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EDITED BY

Carolina Maciel,
World Federation for Animals, United States

REVIEWED BY

Essam Abdelfattah,
University of California, Davis, United States
Michelle Sinclair,
Stanford University, United States

*CORRESPONDENCE

Débora Silvia Racciatti
✉ dracciatti@fvvet.uba.ar

[†]These authors share first authorship

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Links between animal welfare and “One Health”: perception and implementation in Latin America

Débora Silvia Racciatti^{1*†}, Guillermo María Wiemeyer^{2,3†}, Luis Andrés González Gracia⁴, Carlos Blanco⁵, Andrea Szmec³ and María Marcela Orozco^{2,3}

¹Cátedra de Bienestar Animal y Etología, Facultad de Ciencias Veterinarias, Universidad de Buenos Aires (UBA), Buenos Aires, Argentina, ²Instituto de Ecología, Genética y Evolución de Buenos Aires (IEGEGA-CONICET), Buenos Aires, Argentina, ³Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina, ⁴Independent Researcher, Québec, QC, Canada, ⁵Cátedra de Sociología Rural, Facultad de Ciencias Veterinarias, Universidad de Buenos Aires (UBA), Buenos Aires, Argentina

Introduction: The recent COVID-19 pandemic has highlighted the crucial role of the “One Health” (OH) concept in the prevention, early detection, and mitigation of health issues involving humans, animals, and the environment. Recognizing the intrinsic interdependence among human health, animal health, and environmental well-being is crucial, demanding heightened emphasis. Many health challenges stem from situations that compromise animal welfare (AW), human well-being, environmental sustainability, and vice versa. Recognizing the significance of AW across its five domains is essential for preventing future pandemics and advancing global objectives such as food security, reduction of human suffering, biodiversity conservation, and enhanced productivity in the agricultural-livestock sector.

Methods: From March to May 2023, we conducted an online survey using QuestionPro[®] to explore perceptions, experiences, ongoing strategies, and activities within disciplines linked to AW and the OH approach in Latin America. Respondents included stakeholders from various disciplines associated with OH and AW.

Results: Our findings reveal that both concepts are currently undergoing an expansion phase in Latin America. However, the interdependencies between AW and OH are not widely recognized. While animal welfare frequently receives significant attention from diverse educational perspectives, the OH approach has gained considerable momentum over the past decade. Academic sectors and non-governmental organizations (NGOs) are driving initiatives bridging AW and OH in Latin America, underscoring the need for robust public policies to ensure sustainable strategies.

Discussion: Advocating for greater awareness of the interdependence between AW and OH, this study highlights knowledge gaps among the scientific community and policymakers. Actively engaging with these connections can foster comprehensive strategies to address global health challenges and enhance overall well-being. The “One Welfare” framework and other integrative frameworks hold promise in strengthening the linkages between

AW and OH, facilitating theory translation into practical action. Establishing comprehensive, integrated policies that unite these domains is imperative for addressing complex health challenges and advancing the welfare of both animals and humans. Further research and collaborative efforts are essential to transform these concepts into tangible, impactful outcomes.

KEYWORDS

animal welfare, environment, interdisciplinary, One Welfare, policies, One Health, strategies, survey

1 Introduction

Addressing complex health problems associated with the emergence and reemergence of pathogens affecting human and animal health requires integrated and participatory approaches that recognize and consider the effects of environmental changes in new transmission scenarios (Cunningham et al., 2017). Changes in the use of aquatic and terrestrial environments, habitat fragmentation, climate change, illegal wildlife trade and globalization are well-known drivers of the emergence of zoonotic diseases (Brown, 2010). The COVID-19 pandemic has highlighted these interconnections (Wu, 2021) and the substantial impacts these diseases can have globally (Cheval et al., 2020; De Briyne et al., 2020; Marchant-Forde and Boyle, 2020; Martin et al., 2020; Samji et al., 2022). Furthermore, it has led to the establishment of the interdisciplinary “One Health” High Level Expert Panel (OHHLEP) in May 2021 (OHHLEP-FAO, 2021). This panel redefined the “One Health” (OH) concept as an integrated, unifying approach that recognizes that the health of humans, domestic and wild animals, plants, and the environment are closely linked and interdependent. The redefined concept addresses the full spectrum of disease control (disease prevention, detection, preparedness, response, and management) and improves and promotes health and sustainability. It can be applied at multiple levels and relies on shared and effective governance, communication, collaboration and coordination.

At the same time, COVID-19 has shown that the impact of pandemics and the measures for their prevention and mitigation cannot be evaluated considering only health aspects (Bowen et al., 2020; Magouras et al., 2020; Marchant-Forde and Boyle, 2020; Pinillos, 2020). Many health challenges originate in situations that compromise animal welfare (AW), human well-being or environmental sustainability, and vice versa. For instance, bushmeat consumption and traditional medicine drive the illegal trade in wild animals, which can contribute to the emergence of infectious zoonotic diseases (Karesh et al., 2005). Illegal species trafficking has also been studied from its social aspects and its link to human well-being (Tazerji et al., 2022). Furthermore, wildlife trade is a driver of ecosystem degradation and biodiversity loss, which affects ecosystem sustainability (Cox-Witton et al., 2014; Van Uhm, 2016; Symes et al., 2018; Dobson et al.,

2020), and animals taken from their natural habitat, in addition to the stress of capture and transport, are often housed in conditions that are not favorable for their welfare, with lack of hygiene and overcrowding. The immunosuppression resulting from these conditions may modify the transmission patterns of pathogens they may host (Magouras et al., 2020). Continuing with global health threats, antimicrobial resistance is enhanced by domestic animals under intensive management for food production due to permanent growth promoters and antibiotic usage (Jangir et al., 2022). Minimizing environmental and management stressors related to the intensification of animal production can increase immunocompetence. It is widely acknowledged that implementing stress-reduction measures in farm animals can help reduce antimicrobial use and the risk of antimicrobial resistance (Diana et al., 2020; Moser et al., 2020; Stygar et al., 2020; Albernaz-Gonçalves et al., 2022), while simultaneously improving the quality of life of farm animals and better preserving the social license of the agricultural industry (Albernaz-Gonçalves et al., 2022). Human health challenges can also affect AW, as demonstrated by anthroozoonoses and reverse zoonoses, including SARS-CoV-2. This virus can infect and impact the health and well-being of several animal species, as evidenced by the severe consequences observed in minks in breeding facilities due to SARS-CoV-2, resulting in increased rates of disease and mortality (Munnink et al., 2020). Recently confirmed, the transmission of SARS-CoV-2 between humans and white-tailed deer underscores the bidirectional nature of zoonotic transmission (Feng et al., 2023). Although not all implications of SARS-CoV-2 in free-ranging white-tailed deer are fully understood, the existence of bidirectional transmission and its observed impact on other animal species emphasize the intricate relationship between human health challenges and AW (De Briyne et al., 2020; Marchant-Forde and Boyle, 2020; Pinillos, 2020).

The concept of AW proposes the existence of four interacting physical-functional domains that, in turn, can be classified by their relationship to survival (nutrition, environment and health) or to the situation (behavior), and a fifth domain that encompasses the affective experience (state of mind) (Mellor et al., 2020). In the current context, understanding and promoting the relevance of AW in its five domains can help support numerous Sustainable Development Goals (such as food security, reduction of human suffering, biodiversity conservation and improved productivity within the agri-livestock sector) (Pinillos, 2018a; Pinillos, 2018b;

Abbreviations: AW, Animal welfare; OH, One Health; OW, One Welfare; Q, Question.

Marchant-Forde and Boyle, 2020; Olmos Antillón et al., 2021). Also, because of its interconnections with human well-being and health, it could help to prevent future pandemics. The recognition that AW can contribute to addressing environmental challenges, promoting the OH approach and achieving the Sustainable Development Goals has recently led to a call by the United Nations Environment Programme (UNEP) to work in collaboration with the World Organization for Animal Health (WOAH), the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the OHHLEP on issues related to AW and its nexus with human health and the environment, through a OH approach (United Nations Environment Assembly of the United Nations Environment Programme, 2022). This initiative fully aligns with the “One Welfare” (OW) concept, presented in 2016 during the 4th OIE Global Conference on Animal Welfare. Inspired by the OH concept, this new interdisciplinary field of study emphasizes the many links between AW and human well-being and recognizes that both depend on a well-functioning ecological environment (Fraser, 2016; García Pinillos et al., 2016).

A comprehensive assessment of the current scenario concerning interdisciplinary approaches and their regional integration is essential to enhance strategic direction and foster effective collaboration among stakeholders across diverse countries. Therefore, this study seeks to delve into the perspectives and practical experiences of professionals within the Latin American context who are engaged in disciplines related to AW and OH. We also aim to compile valuable insights into the presence and implementation of diverse initiatives bridging AW and OH in Latin America. Through this study, we aspire to contribute essential regional data to inform and enrich global strategies addressing complex health and welfare challenges, ultimately promoting a more integrated and responsive approach to these critical issues.

2 Materials and methods

2.1 Research ethics

This research was granted ethical approval through the Prof. Dr. J.P. Garrahan Hospital Research Ethics and Review Board (N° 31052023). Data collection was conducted from March to May 2023.

2.2 Research tool

The methodology proposed by Casas Anguita et al. (2003) was used to develop a survey hosted online on the QuestionPro® platform. It consisted of 42 questions (Q) divided into five sections: (1) demographic information; (2) general knowledge of AW and OH; (3) perception of linkages between AW and OH; (4) implementation of actions linking AW and OH; (5) OW as an integrating framework and some “housekeeping” questions at the end of the questionnaire (including comments, remarks or

suggestions). Eleven of the thirty-four closed-ended Q were formatted as a six-point Likert scale; eight were open-ended (see Tables 1 and 2). A blank version of the questionnaire (.pdf) is available in the Supplementary Material (Supplementary File 1 – Survey in Spanish; Supplementary File 2 – Survey translated into English). The funnel technique was used to avoid the influence exerted by some Q’s on the answers to others presented later (Casas Anguita et al., 2003). The questionnaire was pilot-tested to ensure its content validity by 11 people from different fields: an expert in wild animal health (veterinarian), an expert in conservation biology (veterinarian), three researchers in epidemiological surveillance (two biologists and a veterinarian), two experts in AW (a veterinarian and a biologist), a zoo keeper, an anthropologist and two experts in survey development (a graduate in political economy and a journalist), all from Argentina. Based on the results of this pilot test, additional modifications were introduced in our questionnaire, such as the incorporation of the option “I don’t know” for some questions (Q14, Q15, Q17–Q22, Q25, Q26, Q29 and Q30) to avoid respondents making random choices out of obligation when in fact they do not know.

In Q14, respondents were asked to identify which of seven keywords are part of the OH definition. The definition proposed by OHHLEP-FAO (OHHLEP-FAO, 2021) was used as a basis for this Q formulation and posterior analysis. Keyword options offered were: “ecosystems”, “people”, “animals”, “intersectorality”, “transdisciplinarity”, “collaboration” and “integration”, all of them included in the definition. Likewise, for Q15, which asks to select which of 4 keywords should form part of a complete definition of AW, a combination of the definitions of Broom (Broom, 1986) and WOAH (WOAH, 2022) was used. The four keywords were: “physical state”; “mental state”; “environmental conditions”; “to cope”. From the results, performance scores were assigned to each respondent, giving the maximum score (100%) to those who had selected all the response options (seven items for Q14 and four for Q15) and the minimum score (0%) to those who had selected none (WOAH, 2022).

2.3 Data collection and target audience

The survey link was distributed by email, inviting stakeholders from disciplines related to AW and OH to participate voluntarily, indicating that they could also resend to other colleagues or professionals linked to those disciplines using snowball sampling (Parker et al., 2020). In addition, the survey link was published in groups of students and professionals related to the topics covered, through social networks (LinkedIn®, Twitter® and Facebook®), WhatsApp® and via email. The inclusion criteria were: 1. To work in disciplines related to OH or AW; 2. To be a student of disciplines related to OH or AW; 3. To work or have worked in their profession or to be studying in a field related to these topics in Latin America. The exclusion criteria were either answering that they did not know the concept of OH or AW (see Q11, Supplementary Files 1 and 2). The inclusion criteria were clearly outlined in the introduction before starting the survey. However, in order to identify those people who had begun to respond despite not meeting these

TABLE 1 Survey overview for sections 1, 2 and 3.

Question topic	Answer type
Section 1 – Demographic information	
(Q1) Age	Numeric input
(Q2) Gender	Select one
(Q3) Discipline of practice	Select multiple
(Q4) Field of work	Select multiple
(Q5) Position you currently hold	Single row text
(Q6) Highest level of education attained (complete)	Select one
(Q7) Year of completion of your undergraduate studies	Numeric input
(Q8) Years of expertise in your field of work	Select one
(Q9) Performance domain	Select multiple
(Q10) Country/ies in which you developed your professional experience	Select multiple
Section 2 – General knowledge of AW and OH	
(Q11) Knowledge/familiarity with the following concepts	Select multiple
(Q12) Quality of AW and OH training during undergraduate studies	Text slider
(Q13) Quality of AW and OH training during graduate studies	Text slider
(Q14) Select keywords that are part of the concept of OH	Select multiple
(Q15) Select keywords for a complete definition of AW	Select multiple
Section 3 – Perception of linkages between AW and OH	
(Q16) Do you consider that your activities are somehow related to OH or AW?	Select multiple
(Q17) Perception of the AW and OH link	Select one
(Q18) Perception of AW Influence on Animal Health	Text slider
(Q19) Perception of AW influence on people's health	Text slider
(Q20) Perception of AW influence on ecosystem integrity	Text slider
(Q21) Degree in which AW improvements will support OH strategies in different groups of animals (companion; production; work; etc.)	Text slider
(Q22) Degree in which AW improvements contribute to addressing different OH challenges (Climate change; Biodiversity loss; etc.)	Multi-point scales
(Q23) Select AW problems that can negatively impact OH	Select multiple

All multi-point scale and text slider questions range from 0 (minimum) to 5 (maximum). All questions were mandatory except for: Q5 and Q13. AW, animal welfare; OH, "One Health"; Q, question. A blank version of the questionnaire (.pdf) is available in the [Supplementary Material](#).

TABLE 2 Survey overview for sections 4 and 5.

Question topic	Answer type
Section 4 – Implementation of actions linking AW and OH	
(Q24) Country selection for answering section 4	Drop-down menu
(Q25) Do you consider that in the last 10 years the understanding of AW importance has improved?	Select one
(Q26) Perception of selected country positioning in reference to AW	Select one
(Q27) Perception of selected country positioning in reference to OH approach communication and dissemination	Text slider
(Q28) Perception of selected country positioning in reference to applying OH approach to public policies	Text slider
(Q29) Which sector do you think the majority of the initiatives/policies come from?	Select multiple
(Q30) Do you consider that the COVID-19 pandemic made OH visible in the country you selected?	Select one
(Q31) Do you think that the COVID-19 pandemic made visible the OH and AW link in the country you selected?	Select one
(Q32) Involvement with OH/AW initiatives	Select multiple
(Q33) Characterize Q32 initiatives (public, private/local, regional, national, international)	Single row text
(Q34) Interest in participating in OH and AW integration projects	Select one
Section 5 – OW as an integrating framework and end of the questionnaire	
(Q35) Knowledge/familiarity with the integrative framework known as OW	Select one
(Q36) Quality of OW training during undergraduate studies	Text slider
(Q37) Quality of OW training during postgraduate studies	Text slider
(Q38) Prioritize different actions aimed at strengthening AW and OH link	Text slider
(Q39) Identification of limitations, gaps, and obstacles to implementing OW	Single row text
(Q40) List and prioritize actions to strengthen the AW and OH link	Single row text
(Q41) Comments or suggestions	Single row text
(Q42) Expression of interest in receiving the survey results	Single row text

All text slider questions range from 0 (minimum) to 5 (maximum), except for Q38 where 1 represents the highest priority and 6 the lowest. All questions were mandatory except for: Q33, Q37, Q39, Q40, Q41 and Q42. AW, animal welfare; OH, "One Health"; OW, "One Welfare"; Q, question. A blank version of the questionnaire (.pdf) is available in the [Supplementary Material](#).

inclusion criteria, some consistency and control Q were incorporated (Casas Anguita et al., 2003), such as: discipline in which you work (Q3), position you currently hold (Q5), country in which you developed your professional experience (Q10) and

country about which you would answer section 4 (Q24). In addition, the survey included two filters (Casas Anguita et al., 2003). Exclusion criteria were verified in Q11, identifying those respondents who did not know the concepts of OH and AW and leading them directly to the end of the survey. Similarly, Q35 allowed filtering out those who had never heard or read about OW (see Supplementary Files 1 and 2). The questionnaire was accessible from March to May 2023. Before beginning the survey, potential respondents were presented with an informed consent form. To proceed with the study, they needed to accept by clicking the “start” button. Respondents were also informed that survey responses would be anonymous and strictly confidential, reporting research data only in aggregate form.

2.4 Data analysis

The data were initially collated, organized and cleansed by removing incomplete datasets and all data from respondents who did not meet the inclusion and exclusion criteria. However, the latter group was considered to account for the number of respondents who did not know the concepts of OH and AW. Initial data manipulation as well as the construction of visualizations were performed using the tidyverse (Wickham et al., 2019) and lme4 (Bates et al., 2015) packages belonging to the R Core Team (2020), together with the Infostat statistical package (Di Rienzo et al., 2016).

Categorical variables were analyzed using conventional statistical techniques including double-entry tables, Pearson χ^2 and G2 maximum likelihood tests (Conover, 1999). Open answers were studied using ethnographic qualitative analysis procedures such as categorization and coding, combining both rational (a priori) and empirical (a posteriori) mechanisms (Sautu et al., 2005; Sautu, 2007; Souza Minayo, 2009). Specifically, for the “other” option in Q3 (discipline), an initial coding was conducted with the assistance of AI, employing the large language model (LLM) GPT-3 and its interface in R rpgt (Zhao et al., 2023). This was followed by manual verification and validation of the coding. Finally, these responses were categorized into eight classes: “agri-food production”, “applied sciences and engineering”, “human sciences and economics”, “local development and projects”, “non-governmental organizations”, “other biosciences”, “public administration and government”, “wildlife management and care”. Responses to questions Q26, Q33, Q39 and Q40 were manually coded. The perception of the countries’ positioning about AW, mentioned in Q26 option “other”, was categorized according to whether it was positive or negative for the understanding of the importance of AW. It was then subcategorized according to different fields (academic, occupational, society, field practice, public policy, business) and sectors (domestic animals in general, companion animals, farm animals, wild and zoo animals), and concerning changes in habits and consumption. The initiatives mentioned in Q33, intended to identify the type of OH, AW, or both initiatives in which respondents were involved, were classified

based on their scope (local, regional, national, and international) and the domain (public, private, and academic) in which they were developed (Supplementary file 3). Open-ended responses to Q39, aimed at characterizing limitations or obstacles identified for the implementation of the OW framework, were categorized into six classes: “economic/commercial factors”, “socio-cultural factors”, “political factors”, “formative/educational factors”, “communicational factors” and “others”. Open-ended responses to Q40, which represented the respondents’ thoughts on more actions aimed at strengthening the link between AW and OH, were categorized into nine classes: “communication”; “economic”; “education”; “interdiscipline”; “legislation”; “public policies”; “socio-cultural factors”; “research” and “other”. All coding processes were carried out in a “double-blind” approach, since at no time were affiliation elements of the respondents (such as name, surname or institution) loaded into the database (Kornblit, 2007; Redon Pantoja and Angulo Rasco, 2017).

3 Results

After reviewing the initial raw dataset of 1,411 received surveys, a total of 357 surveys were discarded based on the exclusion criteria outlined in Q11, as they lacked knowledge of both AW and OH. In addition to the Q11 exclusion criteria, surveys collected from Q1 to Q10 underwent further refinement, excluding incomplete surveys. A final number of 1054 surveys, with respondents from 22 Latin American countries (at least one respondent per country), were considered for the analysis.

3.1 Demographic information

The demographic characteristics of the 1,054 survey respondents in this study are summarized in Table 3. A relevant 58.3% of respondents were aged between 31 and 50 years (Q1), and the predominant gender self-perception (Q2) was female (61.6%) and male (37.1%). Educational attainment (Q6) showed a majority with undergraduate, graduate and doctoral/postdoctoral degrees. Regarding work experience (Q8), 35.9% reported over 20 years in their fields, with 32.0% having 10–20 years. The majority primarily engaged in the animal domain (54.1%) (Q9) and had professional experience in Argentina (61.7%) (Q10). The number of respondents for each country selected as their professional development location is presented in Table 4 (Q10).

3.2 General knowledge of animal welfare and “One Health”

3.2.1 Knowledge of “One Health” and animal welfare (Q11)

Among the total number of processed surveys (n=1054), a majority of 74.7% were familiar with at least one of the two

TABLE 3 Demographic variables of respondents to a survey on the perception of links between animal welfare and One Health.

Variable	Category	Count	Percentage
(Q1) Age	Under 20 years	6	0.5%
	21–30 years	130	12.3%
	31–40 years	292	27.7%
	41–50 years	323	30.6%
	51–60 years	161	15.3%
	Over 60 years	141	13.5%
(Q2) Gender	Male	391	37.1%
	Female	648	61.6%
	Gender–fluid	3	0.3%
	Non–binary	5	0.5%
	No response	6	0.6%
(Q3) Discipline of Practice	Veterinary Sciences	592	49.7%
	Biological Sciences	299	25.2%
	Medical Sciences	80	6.7%
	Environmental Sciences	76	6.4%
	Bioengineering	7	0.6%
	Anthropology	7	0.6%
	Philosophy	4	0.3%
	Meteorology	1	0.08%
	Other	125	10.42%
(Q4) Field of Work	Research	501	30.18%
	Teaching	425	25.60%
	Private Practice	266	16.02%
	Public Administration	203	12.23%
	Students	117	7.05%
	NGO Workers	85	5.12%
	Other	63	3.80%
(Q6) Level of Education	Secondary	49	4.6%
	Postsecondary	30	2.8%
	Undergraduate	313	29.7%
	Graduate	326	31.0%
	Doctoral/ Postdoctoral	336	31.9%
(Q7) Graduation Year	2000 or before	339	32.19%
	2001–2010	298	28.30%
	2011–2020	300	28.49%
	During/after 2021	116	11.02%

(Continued)

TABLE 3 Continued

Variable	Category	Count	Percentage
(Q8) Years of Expertise	More than 20 years	378	35.9%
	10–20 years	337	32.0%
	5–10 years	180	17.1%
	Less than 5 years	159	15.0%
(Q9) Performance Domain	Animals	571	54%
	Humans	103	9.80%
	Ecosystems	63	6%
	Animals–Humans–Environment	82	7.8%
	Animals–Humans	177	16.8%
	Humans–Environment	101	9.6%
(Q10) Professional development country	Animals–Environment	86	8.20%
	Argentina	650	61.7%
	Brazil	126	12.0%
	Colombia	87	8.2%
	Chile	69	6.6%
	Mexico	64	6.1%
	Other Latin American countries	58	<5%

NGO, Non-Governmental Organization; Q, question.

assessed concepts (OH or AW). A deeper examination revealed that 72.2% of respondents claimed to know both concepts, while the rest mentioned familiarity with only one, with OH being more frequently recognized (94.2%) compared to AW (78%). Respondents familiar with both concepts were predominantly (93.3%) university graduates or individuals with higher levels of education (according to Q6).

3.2.2 Undergraduate and postgraduate education in “One Health” and animal welfare (Q12 and Q13)

In reference to the OH concept education (n=965), 76.5% of the respondents rated their undergraduate education between 0 and 2 (low values), while only 23.5% rated it between 3 and 5 (higher values). For the postgraduate period (n=966), 63.4% of the respondents rated their OH education between 0 and 2, and 36.6% rated it between 3 and 5. Regarding the education in AW (n=789), 59.3% of the respondents rated their undergraduate contents between 0 and 2, while 40.7% rated them between 3 and 5. For the postgraduate education received in AW (n=798), 49.5% of the respondents rated it between 0 and 2, and 50.5% rated it between 3 and 5.

A subset of respondents (91.5%) answered questions designed to assess their understanding of OH and AW.

TABLE 4 Number of responses for each country respondents selected as their professional development location (Q 10).

Country	Frequency	LL CI _{95%ç}	UL CI _{95%ç}
Argentina	650 (49%)	0.463	0.517
Brazil	126 (10%)	0.083	0.117
Colombia	86 (7%)	0.056	0.084
Chile	70 (5%)	0.039	0.061
Mexico	64 (5%)	0.038	0.062
Peru	51 (4%)	0.029	0.051
Uruguay	50 (4%)	0.029	0.051
Paraguay	49 (4%)	0.029	0.051
Ecuador	33 (3%)	0.020	0.040
Venezuela	30 (2%)	0.013	0.027
Bolivia	21 (2%)	0.012	0.028
Cuba	16 (1%)	0.005	0.015
Guatemala	15 (1%)	0.005	0.015
Costa Rica	13 (1%)	0.005	0.015
Panama	12 (1%)	0.004	0.016
Honduras	8 (1%)	0.003	0.017
El Salvador	6 (<1%)	**	**
Nicaragua	5 (<1%)	**	**
Dominican Republic	5 (<1%)	**	**
Belize	2 (<1%)	**	**
Puerto Rico	2 (<1%)	**	**
Other	1 (<1%)	**	**

(**Not amenable to completion due to insufficient sample size).

“Other” indicates respondents who responded for the entire Latin America region.

3.2.3 “One Health” keywords (Q14)

The most chosen keywords as part of the OH concept were “animals”, “humans”, and “ecosystems”, and a high percentage of respondents (80.3%) recognized that all three are part of the definition. “Integration” was the next recognized keyword, with 61.5% of respondents acknowledging that the definition includes these four keywords. “Transdisciplinarity” was added to the definition by 50.5% of respondents, while “collaboration” was included by 42.7%. “Intersectorality” was the least recognized keyword within the definition, with only 35.8% of respondents acknowledging the incorporation of all seven keywords into the comprehensive definition of OH. The score performance for Q14 is shown in Figure 1. In addition, 32 respondents introduced complementary keywords, further enriching the OH concept, which is visualized in Figure 2. Among these complementary words, the most mentioned were “plants” and “communication”. Lastly, a minority (9.4%) of respondents (n=91) indicated they were unsure or did not know the answer.

3.2.4 Animal welfare keywords (Q15)

The keyword most chosen as an essential component within the AW concept was “environmental conditions” (95.7%), followed by “physical state” (91.1%) and “mental state” (85.8%). A high percentage of respondents (82.4%) recognized that all three are part of the definition. The concept of “coping” was recognized in fourth place (31.8%), and only 29.9% of respondents acknowledged all four keywords mentioned as part of the complete definition of AW. The score performance for Q15 is shown in Figure 1. Additionally, 66 respondents proposed complementary terms to enhance the AW definition, with 36 doing so even without having selected any of the four keywords listed in the survey for this definition. The complementary words proposed to be part of the AW definition are shown in Figure 3. Among these complementary words, the most mentioned were “behavior” and “health”, followed by “stress”, “emotional stress” and “management”. Some respondents also included terms used in widely known theoretical frameworks, such as “sentience”, “behavioral need”, “a life worth living”, “5 freedoms”, “resilience”, and “One Welfare”. A small fraction (1.1%, n=11) of respondents indicated “I don’t know” regarding this concept.

Respondents’ scores in previously described Qs (Q14 and Q15) are presented in Figure 1 combined with their answers to the filter question (Q10). The joint depicting facilitates detecting coincident results for those who answered “yes” to being familiarized with the concept of OH (Q10), obtaining higher scores in Q14 (knowledge of OH) than those who answered “no” (W=38013 in the Wilcoxon test with a p-value < 0.0001). Similarly, for question 15 (Q15, knowledge of AW), those who responded “yes” to being familiarized with the concept of AW (Q10) also obtained significantly higher scores (W=21991 in the Wilcoxon test with a p-value < 0.0001).

3.3 Perception of linkages between animal welfare and “One Health”

3.3.1 Linkage of professional activities with “One Health” and animal welfare (Q16)

When asked about the linkage of the respondents’ activities with OH and AW, among 811 responses, 63% considered that their work had some level of connection to both concepts. In addition, 24.7% stated that their work was exclusively associated with OH, while 10.3% reported their work to be only related to AW. A mere 2% of respondents considered their work unrelated to either concept.

3.3.2 Perception of overall linkage between animal welfare and “One Health” (Q17)

When respondents were asked about the linkage between AW and OH, an overwhelming 95.56% expressed that AW and OH mutually benefit each other. Only 1.36% believed they hinder each other, and a mere 0.49% expressed that they are unrelated. Additionally, a small proportion of respondents (2.59%) indicated they were unsure or did not know the answer to this question.

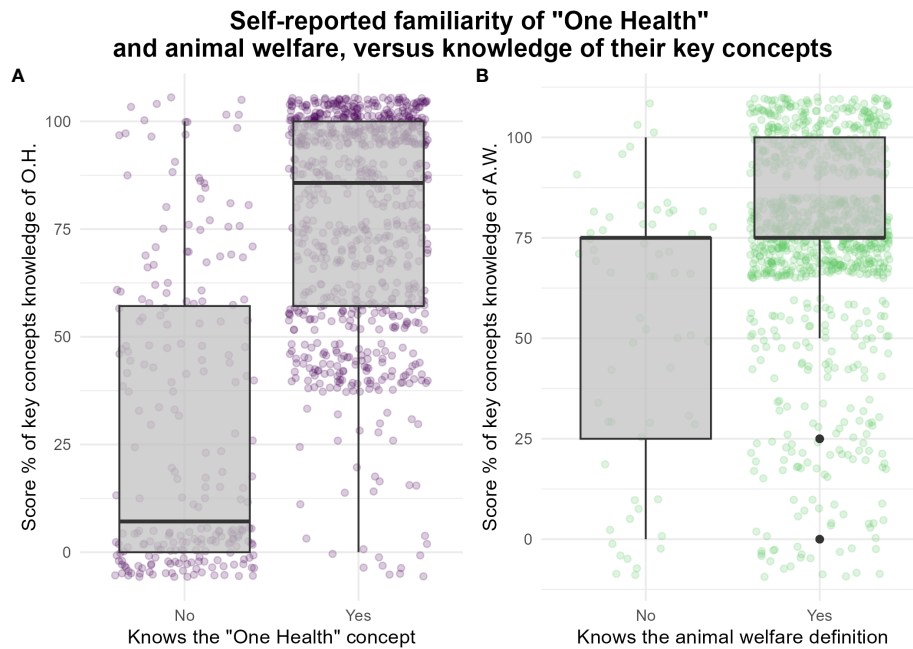


FIGURE 1 Distribution of scores obtained in questions 14 (Q14, panel A) and 15 (Q15, panel B), classified according to whether the respondent affirmed knowledge of the concept of OH and AW (Q11).

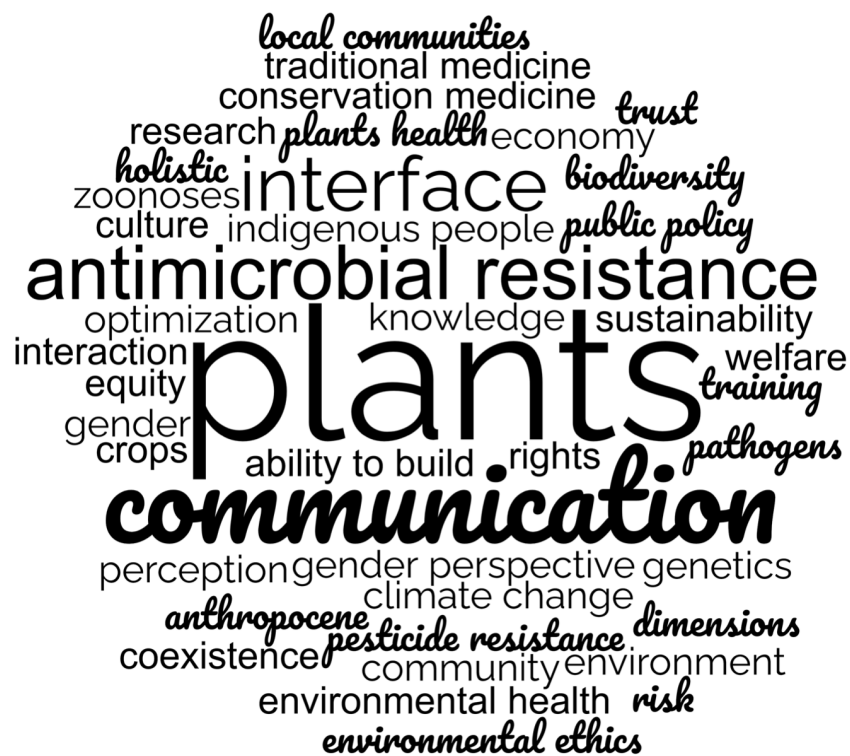


FIGURE 2 Word cloud showing the new keywords respondents proposed as part of the OH definition. The size of each word indicates its relative frequency.

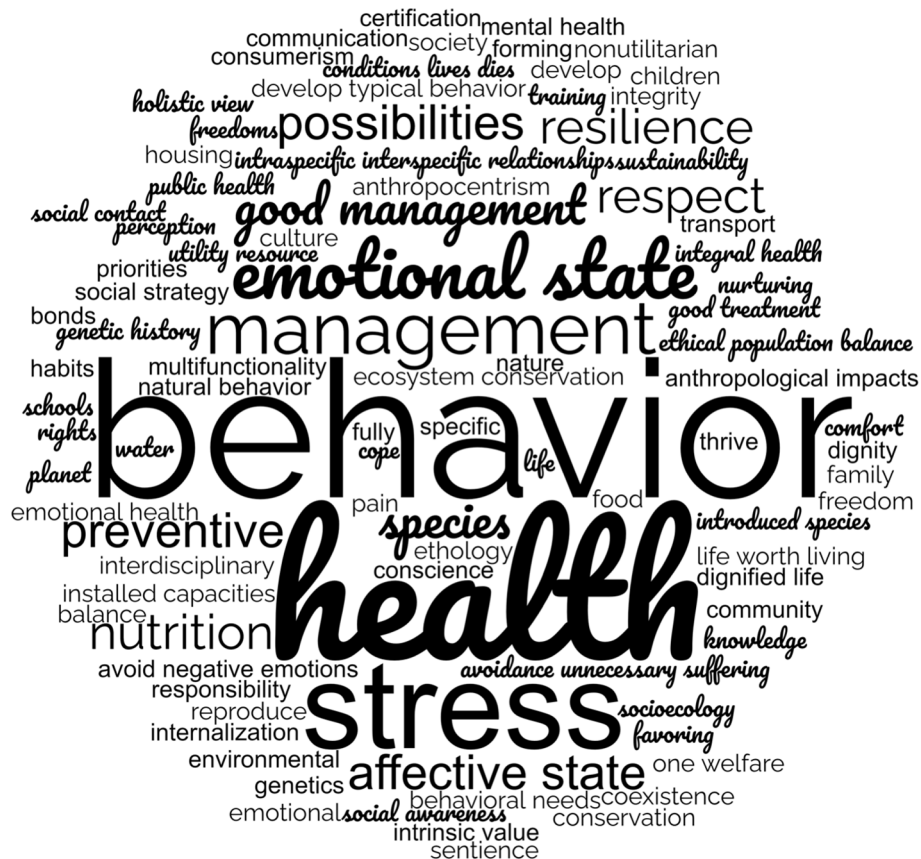


FIGURE 3

Word cloud showing the new keywords respondents proposed as part of the AW definition. The size of each word indicates its relative frequency.

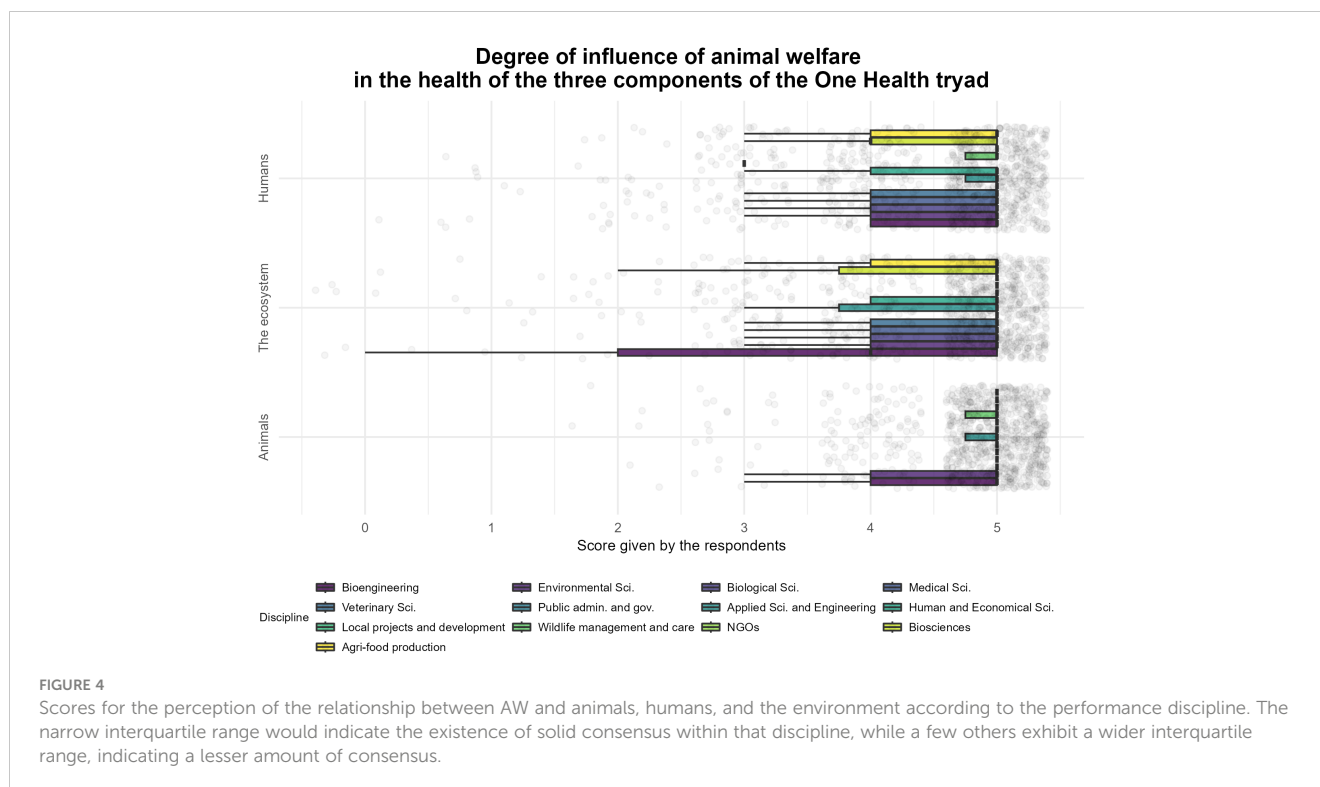
3.3.3 Relationship between disciplines and perceptions (Q3, Q18, Q19, Q20)

We further analyzed the relationship between respondents' professional disciplines and their perception of how AW influences the health of animals, humans, and the environment (Figure 4). Across all performance disciplines, respondents consistently assigned the highest scores to the influence of AW on animal health. Conversely, the environment received the lowest scores. Respondents affiliated with disciplines related to wildlife management and local development projects consistently allocated higher scores to all three items. In a broader analysis, it can be observed that respondents expressed less concern regarding the influence of AW on the health of the environment and humans compared to its influence on animal health.

3.3.4 Perceptions on animal welfare improvements for supporting "One Health" strategies in animals (Q21) and their contribution to "One Health" challenges (Q22)

Respondents' perceptions of the impact of AW improvements on specific animal groups (companion, production, laboratory, work, assisted therapies, captive or free-ranging wildlife) for supporting OH strategies and their beliefs regarding the contribution of AW improvements to addressing various OH

challenges are illustrated in Figure 5. Respondents consistently tended to assign lower scores to war and natural disasters, poverty, malnutrition, and climate change, suggesting AW improvements would have limited relevance in addressing these challenges. In contrast, emerging disease challenges tended to receive the highest ratings and were considered to be effectively addressed by OH strategies. AW improvements in assisted therapy animals and production animals were perceived to have the most significant potential for benefiting OH strategies. In all cases, the mean \pm SEM is indicated. The differences were not significant (Kruskal-Wallis test $H = 0.82592$ with $p\text{-value} > 0.1$). Bringing back questions Q12 and Q13, respondents rated their undergraduate and postgraduate education in OH and AW, allowing us to categorize them by perceiving themselves as having strong (3–5 values) or weak (0–2 values) training in both fields of knowledge. In Figure 5, we depicted the relationship between the perceived training in AW and OH (Q12 and Q13) with Q21 and Q22 to show all four questions (Q12–13–21–22) together in the heat map. As a result, it is clear that the variables war and natural disasters, poverty, malnutrition, and climate change received low scores regardless of the perceived level of education (color tendent to dark green). On the other hand, the highest scores for all variables (major relevance, color tendent to light green) were assigned by those respondents who perceived their education level in OH and AW as very high.



3.3.5 Challenges for animal welfare impact on “One Health” (Q23)

Regarding challenges for AW that can negatively impact OH, 88% of respondents endorsed issues related to inadequate environment, lack of environmental comfort, and suboptimal habitat. Diseases and injuries (86.9%), deficit in water and food availability (85.5%), malnutrition, hunger, and thirst (82.4%), animal abuse (79.8%), persecution and hunting (68.6%), social stress (65.3%), inability to express behavioral needs (57.8%), lack of control over the environment (48.9%), and lack of stimulation and boredom (46.3%) were also identified as critical challenges. Only 2.1% specified “other” issues, while 1.2% explicitly stated that they considered none of the listed problems would have a negative impact on OH.

3.4 Implementation of actions linking animal welfare and “One Health”

Countries that respondents chose as their primary ones for answering this section (in Q24) are presented in [Figure 6](#).

3.4.1 Animal welfare improvement and current perception in Latin America (Q25 and Q26)

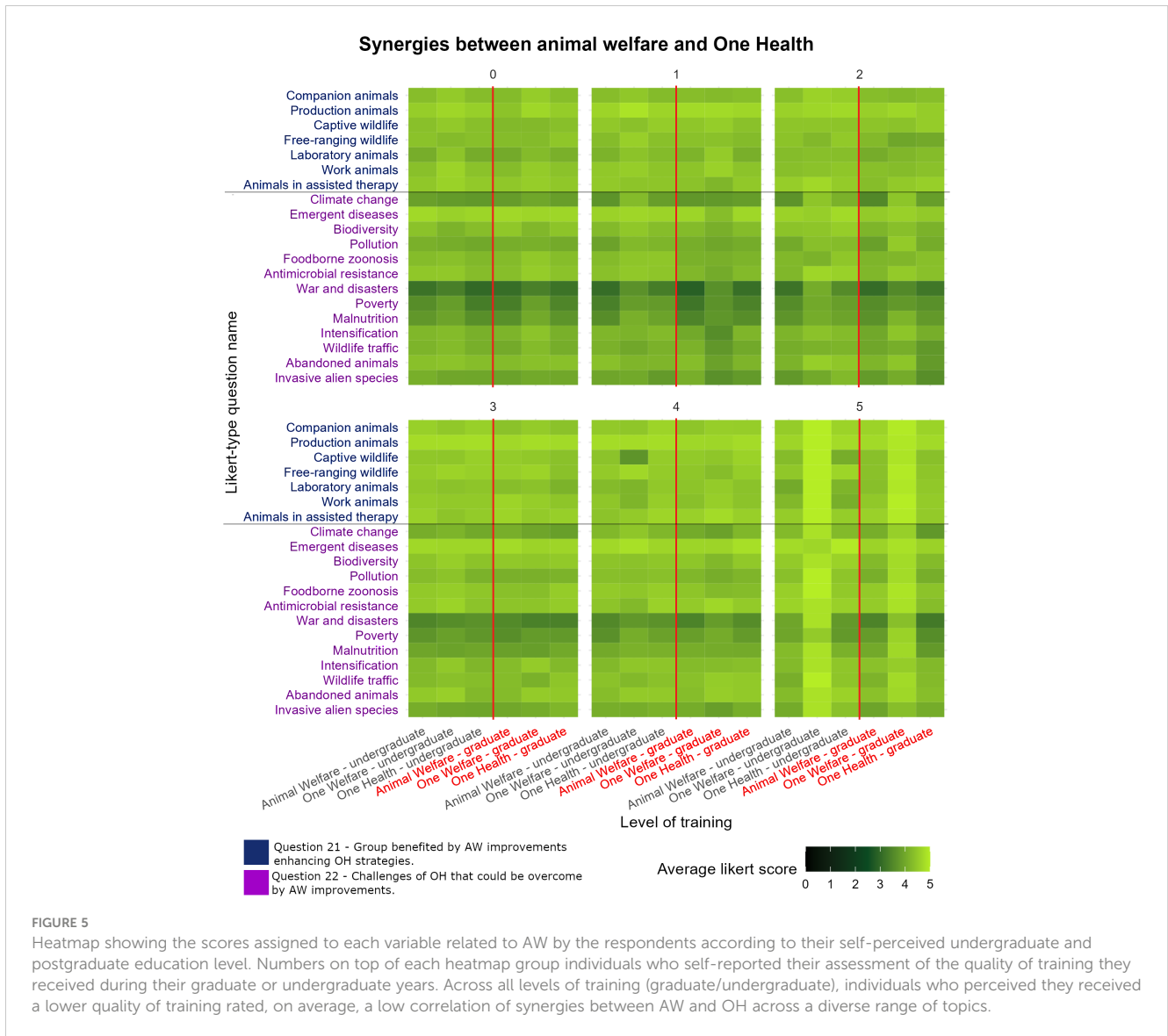
Out of the 739 respondents, over 90% believe that the understanding of the importance of AW has improved in the past ten years (Q25). Specifically, 48.8% consider that the improvement occurred only in specific contexts, 31% believe it has improved in society as a whole, and 14% think it has improved only in academic and professional settings. A significantly smaller percentage of

respondents (4.3%) believe it has not improved, while 1.9% were unsure.

When respondents assessed the status of AW within their own countries (Q26), the two most selected answers indicate there are initiatives in pursuit of AW, but these are not reflected in public policies (27.78%), and AW has improved in academic and work settings, but relevant changes are not seen in the field (18.43%). Analysis revealed no significant variation in these proportions across countries (ML-G2=252.46, DF=232, p-value=0.1701). The summarized results are presented in [Table 5](#). Additionally, 2.44% of respondents chose the “other” option, where they mentioned various interesting issues (presented in detail in [Supplementary File 3](#)). When coding these responses, it was identified that respondents perceive improvements in the understanding of AW importance both in academic and work settings (n=4) and society in general (n=7). In addition, some respondents consider that there is a misunderstanding of what AW is (n=3) or that this does not translate into better practices in the field (n=2).

3.4.2 “One Health” current perception in Latin America (Q27, Q28, Q29)

Perception of how each country is positioned in terms of communication and dissemination of the OH approach is presented in [Table 6](#), considering 735 surveys from 19 Latin American countries. For most (73.7%), the perceptions were scored low, with a mean of two or less. Only six countries were perceived with a mean above two and up to four (Costa Rica, Honduras, Panama, Uruguay, Cuba and Chile), while no country was scored with high mean values above 4. Coincidentally, when the same group (735 cases) was asked to score the application of the OH



approach to their public policies (Q28), the perception was similarly low, with 68.4% of countries scoring mean values below 2, and repeating Costa Rica, Honduras, Panamá, Uruguay, Cuba and Chile with the highest values between 2 and 4. Again, no country was scored with mean values above 4. In relation to the previous question, 70% of the countries stated that the two main sectors running the initiatives were research groups and NGOs, but not government agencies (Q29).

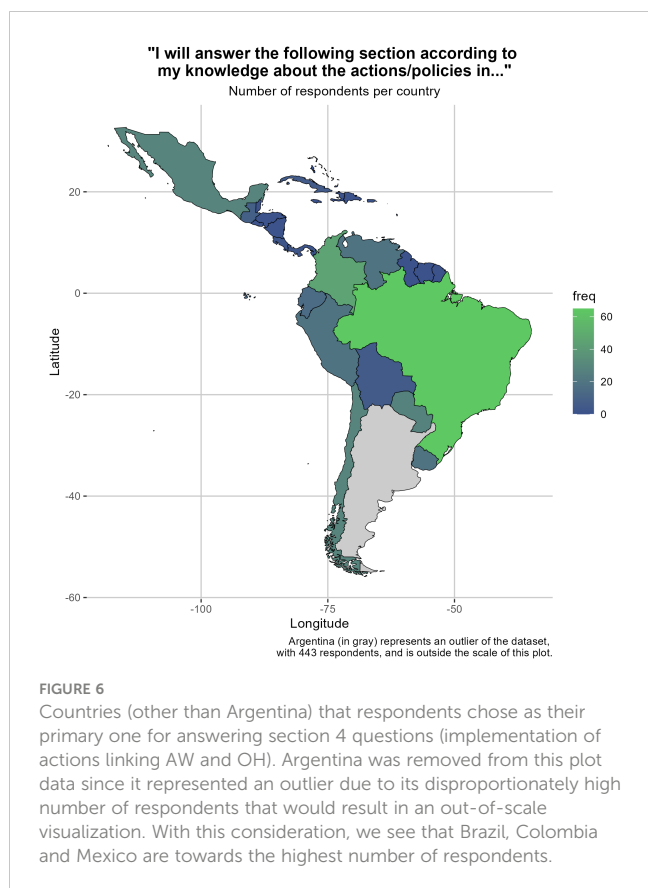
3.4.3 Covid-19 pandemic effect on visualization of “One Health” and its link with animal welfare (Q30 and Q31)

When respondents were asked if the Covid-19 pandemic allowed for the visualization of the OH concept in the selected countries, an accumulated 80% reported some improvement (Figure 7), but only 37% indicated that the Covid-19 pandemic

allowed for the visualization of the relationship between OH and AW (Figure 8). No significant differences were found between countries for either of these questions.

3.4.4 “One Health” and animal welfare initiatives in Latin American countries (Q32, Q33 and Q34)

Respondents were asked if they were currently involved in initiatives related to OH, AW, or initiatives that integrate both. Of the total respondents (n=739), 32.2% reported being involved in AW initiatives, 28% in OH initiatives, and 25.8% in initiatives that link OH and AW. Additionally, 33.7% stated not being involved in any such initiatives. These initiatives were classified according to their scope (local, regional, national, and international) and their sector (public, private, and academic) (Supplementary File 3). A total of 376 individuals responded regarding the scope of the initiatives. Local initiatives were the most frequently reported



(194 initiatives), followed by regional (122 initiatives), national (111 initiatives), and international (12 initiatives). A total of 385 individuals responded regarding the sector of the initiatives. Among the respondents, 48.3% indicated their involvement in public initiatives (including public academic ones), 28.6% in private initiatives (including private academic ones), and 13.2% reported their participation in academic initiatives without specifying whether they were public or private. Furthermore, 9.9% stated their involvement in both public and private initiatives. The total proportion of respondents involved in academic initiatives was 26.5%. Finally, the respondents were queried about their interest in participating in projects integrating OH and AW: 82% expressed a positive interest, nearly 5% responded negatively, and 13% indicated uncertainty.

3.5 "One Welfare" as an integrating framework and end of the questionnaire

3.5.1 Knowledge of "One Welfare" (Q35)

Regarding OW, respondents were asked if they had ever heard or read about this concept. Of the total respondents ($n=734$), a majority responded negatively, with 64.4% indicating that they had not heard or read about the concept. However, a considerable proportion of respondents (35.6%) expressed a positive familiarity with the concept.

TABLE 5 Perceived position for the selected country (Q24) in reference to animal welfare (Q26).

Statement	Percentage (CI95%, Range)
1. The understanding of the importance of animal welfare has improved in academic and work settings, but I do not see relevant changes in practice.	18.43% (CI95%: 16; 21)
2. The understanding of the importance of animal welfare has improved in academic and work settings, which translates into better practices in the field.	13.4% (CI95%: 11; 16)
3. There are initiatives in pursuit of animal welfare, but these are not reflected in public policies.	27.78% (CI95%: 25; 31)
4. The understanding of the importance of animal welfare has improved for a large part of society, but this is not reflected in changes in habits and consumption patterns.	16.13% (CI95%: 13; 18)
5. The understanding of the importance of animal welfare has improved for a large part of society, and this is reflected in changes in habits and consumption patterns.	9.35% (CI95%: 7; 11)
6. There are initiatives in pursuit of animal welfare, which are reflected in public policies.	7.59% (CI95%: 6; 9)
7. No progress or changes of any kind have been made.	2.03% (CI95%: 1; 3)
8. Other.	2.44% (CI95%: 1; 4)
9. I don't know.	2.85% (CI95%: 2; 4)

3.5.2 Undergraduate and postgraduate education in "One Welfare" (Q36 and Q37)

In reference to the undergraduate education received in OW ($n=245$), 78.8% of the respondents rated it between 0 and 2 (low values), while only 21.2% rated it between 3 and 5 (higher values). For the postgraduate education received in OW ($n=221$), 57.5% of the respondents rated it between 0 and 2, and 42.5% rated it between 3 and 5.

3.5.3 Actions to strengthen the connection between animal welfare and "One Health" (Q38)

Based on the survey design, respondents could select multiple options for actions aimed at strengthening the connection between AW and OH (Q38) without exclusivity. This flexibility allowed individuals to choose multiple options with equal priority (Figure 9). The most frequently selected options were those associated with extreme scores (1 and 6). A significant portion of respondents selected all options as top priorities (priority 1), placing particular emphasis on enhancing the curriculum of both undergraduate and postgraduate programs related to AW and OH, and integrating AW and OH concepts within the realm of science and policy implementation. When designating priority 1, respondents consistently emphasized the creation of intersectoral and transdisciplinary research spaces, along with the establishment of new regulatory frameworks or enhancements to existing norms, albeit to a lesser extent.

TABLE 6 Perception of positioning on communication and dissemination of the “One Health” approach, and application of the “One Health” approach to public policies (scale 0–5) – Means and standard deviations by Country.

Country	n	Communication and dissemination of the “One Health” approach				Application of the “One Health” approach to public policies			
		Mean	Standard deviation	LL CI95%	UL CI95%	Mean	Standard deviation	LL CI95%	UL CI95%
Argentina	443	1.77	1.1	1.67	1.87	1.58	1.04	1.48	1.68
Brazil	65	2	1.07	1.73	2.27	1.89	1.04	1.63	2.15
Colombia	45	2	1.09	1.67	2.33	1.91	1.16	1.56	2.26
Chile	29	2.17	0.93	1.82	2.52	2.1	1.18	1.65	2.55
México	29	2	1.16	1.56	2.44	1.97	1.09	1.56	2.38
Paraguay	27	1.77	0.95	1.39	2.15	1.46	0.95	1.08	1.84
Uruguay	19	2.58	1.35	1.93	3.23	2.26	1.37	1.60	2.92
Perú	19	1.68	1	1.20	2.16	1.32	0.75	0.96	1.68
Venezuela	19	1.32	1.06	0.81	1.83	1.26	1.05	0.75	1.77
Ecuador	14	1.5	0.85	1.01	1.99	1.5	0.85	1.01	1.99
Guatemala	8	1.71	1.11	0.78	2.64	1.14	0.9	0.39	1.89
Cuba	5	2.4	1.34	0.74	4.06	3	1.87	0.68	5.32
Bolivia	5	0.75	0.5	0.13	1.37	0.5	0.58	-0.22	1.22
Costa Rica	2	4	1.41	-8.67	16.67	3.5	0.71	-2.88	9.88
Panamá	2	3	1.41	-9.67	15.67	2.5	2.12	-16.55	21.55
Honduras	1	**	**	**	**	3	**	**	**
Nicaragua	1	**	**	**	**	1	**	**	**
Puerto Rico	1	**	**	**	**	0	**	**	**
El Salvador	1	**	**	**	**	0	**	**	**

**The population proportion estimate is insufficient to construct a reliable confidence interval due to the low sample size.

3.5.4 Constraints and challenges in implementing the “One Welfare” framework (Q39)

Consistently with the options prioritized in the previous paragraph, the primary constraints, gaps, and obstacles identified concerning the implementation of the OW integrative framework were most frequently linked to political factors (51.2%) and formative factors (44.8%), followed by economic factors (34.8%). Issues related to communication factors (21.7%) or socio-cultural factors (19.6%) also surfaced as notable challenges. Furthermore, respondents indicated a minor range of other factors that could impact OW framework implementation, summarized in [Supplementary File 3](#).

3.5.6 Actions to strengthen the animal welfare and “One Health” link (Q40)

Finally, 263 respondents proposed 409 actions aimed at strengthening the link between AW and OH (Q40), with education (27.4%) at different levels and groups being the most selected (see [Supplementary file 3](#)). Communication was another action identified (21.8%) to widely disseminate the topic both through social networks and media as well as citizen science and awareness raising. Actions related to public policies (8.8%) and addressing socio-cultural issues (7.1%) were also identified,

followed by the development or improvement of legislative frameworks, their implementation and control, and sanctions for non-compliance (6.1%). Joint work between various disciplines, whether with actions to strengthen multidisciplinary, interdisciplinary or transdisciplinary work, was mentioned in 5.4% of the answers, followed by actions to obtain economic resources, incentives and awards (4.9%) and actions to strengthen research (4.4%). The remaining 14.1% were in the “other” category.

4 Discussion

4.1 Demographic information

Most respondents were female, aged between 41 and 50, and held positions as veterinarians and biologists, primarily in research and education. The 41–50 age group exhibited the highest response rate, which may coincide with the generation that was exposed to the incorporation of the OH approach in most Latin American countries (Cassidy et al., 2015). This generation could have been introduced to OH-related concepts during their undergraduate or postgraduate education.

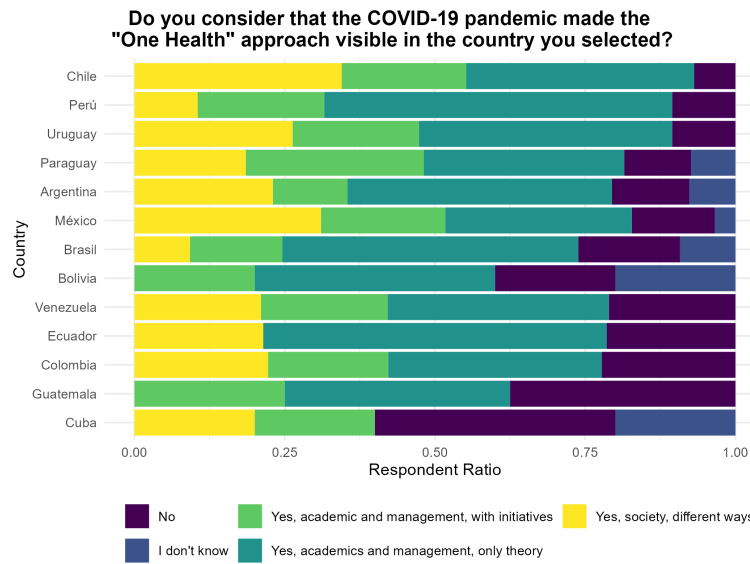


FIGURE 7 Ratio of responses obtained by country to the question of whether the COVID-19 pandemic allowed for the visualization of the OH concept. Countries are sorted by increasing proportion of “No” respondents. Countries that had low representativity ($n \leq 4$) might not reflect the real opinion of the target population and were therefore removed. These include: Costa Rica, El Salvador, Honduras, Panamá, Nicaragua, Puerto Rico and “Others”.

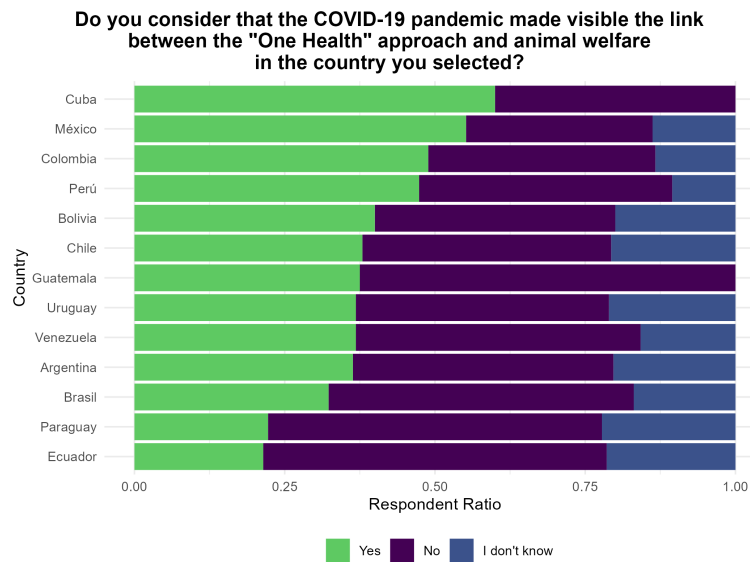
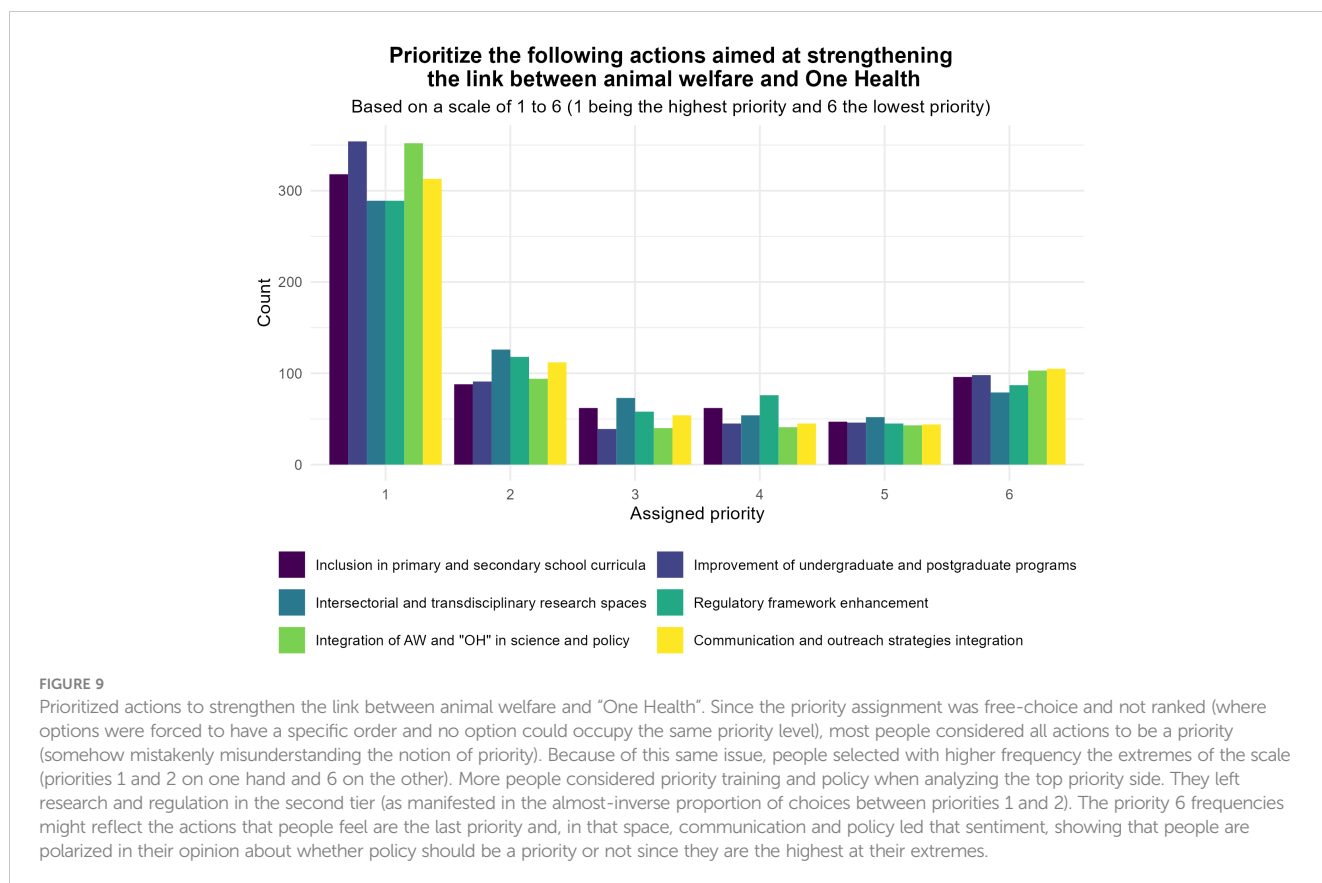


FIGURE 8 Ratio of responses obtained by country to the question of whether the COVID-19 pandemic allowed for the visualization of the relationship between the OH concept and AW. Countries are sorted by decreasing proportion of “Yes” respondents. Overall, there is no homogeneous opinion on whether the pandemic made this phenomenon more visible. Countries with low representativity ($n \leq 4$) might not reflect the real opinion of the target population and were therefore removed. These include Costa Rica, El Salvador, Honduras, Panamá, Nicaragua, Puerto Rico and “Others”.

The survey was distributed to obtain an equal number of responses from disciplines related to the three components of OH (animals, humans, and the environment). However, veterinarians were the majority of respondents, followed by biologists. This phenomenon was also observed in previous studies (E.g., Chiesa et al., 2021) and may be attributed to the historical promotion of the OH approach by professionals in animal health and public health

(Zinsstag et al., 2015). Additionally, the occupational background of the authors (all veterinarians) may have influenced the higher response rate among colleagues in the same field (possible bias and other limitations of this study will be discussed in more detail in a separate section at the end of the Discussion). Despite this limitation, it is essential to highlight that an interesting proportion of respondents had more than 20 years of experience in their field of work (35.9%).



Regarding professional domains, most respondents identified themselves as researchers and educators, with significantly low participation of respondents from the government sector. This scenario was also evident in previous works (Chiesa et al., 2021; Li et al., 2023). This absence gains particular relevance when we consider the results of Q39, which identified significant constraints in implementing the OH integrative framework, with political factors ranking highest at 51.2%. These political factors encompassed key issues such as "lack of commitment," "management articulation," "regulations," "conflict of interest," and "absence of public policies." This convergence of findings underscores a critical gap: while professionals in research and education exhibit deep involvement, governmental participation and commitment, despite their crucial role, are conspicuously lacking. The prevalence of political factors, especially the "absence of public policies," emphasizes the urgent need for increased government engagement in promoting and implementing OH and AW policies, bridging the gap between professionals in the field and effective governmental action to address the identified challenges.

Similar to the evidence provided by Chiesa et al. (2021), the survey responses reflect an unbalanced focus on the components of the Animal-Environment-People triad, with a predominant interest in the animal-human relationship. However, the environmental component, which is crucial, appears to be overlooked. This finding suggests a need for greater attention and awareness regarding the importance of the environmental aspect

within the OH and AW framework. Efforts should be made to promote a more balanced approach incorporating the environmental dimension. As shown later, in the answers to section 5 (Q38 and Q40), this can involve raising awareness, providing education and training, and encouraging interdisciplinary collaboration to ensure a comprehensive and holistic approach to OH and AW initiatives.

4.2 General knowledge of animal welfare and "One Health"

Education and training are vital tools for addressing challenges associated with AW and OH (Stafford and Mellor, 2009; OIE – World Organisation for Animal Health, 2013; Kagan et al., 2015; Sinclair and Phillips, 2019) and for devising strategies aimed at disease prevention, which can impact the well-being of individuals, animals, and the environment (OIE – World Organisation for Animal Health, 2013; Gibbs, 2014; Haxton et al., 2015; Rabinowitz et al., 2017; Villanueva-Cabezas et al., 2022). Our study has unveiled a substantial gap in the undergraduate education of most respondents within the OH and AW domains, as evidenced by their comparatively lower ratings. The results suggest that a significant proportion of the respondents perceive their undergraduate education in these fields as not meeting their expected educational standards, with this dissatisfaction being even greater for OH. A similar trend was observed in postgraduate

education. However, it is noteworthy that a significant segment of respondents perceived a higher quality in their postgraduate education than their undergraduate education in these domains, highlighting the current significance of specialized postgraduate studies in Latin America. At least concerning veterinary education, these results contrast with those reported by [Stafford and Mellor \(2009\)](#). These researchers found that in 69% of the 78 WOA Member Countries that participated in a survey, veterinary schools or other institutions covered AW training at the undergraduate level as part of other subjects, as specific courses in 51%, and as graduate degrees in 37% of the countries surveyed. While this has been further explored in the literature from human and veterinary medicine perspective ([OIE – World Organisation for Animal Health, 2013](#); [Gibbs, 2014](#); [Haxton et al., 2015](#); [Rabinowitz et al., 2017](#); [Villanueva-Cabezas et al., 2022](#)), our findings reveal that the inclusion of AW and OH approaches in university curricula emerges as a critical strategy to enhance understanding of health and well-being and their cross-disciplinary application across all fields (see discussion in Section 4.5).

Our results also provide insights into the respondents' perceptions of the concepts of OH and AW. Regarding the first, the majority of respondents recognized each component of the triad that comprises the original OH definition (“animals,” “humans,” and “ecosystems”) ([WHO, 2021](#)). “Integration” was also acknowledged by a significant proportion of respondents, echoing the literature regarding interdisciplinary approaches within the framework of OH ([Pettan-Brewer et al., 2021](#); [Prata et al., 2022](#)). However, there was less recognition of keywords such as “transdisciplinarity”, “collaboration”, and “intersectorality” (35.8%). These concepts could be nuanced and may not be as widely understood as fundamental elements of OH. While our findings revealed a reduced level of recognition for these keywords, we acknowledge that further investigations are warranted to ascertain whether a lack of understanding or other factors influenced these responses. At the same time, among the keywords mentioned as complementary to the seven proposed, “communication” was the second most cited. This was also reflected in the answers to Q38 and Q40, where communication reappears as one of the essential strategies for strengthening the link between AW and OH. This deserves to be highlighted, given that communication has been reported as one of the main challenges of transdiscipline, essential to enable collaboration and intersectorality ([Fraude et al., 2021](#); [Lawrence et al., 2022](#)). Consequently, the World Health Organization (WHO), the Food and Agriculture Organization (FAO) and the World Organization for Animal Health (OIE) have recognized that addressing health risks at the interfaces between humans, animals, and ecosystems requires strong partnerships among stakeholders who may have different perspectives on certain issues and varying levels of resources. In this vein, in 2010 they defined OH 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 ([WHO et al., 2010](#); [FAO et al., 2019](#)). Within the framework of the COVID-19 pandemic, together with the United Nations Environment Program (UNEP), the tripartite group redefined OH from their advisory panel, the “One Health” High Level Expert Panel (OHHLEP), whose members represent a broad range of disciplines in science and policy-related sectors relevant to OH from around the world. The new definition developed by the OHHLEP states: “One Health” is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent. The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development” ([WHO, 2021](#)). The new definitions of OH ([OHHLEP-FAO, 2021](#)) emphasize the importance of incorporating these additional dimensions into the approach.

Within the context of the AW concept, fewer than 30% of the respondents recognized all four keywords as integral components of the comprehensive AW definition. Respondents favored “environmental conditions” as the most salient keyword, garnering the highest recognition, surpassing both “physical state” and “mental state,” which followed in order of significance. This preference is noteworthy given that AW, by definition, encompasses a state ([Broom, 1991](#); [WOAH, 2022](#)). Surprisingly, “mental state” ranked third in recognition, despite being a central component in several AW definitions ([Duncan, 1996](#); [Duncan, 2002](#); [WOAH, 2022](#)) and theoretical models ([Mellor et al., 2020](#)). Also, based on the definition of AW proposed by [Broom \(1986\)](#), it is unexpected that “to cope” was the least considered among the keywords. While respondents could recognize the keywords of the definition to varying degrees, the survey unveiled diverse responses. This could indicate that the definition of AW is not yet comprehensively understood, and it is primarily associated with the environment, overlooking the importance of an organism's capabilities to cope with diverse circumstances, which is closely linked to its physical and mental state ([Broom, 1986](#)). However, when analyzing these data in context, it turns out that 24.7% of the respondents stated that their work was exclusively associated with OH, which could explain the lower performance in selecting keywords for the definition of AW. Further research is needed to determine the factors that may have influenced this low performance.

The data analysis in “other” reveals intriguing insights into the concepts OH and AW, emphasizing the complexity and diversity of perspectives associated with these domains. Notably, the set of complementary keywords introduces several dimensions, incorporating additional key aspects that enrich and expand our understanding of these domains. Also, the number of respondents who suggested complementary keywords for the definition of AW doubled the number for OH. While this requires further analysis, it may indicate that the definition of AW could be expanded in the

future, as has recently been the case for OH (OHHLEP-FAO, 2021). These findings underscore the dynamic nature of OH and AW concepts (Ohl and van der Staay, 2012; Mackenzie and Jeggo, 2019; Prata et al., 2022), hinting at a trend toward consolidating a unified definition as this expansion broadens the scope of each concept. The inclusion of diverse perspectives further emphasizes the necessity of adopting comprehensive and inclusive approaches to address the complex challenges and issues related to human, animal, and environmental well-being.

4.3 Perception of linkages between animal welfare and “One Health”

The evaluation and analysis of environmental factors and the understanding of organism ecology are crucial for modeling and predicting threats and risks to human and animal health, contributing significantly to OH surveillance (Leifels et al., 2022). Furthermore, there is new evidence of an evolution in thinking and an awareness that AW directly and indirectly impacts many dimensions of human and environmental health and social well-being beyond the animal component itself (Garcia Pinillos, 2017). When examining responses primarily from veterinarians (592 cases) and biologists (299 cases), it becomes evident that over 60% perceive their work as effectively intertwined with OH and AW. Remarkably, more than 95% acknowledge a substantial interconnection between AW and OH, resulting in mutual benefits for these two domains. However, for disciplines unrelated to wildlife management, the conceptualization of the impact of AW within the animal–human–environment triad tends to favor the animal component. This aligns with Chiesa et al. (2021), who noted a tendency to primarily address the human–animal component as “classic zoonoses,” emphasizing their prevention, control, and surveillance. In our study, when respondents were asked to indicate the extent to which AW improvements contribute to addressing the listed OH challenges, emerging diseases received the highest scores. However, climate change, pollution, toxic agents, and socio-environmental aspects received lower scores, potentially biased due to the underrepresentation of certain disciplines, especially social ones, in our study. The lowest scores were assigned to war and natural disasters, poverty and malnutrition, suggesting that there is still no comprehensive understanding of how to link the mitigation of these challenges with improvements in AW.

Both definitions of OH and AW underscore the fundamental role of the environmental component (Broom, 1986; OHHLEP-FAO, 2021; WHO, 2021; WOA, 2022). As exemplified by the ongoing COVID-19 pandemic, it becomes evident that the impact of an infection on health can be significantly influenced by various environmental factors (Kreutz et al., 2023). This underscores the imperative to interpret and evaluate the intricate interplay between an infectious agent and concurrent determinants associated with the physical and social environment. In alignment with the insights provided by Humboldt-Dachroeden and Mantovani (2021),

humans and animals are inherently interconnected across diverse environments, emphasizing the need to incorporate environmental perspectives. This can be achieved through expert involvement, applying techniques to assess environmental factors, and sharing relevant data. Consequently, the environmental pillar emerges as an integrative and unifying thread that benefits and interconnects both OH and AW concepts, underscoring the need to prioritize efforts on this component for effectively addressing emerging challenges.

4.4 Implementation of actions linking animal welfare and “One Health”

According to our study, there is a broad consensus among the surveyed Latin American countries that the importance of AW has improved overall in the past ten years. However, a high proportion of respondents (over 60%) believe these changes are not currently reflected in habits, consumption patterns, or public policies. The perception of how their countries communicate and apply OH concepts to public policies is very poor, highlighting the need for further improvement in this field. Consistently, respondents indicate that research projects or NGOs mainly drive these policies, while government agencies are rarely identified as promoters of AW/OH policies. This result suggests a perceived absence of government involvement in incorporating AW and OH topics into daily life, indicating a disconnection between theory and practice in some cases.

Linking this apparent dissociation with the appropriation of new concepts we observed when respondents proposed new terms for the definitions of OH and AW (see Section 3.2 referring to Q14 and Q15), we could infer that respondents harbor enthusiasm and positivity toward integrating AW and OH. Future investigations could explore whether this positive attitude could be harnessed to support public policies or official initiatives driven by government agencies.

Lastly, the COVID-19 pandemic has brought about changes in public perception of health, zoonoses, and the trade of animals (Shi et al., 2020). However, from our results, we can conclude that while the concept of OH has become more evident for the majority of respondents, the relationship between OH and AW has not been affected in the same way. Knowledge and people’s perceptions of diseases significantly impact their willingness to adopt behaviors that help prevent and reduce disease transmission (Lee et al., 2020). The OH approach is not just focused on zoonotic disease. However, it can address the full spectrum from prevention, health improvement, and health promotion to the detection, preparedness, response, and recovery from health crises (OHHLEP-FAO, 2021). The dissemination of the OH approach can be seen as a first step that will contribute to improving the approaches to these complex issues and preventing future pandemics. However, the connection with AW is essential, especially when addressing the issues of emerging diseases from their origins (Akhtar, 2013; Molento, 2014; Magouras et al., 2020). Efforts to incorporate the links between both approaches must be sustained and widespread.

4.5 “One Welfare” as an integrating framework and end of the questionnaire

Our findings reveal a disparity in awareness and educational experiences related to the OW concept. The majority of respondents demonstrated a lack of familiarity with the OW framework. Among those familiar with the concept, the evaluation of undergraduate and postgraduate education in OW revealed varying perceptions based on when they had undertaken these studies. For instance, most respondents rated their undergraduate education in OW as inadequate, indicating a lack of integrating OW principles into undergraduate curricula, even recently. While OH and AW concepts have been established for over two decades (Broom, 2011; Kahn et al., 2012), the OW approach is relatively new (Pinillos et al., 2016), and our results suggest that it tends to be more frequently addressed in postgraduate studies. A higher proportion of respondents expressed satisfaction with their postgraduate education in OW, suggesting a more positive experience and potential for deeper engagement in the field. This result implies that such approaches are often incorporated into undergraduate university programs after gaining acceptance among professionals, following their establishment through postgraduate courses. The main educational gaps identified for OW implementation included a need for more comprehensive training for teachers and students in these areas, reflecting that AW and OH are only recently being formally incorporated into Latin American education. Addressing the awareness gap and improving educational opportunities can promote the integration of OW principles. This study also emphasized incorporating AW and OH concepts within the scientific community, which could improve the application of these approaches in practice. To this end, introducing the OW concept into the research community has the advantage of helping identify mutually beneficial outcomes between animal, human, and environmental health through the introduction of the key search term OW (Pinillos et al., 2016).

As Colonius and Earley (2013) asserted, the integration of OW approaches could foster collaboration among related disciplines, promote action, and stimulate civic engagement, which was also identified as a priority. These approaches need to transcend disciplinary and academic frameworks and become recognized by society at large. Considering that political factors were also identified as significant barriers to OW implementation, improving OW education should not only focus on closely related disciplines but also on profiles associated with public regulations, policymakers, and government agencies. It should involve the entire community, facilitating collaboration, learning, and exchange based on inclusivity, equity, and access (OHHLEP-FAO, 2021). As emphasized in the new OH definition, these approaches will make it easier for people to understand better collateral benefits, risks, trade-offs, and opportunities to promote equitable and holistic solutions. Interprofessional education is recognized, indeed, as an essential element of successful transdisciplinary collaborative practice, noting that just working with others in particular scenarios or temporary teams is not enough to build an effective

collaborative workforce (Squance et al., 2021) with long-term perspectives, as learned during the recent pandemic COVID-19.

Lastly, implementing policies and creating new or improved regulatory frameworks were also recognized as priorities to strengthen the connection between AW and OH. In this regard, the implementation of the OW framework would empower the AW and OH fields to address the connections between science and policies more effectively in various areas of human society, including environmental sciences and sustainability (García Pinillos et al., 2016).

4.6 Limitations of the study

It is crucial to acknowledge the limitations of this study when assessing and contextualizing our findings. One of the primary limitations encountered was the uneven geographical representation within our sample. We observed a significant disparity in participation from various Latin American countries, with some being highly represented while others had minimal or no representation at all. This imbalance hindered the execution of specific country-level comparative analyses and limited our ability to extrapolate findings to a regional level. Furthermore, a noticeable discrepancy was observed in the representation of academic disciplines and professions among our respondents. While the fields of biological sciences and veterinary sciences were well represented, others, such as medical and environmental sciences and human and economic sciences, were underrepresented. The limited representation of respondents from disciplines related to the environmental component of the OH triad could be a limitation of this study. However, it also reflects the historical development of OH in Latin America. This unequal composition may have introduced a bias toward a perspective centered on biology and veterinary science, potentially hindering a comprehensive understanding of the interconnection between human, animal, and environmental health. Conducting a follow-up survey with targeted sampling to obtain more respondents from ecosystem-related fields and a deeper appreciation of this component would be of interest. These limitations emphasize the need for future interdisciplinary research efforts to address these disparities and facilitate a more holistic and equitable understanding of the interplay between AW and the OH approach in the Latin American region.

4.7 Further considerations

Exploring the links between OH and AW has sparked a debate regarding the inclusion of one within the other. On the one hand, the OH approach, mainly through its new definition (OHHLEP-FAO, 2021), incorporates AW as a fundamental part of the framework. Among the key underlying principles that have been raised, there is a mention of human stewardship and responsibility to change behavior and adopt sustainable solutions that recognize the importance of AW and the integrity of the entire ecosystem,

thus ensuring the well-being of current and future generations. In this sense, it could be understood that OH encompasses AW. However, AW goes a step further by proposing that health is only one of the five domains that compose it and that, either directly or indirectly, attending to each of these domains supports improvements not only to animal welfare but also to human well-being and environmental sustainability. Recognizing this close relationship between AW and global health urges us to consider welfare as an essential element in all public health initiatives and OH approaches. Moreover, it highlights the need to actively promote the care and protection of animals as a fundamental basis for ensuring a healthy and sustainable society.

The OW framework (García Pinillos et al., 2016) is an integrative and novel approach that allows highlighting and enhancing the links between AW and OH. Tarazona et al. (2020) discuss how, in a global context where human actions are damaging much of the world's life, it is essential to remember that the basic concepts of biology, welfare and health are the same for humans and all other living beings. Increased awareness of these issues opens the door to new paradigms. The concepts of OH and OW are now widely accepted and used (Jordan and Lem, 2014). In addition, they have recently been joined by “one biology”. This new approach implies that the biological principles are the same for humans and other animals, although there are species-specific and ontogenetic differences. Understanding the concepts of OH, OW and “one biology” and their application to everyday decisions about production systems, public policies, markets and consumers could help mitigate negative anthropogenic impacts on health, welfare, biodiversity and environmental sustainability (Tarazona et al., 2020).

5 Conclusion

In this study, we explored the perceptions and experiences of individuals working in disciplines related to AW and OH in Latin America. Our findings revealed that both concepts are currently experiencing a period of expansion in the region. However, it was evident that the interconnections between AW and OH are not widely recognized. While the concept of AW is being extensively addressed, with high frequency and from various educational perspectives, the OH approach appears to have gained significant traction in the last decade. The global COVID-19 pandemic has further highlighted the importance of the OH approach, positioning it as a crucial strategy for ensuring global health. Interestingly, most actions and initiatives linking AW and OH in the region seem to originate from academic sectors and NGOs. This finding underscores the lack of robust public policies that can effectively transform these initiatives into sustained state policies and generate long-term sustainable strategies, which may be shared across the countries explored. Therefore, there is a clear need for increased awareness and recognition of the interdependence between AW and OH within the scientific community and among policymakers.

Our study highlights the need to further explore and clarify the relationship between OH and AW, emphasizing the integration of

animal welfare as a prerequisite for overall health within the OH framework. This understanding has implications for policy development, educational programs, and collaborative efforts to promote the well-being of animals, humans, and the environment. By acknowledging and addressing the interdependencies between OH and AW, comprehensive and sustainable approaches can be developed to effectively address global health challenges and ensure the welfare of all living beings. In that sense, the OW framework seems to be the most easily applicable to put theory into practice. Developing comprehensive and integrated policies that bridge these two fields is essential for addressing complex health challenges and promoting the well-being of both animals and humans. Further research and collaborative efforts are warranted to drive the translation of these concepts into practical and impactful actions.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Materials. Further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Prof. Dr. J.P. Garrahan Hospital Research Ethics and Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

DR, GW and MO designed the research, developed the survey, wrote the original manuscript, and reviewed the final manuscript contributing equally. AS coordinated online survey implementation, data monitoring and assisted in manuscript writing. CB and LG assisted with the data processing, statistics and image/figure design and assisted in manuscript writing. All authors corrected and approved the submitted version of the written manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fanim.2023.1242917/full#supplementary-material>

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