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Breastfeeding and risk of parasitic infection—a review

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PEER REVIEW

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Comments

This is an interesting review to describe the association between breastfeeding and risk of parasitic infections and explore the underlying immune responses.
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ABSTRACT

Breastfeeding, as exclusive nutrition in the first six months of life, is a necessary nutritional requisite in infants. Except for very few maternal diseases that contraindicate breastfeeding, some of which still controversial, breastfeeding mothers must continue exclusive and sustained lactation to provide maximum overall benefits through breastfeeding. Parasitic infections is a global disease and children remain a significant proportion of the affected population. The complex and mandatory life cycles of some parasites, particularly the helminths may partly explain their geographical distribution. The world-wide prevalence of parasitic infections as well as the largely asymptomatic nature of most infections, make many of these infections to likely remain under-recognized. Breast milk, the prime infant nutrition must be recognized to be more than a rare vehicle of parasite transmission, but also a general and focused immune defensive tool against some important parasites. The possibility and influence of small quantities of parasite antigens in breast milk have not been adequately explored. It is believed that useful immunological responses both direct and indirect in breast milk that occur due to the presence of parasite antigens, must be further studied in the light of both immediate and long term benefits. Within this context, and prompted by a spectrum of existing uncertainties, researched and hypothetical roles of parasites and associated immunological responses in the lactating mammary gland are proposed and reviewed.

KEYWORDS

Breastfeeding, Parasites, Infection, Uncertainties, Hypothetical, Mammary gland

1. Introduction

The nutritional consequences of parasitic infections are well recognized in children^[1]. Parasites of medical importance include the single cell eukaryotic protozoa, the multicellular eukaryotic helminths, and the arthropod vectors that transmit diseases^[2]. The main groups of parasitic helminths include nematohelminths (nematodes) and platyhelminths (flatworms)^[2]. Platyhelminths are subdivided into cestodes (tapeworms) and trematodes (flukes)^[2]. Geohelminths (soil-transmitted helminths), intestinal

parasites causing human disease include the roundworms [*Ascaris lumbricoides* (*A. lumbricoides*)], whipworms [*Trichuris trichiura* (*T. trichiura*)], and two hookworms (*Ancylostoma duodenale* and *Necator americanus*)^[3].

In children, parasitic infections acquire their full nutritive capacity from a host that can ill-afford to share and often tips the balance of a precarious nutritional state towards its favour. Malnutrition that ensues encourages parasitic infections to flourish as the malnourished host is incapable of effective immunological responses required to limit or to effectively eliminate such infection^[4]. Nutrition is linked

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to immunological processes as nutrition provides necessary substrates for many immunological mediators for important immunological reactions *in vivo*[4]. In children, infections causing prolonged diarrhea predict the development of malnutrition at twelve months of age[5]. Certain parasites in children can cause protein and energy linked nutritional disorders, micronutrient deficiencies and failure to thrive[6].

The mechanisms underlying failure to thrive or inadequate weight gain in children vary according to the type of helminthic infections[3]. Ascariasis causes malabsorption as a result of villous atrophy and lactase deficiency[3]; trichuriasis produces bloody, mucoid diarrhoea and rectal prolapse[3,7]; hook worms interrupt absorption of nutrients through ingestion and digestion of host blood producing the hallmark of a microcytic hypochromic anaemia and can cause a systemic suppression of host immunity not only to itself but also to antigens such as vaccines and allergens[8]. In the young, recognized consequences of chronic heavy hookworm infections are also mental deficits such as poor memory and learning difficulties as iron is required in the synthesis of dopaminergic neurons and some metalloenzymes[9].

The feedback loop between nutritional inadequacies, infections and further deterioration of nutrition is a significant contributor to childhood morbidity and mortality in some parts of the world[4]. The concept of good nutritional care must encompass an approach that deals both with the treatment and more importantly, the prevention of these problems. The immune competence of breast milk may confer important protection[4].

Considering the frequency of parasitic infections worldwide, where one billion people are infected with soil-transmitted helminths, and four hundred million children of school age are infected with many other types of gut parasites[4]—the mother who breastfeeds could well harbour low level of parasites in her gut or any organ system the parasite normally resides in or infects; consequently breastfeeding in the presence of maternal parasite infection is a common clinical scenario to encounter. Although such infections rarely produce symptoms, they are much more likely to be entirely asymptomatic. Hence, breastfeeding and asymptomatic maternal parasitic infection and the effects thereof, should be considered in greater detail.

As similar socioeconomic and sociocultural habits of mother, infant and environment usually coexist, it is possible that the breastfed child may also harbour or be infected by similar parasites just as the mother sometime during the child's life[10]. Additionally, the recognized association of parasitic infections with the lack of accepted standards of hygiene accentuated by poverty and sociocultural habits, are risk factors for parasitic infections in early life. The incorrect marketing of complementary foods that could impede

breastfeeding or encourage the consumption of nutritionally inadequate foods are concerns[11]. Lack of maternal education and ignorance of proper infant feeding methods potentially propagate parasitic infections in a community[3]. Interestingly, a study revealed that parental illiteracy on the whole was a recognised risk factor for *Giardia duodenalis* infection but went on to highlight that paternal illiteracy, as a more important risk for the infection[12]. The study also revealed a possible link between *Helicobacter pylori* infection and *Giardia* infection[12]. Infection in nurseries and day care centres are known[13]. When an infant is not exclusively breastfed, other contributing factors in preparation of artificial formula or complementary foods can be risk factors for parasitic infections. Contamination of infant feeding by water infected by animal or human excreta, inadequate chlorination of water and person to person feco-oral transmission are risk factors[3,13,14]. Aggravation of this situation by human sociopolitical disasters like refugees and refugee settlements have reported frequent strongyloidosis and other parasitic infections linked to sanitation, poor quality of drinking water and lack of foot wear[15].

Particularly in the absence of breastfeeding, one may be concerned about specific immunosuppressive states. Certain clinical circumstances predispose to unique parasitic problems[16]. Chronic helminth infections affect T cell function and lead to immunosuppression[3,17]. Soil transmitted helminths infections often found in areas, endemic to many other infections, increase the risk of diseases such as tuberculosis, malaria, and HIV[3,18–20].

A number of parasitic infections such as *Opisthorchis viverrini*, *Clonorchis sinensis* and *Schistosoma hematobium* are associated with the development of cancer[21].

Cryptosporidium parvum has been linked to digestive carcinogenesis in humans[22]. In a study of the prevalence of intestinal parasites in immunosuppressed children, more than a third had parasitic infections including *Giardia lamblia* (*G. lamblia*), *Entamoeba coli*, *Blastocystis hominis*, *Iodamoeba butschlii*, *Chilomastix mesnili*, *Hymenolepis nana* and *Enterobius vermiculari*[23].

Considering the overall health impact of parasitic infections, it is useful to know if breast milk can protect against parasites and whether a mother infected with parasites influences the course of the infection or the immunological outcome of the disease in her nursing child.

2. Breastfeeding is advantageous in parasite infections of the young

The American Academy of Pediatrics reaffirms its recommendation of exclusive breastfeeding for 6

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