

Approaching One Health in Musculoskeletal Conditions and Disability

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Abstract

Introduction: Musculoskeletal pathology and disability are increasing worldwide due to the aging of the population, which calls for efficient and sustainable health strategies. “One Health” is a flexible model that approaches health from the perspective of the interaction between humans, animals, plants, and the environment.

Aim: The purpose of this article is to perform a narrative review of the literature on the current importance of “One Health” in musculoskeletal conditions and disability.

Methods: On June 28, 2023, a bibliographic search was performed in Medline, EMBASE, CINAHL, PEDro, Cochrane library, using “one health musculoskeletal” as a keyword. The total number of studies included was 109.

Results: Adopting this model brings about economic, social, and health benefits. Environmental problems are associated with increased cognitive impairment, frailty, functional limitation, hospitalization, and mortality, especially in the elderly and in people with disabilities. Socioeconomic status is also an environmental factor related to general physical capacity, obesity, isolation, and difficulty with self-care. To improve overall health, it is necessary to create healthy environments and lifestyles. Along these lines, an appropriate architectural design for cities increases physical activity, improves self-perception of health, and avoids sedentary lifestyles. On the other hand, healthcare generates a significant carbon footprint, especially from surgeries, hospital stays, imaging tests, and drug manufacturing. To reduce this footprint, it is necessary to avoid unnecessary clinical practices, promote telemedicine, and assess anesthetic and surgical techniques, taking into account their environmental impact. It is essential to provide health education that considers the influence of the environment on health.

Conclusion: The “One Health” approach can reduce health costs and improve the sustainability of health systems; however, it requires training and research efforts to unify the methodologies and tools employed. Therefore, more studies are needed to better understand how to apply and measure interventions to improve health at the global, national, and local levels.

Keywords: Heart, Aorta, Aortic Valve, Complications, Health

1. INTRODUCTION AND BACKGRIUND

Schwabe first described the term One Health in 1964 [1]. It is a complex term that refers to the mutual interaction of the confluence of humans,

other living beings, and the environment with health.

The One Health initiative proposes a flexible approach that involves many sectors and applies

to all health problems that arise during the interaction of people, animals, plants, and the environment. The One Health approach is applicable to the Sustainable Development Goals contained in the United Nations 2030 Agenda, designed to achieve a world of “dignity, peace, and prosperity for people and planet, now and in the future” [2].

The tripartite is an organization that combines the World Health Organization (WHO), Food and Agriculture Organization, and World Organization for Animal Health. The tripartite has defined One Health as “An approach to address a health threat at the human-animal-environment interface based on collaboration, communication, and coordination across all relevant sectors and disciplines, with the ultimate goal of achieving optimal health outcomes for both people and animals; a One Health approach is applicable at the subnational, national, regional, and global levels”[3].

Generating models and networks based on One Health can be useful for all countries [4]. For example, efforts to maintain biodiversity and the natural environment for animals can reduce the number of wildlife-borne diseases [5].

Approximately 60% of all human pathogens are zoonotic, and 75% of the infectious diseases that have emerged in recent years that affect humans typically originate in wildlife [6]. However, there has also been an increase in health problems related to current lifestyles and the natural and industrialized environments in which we live.

Protocols for early warning, detection, and risk assessment are also being developed using the Global Early Warning System, which applies to emerging risks in human, animal, and ecosystem interactions. These protocols enable a better-coordinated response to urgent health threats [7].

The purpose of this article is to perform a narrative review of the literature on the current importance of One Health in musculoskeletal conditions and disability. On June 28, 2023, a bibliographic search was performed in Medline, EMBASE, CINAHL, PEDro, Cochrane library, using “one health musculoskeletal” as a keyword. The total number of studies included was 109. **Figure 1** shows the PRISMA flowchart used in this manuscript.

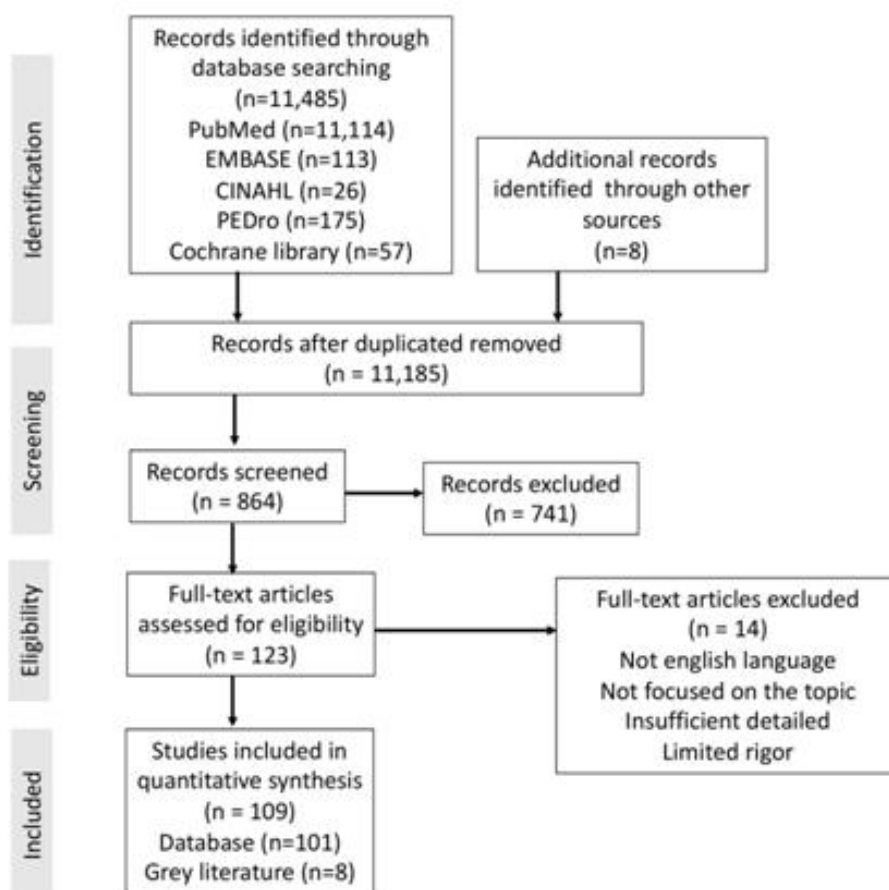


Figure 1. PRISMA flowchart used in this manuscript.

2. REVIEW

2.1. Musculoskeletal Conditions and Disability: a One Health Approach

Musculoskeletal pathology and disabilities are increasing worldwide as the population ages, which is costly and requires the development of efficient and sustainable health strategies [8]. The One Health vision is integrated with the usual multidisciplinary and interdisciplinary approach to rehabilitation, which seeks to optimize functional recovery, focus on the person's remaining capacities, and enhance their relationship with the environment through modifications to the environment, with the ultimate aim of reducing disability.

The environmental changes that most affect health are climate change, biosphere alteration, ocean acidification, scarcity of drinking water, atmospheric changes, modification of the nitrogen and phosphorus cycles, decrease in ozone levels, and the appearance of new organisms [9]. Aspects directly related to climate change can worsen pain in musculoskeletal processes [10].

The importance of the environmental component in public health has been highlighted in diseases as frequent and important as cancer, obesity, and coronary heart disease, all of which can directly impact musculoskeletal health and disability [11]. The relationship between the elements of health, living beings, and the environment is multi-directional (**Figure 2**).

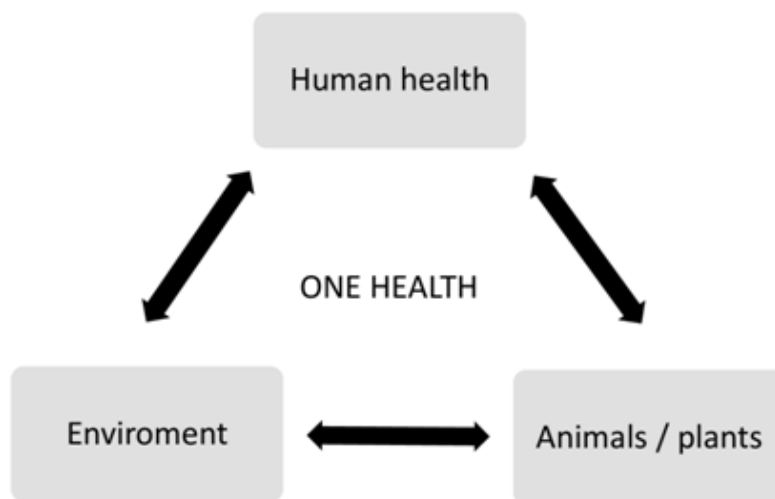


Figure 2. One Health as a model based on the interaction between the health of people, animals, plants and environment

In recent years, it has thus been advised to conduct high-quality research evaluating the environmental impact of orthopedic surgery [12] and rehabilitation medicine (physiotherapy and occupational therapy) [13, 14], allowing solid recommendations to be made to reduce their environmental impact.

2.2. Impact of Environment on Musculoskeletal Health and Disability

Environmental Health involves dynamic and complex relationships between animals, plants, and microorganisms, which form a functional unit when interacting with the environment [15]. It refers to the sum of the environment's physical (e.g., water, air, geography, noise, light, heat), biological (e.g., humans, insects, animals, plants, viruses), and psychosocial (e.g., cultural values, lifestyle, systems, political and social organizations) elements [16]. Physical, chemical, and biological elements can

beconsidered risks to human health, as are social elements [17]. Environmental pathology develops through interactions between pathological factors in the environment and non-environmental factors [18].

It is important to have a better understanding of the environmental factors that affect health and the mechanisms by which this occurs [19]. Moreover, environmental factors not only influence the incidence of diseases, but also their clinical course [20]. For example, climate change has led to changes in the distribution of bats, which act as reservoirs for corona viruses, leading to increased exposure in humans. In addition, pollution exacerbates respiratory disease [21].

Environmental factors have been associated with health problems [22]. The environmental consequences on human health are described in **Table 1**.

Table 1. Environmental consequences on human health

Cognitive impairment
Fragility
Functional limitation
Disability
Traffic accidents
Hospitalization
Interaction with animals
Mortality

Environmental factors can also cause considerable limitations for people with disabilities [23]. Environmental modification has been proposed as a therapeutic measure in rehabilitation medicine to reduce disability [24].

We know that a person’s environment has a significant impact on their experience and the extent of disability. Inaccessible environments create disabilities by creating barriers to participation and inclusion. In this sense,

community-based rehabilitation promotes the coordination of various strategies, driven from distinct factors, to favor the autonomy of the individual and to help equalize opportunities and enable participation in society of all people with disabilities, as reflected in Agenda 2030 [11]. Some of the environmental aspects that influence musculoskeletal health and disability are summarized in **Table 2**.

Table 2. Environmental aspects influencing musculoskeletal health and disability

Climate change
Water pollution
Malnutrition
Micronutrient and protein deficiencies
Obesity
Socioeconomic level
Working conditions
Sedentary lifestyle
Mobility barriers
Urbanization

Thus, the importance of Environmental Health is growing. The WHO has estimated that in 2012, 12.6 million deaths globally were directly related to environmental issues, accounting for 23% of all causes of death. In addition, environmental factors might be responsible for 22% of all disability-adjusted life years [25].

2.2.1. Lifestyles

Climate change has modified the environment by affecting wildlife (wild and domestic), food chains, and human health [26].

Water pollution, air pollution, ionizing radiation, noise, and occupational hazards are all included in environmental health [27]. In this sense, there are other problems directly related to food production, such as an increase in the concentration of atmospheric carbon dioxide or heavy metals in agricultural land [28]. An increase in environmental toxicity is a public health problem [29]. Therefore, it is necessary to consume food products that have been cultivated in an environmentally friendly manner and to have sustainable diets within the ecological concept of public health [30].

Contaminants are a risk to animals and humans who eat them. Their impact depends on their interaction with the environment and the animal’s own metabolism [31]. Changes in factors such as humidity or temperature can increase exposure to contaminants such as lead, affecting animal and human health [32]. In some cases, as a result of industrial waste, insecticides have been found in food, animals, and humans [33]. For example, the major earthquake in eastern Japan in March 2011 and the subsequent crisis at the Fukushima nuclear complex led to radioactive leaks that hampered the production and supply of safe livestock products due to the high levels of contamination in the area [34].

At the nutritional level, it is essential to ensure food safety during production, handling, and consumption [35], and collaboration between human and animal health providers is also important. Population growth, coupled with the impact on nature due to an increasing carbon footprint, has meant that nutrition-related problems (undernutrition, malnutrition, starvation, hunger) continue to be a major threat

to global health [36]. Malnutrition in less-developed countries is considered an environmental pathology; however, obesity due to poor dietary habits is not considered a result of the environment [37]. At the nutritional level, dietary deficiencies in iron and zinc are health problems. It is also advisable to ensure the supply of micronutrients, such as vitamin D and calcium [38], and vitamins B6, B12, and folic acid [39]. In older adults, protein intake is particularly important for maintaining muscle mass and promoting wound healing and recovery from illness [40].

Food production systems are changing rapidly, which has had a dramatic impact on the way food is consumed. Proof of this can be seen in the obesity pandemic, which is linked to the risk of numerous diseases, and whose prevalence doubled from 1980 to 2014. There were 1.9 billion overweight adults and 42 million obese children under the age of 5 years in 2013 and 2014, respectively [41]. Due to this pandemic, patients have shown gait pattern alterations, limb deformities, and increased rates of joint pain [42]. Preventive measures aimed at creating healthier environments and lifestyles can have a significant impact on improving nutritional health [43].

2.2.2. Socioeconomic environment

The main social determinants of health are ethnicity, sex, socioeconomic status, and location [44]. Socioeconomic status is an environmental factor related to general physical ability and obesity development [45].

People with low incomes are more likely to suffer from isolation due to living in flats of buildings without lifts, so stairs make access difficult, especially affecting older adults [46].

The consequences of socio-economic status may also be influenced by gender. For men, living in a neighborhood with a lower socioeconomic status was associated with a higher risk of difficulties in self-care activities. This risk decreases when people live in areas with good street connectivity. However, this relationship was not observed in women [47].

Working conditions also play an important role. For example, there appears to be a relationship between physical disability after retirement and environmental hazards experienced during work life, such as heat, dust, noise, weight bearing, and awkward postures [48].

Therefore, improving working conditions in work-related musculoskeletal pathologies can reduce overuse injuries to muscles, joints, tendons, and vertebral discs [49].

Chronic musculoskeletal diseases, in addition to causing disability, have a negative economic impact on the patients themselves and on society [50].

2.2.3. City design

Other conditions that impact both musculoskeletal pathology and disability are influenced by architectural development and urbanization [51]. Interestingly, most environmental limitations do not influence the functionality of patients without mobility disorders [52]. Individuals with mobility impairments, disabilities, or advanced age are 4 times more likely to report walking problems when living in areas with poorly maintained streets than when living on streets in good condition [53].

Environmental factors are important for reducing the risk of disability and maintaining functional ability through the promotion of a healthy lifestyle [54]. When the accessibility and sociability of physical spaces and social fabric are limited, people's well-being, sense of inclusion, intergenerational relationships, and health are affected [55]. When streetscapes are designed to facilitate the needs of pedestrians and access to recreational places, physical activity, self-perceived health, and risk of obesity are improved [56].

It is essential for the architectural design of cities to combat sedentary lifestyles. This is considered a fundamental environmental health measure [37]. There appears to be a relationship between access to green spaces within the urban landscape and health outcomes [57]. In this regard, living in neighborhoods with more green spaces has been reported to reduce the risk of developing frailty [58].

Transportation within cities is also important, so people can access various services and perform their daily activities [59]. A well-serviced neighborhood is crucial because the easy ability to acquire food with adequate nutrition and its relationship with physical exercise are critical for maintaining physical function [60].

People's needs change throughout life, and they need an urban landscape that considers age-related changes [61]. To facilitate good health, environmental measures such as the creation of age-friendly cities [62] have been proposed.

These are cities with structures, services, and policies designed to facilitate active aging, specifically aimed at enabling older and mobility-impaired people to enjoy good health and participate in society while maintaining their independence and living in the community [63]. Eight domains have been proposed for age-friendly cities: communication and information, social participation, employment, transport, housing, health services, outdoor spaces, and social inclusion [64].

Another interesting concept is that of a Smart City, which refers to an urban area that uses information and communication technologies to improve resource consumption, facilitates the use of open spaces, reduces the cost of infrastructure maintenance, and encourages citizen involvement in local policies [65]. New technologies are constantly advancing, and when used to improve urbanity, they can improve quality of life [66]. However, people who have grown up without access to certain technologies might find it difficult to use them [67]. Therefore, “Smart Cities” must take digital literacy into account and adapt themselves accordingly [68].

Along these lines, the digital transformation of the environment and the use of new technologies in health can improve the connection between various areas and optimize interventions at multiple levels to reduce the environmental aspects of human pathologies [69]. Environmental factors are one of the main causes of traumatic injuries [70]. Traumatic pathology due to traffic accidents is considered to fall within environmental pathology, because environmental interventions (improving roads or signage) reduce their frequency [71].

2.2.4. Relationship with Animals

Animals have long been used in traditional medicine, both through the ingestion of their parts and as amulets in rituals. Plants have also been classically used as remedies for both humans and animals [72].

What is new in the One Health approach is the joint planning of animal, human, and environmental health [73]. Some animal species can be used to increase the clinical knowledge of human pathology. For example, clinical benefits from physical exercise and dietary changes have been reported in humans and horses [74]. Horses have also been used as a model for the study of degenerative osteoarthritis [75] and human tendinopathies, combining the use of genetic analysis techniques and data processing technologies to identify environmental factors that contribute to their pathogenesis [76].

Other aspects of animal integration in human health include the tendency to favor the relationship between people and animals, such as the connection between humans and horses or dolphins for therapeutic purposes. The positive health impact of walking pets has also been described as a socially acceptable and cost-effective measure to prevent obesity and a sedentary lifestyle [77]. However, natural disasters have highlighted health problems resulting from the abandonment of livestock or pets in terms of both human mental health and animal welfare [78].

2.3. Musculoskeletal Health and Lifestyle Impact on Environment

Healthcare is directly and indirectly responsible for a large amount of green house gas emissions, commonly referred to as the carbon footprint. It is considered responsible for up to 5% of the global environmental impact [79].

The main contributors to the carbon footprint of healthcare are surgery, hospital stay, imaging tests, and drug manufacturing [80]. The manufacturing of medical materials and equipment, transport, waste management [81], and orthopedic surgery [82] also contribute significantly to the carbon footprint.

Some of the aspects of musculoskeletal health and lifestyles that increase the carbon footprint are summarized in **Table 3**.

Table 3. Musculoskeletal Health Aspects and Lifestyles that Increase the Carbon Footprint

Drug manufacturing
Imaging tests
Hospital stays
Orthopedic surgery
Surgical material manufacturing
Medical equipment
Operating room cleaning
Medical waste management
Transportation
Food waste

2.3.1. Clinical Practice

Three strategies have been proposed to reduce the environmental impact of the clinical care of patients with musculoskeletal diseases. It is important to reduce the demand for care, which can be achieved by promoting preventive therapeutic interventions. Another important action would be to match the demand for care with the available healthcare resources, which could be achieved by reinforcing healthcare providers. A third important aspect is to reduce the carbon emissions produced during healthcare, which could be achieved by ceasing low-value clinical activities [83].

For example, a key aspect of reducing the carbon footprint of musculoskeletal disease management is to reduce low-value clinical practices in arthrosis [84], shoulder pain [85], hip and knee pain [84], low back pain [86], and sports injuries [87]. One-third of all clinical interventions performed are considered to provide little value [88], thus generating a carbon footprint without producing a clinical benefit to the patient.

Telemedicine and tele rehabilitation are also useful for reducing the environmental impact of therapeutic resources that facilitate access to healthcare [89]. It has been reported that incorporating telemedicine consultations reduces the carbon footprint compared with face-to-face consultations in both hand surgery rehabilitation [90] and preoperative assessment in spinal surgery [91]. In this sense, adapting the home environment and increasing the involvement of caregivers are fundamental for developing home-based rehabilitation programs [92].

2.3.2. Orthopedic Surgery

The weight of waste has been quantified in 205 orthopedic surgeries, including joint replacement, open reduction, and internal fixation in ankle malleolus fracture, facet injections, and arthroscopic hip surgery. The main waste in orthopedic surgeries is non-recyclable [82].

Numerous actions have been proposed to reduce waste in these surgeries, such as separating waste, establishing recycling programs, improving the training of professionals in the management of recyclable waste, analyzing

environmental variables in surgical procedures to make them environmentally friendly, establishing a program to recover supplies, avoiding excessive packaging of surgical materials, using reusable surgical linen, using kits that can be sterilized and used for other procedures, and performing specific protocols [82].

In orthopedic surgery, textiles contribute to more than half of the dry waste weight; this can be reduced from 5.7 to 4.5 kilos in hip replacement surgery by using customized kits with fewer products, packages, and consumables [93]. Therefore, it is recommended that orthopedic surgery practices be adapted to improve their sustainability [94].

Anesthesia is also important when considering the environmental impact of orthopedic surgery. In knee arthroplasty surgeries, the carbon emissions with general anesthesia, spinal anesthesia, or a combination of both are equal when the inhaled anesthetic is the same (sevoflurane) [95]. In the case of single-level transforaminal lumbar interbody fusions, the median carbon emissions under general anesthesia are higher than those under spinal anesthesia [96].

Regarding the characteristics of operating rooms, energy expenditure has been assessed employing various ventilation systems in simulated hip arthroplasty procedures. Laminar flow systems consume 50% less energy while maintaining acceptable levels of bacteria [97].

The environmental impact of manufacturing titanium hip or knee prostheses has also been studied. In both cases, the additive system (layer-by-layer manufacturing) have shown the least impact. In the case of knee prostheses, carbon emissions were reduced by 68% [98, 99].

It has also been shown that the use of disposable materials in lumbar fusion surgery can reduce the carbon footprint by up to 85% compared with reusable materials, owing to the sterilization process [100]. The type of surgical technique employed also has environmental implications. Endoscopic carpal tunnel surgery generates more carbon emissions than open surgery due to the longer surgical time and sterilization of the material used [101]. Measures to reduce the impact of musculoskeletal health and lifestyles on the environment are summarized in **Table 4**.

Table 4. Measures to reduce the impact of musculoskeletal health and lifestyles on the environment

Reducing the demand for care
Encourage preventive interventions
Adequacy of available health resources
Reduce clinical practices that provide little value
Enhancing tele medicine and tele rehabilitation
Separate waste
Carry out recycling and supply recovery programs
Improving training in the management of recyclable waste
Avoid excessive packaging of surgical materials
Use surgical kits that can be sterilized and reused
Cleaning operating rooms with laminar flow systems
Fabrication of additive system joint prostheses

2.3.3. Food waste

Food and food waste also have an environmental impact [102]. It is important to reduce food waste to combat excessive methane production through measures such as food sharing, which can also encourage a more varied diet [103].

An example of a sustainable diet is the Mediterranean diet. Given that it is based on the consumption of vegetables, its production has a low carbon footprint and low water requirement, which means that it has a low impact on the ecosystem [104].

2.4. One Health Outcomes

Most One Health studies show interactions between humans and animals or between humans and the environment. Most of the interventions performed at One Health are environmental and aim to control vectors, contaminants, sanitation, and water, as well as to adapt the environment to favor physical activity. One Health has made it possible to use more antibiotics and vaccines, promote efficient hygiene measures, more sustainable management of the environment, and improve

health development in countries with fewer resources [105].

Key health interventions can reduce the economic burden of health threats at the human-animal-environment interface and generate more efficient systems and methods, which reduce costs. For example, it has been reported that avoiding exposure to secondhand smoke could reduce healthcare costs for cardiovascular diseases by up to \$2.3 billion per year [106].

Environmental factors directly impact healthcare costs. The economic results of interventions based on One Health are cost-benefit ratios, cost savings, or cost-utility ratios. Most (98%) studies have reported positive results. In non-economic outcomes, most interventions attempt to reduce the frequency of disease, although some measure other parameters such as productivity or weight loss, with generally positive results in studies (83%) [107].

Among the economic, social, and health benefits of the One Health approach, several have been described (Table 5) [73].

Table 5. Economic, social and health benefits of the One Health approach described

Improved data exchange between ministries
Improved overall surveillance and outbreak response capacity
Establishment of subcommittees or working groups specifically dedicated to a zoonotic disease
Improved communication with the general public
Further training of professionals working at One Health

2.5. Training at One Health

When managing musculoskeletal diseases, it is advisable to promote the development of ecological health education and to incorporate environmental aspects into health professional training and clinical reasoning strategies [108].

Knowledge and skills are incorporated into the programs of physiotherapy students and professionals with the aim of integrating aspects

of environmental impact and the influence of the environment on their training [13]. For example, a One Health-oriented Masters degree has been created with 2 lines of action: epidemiology, health planning and surveillance; and primary healthcare. Part of this content is taught by veterinarians, economists, dentists, therapists, biologists, pharmacists, and teachers, among others [108].

Online communities have also been created through chat applications and websites by taking advantage of new information system technologies [108]. These communities will make it possible to improve the training and awareness of professionals to achieve fluid and lasting collaboration between the sectors of human, animal, and environmental health.

2.6. One Health Limitations

A primary difficulty lies in promoting a common language on the foundations of One Health, so that professionals and politicians from a variety of sectors can collaborate and develop appropriate tools [7].

The One Health approach requires a strong commitment from countries on a global scale; therefore, political will is an essential component. By definition, any One Health measure must be applied globally. This approach requires political will from all participants and creates the risk of developing an imperialist attitude, in which the most powerful countries impose their vision on less developed ones [105].

It is necessary to standardize and normalize the measurement tools of one health-related intervention to make better decisions and allocate resources appropriately. The various agents involved must assume shared responsibility to distribute tasks and resources fairly [72].

Another problem with the One Health application is the ethical aspect of a lack of equity. Not all agents have financial resources, specific knowledge, and political will to adopt the One Health approach with the benefits that it implies [109]. In fact, countries with the fewest economic resources tend to claim the right to their development and industrialization, as countries with the greatest resources have done in the past decades and centuries, with the environmental impact that this development entails.

3. CONCLUSION

One Health is a concept that applies to the entire planet, making it possible to better deal with health problems such as zoonotic diseases, resistance to antimicrobials, emerging infectious diseases, food toxicity problems, and socio-sanitary aspects such as poverty.

One Health was designed as a collaborative, inclusive, multisectorial, and transdisciplinary initiative to promote the best sustainable care to

achieve optimal health results through the study and promotion of the relationships between people, animals, plants, and their environment. It acts locally, regionally, nationally, and globally.

Various strategies are available to improve musculoskeletal health and reduce disability, such as making lifestyle changes, increasing socioeconomic status, enhancing city design, and bettering relationships with animals. It is also necessary to reduce the environmental impact of healthcare by reducing waste, limiting actions of little value, and promoting telemedicine, as well as ensuring the safety and quality of the food chain to provide optimal nutrition.

The One Health approach can reduce health costs and improve the sustainability of health systems; however, it requires training and research efforts to unify the methodologies and tools employed. Therefore, more studies are needed to better understand how to apply and measure interventions to improve health at the global, national, and local levels.

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