



Original Article

Innate food aversions and culturally transmitted food taboos in pregnant women in rural southwest India: Separate systems to protect the fetus?

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ABSTRACT

Pregnancy increases women's nutritional requirements, yet causes aversions to nutritious foods. Most societies further restrict pregnant women's diet with food taboos. Pregnancy food aversions are theorized to protect mothers and fetuses from teratogens and pathogens or increase dietary diversity in response to resource scarcity. Tests of these hypotheses have had mixed results, perhaps because many studies are in Westernized populations with reliable access to food and low exposure to pathogens. If pregnancy food aversions are adaptations, however, then they likely evolved in environments with uncertain access to food and high exposure to pathogens. Pregnancy food taboos, on the other hand, have been theorized to limit resource consumption, mark social identity, or also protect mothers and fetuses from dangerous foods. There have been few tests of evolutionary theories of culturally transmitted food taboos.

We investigated these and other theories of psychophysiological food aversions and culturally transmitted food taboos among two non-Western populations of pregnant women in Mysore, India, that vary in food insecurity and exposure to infectious disease. The first was a mixed caste rural farming population ($N = 72$), and the second was the *Jenu Kurubas*, a resettled population of former hunter-gatherers ($N = 30$). Women rated their aversions to photos of 31 foods and completed structured interviews that assessed aversions and socially learned avoidances of foods, pathogen exposure, food insecurity, sources of culturally acquired dietary advice, and basic sociodemographic information. Aversions to spicy foods were associated with early trimester and nausea and vomiting, supporting a protective role against plant teratogens. Variation in exposure to pathogens did not explain variation in meat aversions or avoidances, however, raising some doubts about the importance of pathogen avoidance. Aversions to staple foods were common, but were not associated with resource stress, providing mixed support for the role of dietary diversification. Avoided foods outnumbered aversive foods, were believed to be abortifacients or otherwise harmful to the fetus, influenced diet throughout pregnancy, and were largely distinct from aversive foods. These results suggest that aversions target foods with cues of toxicity early in pregnancy, and taboos target suspected abortifacients throughout pregnancy.

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1. Introduction

We report a study in two rural Indian populations designed to test several evolutionary hypotheses regarding the function of pregnancy food aversions and culturally transmitted food taboos. Influential theories of dietary shifts in pregnancy propose that because the fetus is particularly vulnerable to developmental disruption during organogenesis, which occurs early in pregnancy, women evolved to experience physiological aversions in the first trimester toward toxic plant foods (Hook, 1978; Profet, 1995). Immunological shifts early in pregnancy that accommodate the developing fetus were thought to increase mothers'

susceptibility to infection, so mothers should also be averse to foods likely to harbor pathogens, such as meat (Fessler, 2002; Flaxman & Sherman, 2000). Food aversions and nausea and vomiting in pregnancy (NVP) were therefore hypothesized to be evolved mechanisms that protect women and fetuses, which is commonly referred to as "the maternal-fetal protection" hypothesis (Patil & Young, 2012; for reviews, see Patil, Abrams, Steinmetz, & Young, 2012).

Although several lines of evidence support the maternal-fetal protection hypothesis, many of these come from studies in high income countries with a low burden of infectious disease (Patil, 2012). Some studies in populations facing resource scarcity, however, have failed to support it. A study in southern Ethiopia for example, found that pregnant women avoided cereals, which were non-toxic staple foods, but craved meat and other livestock products, which were scarce

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(Demissie, Muroki, & Kogi-Makau, 1998). In Turkana pastoralists, Pike (2000) found that NVP was associated with adverse health indicators among both mothers and developing fetuses, contrary to the maternal-fetal protection hypothesis. More generally, some studies have found variation in the timing and types of items that women find aversive, or avoid, in pregnancy, not all of which are consistent with maternal-fetal protection (Patil, 2012; Young & Pike, 2012).

Shifts in dietary preferences might instead be a strategy to diversify nutrient intake for pregnant women with high levels of food insecurity or nutritional deficiencies (Demissie et al., 1998). East African women, for example, have reported aversions toward staple foods, such as maize, and cravings for meat and milk, two foods perceived by women to increase strength, but that are limited due to reduced food availability and low socioeconomic status (Young & Pike, 2012). South Indian women have reported cravings for pica substances, including mud and chalk, that have questionable health consequences but were directly linked to resource scarcity and psychological distress (Placek & Hagen, 2013).

Culturally transmitted food taboos also shape food choices during pregnancy (e.g., Augner, 1994; Dentan, 1966; Henrich & Henrich, 2010; Placek & Hagen, 2013, 2015). The Semai horticulturalists, for example, avoid unripe fruit in pregnancy because consumption is believed to cause malaria and subsequent fetal death (Dentan, 1966). Augner (1994) found that for some individuals in the Congo basin, particularly pregnant women, adherence to food taboos reduced caloric intake by up to 9%.

Classic anthropological theory suggests that food taboos could function to protect the environment by limiting resource consumption (Harris, 1998), increase group cohesion by serving as a marker of social identity (Whitehead, 2000), or spread due to symbolic reasoning; e.g. through perceptions of purity and pollution (Douglas, 2003).

Alternatively, food taboos might have culturally evolved to identify dangerous foods. Learning about dangerous foods from parents and other local “experts” reduces costs of individual learning (Augner, 1994, 2000; Boyd & Richerson, 1985; Boyd, Richerson, & Henrich, 2011; Cashdan, 1994; Cavalli-Sforza & Feldman, 1981; Fessler & Navarrete, 2003; Henrich & Boyd, 2002; Henrich & Henrich, 2010; Richerson & Boyd, 2005). Henrich and Henrich (2010) found that in Fiji, pregnancy and postpartum food taboos targeted toxic marine species, likely to protect mothers, fetuses, and nursing infants from harm. More generally, as similar functionality can evolve genetically or culturally (Boyd & Richerson, 1985), functional hypotheses for food aversions, e.g., increasing dietary diversity, could also apply to food taboos.

Cultural information can be transmitted vertically, from parents to offspring; obliquely, from members of the older generation to members of the younger; and horizontally, among siblings, friends, and other members of the same generation. These modes of transmission are favored by genetic natural selection under different environmental conditions. Vertical transmission is expected for behaviors that impact fertility and are under strong selection in stable environments. Oblique learning, on the other hand, allows more rapid adaptation in variable environments (McElreath & Strimling, 2008). Henrich and Henrich (2010) argue for the importance of a prestige bias toward oblique learning, finding that women acquired pregnancy food taboos vertically from mothers and grandmothers, and obliquely from mothers-in-law, elders, and prestigious wise women.

The relationship between pregnancy food aversions and taboos has received relatively little theoretical or empirical attention. If aversions and taboos both function to protect mothers and fetuses from dangerous foods, are these the same foods or different foods? Fessler and Navarrete (2003) propose the *socially mediated ingestive conditioning hypothesis*, in which aversive reactions of individuals to a particular food, such as meat, are observed by others, who then learn to associate that food with an aversive response, avoiding it themselves. Aversions acquired via socially mediated ingestive conditioning can gain moral weight via various mechanisms (e.g., *normative moralization* or

egocentric empathy; for details, see Fessler & Navarrete, 2003), leading to a widespread taboo of that food. Under some scenarios, common aversions might become common taboos; under others, idiosyncratic aversions of a few individuals might become common taboos. The few previous studies found little correspondence between food aversions and food taboos (Augner, 1994; Henrich & Henrich, 2010), raising doubts about scenarios in which common food aversions become common taboos.

During socially mediated ingestive conditioning, individuals associate a food with an aversive reaction (e.g., “papaya made me sick”). As there is no scientific, let alone cultural, consensus on the functions of pregnancy food aversions (if any), food taboos might be accompanied by explanations that have little or nothing to do with their underlying functionality. Indeed, Fessler and Navarrete (2003) suggest that “investigators would do well to pause before assuming that such cultural rationales are the principal factor motivating the generation, acquisition, and perpetuation of attitudes and behaviors – they are as likely, if not more likely, to be justifications rather than causes” (p. 24).

Alternatively, because physiological cues of toxicity, such as bitterness and nausea, do not reliably indicate teratogenicity, women might have evolved to individually and socially learn associations between foods and poor pregnancy outcomes, independent of their own or others’ aversive reactions (Hagen, Roulette, & Sullivan, 2013; Placek & Hagen, 2015), consistent with generic cultural transmission models (e.g., Boyd & Richerson, 1985). Under this hypothesis, individual learners would know why they avoided a food, but might or might not transmit this reason to others (e.g., “do not eat papaya because it causes abortion” vs. “do not eat papaya.”).

2. Study goals and predictions

We investigate four major questions: (1) What is the function of pregnancy food aversions, if any? (2) What is the function of pregnancy food taboos, if any? (3) From whom are pregnancy food taboos acquired? (4) If, as several theorists have suggested, aversions and taboos both function to protect individuals from dangerous foods, are these the same foods or different foods? Because pathogen exposure and constrained access to food are key factors in influential theories of aversions and avoidances, we conducted our study in India, a region of high food insecurity and communicable disease.

Currently, 300 million (30%) of India’s rural population is impoverished and lacks access to sufficient foods, basic health care, and education (“India Food Security Portal”, n.d.). In 2012, 41% of Indian deaths were due to communicable disease (“WHO India”, n.d.). Of those with electricity, power outages occur on a daily basis and last for hours (Wilson, Mignone, & Sinclair, 2014). Hence refrigeration, and thus safe food storage, is often absent or unreliable. Finally, India ranks as one of the highest in iron deficiency anemia in the world, with rural pregnant women and children at highest risk (Kalaivani, 2009).

In India, health and illness are framed in terms of humoral theory, in which combinations of five elements in the body — earth, fire, ether, air, and water — determines one’s constitution, and thus one’s well-being. Pregnancy is considered a period of increased heat in the body during which women must avoid “hot” foods (“hot” does not refer to spiciness or temperature) and only consume “cooling” foods in order to bring internal balance and thus ensure a successful pregnancy outcome (Nag, 1994; Placek & Hagen, 2015; Van Hollen, 2003).

Placek and Hagen (2015) found that humoral theory had a strong influence on pregnancy diet: South Indian women primarily avoided “hot” foods, mostly fruits but also some meats; often acquired food avoidances via learning; and frequently stated that foods were avoided to prevent fetal or infant harm. Placek and Hagen (2015) also found that pathogen avoidance seemed to best explain avoidance of meat. This study did not systematically distinguish foods that were avoided due to aversive reactions versus those that were avoided due to advice from others, however (instead relying on mothers to make that

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