Ghazy *et al.*
Egyptian Pediatric Association Gazette (2024) 72:3
https://doi.org/10.1186/s43054-023-00243-1

Egyptian Pediatric Association Gazette

REVIEW

Open Access

Promoting child health through a comprehensive One Health perspective: a narrative review

Ramy Mohamed Ghazy[1,2], Asma Saidouni[3] and Sarah Hamed N. Taha[4*]

Abstract

Children are increasingly exposed to health risks as a result of adverse effects of climate change, including more frequent and intense extreme weather events, disruption of food systems, an increase in food-, water- and vector-borne diseases, mental health issues, clean water scarcity and zoonoses, and habitat destruction causing "zoonotic spillovers". To address these emerging and new health risks, a holistic approach is required. Understanding how these risk drivers impact the physiological and mental development of children is a highly complex challenge. Addressing this complexity requires the collaborative development of multi-disciplinary and comprehensive approaches. In addition, factors such as inadequate nutrition that leads to stunting, maternal characteristics (including age, height, pregnancy, and postnatal care), hygiene habits at home, gender disparity, and the financial situation of the household also play crucial roles. This review is prompted by the pressing need to tackle the substantial and diverse health impacts that will affect children throughout the current century. Emphasizing the importance of adopting the One Health approach, this review aims to mitigate these effects and pave the way for a healthier future for the younger generation.

Keywords One Health, Children, Food insecurity, Zoonotic diseases, Antimicrobial resistance, Environmental sanitation

Background

The concept of 'One Health' was initially introduced in the years 2003–2004, primarily in response to the outbreak of severe acute respiratory syndrome (SARS) in early 2003. This term gained further prominence due to the global spread of the highly pathogenic avian influenza H5N1. Furthermore, the 'Manhattan Principles', a set of strategic goals formulated during a meeting of the Wildlife Conservation Society in 2004, played a significant role in the development and integration of the One Health concept. These principles acknowledge the interconnection of human and animal health, as well as the potential risks that diseases might bring to food security and economic stability [1, 2].

In the latter part of this century, both children born today and those yet to be born will encounter health impacts stemming from shifts in climate patterns, environmental alterations, ocean acidification, deterioration of land, scarcity of water, depletion of marine resources, and the decline of biodiversity. Addressing these challenges demands a global perspective that extends beyond individual diseases or specific regions. Childhood growth impairment is another multifaceted

*Correspondence:
Sarah Hamed N. Taha
snasrtaha@cu.edu.eg
[1] Department of Family and Community Medicine, College of Medicine, King Khalid University, Abha, Saudi Arabia
[2] Tropical Health Department, High Institute of Public Health, Alexandria University, Alexandria, Egypt
[3] World Health Organization Eastern Mediterranean Regional Office, Cairo, Egypt
[4] Forensic Medicine and Clinical Toxicology Department, Faculty of Medicine, Cairo University, Cairo, Egypt

issue necessitating comprehensive, interdisciplinary approaches. Apart from insufficient nutrition, stunting is influenced by various factors such as maternal attributes (age, height, prenatal, and postnatal care), household sanitation practices, gender inequality, and the economic status of the household [3].

The One Health strategy involves a substantial shift in how we handle disorders and diseases that affect children. It provides a hopeful strategy to understand, prevent, and ease the effects of pediatric diseases by acknowledging the complex relationship between human, animal, and environmental health and encouraging interdisciplinary collaboration. Applying an integrated strategy shows higher effectiveness as well as a greater ability to handle complex issues in our interconnected world, leading to improved well-being and bright possibilities for future generations [4].

In recent years, the evidence of the rise and spread of zoonotic diseases, infections that can be transmitted from animals to humans [5], in children has highlighted the urgent need for a comprehensive and cooperative strategy to combat these health hazards. Around 25% of people worldwide have one or more parasitic infections, with food- and vector-borne parasitic zoonotic diseases being the main causes of concern. Deforestation, urbanization, rising international travel, marketing, and commerce, significant changes in agricultural patterns, demographics, food choices, and climatic changes all play important roles in the introduction and reemergence of parasitic zoonoses. The total burden of food- and vector-borne parasite infections accounts for about 60 million disability-adjusted life years (DALYs), though this number is probably underestimated [6].

There are approximately 200 zoonotic diseases. In 2013, the World Health Organization (WHO) identified eight of them as neglected zoonotic diseases (NZDs). Of these eight NZDs, parasites are the cause of four diseases: cysticercosis, hydatidosis, leishmaniasis, and trypanosomiasis [6]. Children, in particular, are very vulnerable to these diseases due to their immature immune systems, close proximity to animals, and engagement in activities that increase their exposure to potential sources of infection. Pediatric zoonotic diseases involve a diverse array of infections, including bacterial, viral, and parasitic agents, among others. These diseases frequently exhibit a wide range of transmission methods, including direct contact with animals, ingestion of contaminated food or water, and exposure to vectors that carry the disease [7]. The One Health concept, which acknowledges the interdependence of human, animal, and environmental health, presents a viable solution to address the growing issue of pediatric zoonotic infections [4]. The One Health concept facilitates interdisciplinary collaboration among professionals in domains such as medicine, veterinary science, ecology, and public health to collectively solve the intricate challenges associated with pediatric zoonotic infections (Fig. 1).

Main text

Zoonotic diseases

There are three types of zoonotic diseases: emerging, reemerging, and neglected zoonotic diseases. Worldwide, especially in developing countries, many zoonotic diseases are endemic [7]. Southeast Asia, Central and South America, Eastern Europe, and Central and East Africa are home to most of the zoonotic animal host species, including domesticated livestock, pets, poultry, bats, and rodents. Zoonotic diseases are transmitted between domestic and wild animals. Due to their close contact, domestic animals frequently spread infections to humans [8]. In general, there are several factors that have directly or indirectly impacted children's health:

Biological vulnerability to zoonotic diseases

It is well known that children have unique biological vulnerabilities, compared to adults, that may affect the disease course or progression. Thorp et al. [9] analyzed over 719 hantavirus pulmonary syndrome cases in the United States of America (USA), from 1993 to 2018, to compare clinical and demographic characteristics in children, teenagers, and adults. The overall mortality rate was 35.4%, with no significant difference in mortality observed between age groups. However, the time between symptom onset and death varied, with children surviving a median of 2 days, adolescents 4 days, and adults 5 days. During the Monkeypox (Mpox) outbreaks in West and Central Africa, where Mpox clade I is endemic, it has been observed that children, compared to other age groups, were at higher risk of morbidity and mortality rates from the disease. This is mainly due to complications, bacterial superinfection [10], and the risk of viral spread to other parts of the body and eyes through scratching [11].

Behavioral factors

While pets undeniably have a positive impact on the well-being and health of children, it is important to acknowledge that they can also pose a risk of transmitting zoonotic diseases. This concern becomes even more complex when dealing with immunocompromised children. These individuals are at increased risk of contracting certain zoonotic diseases, which can cause more persistent or severe symptoms. Several factors play a role in this context, including age, the nature and stage of the underlying disease, CD4+lymphocyte count, the presence of neutropenia, and the use of immunosuppressive

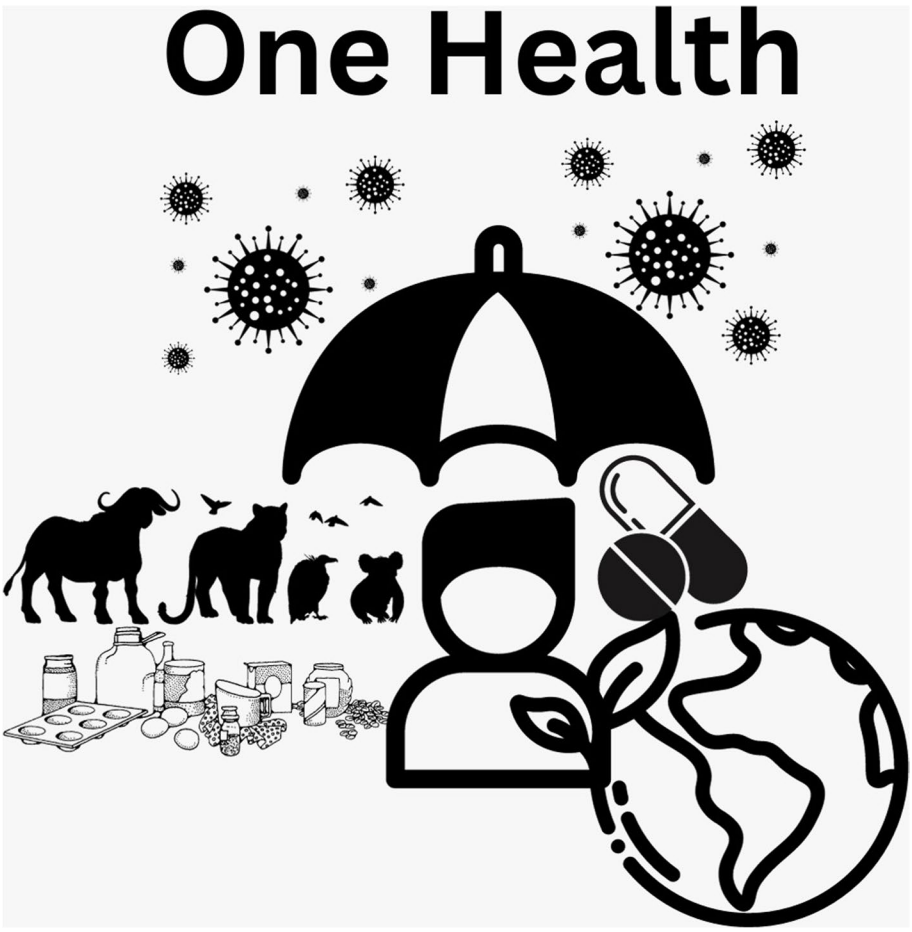

Fig. 1 This figure depicts the interconnectedness and interdependence of human, animal, and environmental health, emphasizing the "One Health" holistic approach. The concept emphasizes the recognition that the well-being of humans, animals, and the environment are inextricably linked and must be addressed collectively in order to effectively address health challenges

drugs [12]. Pathogens that can pose opportunistic infections and/or significant risks to human health through pet contact include organisms like Cryptosporidium, Bartonella, Salmonella, Campylobacter, Toxoplasma gondii, Toxocara, and microsporidia. In Peña's study [13], it was discovered that among pets owned by immunosuppressed children, 28 of them (63.6%) were identified to carry a zoonotic pathogen, and 7 (15.9%) were diagnosed with a facultative pathogen. Most of these zoonotic agents were identified in samples taken from the external ear and intestine of the pets. It is worth noting that to effectively manage the transmission of infectious diseases from pets, it is crucial to implement rigorous hygiene practices. This includes ensuring proper nutrition for pets and adopting regular control measures against vectors and parasites. These measures are recommended to mitigate the risk of zoonoses. For households with immunocompromised children, it is strongly advised to take specific precautions to minimize the potential risk of zoonotic infections. These precautions involve avoiding exotic pet animals (such as reptiles, rodents, and birds) and refraining from interacting with sick or stray animals [14].

Wildlife

Hunting, animal handling, and bushmeat consumption by children expose them to a higher risk of zoonotic disease, especially contact with certain species of rodents that are known to carry around 2 to 11 zoonotic diseases. A study conducted in Guinea demonstrated that children play a key role in the primary transmission of Lassa fever to humans by bringing the rodent home, exposing the younger sibling, and causing food contamination with kitchen utensils used to prepare meat [15]. In developed countries such as France, the number of macaques' bite cases recorded was increasing due to behavioral change. The French Pediatric Emergency Department in 2014

highlighted the risk of simian Herpes (B-virus) for children traveling to exotic destinations [16].

Nutrition

Milk serves as a vital nutritional source, particularly crucial for infants and children who require nutrient-rich foods to support their growth and cognitive development. Numerous studies have demonstrated a link between milk consumption and reduced stunting. It is recommended that children suffering from malnutrition should derive 25–33% of their dietary protein from dairy sources [17, 18]. Infants and children harboring Bifidobacterium, a bovine milk bioactive compound, in their guts, develop a protective intestinal microbiota that hinders the binding of pathogens to the intestinal lining through competitive inhibition. The establishment of these bacteria in the gut is associated with a reduction in stunting, improved cognitive development, and positive health outcomes [19]. It is important to note that Bifidobacterium is particularly sensitive to antibiotics. Children who are prescribed antibiotics or are exposed to antibiotic residues face the risk of disrupting the establishment of this crucial bacterial cornerstone in their gastrointestinal tract [20]. Milk and dairy products are valued for their nutritional benefits, and these benefits are accessible to people in both developed and developing countries due to the commitment of dairy producers and manufacturers to food safety measures. This guarantees the delivery of safe and nutritious products to consumers, fostering their well-being [21].

Food safety

Alongside food contamination that can lead to foodborne disease in children, mastitis in animals occurs when bacteria enter the mammary gland through the teat end, subsequently colonizing the mammary tissue. Such pathogens may find their way into the food chain directly or via equipment contamination [22]. Milk is one of the main sources of proteins for children and is considered an optimal nutrient-rich medium for bacterial growth. Once they infiltrate the milk supply, they can rapidly multiply and establish biofilms within milk processing facilities. Certain organisms, such as Listeria, are adept at thriving at lower temperatures [23].

Antimicrobial resistance

In 2019, an estimated 4.95 million deaths were associated with bacterial antimicrobial resistance (AMR), with the highest all-age death rate in western sub-Saharan Africa and the lowest in Australasia. Lower respiratory infections accounted for over 1.5 million deaths, making it the most burdensome infectious syndrome [24]. According to global estimates for the year 2019, it was evident that children carry a significant proportion of mortality, as 254,000 out of the total of 1.27 million deaths can be directly attributed to AMR. More than 99% of the 254,000 children deaths came from low- and middle-income countries (LMICs). Shockingly, over half of these children do not survive beyond their first month of life [25]. The six leading pathogens were Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Streptococcus pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa [24]. It is worth noting that the majority of childhood deaths occur in LMICs, mostly because of preventable diseases such as respiratory, vector-borne, and gastrointestinal diseases, including cholera outbreaks [26]. Often, antibiotics are the only viable treatment option in resource-limited settings, but inadequate regulatory oversight and misuse of antibiotics have led to a widespread surge in AMR. This scenario particularly affects the most vulnerable populations living in regions with high levels of AMR. Progress has been made globally in the fight against AMR since the 2016 United Nations General Assembly, where leaders committed to a "One Health" approach [27]. Nevertheless, the gap between the increasing incidence of AMR and the funding allocated to address it in LMICs continues to widen, demanding substantial efforts. To address these challenges, national and international partners have been concentrating on innovative strategies to combat AMR at the country level. In 2019, the WHO proposed the use of targeted strategies involving diverse stakeholders to advocate for the inclusion of AMR in national development agendas [28]. Researchers are also taking on the task of creating evidence-based interventions against AMR. However, there has been limited exploration into the comprehensive factors across the One Health spectrum, especially in resource-constrained environments.

Food insecurity and stunting

Addressing food security is a worldwide imperative that demands a multidisciplinary strategy. Despite the notable growth in agricultural production over the past two decades, the prevalence of malnutrition among children remains relatively high in many developing countries [29]. To address this issue, local initiatives, such as improving traditional livestock-crop systems, have the potential to offer sustainable solutions to the ongoing demographic challenges in Africa. These challenges are contributing to the growing demand for increased food availability, improved livelihood prospects, and reduced migration to urban areas [30]. Stunting, characterized by low height for age, affects about a quarter of children under five and is associated with higher mortality, impaired brain development, increased risk of chronic diseases, and decreased productivity. While global

stunting rates are slowly declining, Africa's stunted child population is growing due to rapid population growth [31]. Nutrition interventions, even with 90% coverage, would only lower stunting by 20%, necessitating additional approaches [32]. Improved water, sanitation, and hygiene (WaSH) to prevent diarrhea is a key strategy for reducing stunting [33]. However, recent molecular studies show that enteropathogenic colonization starts much earlier in LMICs than previously thought [34]. Subclinical carriage of these pathogens, rather than overt diarrhea, has a more significant negative impact on linear growth. This subclinical carriage is linked to environmental enteric dysfunction (EED), an underlying gut disorder involving inflammation and malabsorption, contributing to stunting [35]. An often-overlooked aspect of WaSH programs is reducing microbial transmission from animals to children. Animal feces can harbor entomopathogens that cause diseases in humans, especially children [36]. Balancing this with the importance of animals for rural livelihoods and the shared environment is crucial. A comprehensive perspective, aligning human, animal, and environmental health within the framework of One Health, could be pivotal in effectively tackling stunting [37].

Integration of the One Health approach in education

According to Jean Piaget, "The principal goal of education in schools should be to create men and women who are capable of doing new things, not simply repeating what other generations have done". Teachers are not speakers; their role should be to stimulate young people's minds not only with theoretical lectures but also by letting them do things because 'playing is the child's job' and by acting they discover the world [38]. Currently, the integration of One Health education into medical schools is in its early stages and is trailing behind veterinary schools, where One Health has already become a central component of its educational programs. Recent initiatives that have been published involve collaborative training between institutions responsible for human health education and those responsible for veterinary medical training. These initiatives place emphasis on subjects like ensuring shared access to clean water [39]. Furthermore, additional educational initiatives include the development of specialized One Health curricula customized for high school students. These curricula aim to enrich their knowledge of infectious diseases [40].

Pediatric disease prevention: a One Health success story

The significance of the One Health approach as a central strategy in disease prevention has become increasingly evident during the coronavirus disease 2019 (COVID-19) pandemic. In the context of One Health, the University of California Health (UCH) effectively addressed the challenges related to unaccompanied migrant children arriving at the southern border of the USA. Through collaboration with various government agencies, UCH established a quick and comprehensive response. They assembled a diverse team to offer specialized medical care to these children at two emergency intake sites in California. The children received trauma-sensitive medical treatment and culturally appropriate psychological and social support. Over a span of 5 months, both sites collectively provided care for 4911 children between the ages of 3 and 17 years. In particular, 782 children tested positive for COVID-19, and many were already infected prior to arrival. Most of the children (3931) were successfully reunited with their families or sponsors. To ensure continuity of care, an electronic health record system was employed post-reunification or upon placement in long-term shelters [41].

During the winter of 2010 in northwestern Nigeria, Médecins Sans Frontières physicians were conducting meningitis screenings when they noticed an unusually high number of illnesses and deaths among children in four villages, particularly those under 5 years old [42]. The symptoms included vomiting, abdominal pain, headaches, and convulsions. Initial treatment efforts involving antimalarial and antibiotic therapies were ineffective. Further investigation revealed that the affected children were from villages engaged in unregulated subsistence gold mining, leading to blood lead levels (BLLs) ranging from 168 to 370 mg/dL. This was far higher than the recommended intervention threshold of 5 mg/dL by the Centers for Disease Control and Prevention. Tragically, approximately 400 children died due to lead poisoning, with one village reporting a 30% mortality rate among children under 5 in a year. A subsequent report in 2012 by Dooyema et al. [43] showed that a significant portion of northwest Nigeria was contaminated with lead, necessitating treatment for around 1500 to 2000 affected children. Alarming signs included the deaths of numerous waterfowl and livestock, which acted as an early but overlooked warning signal. Approximately 4 months before the outbreak of lead poisoning among children, residents of the worst affected villages observed a nearly 100% mortality rate among ducks that live in and around nearby ponds. It was later established that the few surviving ducks in the less contaminated villages had BLLs of at least 5 mg/dL, indicating that they had also suffered from lead poisoning. The 2010 epidemic of childhood lead poisoning in Northwestern Nigeria serves as a stark example of the consequences arising from human activities like small-scale artisanal gold mining. This incident highlights how alterations in animal health and behavior can act as early signals of significant environmental dangers,

offering a potential warning before these hazards have adverse impacts on human health [44].

For the past 30 years, the Gorakhpur division in Uttar Pradesh, India, encompassing Gorakhpur and nearby districts like Deoria, Kushinagar, and Maharajganj, has been grappling with seasonal outbreaks of acute encephalitis syndrome (AES) affecting children. In 2005, investigations revealed that the Japanese encephalitis (JE) virus was responsible for AES cases. Efforts to control the disease were successful, as JE vaccinations and other strategies led to a decline in its incidence. However, outbreaks of acute febrile illnesses with neurological symptoms persisted. Subsequent research identified Orientia tsutsugamushi, the causative agent of scrub typhus, as the primary cause of AES outbreaks in the region. Through surveillance of acute febrile diseases in children attending local health facilities, scrub typhus emerged as a significant cause of fever during the monsoon and post-monsoon periods. Population-based serosurveys indicated a high prevalence of scrub typhus. Entomological studies highlighted that the vector mites and small animal hosts were naturally infected with Orientia tsutsugamushi. Children usually contract infection outdoors while playing, visiting fields, or defecating in open areas. Some of the children with scrub typhus progressed to central nervous system manifestations. Therefore, prompt administration of appropriate antibiotics is crucial to prevent the escalation of acute febrile illness due to scrub typhus into AES [45].

In July 2018, several individuals fell ill after coming into contact with water near a natural playground. Most of the reports involved children who had interacted with both a recreational lake and a nearby natural playground, which features shallow water for play, over the weekend prior to the notifications. The characteristics of the outbreak and its symptoms pointed towards a possible norovirus (NoV) outbreak. The rapid onset and disappearance of symptoms like diarrhea and vomiting aligned with the patterns associated with NoV outbreaks, which are commonly linked to untreated recreational water. In this investigation, a comprehensive One Health approach was employed, considering factors from human, animal, and environmental perspectives [46].

In Tanzania and Zambia, the prevalence of stunting in children under 5 years, a critical factor in personal development, stands at approximately 42% and 45%, respectively. This persistent issue remains despite substantial efforts in agricultural research and development. In response, both countries are actively seeking sustainable remedies to address food security challenges and enhance human nutrition by bolstering household income and dietary variety. The primary goal of a 5-year funded project was to combat childhood undernutrition. This would be achieved by examining and implementing strategies to empower women to optimize the integration of poultry and crop systems, thereby boosting efficiency and bolstering household nutrition in an ecologically responsible manner. Employing a One Health approach, the project amalgamates expertise from animal, crop, and human health specialists, as well as economists, ecologists, and social scientists, to collaborate with participating communities. This collective effort aimed to enhance poultry and crop value chain efficiency, elevate household food security, and improve overall nutritional well-being [30].

Conclusions

The One Health approach is indispensable for safeguarding child health by acknowledging the significant interdependence between human, animal, and environmental health and emphasizing its critical role in the identification, prevention, and management of diseases that affect these interconnected domains. Government officials, researchers, and workers spanning various sectors on local, national, regional, and global scales should collaborate to address health threats through coordinated efforts. This involves establishing shared databases and surveillance systems that span multiple sectors, along with devising innovative approaches that tackle the underlying causes and connections between risks and consequences. With a holistic strategy, we can better predict, prevent, and respond to the complex health threats and risk factors that children face, ensuring a healthier future for the youngest and most vulnerable members of our global community. Engaging with communities is crucial to foster habits and attitudes that minimize risks while aiding in the early identification and control of disease threats.

Abbreviations

AES	Acute encephalitis syndrome
AMR	Antimicrobial resistance
BLLs	Blood lead levels
COVID-19	Coronavirus diseases 2019
DALYs	Disability-adjusted life years
JE	Japanese encephalitis
LMICs	Low- and middle-income countries
Mpox	Monkeypox
NoV	Norovirus
NZDs	Neglected zoonotic diseases
SARS	Severe acute respiratory syndrome
UCH	University of California Health
USA	United States of America
WaSH	Water, sanitation, and hygiene
WHO	World Health Organization

Acknowledgements

Non.

Authors' contributions

RMG: conceptualization of research idea, writing and reviewing the manuscript. AS: writing, extensive review, providing suggestions to the manuscript,

editing. SHNT: writing, review, and editing. All authors read and approved the final manuscript.

Funding
This research did not receive any funds.

Availability of data and materials
Not applicable.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 17 September 2023 Accepted: 14 December 2023
Published online: 15 January 2024

References

1. Mackenzie JS, Jeggo M. The One Health Approach—why is it so important? Trop Med Infect Dis. 2019;4:88. Available from: https://www.mdpi.com/2414-6366/4/2/88
2. One World, One Health: building interdisciplinary bridges to health in a globalized world. 2004 [cited 2023 Sep 9]. Available from: http://www.oneworldonehealth.org/sept2004/owoh_sept04.html
3. Walton M, Guest D, Raynes-Greenow C (2021) One planet one health: what about the kids? J Paediatr Child Health Wiley 57:1741–1744. https://doi.org/10.1111/jpc.15758
4. Velazquez-Meza ME, Galarde-López M, Carrillo-Quiróz B, Alpuche-Aranda CM. Antimicrobial resistance: One Health approach. Vet World. 2022;743–9. Available from: http://www.veterinaryworld.org/Vol.15/March-2022/27.html
5. Pisarski K (2019) The global burden of disease of zoonotic parasitic diseases: top 5 contenders for priority consideration. Trop Med Infect Dis. 4:44. Available from: https://www.mdpi.com/2414-6366/4/1/44
6. Anisuzzaman, Hossain MS, Hatta T, Labony SS, Kwofie KD, Kawada H, et al. Food- and vector-borne parasitic zoonoses: Glob Burden Impacts. 2023. p. 87–136. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0065308X23000118
7. Rahman MT, Sobur MA, Islam MS, Ievy S, Hossain MJ, El Zowalaty ME et al (2020) Zoonotic diseases: etiology, impact, and control. Microorganisms. 8:1405. Available from: https://www.mdpi.com/2076-2607/8/9/1405
8. Han BA, Kramer AM, Drake JM (2016) Global patterns of zoonotic disease in mammals. Trends Parasitol. 32:565–77. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1471492216300101
9. Thorp L, Fullerton L, Whitesell A, Dehority W. Hantavirus pulmonary syndrome: 1993–2018. Pediatrics. 2023;151. Available from: https://publications.aap.org/pediatrics/article/151/4/e2022059352/190789/Hantavirus-Pulmonary-Syndrome-1993-2018
10. Zimmermann P, Curtis N (2022) Monkeypox—what pediatricians need to know. Pediatr Infect Dis J. 41:1020–31. Available from: https://journals.lww.com/10.1097/INF.0000000000003720
11. "What pediatricians need to know" about monkeypox in children. News Med Life Sci. 2022 [cited 2023 Sep 14]. Available from: https://www.news-medical.net/news/20221028/Few-children-affected-by-monkeypox-so-far-e28093-but-risks-are-higher-in-children-8-or-younger.aspx
12. Glaser C, Lewis P, Wong S (2000) Pet-, animal-, and vector-borne infections. Pediatr Rev Am Acad Pediatr (AAP) 21:219–232. https://doi.org/10.1542/pir.21.7.219
13. Peña A, Abarca K, Weitzel T, Gallegos J, Cerda J, García P et al (2015) One Health in practice: a pilot project for integrated care of zoonotic infections in immunocompromised children and their pets in Chile. Zoonoses Public Health Wiley 63:403–409. https://doi.org/10.1111/zph.12241
14. López J, Peña A, Pérez R, Abarca K (2013) Tenencia de mascotas en pacientes inmunocomprometidos: actualización y consideraciones veterinarias y médicas. Rev Chil infectología SciELO Agencia Nacional de Investigacion y Desarrollo ANID. 30:52–62. https://doi.org/10.4067/s0716-10182013000100009
15. Douno M, Asampong E, Magassouba N, Fichet-Calvet E, Almudena MS (2021) Hunting and consumption of rodents by children in the Lassa fever endemic area of Faranah Guinea. Bird B, editor. PLoS Negl Trop Dis. 15:e0009212. https://doi.org/10.1371/journal.pntd.0009212
16. Bréhin C, Debuisson C, Mansuy J-M, Niphuis H, Buitendijk H, Mengelle C et al (2016) Keep children away from macaque monkeys! J Travel Med. 23:taw006. Available from: https://academic.oup.com/jtm/article-lookup/doi/10.1093/jtm/taw006
17. van Stuijvenberg ME, Nel J, Schoeman SE, Lombard CJ, du Plessis LM, Dhansay MA (2015) Low intake of calcium and vitamin D, but not zinc, iron or vitamin A, is associated with stunting in 2- to 5-year-old children. Nutrition 31:841–846. https://doi.org/10.1016/j.nut.2014.12.011. Elsevier BV
18. Michaelsen KF, Hoppe C, Roos N, Kaestel P, Stougaard M, Lauritzen L et al (2009) Choice of foods and ingredients for moderately malnourished children 6 months to 5 years of age. Food Nutr Bull 30:S343-404. https://doi.org/10.1177/15648265090303s303. SAGE Publications
19. Gopal PK, Gill HS (2000) Oligosaccharides and glycoconjugates in bovine milk and colostrum. Br J Nutr 84:69–74. https://doi.org/10.1017/s0007114500002270. (Cambridge University Press (CUP))
20. Tanaka S, Kobayashi T, Songjinda P, Tateyama A, Tsubouchi M, Kiyohara C et al (2009) Influence of antibiotic exposure in the early postnatal period on the development of intestinal microbiota. FEMS Immunol Med Microb. 56:80–7. https://doi.org/10.1111/j.1574-695x.2009.00553.x. (Oxford University Press (OUP))
21. Garcia SN, Osburn BI, Cullor JS (2019) A one health perspective on dairy production and dairy food safety. One Heal. 7:100086. Available from: https://pubmed.ncbi.nlm.nih.gov/30911596
22. Smith KL, Todhunter DA, Schoenberger PS (1985) Environmental mastitis: cause, prevalence prevention. J Dairy Sci. 68:1531–53. https://doi.org/10.3168/jds.s0022-0302(85)80993-0
23. Lee Wong AC (1998) Biofilms in food processing environments. J Dairy Sci. 81:2765–70. https://doi.org/10.3168/jds.s0022-0302(98)75834-5. American Dairy Science Association
24. Murray CJL, Ikuta KS, Sharara F, Swetschinski L, Robles Aguilar G, Gray A et al (2022) Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet. 399:629–55. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673621027240
25. The United Nations International Children's Emergency Fund. The urgent threat of drug-resistant infections: protecting children worldwide. 2023. Available from: https://www.unicef.org/media/144266/file/The-Urgent-Threat-of-Drug-Resistant-Infections:-A-UNICEF-Guidance-Note-on-Antimicrobial-Resistance-2023.pdf
26. Gladstone BP, Das AR, Rehman AM, Jaffar S, Estes MK, Muliyil J et al (2010) Burden of illness in the first 3 years of life in an Indian slum. J Trop Pediatr. 56:221–6. Available from: https://pubmed.ncbi.nlm.nih.gov/20028725
27. Chestnov O. World Health Organization global action plan for the prevention and control of noncommunicable diseases. Geneva. 2013
28. World Health Organization (2019) Turning plans into action for antimicrobial resistance (AMR): working paper 2.0: implementation and coordination. World Health Organization
29. Masset E, Haddad L, Cornelius A, Isaza-Castro J (2012) Effectiveness of agricultural interventions that aim to improve nutritional status of children: systematic review. BMJ. England 344:d8222–d8222. Available from: https://pubmed.ncbi.nlm.nih.gov/22251864
30. Bruyn DE. Using a One Health framework to promote food security in Tanzania and using a One Health approach to promote food and nutrition security in Tanzania and Zambia. 2015;
31. UNICEF/WHO/WORLD BANK. Levels and trends in child malnutrition UNICEF / WHO / World Bank Group Joint Child Malnutrition Estimates Key findings of the 2021 edition. World Heal Organ. 2021;1–32. Available from: https://www.who.int/publications/i/item/9789240025257
32. de Onis M, Branca F (2016) Childhood stunting: a global perspective. Matern Child Nutr. England 12:12–26. Available from: https://pubmed.ncbi.nlm.nih.gov/27187907

33. Checkley W, Buckley G, Gilman RH, Assis AM, Guerrant RL, Morris SS et al (2008) Multi-country analysis of the effects of diarrhoea on childhood stunting. Int J Epidemiol. 37:816–30. Available from: https://pubmed.ncbi.nlm.nih.gov/18567626
34. Rogawski ET, Liu J, Platts-Mills JA, Kabir F, Lertsethtakarn P, Siguas M et al (2018) Use of quantitative molecular diagnostic methods to investigate the effect of enteropathogen infections on linear growth in children in low-resource settings: longitudinal analysis of results from the MAL-ED cohort study. Lancet Glob Heal. 6:e1319-28. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2214109X18303516
35. Humphrey JH (2009) Child undernutrition, tropical enteropathy, toilets, and handwashing. Lancet 374:1032–1035. https://doi.org/10.1016/s0140-6736(09)60950-8
36. Prendergast AJ, Gharpure R, Mor S, Viney M, Dube K, Lello J et al (2019) Putting the "A" into WaSH: a call for integrated management of water, animals, sanitation, and hygiene. Lancet Planet Heal 3:e336–e337. https://doi.org/10.1016/s2542-5196(19)30129-9
37. Gharpure R, Mor SM, Viney M, Hodobo T, Lello J, Siwila J et al (2021) A One Health approach to child stunting: evidence and research agenda. Am J Trop Med Hyg. 104:1620–4. Available from: https://pubmed.ncbi.nlm.nih.gov/33684062
38. Snelbecker GE (1974) The open classroom reader. Psychol Sch. 11:381–2. Available from: http://dx.doi.org/10.1002/1520-6807(197407)11:3%3C381::aid-pits2310110332%3E3.0.co
39. Courtenay M, Sweeney J, Zielinska P, Brown Blake S, La Ragione R (2015) One Health: an opportunity for an interprofessional approach to healthcare. J Interprof Care 29:641–642. https://doi.org/10.3109/13561820.2015.1041584
40. Haxton E, Lindberg A, Troell K, Redican KJ (2015) One Health education meets science. Infect Ecol Epidemiol. 5:30264. Available from: https://pubmed.ncbi.nlm.nih.gov/26689655
41. Devaskar SU, Cunningham CK, Steinhorn RH, Haq C, Spisso J, Dunne W et al (2023) Academic health centers and humanitarian crises: One Health system's response to unaccompanied children at the border. Acad Med. 98:322–8. Available from: https://pubmed.ncbi.nlm.nih.gov/36512839
42. Dooyema CA, Neri A, Lo Y-C, Durant J, Dargan PI, Swarthout T et al (2012) Outbreak of Fatal Childhood Lead Poisoning Related to Artisanal Gold Mining in Northwestern Nigeria, 2010. Environ Health Perspect. 120:601–7. Available from: https://pubmed.ncbi.nlm.nih.gov/22186192
43. Lo Y-C, Dooyema CA, Neri A, Durant J, Jefferies T, Medina-Marino A et al (2012) Childhood Lead Poisoning Associated with Gold Ore Processing: a Village-Level Investigation—Zamfara State, Nigeria, October–November 2010. Environ Health Perspect. 120:1450–5. Available from: https://pubmed.ncbi.nlm.nih.gov/22766030
44. Edwards JR, Fossum TW, Nichols KJ, Noah DL, Tarpley RJ, Prozialeck WC (2017) One Health: children, waterfowl, and lead exposure in Northwestern Nigeria. J Osteopath Med. 117:370–6. https://doi.org/10.7556/jaoa.2017.075
45. Murhekar M, Vivian Thangaraj J, Sadanandane C, Mittal M, Gupta N, Rose W et al (2021) Investigations of seasonal outbreaks of acute encephalitis syndrome due to Orientia tsutsugamushi in Gorakhpur region, India: A One Health case study. Indian J Med Res. 153:375. Available from: https://pubmed.ncbi.nlm.nih.gov/33907001
46. Sips GJ, Dirven MJG, Donkervoort JT, Kolfschoten FM, Schapendonk CME, Phan MVT et al (2020) Norovirus outbreak in a natural playground: a One Health approach. Zoonoses Public Health. 67:453–9. Available from: https://pubmed.ncbi.nlm.nih.gov/32037743

Publisher's Note