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Global incidence of helminthic contamination of vegetables, cucurbits and fruits: A systematic review and meta-analysis

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ABSTRACT

Accidental ingestion of infective stages of helminths through consumption of contaminated vegetables and fruits causes a wide range of food-borne diseases in humans. This systematic review and meta-analysis evaluated the global incidence of helminthic contamination of vegetables, cucurbits and fruits. Several databases (Science Direct, Web of Science, PubMed, Scopus, and Google Scholar) were searched for literature published prior to November 2020. Overall, 184 articles (32 countries) met the inclusion criteria. Among these, 137 studies documented helminthic contamination in vegetables, 46 in cucurbits and 9 were in fruits. The pooled incidence (95% confidence interval) was 31% (26%–37%) for vegetables, 20% (14%–27%) for cucurbits and 20% (8%–37%) for fruits. The highest incidence rate was found in the Western Pacific WHO region (54%; 9%–95%). The most prevalent parasitic agents were *Ascaris lumbricoides* eggs (12%; 9%–15%) and *Strongyloides stercoralis* larvae (12%; 8%–16%) in vegetables, *S. stercoralis* larvae (10%; 5%–15%) and *Toxocara* spp. eggs (10%; 3%–21%) in cucurbits, and *Trichuris trichiura* eggs (9%; 1%–22%) in fruits. The highest incidence rate was found to be associated with lower-middle income countries (34%, 28%–41%) and regions with a tropical rainforest climate (50%, 10%–91%). The potential role of vegetables, cucurbits, and fruits in the spread of helminthic parasites was revealed. Utilizing clean water for irrigation, proper washing and cooking of vegetables and improved sanitary practices can decrease the public health hazard regarding the consumption of vegetables, cucurbits, and fruits.

1. Introduction

Parasitic helminths affect more than 1.5 billion of the world's population and are considered as one of the main public health problems in developing countries, especially in tropical and sub-tropical regions (Al Amin & Wadhwa, 2020; Flammer et al., 2020). Eggs and larval stages of

helminths may contaminate vegetables during pre-harvest or post-harvest procedures (Luz et al., 2017). The risk of several chronic diseases has decreased due to the regular consumption of wide variety of vegetables and fruits, as they contain fibers and micronutrients including different minerals and vitamins (Flyman & Afolayan, 2006; Haq et al., 2014; Liu, 2013). Despite this, consumption of raw vegetables

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