA) report different forms of pica (e.g., paint, paper). There is evidence, however, that pica represents a socially appropriate behavior in certain African regions, which would result in dismissal of a pica diagnosis in many cases if diagnosed according to DSM-5 criteria. For example, Geissler et al. (1997) report that in their study of Western Kenya, “soil eating is a conscious and

non-stigmatized activity of the children in the study area and part of their collective everyday life” (p. 625). Another study reported that in Zambia, local vendors sold earth for consumption (Nchito et al., 2004). In sum, many prior studies have used criteria disparate from the DSM and reported on specific subgroups that are not translatable to our current clinical definition of pica. Further research using rigorous methodology consistent with the current DSM (DSM-5) is needed.

In the pregnant women and individuals with developmental or intellectual disabilities, Young (2011) reports 47 representative studies (*n*'s ranging from 40 to 70,000). The most recent of the studies in pregnant women (utilizing DSM-IV-TR criteria) reported prevalence rates from 0.02% in a national representative sample in Denmark (Mikkelsen, Andersen, & Olsen, 2006) to as high as 63.7% in a health facility sample in Tanzania (Nyaruhucha, 2009). Geophagy was again the most prevalent form of pica in African samples. Among individuals with intellectual disabilities, Ashworth, Hirdes, and Martin (2009) reported that 22% or more of 1000 institutionalized individuals with intellectual disabilities in the USA suffered from pica, using DSM-IV-TR criteria. Zainab (2001) reported high prevalence rates in institutionalized populations (9–25%) and slightly lower rates in community settings (0.3–14.4%) in his review. The large range of these prevalence rates might be due to a sampling bias or be due to an increase with mental impairment.

In sum, as recent epidemiological studies are still missing, no clear conclusion can be drawn for the prevalence rates of pica among children (other subgroups or the general population). The prevalence rates of all available studies require cautious interpretation, as some studies date back to the mid-twentieth century, using outdated, less specific diagnostic criteria than the DSM-5 criteria at the time or describing pica behavior, not the disorder (see above). For instance, in all subgroups, the new categorization as nonfood (particularly for ice cube and raw starch pica) might diminish the frequency of pica cases.

Although there is still a lack of longitudinal, representative data, the typical onset of the disorder seems to be in childhood, often spontaneously

remitting after a while and rarely persisting through adolescence and adulthood (APA, 2013). This is reflected in the prevalence rates that seem to decline with age except for certain subpopulations, as mentioned above. However, in children with developmental or intellectual disabilities, pica can persist over time if it remains untreated, as difficulties in perception and learning as well as resulting challenging behaviors do not remit in most people with such disabilities (Matson, Belva, Hattier, & Matson, 2011). Moreover, pica may onset in adolescence or adulthood, particularly for certain subgroups like pregnant women (APA, 2013).

Comorbidities, Associated Impairments, and Developmental Challenges

As previously mentioned, pica (or pica behavior) can be associated with intellectual or developmental disorders, e.g., autism spectrum disorder (ASD). A recent study reported pica behavior in half of its sample of the children (3–10 years of age) with ASD (Clark, Vandermeer, Simonetti, & Buka, 2010), supporting the findings of an earlier study (Kinnell, 1985) that found that 60% of the individuals of the ASD group had shown pica behavior once and 13% repeatedly to chronically. Pica behavior in ASD might be seen as part of a prolonged developmental delay (oral investigation and mouthing behavior are common in healthy toddlers, as mentioned above) and therefore might not warrant a separate diagnosis. However, one should consider the need of additional medical attention due to potential medical consequences, potentially rendering a diagnosis useful.

In adults, other comorbidities can be found as well. Bhatia and Gupta (2009) reported a case where a woman described an impulse to eat chalk. Her pica eating was similar to obsessions (ego-dystonic and persistent) and decreased with education about coping mechanisms during stressful situations and the use of a selective serotonin reuptake inhibitors (SSRIs). Thus, pica may in some cases be stress-induced and might share underlying mechanisms with obsessive-compulsive spectrum disorders (Bhatia & Gupta, 2009). This supports

older findings by Stein, Bouwer, and van Heerden (1996) that analyzed five cases of pica. Two cases described pica behavior as a compulsion, while two other cases describe pica behavior as a means to decrease tension, similar to an impulse control disorder. Four of the cases were successfully treated with SSRIs. Dumaguing, Singh, Sethi, and Devanand (2003) reported on three cases of geriatric patients with schizophrenia or schizoaffective disorders who developed pica late in life, resulting in fatalities in two of the cases (asphyxiation and obstruction/puncturation). In a field study for DSM-5 criteria of feeding and eating disorders, Delaney et al. (2014) found prevalence rates of pica behavior of 7.4% in a residential eating disorder sample and 4.0% in an outpatient weight-loss seeking sample with most patients reporting pica behaviors for the reason of weight control. Only 1.3% (two individuals) of the residential sample (and 0% of the weight-loss sample), however, received a DSM-5 pica diagnosis consuming gum and plastic.

Besides comorbidities with other psychological disorders, pica is associated with a number of medical issues. Decker (1993) reports that of 35 patients who received treatment for pica in a hospital, three quarters required surgery, with one third resulting in complications and 11% resulting in death. As children might not be able to link pain and digestive problems to their pica behavior, they might develop even greater medical impairments before pica is noticed and treated. As our digestive system has adapted to certain types of food, it cannot cope with most nonfood items, and depending on the substance, there may be various resulting medical complications. Such complications include intestinal perforation due to the shape and consistency of the objects ingested (e.g., rocks, metal parts), which might result in the need for surgery, or even death. Other possible complications include intestinal obstructions (e.g., when hair is consumed) or lead poisoning (e.g., when paint is consumed). Furthermore, endoscopies and laparotomies might be necessary to remove nondigestible foreign objects from the intestinal tract (Decker, 1993). Asphyxiation is also possible when swallowed items clog the trachea (Dumaguing et al., 2003). Infections are also

frequent when earth is the preferred substance: For example, Luoba et al. (2005) examined the reinfection rate with intestinal helminths among women in Kenya who were dewormed during their pregnancy and found that women with geophagy were more often and more intensely reinfected postpartum than women without geophagy. Saathoff, Olsen, Kvalsvig, and Geissler. (2002) reported similar results among schoolchildren in South Africa who ate soil from termite mounds. Many individuals with pica also have deficiencies in minerals or vitamins, although this is often considered a preexisting or even risk factor rather than a consequence of the disorder (see “Etiology”). There is not much literature on the psychological consequences of pica, but many individuals have reported feeling significant levels of shame (see “Symptom Presentation”). As a consequence, individuals struggling with pica may socially withdraw and/or develop depressive symptoms.

Pica may be associated with developmental challenges, but research has not targeted this topic to date. First, one might assume that the association with intellectual disability and other neurodevelopmental disorders might delay the individuals concerned in all aspects of development. This factor might be particularly pronounced given the large comorbidity between pica and developmental or intellectual disabilities (Matson, Hattier, Belva, & Matson, 2013). Second, social withdrawal due to shame may lead to depression, which is often associated with developmental challenges (Steinhausen, 2013). Finally, pica may lead to medical consequences and residential/emergency treatment including long hospital stays, which can impact children and adolescents developmentally, e.g., in their school or social development.

Differential Diagnoses

There are five main differential diagnoses one has to consider when diagnosing pica. If the pica behavior only occurs in the context of another disorder or serves a purpose within another condition, the diagnosis of pica is not warranted.

First, if nonfood, nonnutritive items are solely consumed in order to lose weight or prevent weight gain (e.g., in eating disorders), then a diagnosis of pica is not warranted. In a sample of 149 patients diagnosed with eating disorders in a residential treatment center and 100 weight-loss seeking patients in an outpatient clinic, Delaney et al. (2014) found that while only two patients met the DSM-5 criteria for pica, a total of 15 patients engaged in pica behavior. Qualitative analysis showed nine of those individuals mainly ate ice, for different reasons (e.g., as a supplement for food, to keep the mouth moist when restricting fluids, or to avoid hunger). Second, individuals suffering from avoidant/restrictive food intake disorder may concurrently exhibit pica behavior, but a separate diagnosis of pica would not be conferred, as they may actively seek out substances with the preferred sensory (i.e., textural, smell) qualities irrespective of them being considered food or having nutritional value (Hartmann, Becker, Hampton, & Bryant-Waugh, 2012). Third, individuals who engage in non-suicidal self-injury and ingest nonfood items might swallow potentially harmful objects, like razorblades, or objects that cause pain during digestion, like stones, to evoke pain as an emotion regulation strategy. Ingestion of such objects is thus treated as part of the disorder (i.e., treatment of self-injurious behavior) and does not warrant an additional pica diagnosis. Fourth, some individuals with schizophrenia (e.g., Fishbain & Rotondo, 1983; Foulon, 2003) may consume nonfood substances, possibly as a consequence of auditory hallucinations in which the voices order the individual to do so or as a function of a delusional system. In these cases, pica behavior may cease once overall schizophrenia symptoms are treated. Finally, DSM-5 mentions factitious disorder is named as a possible differential diagnosis. In factitious disorder, individuals swallow and ingest items to cause injury and falsify medical symptoms in order to get medical attention. Pica behavior is part of the deceptive behavior typical of the disorder and therefore not diagnosed separately (APA, 2013).

In addition to the aforementioned presentations that may include pica behavior, there are

other presentations that may consist of similar characteristics. For instance, pica may be falsely diagnosed as a substance use or addictive disorder; from a clinical perspective, the cravings of individuals with pica are comparable to that of individuals struggling with substance use. Internet forums for people suffering from pica (e.g., <http://www.experienceproject.com/>, search for pica) contain many examples of language very similar to that of individuals abusing drugs: “its dry, white and powder texture drives me insane” (Adiaz268, 2011), “I (...) somewhat panic when I run out” (Omnia41, 2014), “I didn’t give in for a long time. One day (...) I couldn’t take it anymore. I went outside and got a rock (clay) and put it in my mouth. It was so satisfying” (Humhoney, 2010), “I’ve been clean”, and “I did...” (Young, 2011, p. 14f). Some criteria for addiction might also be fulfilled by someone suffering from pica (e.g., the time spent to obtain the specific craved substance), but tolerance effects are likely not seen with pica. Therefore, if the substance consumed is psychotropic and listed in the “Substance-Related and Addictive Disorders” category of DSM-5, pica should not be diagnosed. One might also see a resemblance to the attempts by individuals suffering from obsessive-compulsive disorder (OCD) who have difficulties controlling their urge to engage in compulsive behaviors. However, unlike the compulsions in OCD, it seems that most individuals with pica do not consume the substance in order to reduce anxiety or stress, or prevent a feared event, but rather describe it as an addiction or a pleasure. Phrases like “I personally love starch” (Young, 2011, p. 12) have been found in Yahoo! discussion groups or other forums. There are, however, case reports of pica eating as compulsions, sometimes reacting to intrusive, ego-dystonic obsessions (see “Comorbidities”).

Etiology

No integrative etiological model of pica exists in either children or adults. Over the course of the history of the disorder, various theories emerged, some of which will be explored in detail below.

First, potential etiological factors inherent to the individual, such as personality factors, developmental delay patterns, and traumatic childhood development, are discussed. Afterward, three theories that have been posited comprising social or cultural factors leading to pica, particularly focusing on geophagy, are focused upon.

There are different models comprising the etiology of eating disorders in general, which conceptually include pica (Carter, Wheeler, & Mayton, 2004). Marchi and Cohen (1990) suggested lack of self-control as an underlying factor for pica, associating picky eating with self-control in children on the other hand. In children, especially with intellectual or developmental disorders, pica is sometimes viewed as a simple developmental retardation. It is possible that the behavior of oral investigation and mouthing, being developmentally appropriate until the age of two, could expand over a longer period of time in some children including the ingestion of items that are consistent with pica. Other variables associated with pica in children include potentially traumatic events such as parental separation, neglect, or too little interaction between parents and the child (Singhi, Singhi, & Adwani, 1981). In individuals with intellectual disabilities, pica has been significantly associated with lack of support and social contact in- and outside of the family as well as the absence of involvement (activities or day programs), but has not been associated with interpersonal conflict (Ashworth et al., 2009). These aspects might also be relevant in children without intellectual or developmental disabilities.

In her book on pica, particularly geophagy, Young (2011) posits three main etiological theories of pica:

1. *Earth or other pica substances as a famine food.* There are many accounts of people engaging in geophagy in times of food shortage. There are also incidents in modern history: in 2008, during a food crisis in Haiti, some inhabitants would eat “cookies made of dirt, salt, and vegetable shortening” (Katz, 2008). Populations with the highest pica prevalence rates seem to be in Third World countries or in areas with low socioeconomic status

(see section “Epidemiology”). However, this does not explain cases of individuals with pica like Alexia, who do not lack food and do not need the earth for its (questionable) nutritional value. Young’s hypothesis (Young, 2011) also does not hold up for the many individuals with pica who consume items that do not hold any nutritional value. Additionally, hunger is likely not a core motivator in all types of pica, as many individuals with pica stick to one specific substance regardless of item availability or their hunger state. In order to test if the hypothesis is at least partially true, Young (2011) performed a review of geophagy literature where data on hunger status of the individuals was included, with some of the reports dating back to the nineteenth century. Only half of these reports found any relation between geophagy and hunger (28% sometimes, 22% always), while the other half stated that the consumption of earth was never associated with hunger and reported geophagy in populations where there was never a supply shortage. In a more recent study (Young et al., 2010), the participants were specifically asked for possible motivations for pica, including hunger. None of the participants gave hunger as a reason for their pica, and indirect indicators of possibly low socioeconomic status (which could prompt hunger that might not be reported directly due to embarrassment) did not differ between individuals suffering from pica and those who did not. In sum, the theory does not explain all cases of pica and pica substances.

2. *Pica as a dietary supplement, mainly because of a lack of micronutrients.* Micronutrient deficiencies related to pica are primarily iron deficiency and to a lesser extent calcium and zinc. This theory is useful to explain the pica prevalence rates in pregnant women who may become deficient in certain micronutrients, particularly iron. Furthermore, there is evidence from case studies that connect pica to micronutrient deficiencies. For example, Young et al. (2010) found a strong correlation between iron deficiency and pica, even after controlling for confounding factors. Interestingly, one could reason that once any micronutrient deficiency was eliminated in individuals with pica, their

pica behavior would remit. While there are many historical accounts for this theory, mainly involving the correction of anemia (e.g., Carlander, 1959), one recent randomized controlled trial (RCT) study investigating this hypothesis in Zambian children (Nchito et al., 2004) reported no decrease in pica behaviors after supplementing iron or multivitamin supplements. In sum, evidence for this particular theory is inconsistent, and, importantly, there are no studies to date allowing for the attribution of causal effects.

3. *Pica as a protection and a detoxifier.* Young (2011) finally posits the theory that in some cases, like geophagy, pica may help to shield individuals from harmful substances or detox if the harmful substances have already been ingested. This theory might explain why individuals with low immune defense, like children and pregnant women, are affected by pica. Bhatia and Kaur (2014b) mention antidiarrheal properties of certain types of clay (e.g., Vermeer & Ferrell, 1985). However, to our knowledge medicinal or therapeutic properties have not been found for other common pica substances besides clay. This also does not explain the ingestion of harmful objects that often leads to medical complications in individuals suffering from pica (see “Associated Impairments”).

In sum, the understanding of pica is very limited currently. No model is able to explain the occurrence and maintenance of pica in all subgroups or for all pica substances. More research needs to clarify whether a unified theory exists; how multifactorial models including socioeconomic, biological, and psychological factors should be composited; and how to delineate successful treatment strategies.

Diagnosics and Treatment

Before starting psychological treatment, it is essential to determine how the individuals’ symptom presentation fits into a diagnostic classification and select treatment strategies accordingly. The Eating Disorder Assessment for DSM-5 (EDA-5; Sysko et al., 2015) allows for the

assessment of pica according to the new DSM criteria. To our knowledge, an adaptation for children is planned for. In areas of the world where pica might be stigmatized, the interview strategies should be chosen accordingly. For example, in the diagnostic process, several variables might be considered, like matching interviewers to the sex and social and ethnic background of the interviewee. To minimize underreporting, normalizing the behavior at the beginning of the interview and using certain rhetoric techniques might be helpful (Young, 2011).

Alternative methods to assess pica behavior in individuals that do not, cannot, or do not want to provide information in self-report are available even if not standardized. Individuals with potential pica can be presented with various nonfood or placebo items for dangerous substances, to assess choices of pica substances (Study III in Foxx & Martin, 1975; Piazza et al., 1998). X-rays can detect potential items in the digestive system (e.g., Anderson, Akmal, & Kittur, 1991). In behavior functional analyses (Hirsch & Myles, 1996; Piazza, Hanley, Blakeley-Smith, & Kinsman, 2000), particular reinforcements for pica behavior instead of pica behavior itself can be analyzed. Admittedly, the latter needs at least minimal engagement of the patient.

Literature on psychological treatment outcome and recommendations is scarce. There are no randomized controlled trials for treatments of pica, but various case studies provide suggestions of different approaches. As many cases of pica show spontaneous remission, especially in children, most reports of treatment attempts are for individuals with intellectual disabilities. However, most of the strategies from these reports can be applied to otherwise healthy youth with pica.

Bell and Stein (1992) concluded in their review that pica “may be a learned behavior subject to change by manipulating antecedent or consequent events in the subject’s environment” (p. 378). This has important implications for treatment conceptualization, and as a consequence, most strategies found in case studies can be characterized as behavior modification, e.g., stimulus control, response blocking, and positive reinforcement with pleasant consequences. These and other strategies mainly employed historically

or today in very severe cases are explored in more detail below.

Stimulus control is a traditional strategy used to control or inhibit a behavior. It describes the manipulation of overt or covert behavior through the intended exploration, avoidance, or change of stimuli that precede the targeted behavior (for an example of stimulus control in treatment of an individual with pica, see Piazza, Hanley, & Fisher, 1996). In the case of pica, stimulus control might include the limitation of access to the substance or to the location where the substance is usually consumed. *Response blocking* is often used in individuals with developmental disabilities (Matson et al., 2013), interrupting attempts to engage in pica, sometimes in baiting situations to increase contingency of the treatment. Reportedly, response blocking was used effectively in three individuals with intellectual disabilities (McCord, Grosser, Iwata, & Powers, 2005) and in two other studies, which combined response blocking with alternative real foods (Hagopian & Adelinis, 2001; Piazza et al., 1996). *Positive reinforcement with pleasant consequences* for appropriate behavior is another method used. Differential reinforcement has been given in various ways, but with mixed results (Bell & Stein, 1992). Such reinforcements have included contingency management on reduction of pica, or for behaviors incompatible with pica, mostly stimulating the same senses as the pica behavior using consumable reinforcements. Discrimination training has also been used in children, reinforcing correct answers to questions concerning the problematic behavior (e.g., which substances should or should not be eaten), yielding similarly mixed results, possibly due to differing language functioning (Bell & Stein, 1992).

Besides currently used strategies, some techniques have more of a historical value or are only used in very severe cases, such as significant intellectual impairment or use of highly dangerous substances. There are some accounts of contingently applied *overcorrection* as a treatment for pica, including extensive oral and personal hygiene or tidying of the area pica behavior was typically engaged in (Singh & Winton, 1984). These procedures produced mixed results, but

especially the application of oral hygiene seems to be somewhat effective as a treatment (Bell & Stein, 1992). According to Matson et al. (2013), overcorrection has not been used for three decades. There are also accounts relying on contingent *positive reinforcement with unpleasant consequences* for pica behavior. For example, Paisley and Whitney (1989) conducted a series of experiments in an adolescent with intellectual disabilities, including the contingent application of lemon juice in the subject's mouth, reporting decrease of pica. Like overcorrection, this procedure is not socially acceptable today and has more of a historical value (Matson et al. 2013). Other examples of punishment methods include time-outs, like facial screening (e.g., therapist's hand over the eyes of the individual as reported by Fisher et al. (1994) and Falcomata, Roane, and Pabico (2007)). This was shown to be effective in three children in combination with rewarding procedures or enriched environment (see below), respectively. Physical restraint has also been used in case studies, proving to be effective in most (Bell & Stein, 1992). For example, Singh and Bakker (1984) compared an overcorrection procedure to a brief restraint, removing the pica substance and holding the subject's arms. Both were similarly effective, but the restraint was less time-consuming. Hand-held restraint also significantly reduced pica in a woman with intellectual disabilities (Bogart, Piersel, & Gross, 1995). Restraint is controversial, but still used today (Matson et al., 2013). In cases in which the behavior is life-threatening or the person is too intellectually impaired, *self-protection devices* like helmets or restriction jackets have been used (e.g., Rojahn, Schroeder, & Mulick, 1980). This is mostly seen in institutionalized individuals and might reduce pica, but probably increases other maladaptive behaviors, such as stereotypy (Rojahn et al., 1980) and other negative consequences, like reduced social interaction.

Various comorbid disorders or conditions in which pica behavior might occur without warranting a separate diagnosis (see "Comorbidity and Impairment") may warrant treatment first of the other diagnosis and then pica secondly, as pica may remit with the treatment of the primary disorder.

Moreover, psychological issues presenting in the families of the children suffering from pica might need attention prior to engage in the treatment of pica itself (Bhatia & Kaur, 2014b). Besides psychological treatment, *medical treatments* may also be indicated, such as treating potential underlying nutritional deficiencies with supplements. So far, however, nutritional supplementation has not proven effective by an RCT to date (see “Etiology”). SSRIs may be effective in some cases of pica (e.g., Beck & Froberg, 2005; Bhatia & Gupta, 2009; Bhatia & Kaur, 2014a; Stein et al., 1996) and should be researched further to investigate generalizability of findings beyond treatment of potential underlying symptoms of depression. Surgery represents the most common treatment of associated medical consequences (discussed in “Associated Impairments”) (Decker, 1993).

In summary, there are many case studies investigating different treatments, but none (except for micronutrient supplementation) has been tested in an RCT. Existing case studies suffer per definition from missing control groups, if not additional, other major methodological flaws (Bell & Stein, 1992). Due to the different characteristics of populations presenting with pica, presumably various treatment strategies will be necessary to treat pica differentially dependent on the substance consumed. As Matson et al. (2013) put it: “more research is needed investigating algorithms with pica, based on type of behavior, frequency, intensity, chronicity and cause” (p. 2569).

Summary and Outlook

Pica is a disorder that appears to mainly occur in children, pregnant women, and individuals with intellectual disabilities. However, representative epidemiological data is rare and, for the general population, nonexistent. It is characterized by eating substances that are considered nonfood and nonnutritive. It can occur within the context of other mental disorders such as neurodevelopmental disorders, schizophrenia, eating disorders, non-suicidal self-injury, and factitious disorder and is not diagnosed separately unless

needing additional medical attention or if not fully explained by the other disorder (e.g., not only eating a nonnutritive, nonfood substance to substitute for real food but also for other reasons in the case of eating disorders). In some cases, pica may be mistaken for a substance use disorder or OCD. Pica is also associated with severe medical impairments (e.g., intestinal perforation or obstruction, infections, or asphyxiation), while little is known about associated psychological impairment. The extremely relevant topic of developmental challenges associated with pica has not been researched to date, beyond our current understanding of potential factors impacting developmental delay, such as shame, withdrawal, depression, and medical hospitalization. Currently, there is no unified etiological model of pica; instead, single theories exist that explain pica behavior with a limited number of substances and/or subgroups. Psychological treatment in children is limited to techniques of behavior modification that are only supported by case studies. In case of pica behavior as part of another mental disorder, the latter should receive treatment first, possibly also leading to a remission of pica behavior. Pharmacological treatment of individuals with pica is scarce, but there is some limited support for the use of SSRIs. And, of course, medical complications should be treated immediately, in most cases needing surgical procedures.

Apart from television shows that feature individuals with pica as a popularized anomaly or weird addiction, pica has not received much attention in the general community. Importantly, general knowledge of pica is scarce in the medical and mental health professional community. In order to inform the public as well as health-care providers, more research is needed to elucidate prevalence rates across populations as well as the longitudinal course of pica. Moreover, experimental studies will help to elucidate etiological mechanisms. Current approaches based on the Research Domain Criteria (RDoC) might be useful to investigate underlying neurological, genetic, and behavioral mechanisms making use of multiple methods investigating the different domains (cognition, social processes, arousal/regulator systems, and negative as well as positive valence

systems) (for an overview over RDoC, see, e.g., Morris & Cuthbert, 2012). Furthermore, future research could utilize models from phenotypically related disorders (e.g., impulse control disorder, substance abuse). These findings will then allow us to develop treatment strategies. Eventually, new treatment strategies can be developed and tested in larger scale randomized controlled trials.

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