

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

Aida Vafae Eslahi ^a, Meysam Olfatifar ^b, Md Robiul Karim ^c, Raed AbuOdeh ^d, Ehsan Modirian ^e, Elham Houshmand ^f, Amir Abdoli ^g, Rasoul Samimi ^h, Simin Sotoodeh ^h, Razzagh Mahmoudi ^h, Elham Hajjalilo ^{ij}, Sima Hashemipour ^k, Milad Badri ^h,

^a Clinical Research Development Unit, Velayat Hospital, Qazvin University of Medical Sciences, Qazvin, Iran

^b Gastroenterology and Liver Diseases Research Center, Research Institute for Gastroenterology and Liver Diseases, Shahid Beheshti University of Medical Sciences, Tehran, Iran

^c Department of Medicine, Faculty of Veterinary Medicine and Animal Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, 1706, Bangladesh

^d Medical Laboratory Sciences Department, College of Health Sciences, University of Sharjah, Sharjah, United Arab Emirates

^e Department of Emergency Medicine, Qazvin University of Medical Sciences, Qazvin, Iran

^f Department of Parasitology, Faculty of Veterinary Medicine, Rasht Branch, Islamic Azad University, Guilan, Iran

^g Zoonoses Research Center, Jahrom University of Medical Sciences, Jahrom, Iran

^h Medical Microbiology Research Center, Qazvin University of Medical Sciences, Qazvin, Iran

ⁱ Department of Parasitology and Mycology, Qazvin University of Medical Sciences, Qazvin, Iran

^j Student Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran

^k Metabolic Diseases Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran

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.

Keywords: Vegetable Cucurbits Fruits Helminthic contamination Public health Food safety