



What Makes the Elderly Prone to Parasitic Infection?

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Authors' contributions

This work was carried out in collaboration between both authors. Author FES designed the review, conducted a literature search, and wrote the first draft of the manuscript. Author EM managed the analyses of all the literature and performed analysis and discussion. Both authors read and approved the final manuscript.

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ABSTRACT

The number of the elderly is increasing globally, and as a consequence the number of geriatric health problems also increased, including parasitic infection. The skin and the GI tract were among the most common locations of parasitic infections of the elderly. Underlying biological and social problems can prevent their independence in maintaining basic personal hygiene which made them depend on other's help, permanently. These seniors sometimes become the permanent residence of nursing homes. their dependence made them attached very close to the staff or other helper, even maintaining the basic function of life like eating. If this helper actually a parasitic agent carrier, parasitic infection transmission will be made easy by this symbiotic relationship. Besides behavior, some biological factors, e.g immunosenescence and or organ dysfunction, may contribute to infection.

Keywords: Behavior; protozoa; arthropods; nursing homes; handicap; dependent; food handler.

1. INTRODUCTION

In general population, the relative and absolute number of adults and older people are increasing

quickly [1]. This also follows geriatric problems that are soon becoming global matters. In the year 2017, the global population aged over 60 years around 962 million, more than doubled

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compared to 1980 when there were only 382 million older persons, globally. The number is even predicted to increase at least two-fold again by 2050 (estimated to reach 2.1 billion). In Indonesia nowadays, with around 21 million older persons (8.2%) in the population, Indonesia presents the largest number of older persons in Southeast Asia [1]. Frailty has become a major health problem among elderly, and this become implications and challenges for the government and the health care policy [2].

Considering that health is the outcome of mixed multiple determinants — factors such as biogenetics, environment and socioeconomic forces- are interrelated and mutually affect a person's health or illness [3]. Even in the elderly population, problems come from their own inner world (e.g frailty, comorbidities, handicap) and also from outside (e.g abandoned, lack of financial support). All of these condition makes the elderly prone to infection, including parasitic infection.

The parasite is an organism that lives in or on an organism of another species (its host) and benefits by deriving nutrients at the other's expense; it caused infection commonly called parasitic infection. Parasitic infection is still a major global health problem. Actually there is no human invulnerable to parasitic infection, but to some extent, it seems more virulent to some part of the population, especially the elderly. According to many case reports or original study articles, common parasitic infection in the older age group usually attack their gastrointestinal tract and or the skin/integument [4,5]. Eventhough those previous study on parasitic infection among geriatric population were seldom reported and fragmentary [6].

This minireview aimed to discuss about what factors makes the elderly prone to parasitic infection and also reveal the underlying bio-social problems that might contribute to it.

2. COMMON PARASITIC INFECTION OF THE ELDERLY AND ITS EPIDEMIOLOGY

Parasitic infection is also commonly found in the elderly, just as in another specialized group of the population, e.g children. Actually nobody immune to parasitic infection. The type of commonly found parasitic infections of the elderly actually affecting the skin and or the intestinal [5-8]. Due to previously mentioned factors that

make the elderly more prone to parasitic infection, it seems some parasitic agents having more privilege to make infection in certain areas of the elderly body, and they seems to be hyper-virulent when attacking the elderly population [7-11].

The epidemiology of parasitic infection among older people is scarce, varied and geographically restricted. This is also a problem, because the number of the elderly increasing and cannot be ignored [12]. Recent study by Arserim et al. [13] which conducted on ≥65-year-old nursing home residents and found out that 17 (20.7%) of the 82 stool samples examined positive of infected with intestinal protozoan, the most common agent was *Blastocystis* spp. (13.4%), followed by *Cryptosporidium* spp. (2.4%) and *Dientamoeba fragilis* (2.4%). Giroto et al. [14] in Brazil that examined intestinal protozoan among elderly residents at Long Term Residency Institutions in Southeastern Brazil found the prevalence of *Giardia duodenalis*, *Cryptosporidium* spp., *E. histolytica/dispar* in the elderly were 4.0%, 1.0% and 0.3%, respectively. Nurses and food handlers showed 4.8% and 5.2% positivity only for *G. duodenalis*, respectively. Besides intestinal parasites, skin parasitic infections also commonly found. Scabies, a skin infestation with the mite *Sarcoptes scabiei*, is often intensely pruritic and distressing [8]. Other parasitic infection of the skin commonly found in the elderly were pediculosis caused by *Pediculus humanus capitis et corporis*, or superficial fungal infection e.g *Dermatophytes* [8,9].

The reason why skin is the most involved organ beside the intestinal is that because the skin is located in the outer part of human body. Consequently, it is exposed more often to body's outer world, compared to any organs in the human body and there are certain areas (fold areas) that are potentially moister such as the elbows, armpits, groin, etc. Due to those reasons, the skin is quite prone to parasitic infection, especially ectoparasite [5,7]. Ectoparasites infestation such as *Pediculus humanus capitis et corporis*, *Sarcoptes scabiei* and superficial fungal infection are common forms of parasitic infection reported. All of these parasitic agents transmitted via direct contact, and this is most likely to happen to those who live together closely for a long time where poor practice of personal hygiene predispose for this kind of infection [7-9].

In other condition, intestinal parasitic problems of the elderly can be caused by helminths

infestation, e.g *Enterobius vermicularis* or even a protozoan water-borne infection like *Cryptosporidium parvum* and *Giardia lamblia* that have been found in residents of nursing homes. Another prevalent parasitic infection caused by *Ascaris lumbricoides* or intestinal amoebiasis cause by *Entamoeba histolytica* is also seen in this elderly homes repeatedly because of their direct life cycle and easily oral-fecal transmission of their eggs (in case of helminths) and cysts (in case of protozoa). Poor hygiene practice and handicap among elderly made them dependent on others, e.g nurse or other fellow resident of nursing homes.

2.1 Modalities of Transmission

Maintaining parasitic infection rely on three condition: transmission, closed contact within certain period of time and the existence of prone individuals to become the candidate of potential host.

Long term direct contact with carrier individual that brings parasitic agent in their body is one of

the most common route of transmission [6]. There are also physical problems that leads to handicap and prevent the elderly from maintaining their own personal hygiene and or low efficient self-care in older people, leading to lack of sanitary practice and deficient personal hygiene [3]. These condition that make old people more prone to parasites infections [14,15].

Their susceptibility to infection, including parasitic infections, can be the result of various factors, a mixture of (1) constant exposure to parasitic agents, (2) age-related immune system malfunction, (3) decrease in organ functions (e.g colonic motility in case of intestinal parasite), (4) changes or shift in normal flora composition and (5) comorbidities.

Resistance to these parasitic disease tends to be reduced among old age [1,2]. Aging promotes the host's susceptibility to disease, whether it is communicable or non-communicable illness, which is to some extent related with a reduction of cellular immunity response [6,16,17].

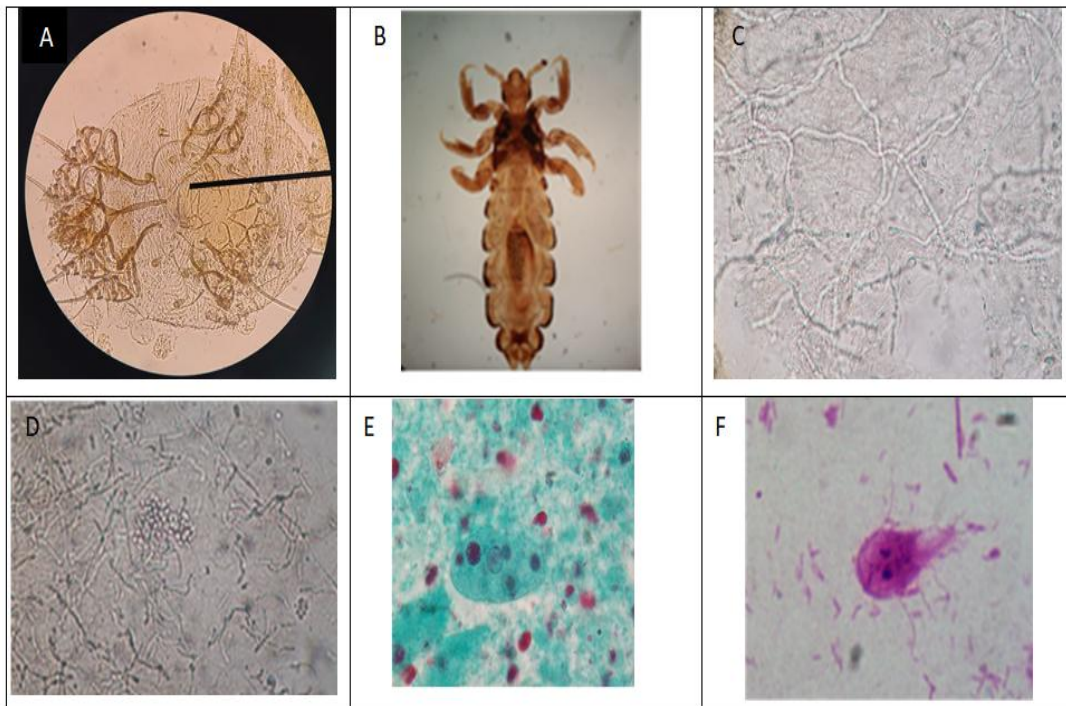


Fig. 1. Some common parasites found in the elderly population. A. *Sarcoptes scabiei* (400× magnification), B. *Pediculus humanus capitis* (100×), C. Dermatophytes (400×) D. *Tinea versicolor* (400×) E. Trophozoites form of *Entamoeba histolytica* (1000×) F. Trophozoites form of *Giardia lamblia* (1000×) (all slides belongs to the dept. of Parasitology, Faculty of Medicine Universitas Kristen Indonesia, Jakarta-Indonesia)

Aging actually has effects on the formation of infection, in term of frequent or severity, which then might augments illness spectrum, the dependence condition and even fatality [5,6]. Also, those previously mention condition might precede the onset of stress which further supresses the immuno-armamentarium; this contributes to the formation of immune defects that increases risk of infectious illnesses in the elderly [17]. Some studies conducted on stress condition among the elderly provide solid proof that several spectrum of stress condition, e.g increased stress exposure, poor stress buffering, exaggerated stress reactivity, unlimited anxiety duration, and probably diminished restorative processes, have direct consequences that copy, add, and or sometime even accelarate the occurrence of negative effects of aging on immunity [5-7].

2.1.1 Social problems

Getting old is a natural and inevitable condition occurring on every human's final stage of life. The aging population reflects the increasing proportion of aging group, accompanied by the decrease in the number of young people. This requires, all stakeholders to adjust to the medical and social needs of this aging population. In the foreground, increasingly exposed are the older people's problems of the elderly people related to their provision and the basic need for competent health care. If this individual basic need failed to be fulfilled, then the problem can become bigger and affecting other member of the population, and become social problem.

The social condition that might contribute and potentiate health risks for the elderly are as follows (1) live separately from their family, (2) having handicap or physical limitation (e.g age related or due to other underlying comorbidities such as post-stroke condition), (3) with no social nor health coverage, (4) having psycho-physical problems (e.g. difficulties in communication), (5) having their own medical and nutritional needs, (6) potentially suffer from bullying or neglected (especially women), (6) nursing homes with low hygiene and high population density. The next discussion will focus on nursing homes.

2.1.2 Nursing homes

In the western world, it is common practice that older people living in the nursing homes. Depend on the type of service, a nursing home provides facilities for the residential care of elderly or disabled individuals. Per definition, nursing home

is a dwelling place for any individuals who do not need to be hospitalized but considering their present health condition/problem, they still cannot be cared for at their own home, because of the need for more active medical care. A nursing home is the answer to those problem. Nursing aides, skilled nurses on hand, the option to provides medical care, the ffort to make it like home, and even some specialized services for several type of diseases, e.g Alzheimer's disease, are some services nursing homes.

But unfortunately, infections are common in older people, especially those kept in nursing homes for the long-term. Nursing homes with low hygiene levels, minimal staff and a very dense population due to very minimal financial support become the locus of infection transmission [11]. In parasitic infection, the existence of a potential carrier that might play an important role in disease transmission cannot be excluded. When this potential carrier works as a food handler or constantly help feed those unfortunate elder who cannot eat by themselves, this can be the *port de entry* of parasitic agents through the mouth and enter the gastrointestinal tract [13,14].

2.1.3 Biological factors

Contribution of some biological factors that might potentiate health problem in the elderly: (1) age-related change/shift of immune system, (2) age-related dysfunction of some vital organs, (3) comorbidities (e.g. inflammatory bowel disease), (4) malnutrition or dysnutrition, (5) lack of movement/exercise, (6) impairment of personal hygiene due to physical handicap, (7) overmedication or uncontrolled medication (e.g, related to their comorbidities).

2.1.3.1 Immune status

The effects of aging on the immune system are manifest at multiple levels that include reduced production of B and T cells in the bone marrow and thymus and diminished function of mature lymphocytes in secondary lymphoid tissues. As a result, elderly individuals do not respond to the immune challenge as robustly as the young [12,16]. Just limited in this context, aging is always connected with reducing adaptive and innate immunity; a natural condition established as part of immunosenescence when someone gets older. Immunosenescence is an advance concept that reflects the chronological age-related shifts of innate and adaptive immune responses. To say it in brief, elderly individuals usually always present with some chronic low-

level inflammation, higher infection rates, and chronic diseases [17]. This condition is actually when someone enters the old age.

2.1.3.2 Age related dys-function of some vital organs

Aging is also related to a non-reversible condition of progressive degeneration; especially organ and tissue function. It also makes the structure and function of vital organs reduced gradually; and this condition can be said to be the most important known risk factor for the occurrence of most chronic diseases. The number of the world's population aged >60 years has increased dramatically, This will be followed by an enhancement of the incidence of chronic age-related diseases; this condition will surely add a huge burden on healthcare resources, e.g financial, medical staff, medical services [2].

Evidence showed us that many type of chronic inflammatory diseases actually mimic the condition of of the aging process's acceleration. For example, chronic pulmonary diseases represents an important component of the increasingly prevalent multiple chronic debilitating diseases for older people, a dominant cause of sickness spectrum, e.g, severity, frequency of admission and even fatal mortality, particularly in the elderly with specific comorbidities [18]. One large nationwide, population-based, cohort study in France showed an increased incidence of serious and opportunistic infections in patients 65 years or older compared with younger patients, with a 2- to 3-fold greater absolute risk of infection in the older population [15].

For example of organ related aging, in the skin, aging is directly caused the thinning of overall epidermal lining, reduced barrier properties due to diminished amount of subcutaneous fat, ready and active pro-inflammatory condition of immune armamentarium with consequences of gradual reduction of the local epidermal immune response. For example, aging hair will loss the mucus membranes of hair cells, whose actual function was to remove any pathogens attach to hair. But in the elderly, its number reduced and then it affect its movement, as well as presenting ultra structural changes Immunoglobulin (Ig) A, which is the primary ingredients in secretions. This structural changes reduced their function. Therefore, structural and physiologic changes occur as a consequence of intrinsic aging combined with the environment can produce a

marked susceptibility to dermatologic disorders in the elderly [17]. In other example the lung, as in the case of chronic obstructive pulmonary disease (COPD), it is a condition of accelerated lung aging and that aging may provide a mechanistic link between COPD and many of its extrapulmonary effects and comorbidities [18].

2.1.3.3 Comorbidities

In medicine, comorbidity is the presence of one or more additional conditions often co-occurring (concomitant or concurrent with) with a primary condition. Comorbidity describes the effect of all other conditions an individual patient might have other than the primary condition of interest, and can be physiological or psychological based. In the context psychiatry, comorbidity is often related to disorders that are often coexistent with each other. Lin et al. [16] reported serious and opportunistic infections in elderly patients with inflammatory bowel disease often treated with biologics and immunomodulators. Comorbidity can indicate either a condition existing simultaneously, but independently with another condition or a related medical condition [19]. The latter sense of the term causes some overlap with the concept of complications. Cassell et al. [20] reported Scabies outbreaks in residential and nursing care homes for the elderly people are common, subject to diagnostic delay, and hard to control.²⁰

2.1.3.4 Malnutrition or dysnutrition

Cumulative influences of aging and malnutrition lead to poor immune responses in the elderly that increase the risk of any infection, including the parasitic agents. Malnutrition and infection operate in a vicious mutual synergism. Malnutrition predisposes to infection and increases the severity and mortality of infections. Infection reduces nutrient intake, interferes with substrate utilization and promotes tissue breakdown. Malnutrition and infection tend to occur in the same populations: resource-poor settings, poverty, and extremes of age are major risk factors; hospitalized patients are also at significant risk [19].

2.1.3.5 Lack of movement/exercise

Lack of movement or exercise in the elderly may interfere with their health condition. Mobility, including the ability to walk and/or climb stairs, is an important predictor of quality-of-life (QOL) among older adults and a measure of successful

aging. Mobility limitations put older adults at risk for falls, reduced access to medical services, poor psychological health, declining functional abilities and negative health outcomes [21]. There is positive association between regular physical activity, exercise participation and the improvement of health in the elderly. But unfortunately, in industrialized countries where people are living longer lives and more stable financially, the occurrence of chronic health derangement are increasing and physical activity has become less. This is a predisposition to infection, including parasitic infection [22].

Impairment of personal hygiene due to physical handicap aging is a multi-directed process occur to someone when he/she become older and its affecting both physical and psychological condition. Actually, scientists believe that when the elderly have their own state of fitness, to some extent it will allows them to at least still functioning at their own free will; and such condition is important for maintaining independence in routine daily life.

Aging also involves a decrease in muscle mass and also its strength; this condition marked the gradual loss of independence in everyday life. For example, motoric muscle of the lower limb is important to make them able to move around while on the same time an appropriate strength and balance of the upper part of the body, including the muscle, are important for keeping the ability to manage their life (e.g. condition of daily life like performs mild domestic activity, cleaning their face or extremity or like dress oneself). Maybe in the beginning, the elderly were not able to do the activities that require muscle strength, self-balance and manual dexterity (e.g. long walks while shopping, heavy domestic chores, stairs climbing the stair, clipping toenails or reaching the most distal part of the body). These elderly might stay independent the longest in the context of in which involves fitness of upper body (having their meals, maintaining basic personal hygiene) [23].

2.1.3.6 Overmedication or uncontrolled medication (e.g. related to their comorbidities)

The practice of polypharmacy is actually a common condition in older adults; studies found out that the highest number of drugs taken by those elderly residing in nursing homes. Early 50% of older adults take one or more medications that are not medically necessary.

There is a strong negative relations between polypharmacy and clinical condition as the consequences of unnecessary medication [22,24]. Specifically, the burden of polypharmacy has been related to financial loss due to (1) greater health care costs, (2) adverse drug events (ADEs), (3) unnecessary drug-interactions, (4) medication non-adherence, (5) diminished functional capacity due to medication and (6) multiple geriatric syndromes related to polypharmacy. Actually, well-designed inter-professional intervention that focus on enrolling high-risk older patients with polypharmacy have shown that this multi-disciplinary approach can be effective in improving the overall quality of prescribing, preventing polypharmacy and its effect with mixed results on further health outcomes [1,2,23,24].

3. CONCLUSION

Parasitic infections among elderly are quite common, even though epidemiologically, the report is scarce and incomplete. Transmission occurs facilitated by closed contact and the availability of vulnerable people like the elderly. The consequences of social and biological factors might contributes to parasitic infection among the elderly, and these factors can add the risk, eventhough it is still possible to tackle, by incorporating all stakeholder effort in order to prevent and eliminate parasitic infection among the elderly. Further implementation studies are needed to reveal the practical application of incorporating every effort made by all stakeholders to help these seniors to have a better quality of life, free from parasitic infection.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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