Increasing prevalence of allergic and autoimmune diseases in children prompts the question: Are parents too clean?

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**Audience:** This review is a handout for parents or caregivers of young children in a semi-urban area of South Central Pennsylvania. It could be given to parents in a pediatrician’s office, for example.

**Research Question:** By effectively ‘sterilizing’ the environment where children eat, sleep and play, are parents setting their children up to develop chronic diseases that could otherwise be prevented?

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As members of an industrialized society, we have access to a clean water supply, pasteurized milk, irradiated food, and numerous cleaning products. We carry our hand sanitizers and swiffer often. Bleach, sanitize, disinfect. Some parents have turned into germaphobes, excessively washing toys, cloroxing the Wal-Mart shopping cart, distancing their children from those daycare kids.

Without a doubt, improved sanitation and home hygiene has largely contributed to the decreased prevalence of infectious diseases in developed countries. However, the decreasing incidence of infectious diseases has been associated with an increasing incidence of allergic and autoimmune diseases in children, in accordance with the ‘hygiene hypothesis’ (1). In contrast, the prevalence of allergic and autoimmune diseases is low in developing countries where the prevalence of infectious diseases is high (1).

These contrasting trends bring about a noteworthy question: by effectively ‘sterilizing’ the environment where children eat, sleep and play, are parents setting their children up to develop chronic diseases that could otherwise be prevented? Perhaps what kids need is a little more dirt, rather than less? This literature review explains the development of the hygiene hypothesis and provides supporting evidence by examining the results from several epidemiological studies. It also provides justification for the hygiene hypothesis in terms of immune system regulation and offers suggestions for parents or caregivers whose practices may actually be detrimental to their children’s health.
The ‘Hygiene Hypothesis’

In 1989, David Strachan reported an important observation that he made after studying cases of hay fever in British children: the incidence of hay fever was inversely related to the number of children in the household (2). In other words, children in larger families were less likely to develop an allergic disease like hay fever. Strachan suggested that through ‘unhygienic contact’ with older siblings, children acquired infections early in life that protected them from developing allergic diseases (2).

Strachan’s observation fueled further investigation of what became known as the ‘hygiene hypothesis’ and many epidemiological studies have since confirmed the association between early microbial exposure and decreased development of immunological disorders among children. Studies have also revealed that the type of exposure, duration and time of exposure, and a child’s genetic background are all factors that interact to determine whether an individual will be protected (3). It is now widely accepted that infectious pathogens are not the only organisms that reduce the prevalence of immunological disorders. Saprophytic (soil-dwelling) microorganisms and probiotic bacteria are also protective, as well as non-viable microbial components (4).

Many factors that would change a child’s microbial exposure have been explored. Some include antibiotics and vaccines, day care attendance, and altered living conditions (5). The studies that compare the prevalence of allergic diseases among children raised in rural versus urban areas have arguably won the most support for the ‘hygiene hypothesis.’
The Dirt on Rural Versus Urban Living

In a study of allergic diseases among teenagers in Sweden, researchers found that teens with an allergic disease were much more likely to have lived in an urban environment than in a rural environment for at least the first two years of life (6). A rural area was defined as having less than 200 residents, whereas an urban area had greater than 10,000 residents (6). Other studies have also confirmed that children raised in an urban area are at a greater risk for developing an allergic disease. Because there are several differences between rural and urban environments, there are many possible explanations for the greater prevalence of allergic diseases among children raised in an urban environment. One possibility is that children raised in an urban area spend more time indoors, which would decrease their exposure to soil-dwelling and other microorganisms in the environment. Another possibility is that the urban environment is ‘cleaner’ than the rural environment, which would also decrease microbial exposure.

Researchers have also investigated whether there is a difference in allergic diseases among children raised in rural farming and non-farming environments. Indeed, Braun-Fahrländer and colleagues reported that Swedish children raised on a farm had a lower prevalence of allergic diseases than children in the same rural community who had not lived on a farm (7). Exposure to hay lofts and animal sheds, as well as consumption of unpasteurized milk were identified as protective factors (3). Children exposed to some or all of these factors prior to age one were at lower risk of developing allergic diseases than children exposed after age one (8). In another study, children whose mothers often worked on the farm during pregnancy were less likely to
develop allergic diseases than children whose mothers did not (8). Thus, the timing of exposure is important and appears to begin in utero.

Organisms associated with proper immune system development and protection from immunological disorders include those found in animals, feces, and mud (9). The results of these epidemiological studies indicate that a major contributing factor related to the increased prevalence of allergic diseases in industrialized countries is decreased exposure to these organisms and their non-viable components. Similar results have been reported for the increasing prevalence of autoimmune diseases. Certainly, other factors are involved in the development of allergic and autoimmune diseases as well, including genetic susceptibility. In recent years, investigators have shifted the focus from rural versus urban living to the second part of Strachan’s original hypothesis, which suggested that “improvements in household amenities and higher standards of personal cleanliness have reduced the opportunity for cross infection” (2).

**Home Hygiene**

Attempting to identify common hygiene practices among parents of young children, Sherriff and colleagues distributed a questionnaire to parents of 15 month old children. Parents were asked how often their child’s face and hands were wiped each day as well as how often hands were washed before meals. They were also asked how frequently baths were given. Children were scored from 2 (least hygienic) to 14 (most hygienic). A ‘cleanliness norm’ was given as one bath or shower per day, hand washing before meals, and wiping of face and hands 3-4 times each day. 0.4 % (43 children) were bathed more than once per day, had their hands and faces wiped more than five times, and always had their hands washed prior to meal-time (10). In an additional
study, Sheriff and colleagues found that greater hygiene levels were associated with increased incidence of wheezing and atopic eczema in 15 month old children (11).

Home hygiene practices likely vary in different parts of the world. In industrialized countries like the United States, clean water and a variety of inexpensive cleaning products have made it relatively easy for parents to nearly sterilize their child’s living environment with excessive cleaning. It is also evident that some parents promote excessive hand washing and bathing more than once per day. This appears to be a double-edged sword. By effectively eliminating microorganisms from a child’s living environment, parents or other caregivers reduce the opportunity for infection by pathogenic organisms but also remove the organisms that help to promote normal immune system development.

**Immune Regulation (or lack thereof)**

Immune system development is complex and begins *in utero*. Exposures within the first few years of life are critical for proper immune system development and regulation. Under normal circumstances, regulatory T (Treg) cells respond to antigenic stimulation by microorganisms or their components and modulate the immune system response (12). The activities of two types of T helper cells, Th1 and Th2, are regulated by Treg cells. Th1 cells are involved in the autoimmune response whereas allergic diseases are largely Th2-driven. Treg cells are involved in down-regulating T helper cell responses by producing immunosuppressive cytokines such as IL-10 and TGF-β (12).

Early exposure to saprophytic and probiotic microorganisms ‘primes’ the immune system by stimulating proper regulatory activity of Treg cells. Why adapt to the presence of these organisms rather than promote an adverse response? This has been
explained by the ‘Old Friends’ hypothesis, which suggests that the immune system
developed to tolerate many environmental microorganisms because they were once
present in vast quantities in the food and water that our ancestors consumed (12).
When these organisms are eliminated from the living environment by improved
sanitation, excessive cleaning and personal hygiene, the development of proper
immunoregulation becomes compromised and otherwise preventable diseases may
develop (9). It is not surprising, then, that immunoregulation is inadequate in people
with allergic or autoimmune diseases (12).

‘Let Them Eat Dirt’

It goes without saying that home hygiene and personal cleanliness are important
for protection from bacterial pathogens that may be quite harmful. Especially when
handling food or after using the restroom, hand washing is very important and should be
promoted at a young age. In addition, there are definitely circumstances that require
excessive cleanliness, especially if a child’s immune system is suppressed by
medication or an underlying condition. In the case of a young child with a healthy
immune system, however, microbial exposure is important and reducing a child’s
exposure may cause more harm than good.

This review of several epidemiological studies demonstrates that there is a
strong association between the reduction in early microbial exposure and the
development of allergic and autoimmune diseases. Moving to a farm or feeding a child
dirt are certainly more theoretical than practical suggestions. Instead, realize that
children can benefit from a little more dirt. There is no need to wash the toys daily or
the kids for that matter. They may be trying to protect their children but by sterilizing the
living environment and promoting excessive cleanliness, parents and caregivers are actually targeting their children for disease.
Works Cited


Figure on title page: www.clorox.com/products