Promoting Healthy, Resilient, and Sustainable Development at the Individual, Family, and Community levels: A Systematic Review and Meta-Analysis of Human-Animal Interactions

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November 7, 2022

Acknowledgement:

Promoting Healthy, Resilient, and Sustainable Development at the Individual, Family, and Community levels: A Systematic Review and Meta-Analysis of Human-Animal Interactions is co-funded by the Social Sciences and Humanities Research Council and Employment and Social Development Canada.

Promouvoir un développement sain, résilient et durable de l'individuel, de la famille et de la collectivité: une revue et méta-analyse systématiques des interactions homme-animalest cofinancé par le Conseil de recherches en sciences humaines et Emploi et développement social Canada.

The authors would like to show their gratitude to the research assistants: Jessica Neal, Mandy Yung, Daniel Villarreal Hernandez, and Lama Farhat from Dalhousie University and Xiao-Lu (Sandya) Zhang from the University of British Columbia for their support.

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Executive summary

Background

Human-animal interactions (HAIs) are essential in core societal functioning. The global public health emergency of COVID-19 has shed light on the HAI's powerful agent in reducing loneliness and social isolation by stimulating individual and collective pro-societal human-environment interplay, demonstrated by a dramatic increase in animal guardianships worldwide. Despite recognized tangible benefits, there is a distinct systematic review and analysis deficit of HAI knowledge, jeopardizing HAI-specific knowledge mobilization and further weakening the advancement of related practice and policy to address complex societal issues during COVID-19 broadly and beyond.

Objectives

Positioned in a rapidly changing Canadian and worldwide socio-economic landscape, this project aims to critically identify HAI-specific social and health benefits that potentially could enhance the existing and prospective practices and policies of reducing asocial behaviours and other issues at the individual, family, and community levels, ultimately building healthy, resilient, and sustainable societies. The objectives are: (1) to systematically examine HAI-specific knowledge, strategies, and outcomes toward coping with various social and health challenges engaged in at the individual, family, and community level; (2) to comprehensively catalogue HAI-specific research merits and demerits, to advance HAI-driven cross-sectoral investigation; and (3) to effectively promote HAI-informed cross-sectoral practice and policy decision-making through encouraging evidence-based knowledge translation and mobilization in Canada and beyond.

Results

At the individual level, HAI's health and social benefits have been extensively researched worldwide, including physical and mental health, overall well-being, early childhood development, disaster response and mitigation, and an enhanced sense of responsibility and vocational skills, especially for vulnerable and marginalized groups (e.g., children and youth, older adults, persons with (dis)Abilities, the homeless, veterans, and incarcerated persons).

At the family level, HAI contributes to uniting family members, strengthening family structure, and promoting overall well-being among family members (particularly for military families). Family-specific social support and mental health benefits of HAI were significantly

emphasized during COVID-19. Family-level HAI can act as a bridge or intermediary between individuals and communities.

At the community level, HAI can create strong, connected communities by stimulating social interaction among community members, encouraging individual social engagement in community development, and reshaping the community-built environment. Community-level HAI is aligned with the One Health framework, focusing on the interconnections among humans, animals, and environments. Alongside HAI and animal-assisted interventions (AAI), One Health enhances individual and collective health and well-being, creating more robust, resilient, and sustainable communities on a larger scale.

Key messages

Future research should extend the investigation of HAI from companion and service animals to other animals (e.g., industry animals, laboratory animals, and wildlife) and from major vulnerable and marginalized groups to other underrepresented groups (e.g., adolescents and adults with autism spectrum disorder).

Animal-friendly facilities must be included in applicable government policies because of the magnitude of HAI benefits. Social service policy should consider animal-friendly health and care organizations (e.g., homeless and violence shelters) to support vulnerable and marginalized populations with companion animals.

Since HAI benefits have been internationally recognized, public health and other policy/decision-makers should consider HAI interventions in their pandemic-related practice and policy regarding pandemic recovery to increase resilience and sustainability at the individual, family, and community levels.

Methodology

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach was employed to guide this systematic literature review project. Multi-keyword and multi-dataset searching identified the initial literature pool of 2436 publications. Inclusion and exclusion criteria were developed in accordance with research objectives to evaluate each literature candidate's eligibility through (1) title and abstract screening and (2) full-text review, yielding a total of 240 publications for final analysis. A mixed-method analysis approach, namely quantitative (univariate analysis) and qualitative (thematic inquiry), was utilized to identify findings and synthesize the results into recommendations.

Full Report

Background

Human-animal interactions (HAIs) (or human-animal relationships/bonds) play an essential role in the operation of core societal functioning (e.g., healthcare, food security, and recreation) (Salter & Harvey, 2014). Since all the societal dimensions (e.g., biological, physical, social, and economic environments) collectively affect human health and well-being, and animals are essential across these domains (Pinillos, 2018), HAI supports healthy individual, family, and community development. Historically, a range of HAI social and health contributions (e.g., research, practice, and policymaking) toward the improvement of individual, family, and community social development has been identified in various fields, including disaster and emergency management (DeYoung & Farmer, 2021) communication (Hooper et al., 2021), planning (Sepulveda et al., 2014), psychology (Rhoades et al., 2015), social work (Wu et al., 2021), and sociology (Irvine, 2013). Specifically, therapeutic and assistance-based HAIs have been considered a cost-effective strategy endorsed by human healthcare and social service providers worldwide to fulfill different patients' and service users' requirements (Nimer & Lundahl, 2017; Villalobos, 2019).

Additionally, the broader scope of HAI health and social benefits generated through companionship promotes overall human well-being, including psychological wellness (Herzog, 2011), recovery from serious illness (Wisdom et al., 2019), family relationships (Walsh, 2009), end-of-life care (Banks et al., 2008), a lifeline for vulnerable populations (Irvine, 2013), and food safety and nutrition (Fisher et al., 2012). These profitable HAI outcomes have stimulated the establishment of the 'One Welfare' approach towards achieving optimal health and well-being for both human and non-human forms (World Health Organization, 2017).

The global public health emergency of COVID-19 has shed light on the HAI's powerful agent in reducing loneliness and social isolation by stimulating individual and collective pro-societal human-environment interplay (Amiot et al., 2022;), demonstrated by a dramatic increase in animal guardianships worldwide (Bogage, 2022). In Canada, companion and service animal guardianships have increased by 18% since the onset of COVID-19 in March 2020 (Narrative Research, 2020). Animals have been considered "loved family members" in Canada and beyond to an increasing extent (Rauktis et al., 2017). Health Canada states that "healthy pets" means

"healthy Canadians," illustrating the tremendous health benefits that animals bring to Canadians, their families, their communities, and Canadian societies (Government of Canada, 2016). The HAI social and health benefit spectrum, especially responding to the "loneliness epidemic," its lockdowns, quarantines, and related public health mitigation measures, have attracted intensive research, practice, and policymaking attention (Hughes et al., 2021).

Despite recognized tangible benefits, there is a distinct systematic review and analysis deficit pertaining to disciplinary-specific HAI knowledge, strategies, and outcomes. This deficit has been jeopardizing HAI-specific inter/transdisciplinary cross-sectoral knowledge translation and mobilization and further weakening the advancement of related practice and policy decision-making to broadly address complex societal issues during COVID-19 and beyond (Arluke & Irvine, 2017; Morris et al., 2021). The inadequate expertise amalgamation identified above encumbers potential comprehensive HAI's social and health gains that will trigger the long-term negative influences on building resilience and sustainability at the individual, family, and community levels. Hence, a comprehensive HAI-associated knowledge, strategies, and outcomes synthesis is urgently needed.

Objectives

An HAI-specific knowledge synthesis will yield actional insights, promising practice, and evidence-based policies, positioning HAI as a tangible intervention strategy for public health and other societal challenges (e.g., anti-society behaviours and lack of a sense of belonging). This synthesis will provide a model for leveraging diverse l human-animal-environmental benefits to promote healthy, resilient, and sustainable post-COVID-19 societies. Responsively, this project employs the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach to comprehensively recognize state-of-the-art HAI-specific social and health knowledge, strategies, and outcomes associated with building healthy, resilient, and sustainable individuals, families, and communities, to inform current pandemic recovery in particular, while more generally applicable to long-term societal development practice and policy.

Positioned in a rapidly changing Canadian and worldwide socio-economic landscape, this project aims to critically identify HAI-specific social and health benefits that potentially could enhance the existing and prospective practices and policies pertaining to reducing asocial behaviours and other issues at the individual, family, and community levels, ultimately building

healthy, resilient, and sustainable societies. The three HAI-targeted objectives are:

Objective 1 - Portraying the landscape of HAI-specific comprehension: To systematically examine HAI-specific knowledge, strategies, and outcomes toward coping with various social and health challenges engaged in at the individual, family, and community levels;

Objective 2 - Enhancing HAI-driven research: To comprehensively catalogue HAI-specific research merits and demerits, to advance HAI-driven cross-sectoral investigation, supporting prosocial individual, family, and community development; and

Objective 3 - Advancing HAI-informed practice and policy: To effectively promote HAI-informed cross-sectoral practice and policy decision-making through encouraging evidence-based knowledge translation and mobilization in Canada and beyond.

Methods

Built on the wide-ranging HAI's social and health benefits, this systematic review is guided by an overarching research question: How can current HAI-specific knowledge, strategies, and outcomes support healthy, resilient, and sustainable development at the individual, family, and community? PRISMA guideline (Page et al., 2021), which is a widely accepted approach for reporting in systematic reviews and meta-analyses, is employed to collect data to answer the research question through the following three steps: data curation, data management, and data reporting (Analyzing and Synthesizing Data).

Step 1: Data Curation: As identified above, HAI benefits have been mentioned broadly throughout academic mechanics (e.g., journal articles, books, and conference proceedings). Accordingly, the following eight multi-disciplinary academic databases were chosen to thoroughly identify related publications, especially in social sciences, humanities, and health sciences (including veterinary sciences), namely, ProQuest, PsycINFO, EBSCOhost, PubMed, Web of Science, Scopus, Embase, and VetMed (see Table 1). Three groups of keywords, reflecting the three primary components associated with the project objectives and the research question, were established: human-animal interactions, types of animals, and related influences (see Table 2). The keyword combination within each group used "OR" and between each group used "AND," were applied to each database to pull out all the related literature. Two filters, years of publication (January 2011 to April 2022) and languages (English), were chosen to narrow the search boundary. The reference lists of 4195 identified literature from the eight

datasets mentioned above were imported into Covidence, which is a web-based systematic review tool designed to facilitate the process of screening, data extraction, and analysis (Covidence, n. d). The Covidence automatically removed 1759 duplicates, and an initial dataset of 2436 publications was moved to Step 2.

Table 1. Databases and Identified Literature

Database	**Number of Identified literature**	**Number of Duplicates**	**Number of Included literature**
ProQuest	411	8	403
PsycINFO	196	27	169
EBSCOhost	294	173	121
PubMed	201	112	89
Web of Science	1607	395	1212
Scopus	1035	726	309
Embase	343	316	27
VetMed	108	2	106
Total	**4195**	**1759**	**2436**

Table 2. Keywords

Group	**Keyword**
Group 1: Human-Animal Interaction	Human-Animal Interaction* (HAI*), Human-Animal Relationship* (HAR*), Human-Animal Bond* (HAB*), Animal-Assisted Interventions (AAI*), Pet Ownership*, Pet Guardianship*, Pet Guardian*, Companion Animal Guardian*
Group 2: Animal	Companion Animal*, Pet*, Service Animal*, Agricultural Animal*, Laboratory, Zoo, Wild-Living Animal*
Group 3: Influences	Social, Health (Physical Health, Mental Health), Well-Being, Wellness, Individual*, Famil*, Communit*

Step 2 - Data Management: Screening and Extracting Data

The 2436 identified publications in the initial literature dataset were first screened through their titles and abstracts. Three criteria associated with the three research objectives were established to assess eligibility and determine suitability. In order to reduce biases and/or screening mistakes, each publication was voted by two researchers independently, and two extra team members resolved the disagreements. The screening removed 1550 irrelated publications, and 886 publications were moved to full-text studies assessed for eligibility.

As same as the screening stage, the full text of each publication was reviewed by two researchers independently. In this stage, the two researchers deeply examined each publication's merits and demerits through the following three inclusion/exclusion criteria, and the disagreements were resolved in a full-team discussion. The inclusion/exclusion criteria are (1) if the publication examines HAI-specific knowledge, strategies, and outcomes toward coping with various social and health challenges at the individual, family, and community levels; (2) if the publication illustrates HAI-specific disciplinary research merits and demerits, to advance HAI-driven inter/transdisciplinary cross-sectoral investigation, supporting prosocial individual, family, and community development; and (3) if the publication contributes to promoting HAI-informed cross-sectoral multi-engaged practice and policy decision-making. This full-context review removed 646 publications, including 593 publications that did not fit the inclusion criteria and 53 publications whose full text cannot be accessed.

In total, 240 publications were extracted for final data analysis. The final literature dataset was inventoried in a literature review data extracting form and published in the online data repository at Dalhousie University, Dalhousie Dataverse @ Borealis, promoting data reuse, promoting data reuse among researchers, practitioners, policy decision-makers, and other stakeholders. Figure 1. indicates the entire data curation, screening, and extraction process.

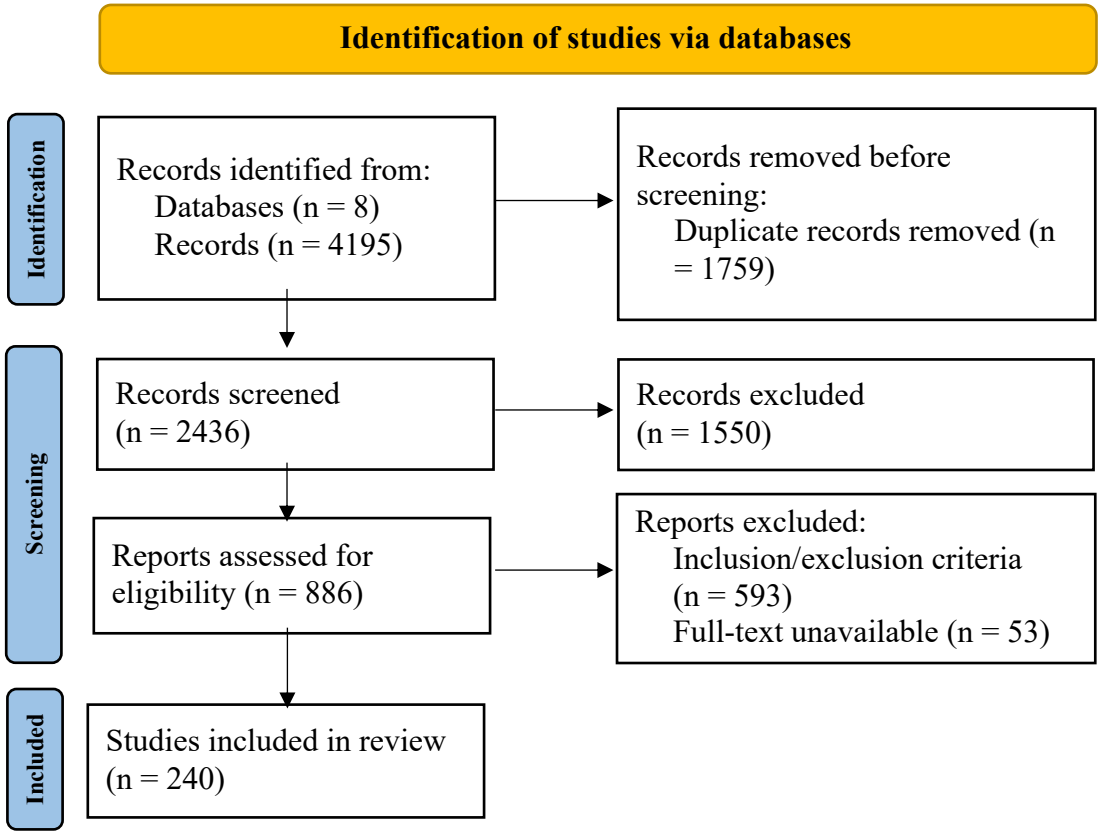
Step 3: Data Analysis

A mixed-method analysis approach, namely quantitative (univariate analysis) and qualitative (thematic inquiry), was utilized to identify findings and synthesize the results into recommendations. Two researchers independently and collectively conducted each analysis approach and a third researcher solved the disagreements. The synthesis of the quantitative and qualitative outcomes was discussed in full team meetings to generate recommendations.

During Step 2 of screening data, two researchers identified several standard fields the literature addressed. These fields, such as types of animals (e.g., birds, horses, and dolphins), community settings (e.g., educational organizations, healthcare organizations, prisons, and zoos), and beneficiaries (e.g., older adults, children and youth, women, veterans, and people living with disabilities), became the initial categories for statistical analysis. Two researchers collectively reviewed the first ten publications and identified potential variables under each catalogue. Then each researcher independently reviewed the rest publications and calculated the frequency of each variable. They discussed the newly added variables, merged their outcomes, and confirmed

the final frequency data.

Figure 1. Flowchart of PRISMA approach.



Similarly, two researchers used a thematic approach to complete the qualitative analysis. Since this project aims to identify HAI-specific health and social benefits at the individual, family, and community levels, these three levels were the initial categories that guided the coding and theming process. The two authors conducted deductive coding and developed the general sub-themes independently. They discussed their initial sub-themes and confirmed the final sub-themes. Then they applied an inductive approach to code the publication again to further produce detailed coding information to enrich the sub-themes. The quantitative and qualitative outcomes are presented in the next section. Two researchers discussed and synthesized these outcomes and determined the practice and policy recommendations. They merged the quantitative and qualitative results to pinpoint future research directions.

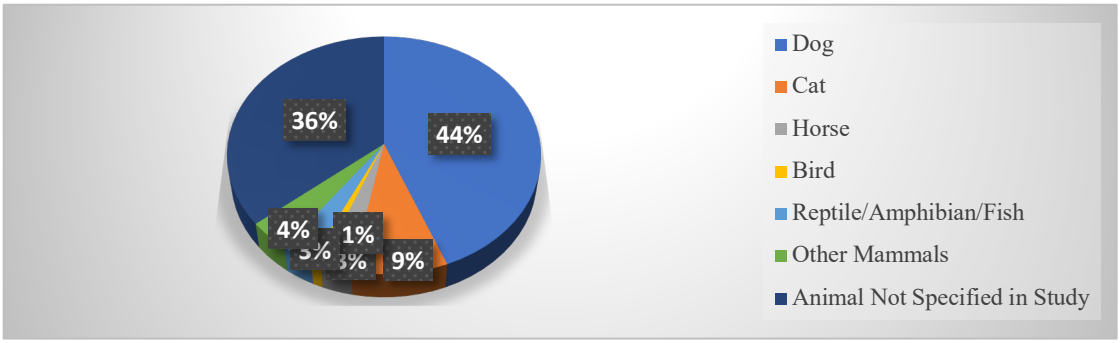
Results

Quantitative Results

For the quantitative analysis, the research team examined the selected articles and categorized them based on codes focusing on topics, such as type of animal, geographic location of the study, health impacts, and vulnerable or marginalized populations included in the study, to name a few. Articles were categorized into these topics in order to calculate frequencies and percentages of the current research literature landscape surrounding HAI. These frequencies and percentages can then dictate current research gaps and surpluses in the field of HAI.

When the type of animal was explicitly listed in a study (see Figure 2), the overwhelming majority focused on dogs (44%). The next largest category of animals that literature in the review focused on were cats at only 9% of the research studies. Based on the percentages of the types of animals included in the studies, there is a significant gap in the research surrounding the potential benefits of HAI with other types of household pets or other types of animal therapies. For example, equine-based therapies and interactions only make up 3% of this literature review, which indicates a critical gap in the research. Other types of household pets are also absent from the literature. Reptiles, amphibians, birds, rodents, fish, or other mammals (these types of animals make up only 8% of the research studies combined) should be an area of study that is further examined in future research projects. The inclusion of a greater number of these animals and the owners of the animals can provide important insight into similarities, differences, and nuances that may not be present in the most popular studies on dogs and cats.

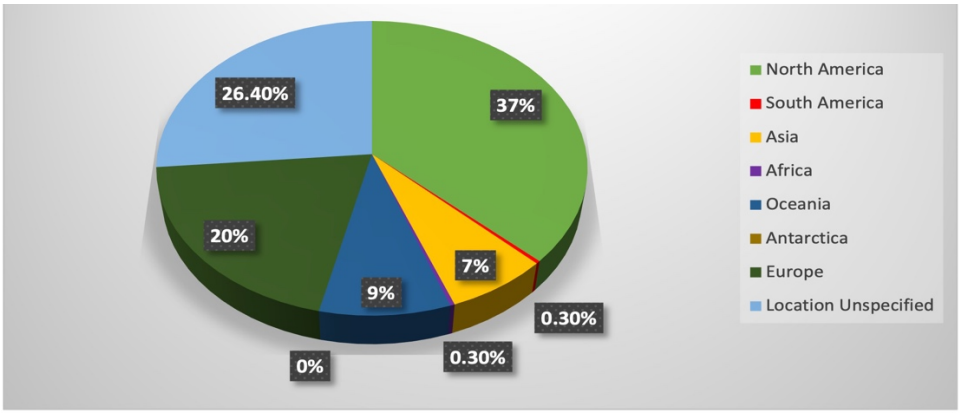
Figure 2. Type of Animal



The research team also calculated the percentages of studies completed by geographic location (see Figure 3). When the geographic location of the study was specifically listed in the article, North America had the highest number of studies (37%), followed by Europe (20%), Oceania (9%), and Asia (7%). Based on the review of literature compiled by the authors, there were very few studies conducted within an African (0.3%) and South American (0.3%) context. Although it is essential for this report to provide HAI-specific knowledge for Canadian societies,

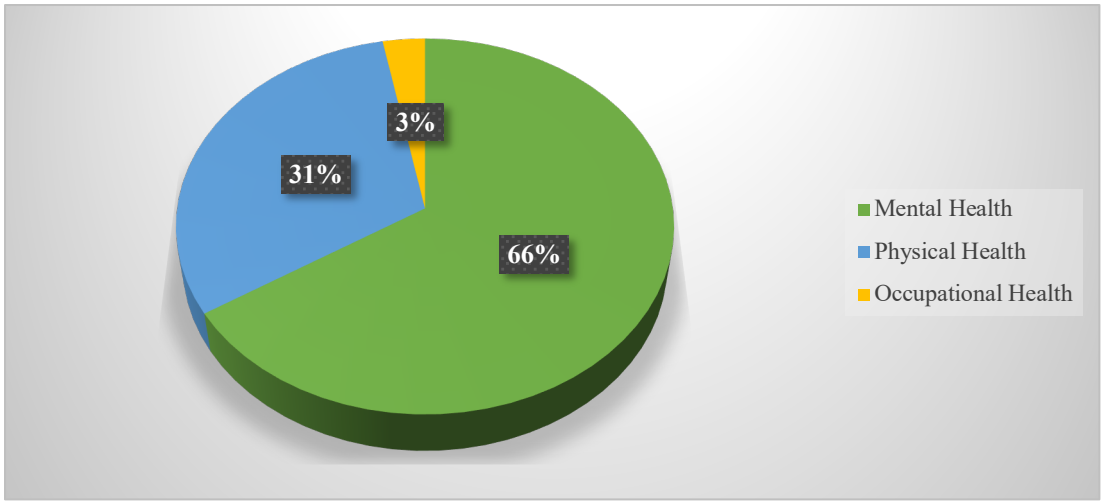
it is critical that research is conducted in countries globally because of the potential impacts on Canada. For example, increased research on HAI in Africa could show different outcomes than in Canada, thus providing opportunities to explore other methods, interactions, and policy initiatives based on research results in an African context. Because family structure, community structure, and cultural values and norms (e.g., religions and traditions) differ from country to country, increased research on a global scale has the potential to impact Canada positively.

Figure 3. Studies by Geographic Region



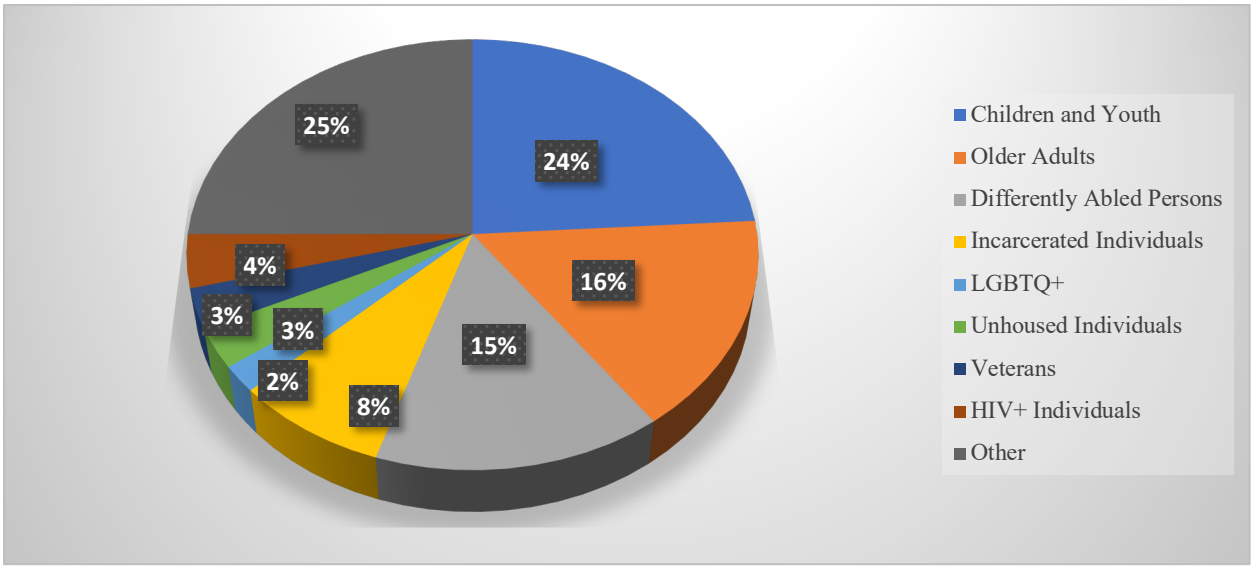
Articles included in the review were also categorized by the health outcomes examined. There were five categories that the research team coded for mental health, physical health, sleep disorders, occupational health, and animal welfare (see Figure 4). Overall, mental health was examined in approximately two-thirds of the articles included in the review (66%). Comparatively, physical health outcomes were discussed at half of that rate (31%). Occupational health was a separate category created for HAI research conducted on health outcomes in the workplace. These studies only made up 3% of the studies. Based on this analysis, it is clear that further research needs to be completed on the physical health impacts of HAI, sleep disorder impacts of HAI, and studies on occupational health. The different health and wellness components operate hand-in-hand to produce a collective, integrated system of personal, familial, and community health. Therefore, it is essential to conduct further research in the areas that are lacking so that researchers and health officials can determine how to create holistic health and wellness plans backed by empirical research. This, in turn, will allow individuals, families, and communities to determine the best course of HAI.

Figure 4. Health Outcomes in Studies



The research team also coded for research that focused on impacts on vulnerable and marginalized populations. As is evidenced in the qualitative results in the following section, vulnerable and historically marginalized populations are a popular sample of the population to examine the effects of HAI on daily life. Based on the analysis, the three most frequently researched vulnerable and marginalized populations in the research studies collected were children and youth (24%), older adults (16%), and people who are differently abled (15%) (see Figure 5). Other vulnerable and marginalized groups coded for included incarcerated individuals, veterans, the LGBTQ+ community, unhoused persons, and HIV-positive individuals. Research has been abundant on vulnerable or marginalized people based on age—children and older adults make up 40% of the articles reviewed. Future research should focus on other historically marginalized and vulnerable populations due to the importance that public policy and practice play for HAI and these groups. For example, as greater numbers of individuals and families face housing insecurities, HAI may bring lower levels of stress and greater levels of comfort. However, policy and practice surrounding housing may need to be drastically altered due to the limited number of pet-friendly locations for housing-insecure people. Incarcerated individuals are another population that could benefit from policy and practical changes surrounding HAI and the prison industrial complex. As discussed in the next section, incarcerated individuals that are allowed HAI or that participate in AAT programs see several benefits based on those interactions. Due to the low number of studies included in the review on incarcerated persons (8%), further research should be done to determine best practices and a reshaping of public policy to provide these individuals access to the support that they need.

Figure 5. Historically Marginalized and Vulnerable Populations Studied



The following section emphasizes the qualitative results of the HAI studies included in the review. The qualitative analysis was centred on three distinct thematic elements: individual-level interaction, family-level interaction, and community-level interaction. These overarching themes were drawn from the quantitative analysis as the research team coded for the population examined within each article. The overwhelming majority of the research articles in the review focused on HAI at the individual level (72%). The community-level HAI research was the next largest followed by the family-level HAI research. Each of these collective themes and the subthemes within them is analyzed in the following section.

Qualitative Results

This section details the qualitative themes uncovered HAI-specific themes at the individual, family, and community levels. The individual-level studies featured the largest number of research articles; therefore, the subthemes were robust and were broken into four categories. The first theme, individual health and well-being, includes research on how HAI impacts individuals' physical health, mental wellness, and overall well-being. This theme is broad and can consist of wide-ranging topics, from the psychological benefits of HAI to how HAI helps patients in hospitals with recovery. The second theme focuses on children, teens, and emerging adults– specifically on their development and education. This theme examines research findings on topics such as the developmental benefits of HAI on children, the educational benefits of HAI, and how HAI impacts university students. The third theme explores research findings focused on HAI in vulnerable populations like older adults, differently-abled persons, and those who are

unhoused. This theme connects directly to the fourth theme that emerged, which emphasizes HAI following adverse events, including disaster, incarceration, and war and/or combat for veterans. Themes three and four are interconnected because often, those facing adverse life events end up being members of vulnerable populations. As such, there will be several parallels between those two thematic sections.

The second overarching theme, HAI at the family level, was the smallest section of reviewed articles. However, as an intermediate point between the individual and community levels connections can be made by exploring how individual-level HAI could potentially impact the family level. The family level can then help direct attention to how HAI can take small-scale interactions and effects at the individual and family levels and build upon them to larger structures like the communities in which individuals and families reside.

The final theme is HAI at the community level. While HAI has been studied extensively at the individual level–as evidenced by the plethora of research and subthemes within the topic–research specifically focused on the community aspects of HAI impacts has not been researched in as great of a capacity. However, the research focused on HAI's implications on building better communities has shown promising results. Also, there are several ways that research on individual and family-level interactions can be presented as beneficial building blocks to connected, resilient communities in Canada.

Human-Animal Interaction on the Individual Level

Research examining human-animal interaction at the individual level was the most common during the analysis of the articles collected. Several themes emerged from the researchers' codes that focused on HAI's impacts on individuals. The first theme that emerged for research focused on individuals was HAI promoting individual health and well-being. The second theme focused on children, teens, and emerging adults in the context of development and education. This theme also includes articles that concentrated on HAI within the educational settings which these individuals occupy. The third theme was based on vulnerable populations such as older adults, individuals who are differently abled, and unhoused populations. The final theme included articles based on the theme of individuals who have used HAI in the face of adverse events such as disaster, incarceration, or war/military deployment (veterans). It should be noted that these thematic elements are not mutually exclusive, meaning individuals may fall into multiple

categories. This ultimately shows the importance of HAI to individuals as they can occupy several identity categories in which HAI serves as a benefit to them.

Individual Health and Wellbeing

Human-animal interaction and its impacts on individual health and well-being have been extensively researched. Previous studies have shown the numerous benefits of having pets and interacting with animals have had on stress (Sorensen et al., 2018; Wu et al., 2018; Sumner et al., 2020), loneliness (Powell et al., 2019; Krause-Parello et al., 2020), mental health problems (Brooks et al., 2018; Carr et al., 2020b; Lloyd et al., 2019; Muela et al., 2021), and physical health issues (Levine et al. 2013; Bradley & Bennett, 2015; Ogechi et al., 2016; Ballantyne, 2021; see also Carr et al., 2020a for a review on HAI effects on chronic pain).

One of the recent significant areas of interest regarding HAI and individual health and well-being has been the COVID-19 pandemic. Because the COVID-19 pandemic was–and remains–such a large public health, environmental, and social problem, researchers began examining the impacts that HAI could have on the global community. Several studies have provided insight into how interacting with animals has benefitted humans at the individual level through the pandemic. These insights allow public health and government officials to develop potential measures, building resilience and supporting recovery among individuals.

For example, Bussolari and colleagues (2021) conducted a survey on the experiences of adults and their dogs at the beginning of the COVID-19 pandemic in 2020. In large part, respondents felt reduced stress and more positive experiences because of their dog. There was also a sense of lowered isolation and loneliness due to the relationships and time spent with their dogs during the early stages of the pandemic. Finally, respondents also described that their dogs provided them with a sense of purpose and benefitted their mental health because of the connection and routine structure. Grajfoner and colleagues (2021) had similar findings focused on the COVID-19 lockdown in Malaysia. Their results showed that compared with individuals that did not have pets, pet owners showed significantly higher levels of mental well-being and had significantly more positive emotions during the COVID-19 lockdown period.

> *Pets can have a positive impact on some aspects of mental health and well-being in very challenging times, where contact with other humans may not be possible. Consequently, companion animals and other forms of animal-assisted activities and interventions can be considered in the context of any mental health and well-being recovery programs and*

explored in other situations and with other groups of participants, who could in different circumstances experience lack of human contact and social isolation (Grajfoner et al., 2021, pp. 8-9).

Based on the research above related to the COVID-19 pandemic, there is empirical evidence that suggests that HAI can benefit individuals suffering from the hardships that the pandemic has brought on. The pandemic and the impacts of HAI on individuals was an ongoing theme that emerged throughout this review, as evidenced by research results focusing on specific populations in later sections. Overall, HAI can positively impact some of the struggles faced by individuals and can be used as a model for future programs to assist vulnerable and marginalized populations in the future, as noted by Grajfoner and colleagues (2021). Such programs centred on HAIs can profoundly affect individuals and their overall health and well-being.

Children, Teens, and Emerging Adults: Development and Education

The second central thematic element within the individual-level impacts of HAI that emerged during the review of prior research was the effects of HAI on children, teens, and emerging adults. The research under this theme spans HAI impacts on early childhood development to the use of animal-assisted interventions at universities for college students. There has been a wide range of studies focusing on childhood development and the benefits of HAI (see Mueller, 2014; Pendry et al., 2014). The studies of childhood development and the benefits of HAI extend to AAI programs in schools. Connell and colleagues (2019) used three dog-assisted programs with a total of sixty-three children aged 6-8. Their results indicated that:

Children showed significant improvements across time for reading ability for all three conditions, including the condition with minimal dog contact, with no significant group or interaction effects. Exploratory analyses unexpectedly indicated that children who had lower starting abilities displayed the greatest levels of reading improvement. While it cannot be determined that these findings are the result of the presence of the dog alone, they nonetheless may indicate that dog-assisted reading programs are an effective means of benefitting those children who most need help to become fluent readers (Connell et al., 2019, p. 347).

This study shows that HAI and AAI programs can go a long way not only in promoting childhood development but also in a more robust educational experience. While these results are promising, in a review on HAI and promoting social and emotional competencies in youth, Chan

and colleagues (2022) stated that there was an outstanding need to find more rigorous methodological work to be done in this space to make any conclusive and effective action.

The benefits of HAI have also been found in adolescents (see Dominick et al., 2020; Endo et al., 2020) and in emerging adults (Barker et al., 2016; Barker et al., 2017; Foreman et al., 2019). Dominick and colleagues (2020) looked at a slightly different effect–post-traumatic growth, positive changes and individual experiences after a traumatic event. Although having a pet did not explain post-traumatic growth or symptoms of stress, there was a positive correlation between spending time with pets and relating to others:

> *For adolescents, spending more time with pets corresponds with higher growth in the domain of PTG that is associated with relationships, possibly due to social support garnered from interacting with pets or from pets prompting interactions that foster perceptions of support from others. (Dominick et al., 2020, p.547)*

Due to the inconsistent results and lack of overall research on adolescents, more research should be undertaken to examine the development during this critical life stage. More research has been done on emerging adults, specifically in the context of students enrolled at university. University campuses have been exploring ways to support students' mental health and well-being. A popular intervention has been canine-assisted intervention (CAI) programs. In a study at a Canadian university, Binfet, Green, and Draper (2022) recruited college students into three groups—direct contact, indirect contact, and handler only—for a CAI program to determine the impacts on their psychological health and well-being. The results showed that participating in a CAI program that offers direct contact with a therapy dog can significantly increase measures of well-being such as happiness, positive affect, social connectedness, and engagement. It can also significantly decrease stress, negative affect, loneliness, and homesickness.

In Marginalized Populations: Older Adults, Differently Abled, Unhoused

Marginalized populations have also been a focus of extensive research in individual-level HAI. The researchers thematically coded for older adults, differently abled individuals, and unhoused individuals. It should be noted that other populations coded for (e.g., children, survivors of disasters, incarcerated persons, and veterans) can also be defined as marginalized or vulnerable to some extent. The chosen grouping does not reflect any group as more marginalized than another, but rather that these coded thematic groups overlap with one another and can fall into multiple categories for which HAI may be helpful.

Animal-assisted intervention (AAI) programs have also been shown to assist older adults (Borgi et al., 2020; see also Berry et al., 2012; Krause-Parello et al., 2020). In their study examining pet attachment, social support, and loneliness during the COVID-19 pandemic, Applebaum and colleagues (2021) found that there was no significant difference between older adults (aged 65+) and their younger subset (aged 18-64) when it came to the attachment they felt to their pets. However, the older adults reported significantly lower levels of social support and considerably lower levels of loneliness compared to their younger counterparts. This interesting result was explored further using qualitative data from responses to the questions about the pros and cons of living with pets. The "pros" of living with pets that were most often discussed were that pets kept individuals company or acted as companions during the pandemic. The qualitative data provided greater context to the quantitative data in this study because "older adults in this sample overwhelmingly found their pets to offer companionship and support, it is possible that their pets may have played a role in their resilience, therefore helping owners to feel less lonely" (Applebaum et al., 2021, p.7). These studies highlight HAI's benefits on older adults overall, specifically during the COVID-19 pandemic. This evidence supports the need for further research to ensure that older adults are supported during pandemic recovery.

Studies have also supported that HAI may have beneficial impacts on people who are differently abled or neurodivergent, including children (O'Haire et al., 2013; Grigore & Rusu, 2014; Elmaci & Cevizci, 2015; O'Haire et al., 2015; Barber & Proops, 2019; Dollion et al., 2021) and adults (Crowe et al. 2014; Martellucci et al., 2019). While there is abundant research on differently abled and neurodivergent children (specifically regarding autism spectrum disorder – ASD) far less has been conducted on adults. Barcelos and colleagues (2021) echo this point by stating that regarding autism, there is a lot of research focused on children, while there is less on adults, even though autism is a lifelong developmental condition. In interviews with participants formally diagnosed with autism, Barcelos and colleagues (2021) noted several benefits that dogs provided participants, including increased autonomy, personal growth, and self-acceptance. Multiple participants mentioned that owning a dog can give them a purpose in their lives and provide an opportunity to build positive relationships with others, which will be discussed further in the section on community-building benefits to HAI (Barcelos et al., 2021).

One of the most critical findings, however, is that for six of the thirty-six participants having a dog prevented them from taking their own lives. The results of the research show

pathways to suicide prevention because of owning a dog. This is done through the dog showing the owner love and/or affection and the owner needing to care for the dog (Barcelos et al., 2021). These findings highlight the importance of research on differently abled and neurodivergent individuals. Human-animal interactions, interventions, and therapies should be heavily invested due to potential life-saving outcomes for individuals in this population.

The final subtheme that emerged within the vulnerable population theme was the importance of HAI for unhoused populations. Past research has examined the relationship between pet ownership and unhoused persons (see Kerman et al., 2019, for a review). Recent studies have focused on mental health, unhoused populations, and interactions with pets. This is especially relevant due to large-scale mental health struggles and housing issues during the COVID-19 pandemic. Cleary and colleagues (2021) found that unhoused populations face several struggles beyond housing, such as employability and health problems–namely, mental health. They interviewed individuals in Australia who experienced a lack of stable housing and who also owned pets. In their results, they share a story of a woman they interviewed:

> *She described the difficulty associated with trying to find rental properties that would allow cats and the stress associated with this, an experience she labelled as 'worse than being in my DV [domestic violence] situation.' She stated that she was unable to utilise any refuges because there were none that could accommodate her cats, nor were there any services that would offer respite for her animals to allow her to access refuge accommodation… There was no support to cover pet food, no respite services (other than that offered by the veterinarian at one point of crisis), no pet-friendly shelters, and no services to assist with burial or cremation. But she insisted that despite these challenges she simply 'found a way.' (Cleary et al., 2021, pp. 742-743)*

The experience shared by this participant highlights the importance of providing proper accommodations that cater to individuals with pets. Due to the magnitude of benefits pets provide their owners, it is critical that government programs begin examining avenues to provide adequate shelter for those with unhoused pets or who face unstable housing situations. Similar policy considerations are desperately needed for those facing adverse events–such as disaster–which is covered in the following section.

Adverse Events: Disaster, Veterans, Incarcerated Persons

The final theme that emerged during the analysis of the articles on HAI research was individuals

facing adverse life events. These individuals include those impacted by environmental, climate-induced, and public health disasters, veterans who faced combat or were deployed on military duty, and incarcerated individuals. This sub-theme concentrates on the benefits of HAI on those individuals in order to present strong evidence indicating the need for continued research, strong policy initiatives, and support for practice regarding HAI and individuals facing these events.

Evidence has shown that individuals that have gone through a disaster can benefit from HAI. According to Adamson (2021), there is recognizable importance of the relationship between humans and their companion animals, and "social work practice in planning and response can be informed by people's attachment to their animals" (p.26). This is especially true in times of disaster because there is a distinct impact that HAI has on vulnerable and marginalized individuals that disproportionately face greater impacts from disaster. Therefore, it is important to have animal-inclusive disaster planning because the bond of HAI can encourage people to better prepare for disaster, heed evacuation warnings, and lower the risk of potential trauma from loss or needing to rescue an animal (Adamson, 2021).

Indeed, one such public health disaster of late has been the COVID-19 pandemic. Bowen and colleagues (2020) investigated how confinement during a lockdown period in Spain impacted pet behavior and the social support offered by pets to their owners. When looking at the effects of the lockdown on the bond between animal and owner, they found increased emotional bonds and interaction and decreased perceived costs of having a pet. Each of these scores was significantly different from zero. Additionally, when an owner's quality of life due to the pandemic-induced lockdown decreased, the social support from their pets was more profound, statistically speaking. Based on these two examples from the prior literature, governments must consider HAI in disaster planning, especially for those most likely to be adversely impacted. Regarding environmental disasters such as hurricanes, floods, and wildfires, warning information and alert systems should account for HAI because of the risk reduction potential. For disasters such as COVID-19, HAI has benefits that may counter some of the negative mental health impacts due to necessary COVID-19 lockdown measures enacted to lower transmission.

Human-animal interaction in the context of military veterans was also a common theme that emerged at the individual level. Veterans were placed within the category of adverse events due to the trauma caused by deployment, combat, or war. The benefits and challenges of HAI on

veterans and veteran-centred programs have been researched in the past (Krause-Parello et al., 2012; Meyer & Sartori, 2019; McCall et al., 2020). Bergen-Cico and colleagues (2018) examined the impact of a canine-assisted therapy program for military veterans who experience symptoms of post-traumatic stress disorder (PTSD) and found that veterans that participated in the program "experienced significant reductions in symptoms of post-traumatic stress, perceived stress, isolation, and self-judgment accompanied by significant increases in self-compassion." (Bergen-Cico et al., 2018, p. 1166). Further, the authors found:

> *The areas that demonstrated the strongest and most consistent statistical changes were the measures of self-compassion and self-judgment. These changes may be associated with the general orientation of empathy, non-judgment, and acceptance that is associated with human-animal interactions. Researchers have observed that dogs provide a nonjudgmental entity for emotional attachment and support which may reduce self-judgment; their findings support this theory. The unique attachment and relationship with one's dog may facilitate increases in self-compassion, which is constructive because self-compassion is a protective factor against PTSD among military veterans. Increased self-compassion is important because higher levels of self-compassion are characterized by objective less distorted observation while also being associated with well-being, resilience, and lower rates of depression. (Bergen-Cico et al., 2018, p. 1173).*

The findings from Bergen-Cico and colleagues (2018) indicate the importance of implementing programs for veterans in Canada. Programs using HAI are cost-effective options that have empirical evidence supporting positive impacts on veteran health and well-being. The final central area of research that emerged as a theme within the HAI literature at the individual level considered incarcerated populations. Much of the research regarding incarcerated populations and HAI focused primarily on therapeutic interventions or programs taking place while individuals were incarcerated (Minke, 2017; Humby & Barclay, 2018; Jalongo, 2019). Though research suggests that HAI and animal-based interventions and therapies in prisons are effective, few programs exist in Canada. According to Dell et al. (2018), only six programs exist in Canada. One of these programs was the focus of research by the authors. In accordance with previous findings, Dell and colleagues (2018) found that incarcerated individuals who participated in the program had improved emotional states and reported positive behavioural change. This was due to the therapy dogs displaying love, comfort, and support. Further, the

researchers noted that:

> *The development of a human–animal bond in the AAT sessions facilitated inmates' recognition of their feelings, and in turn improved their emotional state. The mental health-oriented skills identified by the inmates and their clinicians focused heavily on inmates' feelings and emotions, including decreasing anger, stress and loneliness and increasing calmness, willingness for positive interactions and happiness. The inmate data, augmented by the mental health clinician and handler data, relayed that happiness and other positive emotions were primary reasons inmates were glad they met with a therapy dog. This supported their respective correctional plans. (Dell et al., 2018, p. 222)*

This is just one example of the positive impact that animal-assisted therapy and HAI can have on those who have gone through or are currently going through adverse events. When Dell and colleagues (2018) conducted their research project, there were only six animal therapy programs in Canadian prison systems. Adding more of these programs could provide incredible benefits to those incarcerated and reduce recidivism in Canada.

This section examined the research conducted on HAI at the individual level. Four distinct themes emerged when analyzing the current landscape of research literature: individual health and well-being, children, adolescents, and emerging adults, vulnerable populations, and individuals facing adverse events. Within those themes, articles focused on the parameters of those thematic elements (e.g., literature on older adults in 'vulnerable populations' and literature on combat veterans in 'individuals facing adverse events'). However, this does not mean that these categories are mutually exclusive. Due to the complex nature of the individual-level research, a person may fit into multiple categories, thus showing the cross-sectoral benefits of HAI and HAI-related interventions and therapies on individuals. The following section focuses on family-level research regarding HAI.

Human-Animal Interaction at the Family Level

Research that focused on family-level HAI was relatively scarce. Because of the lack of research, no prevalent thematic elements emerged during the family-level analysis. However, HAI at the family level can act as an intermediary level between individuals and communities. Positive impacts on individuals can positively impact their families. This leads to greater positive implications at the larger community level. This section on HAI at the family level shows results

from the few studies that focused directly on the family unit. Following those results, examples of how family-level HAI acts as an intermediary point between individual and community.

Benefits to Families

Human-animal interaction can have distinct benefits for the family unit. In many cases, families view their pets as integral parts of their family unit, treating them as equal family members as though they are human. McConnell and colleagues (2019) found this aspect of familial inclusion to have positive impacts on the family structure and the overall well-being of members of the family. This following quote shows that when families view their pets as members of their families–indeed, as human members of the family–they are therefore projecting them as having a sense of humanness. This depiction causes family members to perceive their pets as having higher levels of social support, thus generating greater well-being for the family members.

> *…animals are moved up the continuum of humanness and seen as having greater socially supportive qualities that, in turn, enhance owners' well-being…the current work shows that people extend their most sacrosanct ingroup member status to animals, perceiving them as agents of social support that facilitate well-being. (McConnell et al.., 2019, pp. 467-468)*

There were similar benefits to family units found by Bennetts and colleagues (2022). They used surveys to collect data in Australia and implemented a biopsychosocial model to map the challenges and benefits of having pets during the COVID-19 pandemic. The authors mapped participants' biological, psychological, and social responses in a Venn diagram, each of the three circles converging in the center surrounded by the common theme of well-being to members of the family. Bennetts and colleagues (2022, p.11) describe that:

> *Although the direct health impacts of the pandemic in Australia have been far less than for many other countries globally, our findings speak to the important role of companion animals, especially during times of uncertainty, change, and social isolation…This underscores the significant social impacts of the pandemic on families (e.g., physical distancing, isolation, limited social interaction) and suggests that family pets play a critical role in addressing this "gap." Findings highlight the powerful role of pets in providing non-judgmental companionship, comfort, and support for families with children.*

This excerpt shows the critical role of pets in families in Australia during the COVID-19 pandemic. The HAI pets provided to families helped support members during times of isolation

or limited social interactions that the pandemic brought across the world. This research highlights the importance of family pets in offering social support through a difficult time and, therefore, could provide greater capacities for recovery and resilience as the global community continues moving toward a post-pandemic world.

Finally, human-animal interaction has also been beneficial for families of military personnel, specifically the children in military families. Human-animal interaction could be a resource that supports thriving and resilient family structures, and family pets can be an added strength within a family context supporting positive health factors and helpful in development (Mueller & Callina 2014). Specifically, regarding youth within a military-connected family, results had shown that when youth were more attached to their pets, there was a statistically significant association with positive youth development. Moreover, regarding coping skills, youth with an actively deployed family member showed a significantly positive association between pet attachment and coping (Mueller & Callina 2014). The authors went on to state that:

> *Although these findings are cross-sectional and therefore unable to be used to establish causality, they suggest that an emotional attachment to an animal could be a means by which youth may engage in more positive coping strategies (such as having a proactive attitude about handling stressful problems and engaging in social activities). Therefore, it is possible that a social relationship with an animal could serve as a "bridge" to developing and maintaining peer relationships during a time of stress. (Mueller & Callina, 2014, p. 221)*

This quote provides essential insight into how HAI and pets can strengthen the family unit within military families through positive youth development. The results of this research can provide military families with effective options for supporting family members–especially youth–before, during, and after a deployment. It also shows how HAI can benefit youth outside of the family structure in terms of continuing to develop relationships with others and managing stress in healthy ways. These connections serve as the overarching thematic element from the review of HAI literature–the family level acts as an intermediary between individual and community level benefits from human-animal interaction.

Bridging the Gap Between Individual and Community

HAI at the family level has received less attention compared to the individual and community levels when examining research specifically focusing on the family unit. However, family units

are made up of individuals that benefit from HAI; therefore, the assumption can be made that when individuals receive benefits from HAI, the families see benefits as well.

Humby and Barclay's (2018) work examining prison programs in Australia exemplifies this connection. Although these programs are focused on the individual level, there are concrete benefits at the family level. Within some of the prison dog programs in Australian correctional facilities, HAI offers incarcerated individuals the opportunity to enhance their sense of responsibility. The participants in the prison dog program are required to take care of the animals by feeding them, giving them water, grooming them, and training them. Humby and Barclay (2018) stated that these activities allow the participants to take on responsibility as a life skill which can then translate to their role as a parent. Furthermore, vocational skills come along with some prison dog programs, which can translate to real-world work opportunities outside the correctional facility. Both skills learned through HAI and taken on by incarcerated individuals benefit them individually and help them at the family level after incarceration.

Through this process, HAI at the family level is an intermediary between the individual and community levels. As individuals see benefits and bring them to the family unit, the benefits at the family level can be passed on to the larger community. Using the same example of prison dog programs in Australian correctional facilities, the vocational skills that benefit the incarcerated person at the individual level and then at the family level extend to the community level. Through vocational skills and joining the workforce after incarceration, the dog programs and HAI initiated through those programs allow formerly incarcerated persons to be contributing members of the community, thus benefiting the community at large (Humby & Barclay, 2018).

The researchers conducting this review found that HAI at the family level was not as widely researched compared to the individual and community level. Instead, the family level acted as a bridge or intermediary between the two–benefits from the individual benefitted the family, thus building the communities that the families occupy. The examples listed are only a few of the benefits for individuals and communities that are connected by the family unit. More connections are examined in the next section on community-level HAI.

Human-Animal Interaction at the Community Level

Research has shown that HAI has been beneficial in building engagement within communities and among community members. This section examines the community-level benefits of HAI in

three distinct ways. First by detailing research that shows how communities are built based on social connections through HAI. Second, the research on the One Health perspective shows how public health is intertwined with humans, animals, and the community environment. Finally, overall connections are made to the previous sections on family and individual levels of HAI to show how benefits to the community stem from the individual and family structures.

Promoting Social Communities

One of the benefits of HAI is that research has shown that HAI can create strong, connected communities by using humans' interaction with animals to connect them to other people, thus growing communities.

> *Walking a friendly dog to the park is not like walking alone…dogs are companionable and sociable; they enjoy meeting and greeting other dogs, enabling the different owners to meet and chat. Pleasantries are exchanged along with a friendly wave and with a little time, many familiar people will give a wave and say "hello" and pass the time of day. Similarly, if you admire someone's dog, the owner will likely remember you and smile at your appreciation of his pet and even a quick and cheery exchange can make the day a better one. (Brahams, 2021, p.2)*

Brahams (2021) explains that taking a dog out for a walk can allow owners to meet one another and have a conversation, building community bonds through animal interaction. Higgins and colleagues (2013) also found that dog walking benefitted participants because of socializing and social group formations based on their pets. The social and community-building aspects also motivated participants to walk their dogs because of the positive encounters with others. This same idea was found in older adults through research on dog walking during the COVID-19 pandemic (Carr et al., 2021). Researchers found that dog walking could curtail loneliness because of more opportunities to socialize, even at a distance due to the pandemic. Further, connections made through dog walking can be the starting point for new conversations and friendships (Carr et al., 2021).

Similar findings have been found in other research on animals and community interaction. Animals—specifically dogs and dog walking—can serve as catalysts for conversation among people, social interaction, and even "a source of social capital, defined as the glue that holds society together." (Lang & Hornburg, 1998, as cited in Gee et al. 2021) (see also Wood et al., 2005; Sorensen et al., 2018). Wood and colleagues (2015) illustrate that having pets within a

community helps with community-building and more significant interaction among members of the community because of interactions between people because of their pets.

Public, community spaces that offer HAI, such as parks, zoos, and aquariums, have also been evidenced to support positive impacts on the individuals that visit those places. Clements and colleagues (2019) described that most HAI research focuses on the benefits of the physical interaction between humans and animals, but some populations may not be suited for that kind of study because of accessibility or other issues involved. Community-based HAI settings may be best for these individuals and can benefit the health and well-being of individuals and communities. Zoos, for example, provide a positive community experience where people can view and sometimes interact with animals and provide space to build community and relationships with other people. Escobar-Ibarra and colleagues (2021) stated that zoos are an experience that often provides sharing experiences with others as well as intellectual stimulation within those interactions. Godinez and Fernandez (2019) also found that there are benefits to the environmental community as visitors to zoos felt more positive perceptions of conservation efforts after more interaction with exhibits and zoo personnel, thus building community connections and pleasant living environments for their community. Sumner and colleagues (2020) also reviewed the current research on the health benefits of visiting zoos.

Aquariums are like zoos as they offer a different interaction experience compared to owning a pet. Clements and colleagues (2019) reviewed the literature on public aquariums and the benefits they provide visitors. In the few studies that have been done, there were health benefits associated with visiting public aquariums. These studies show that community-based zoos, parks, and aquariums offer different HAI options that can benefit individuals, including health benefits and opportunities to facilitate conversations with others in the community.

While the benefits of pet ownership on the physical communities in which people live are clear, studies have also shown benefits in virtual communities that can translate to the real world. In a study focused on adolescents and their online and offline social interaction, Charmaraman and colleagues (2020) examined how the HAI of having a pet influenced these interactions in both physical and virtual spaces. The researchers found that simply having a pet did not indicate the quality of online or offline interactions. However, dog owners spent more time socializing in their online communities than those who don't own dogs. Additionally, pet owners who felt highly attached to their pets also displayed a greater capacity to display community-helping

behaviour and are willing to take greater social risks online (Charmaraman et al., 2020). This evidence shows that pets, specifically dogs, have a substantial impact not only on physical communities by encouraging communication and interaction, but also on virtual communities, which are becoming increasingly popular for outreach, interaction, and activism.

A One Health Perspective

A supplementary theme that emerged during analysis was the idea of HAI as part of a One Health framework. The One Health framework connects to the concept of HAI at the community level more broadly, viewing the "community" as one that includes humans, animals, and the environments that house the two. Chalmers and Dell (2015) describe that the One Health framework and HAI go hand-in-hand as they build on one another to benefit community health and well-being. They further state that a One Health framework can work alongside HAI and animal-assisted interventions (AAI) to support individual-level well-being.

> *The complexity of the AAI–environment interface must be recognized to move AAI research forward. Indeed, the social environment is relevant to One Health; people and animals exist in social communities. For example, those faced with ill health, such as mental health or addictions, need to effectively re-integrate within the ecologies of their families and society at-large. In AAIs, the animals themselves are the health intervention. They enhance positive feelings in people, raise oxytocin levels, encourage clients out of emotional numbness, and foster trusting and non-judgmental relationships. (Chalmers & Dell, 2015, p. 561)*

This exemplifies how a One Health framework can enhance and progress HAI and AAI research and research outcomes. Specifically, the authors noted an example at the individual level. They mentioned that the One Health framework identifies the need to reintegrate with larger structural social units such as families and communities, and to do so they can use AAIs and HAI to benefit their specific needs.

A One Health framework can be seen as a way to include HAI at the community level for humans, animals, and the larger, integrated environment, through implementing programs and committees with missions aimed at building HAI and AAI research that promotes the well-being of these building blocks to the community at large. Day (2016) synthesizes One Health's role in using HAI and AAI to build the capacities of individuals and their family units.

> *One Health also directly addresses the health and well-being of families by recognizing the*

unique role of the small companion (pet) animal. In 2010, the World Small Animal Veterinary Association established a One Health Committee with the mission of ensuring that the impact of companion animals was included in the One Health agenda. One Health that is important to family physicians is the human-companion animal bond. Pets bring enormous well-being to their owners and, for some individuals (e.g., older, isolated, chronically ill, or childless persons), pets provide a major focus in life. Interaction with pets improves health and reduces healthcare expenditure. Pet therapy in hospitals, schools, prisons, and nursing homes has been reviewed by the One Health Committee. (Day, 2016, p. 345)

Day (2016) expresses the importance of merging One Health with HAI and AAI by describing the benefits of interactions with companion animals for families and individuals and animal-assisted therapies in several social institutions. Therefore, integrating the overarching One Health framework with HAI and the associated animal-based interventions and therapies is a path that government systems can take to effectively create connected, healthy, and resilient communities. Based on the research above, a One Health framework can benefit the building blocks of communities–individuals and families–by using HAI to enhance health and well-being. By doing so, those building blocks then create stronger, healthier communities at a larger scale.

Connections to Family and Individual

HAI at the community level is partially built through interactions on the individual and family levels. At both the individual and family levels, HAI has been shown to increase the well-being of individuals or family units. This has been especially true during the COVID-19 pandemic. It is possible to extrapolate those benefits to the larger, community level to explore opportunities to facilitate community connectedness, enhance recovery, and promote resilience in Canada and abroad. On the individual and family levels, dogs and dog walking provided people with structure, routine, and purpose (Bussolari et al., 2021; Barcelos et al., 2021; Carr et al., 2021). As people find structure, routine, purpose, and wellness benefits at the individual and family levels through a task like dog walking, it builds the community as well. This quote below shows the distinct connection that individual- and family-level action makes in building community, even during the COVID-19 pandemic. This suggests that the individual and family-level benefits that stem from HAI, can have powerful impacts on the larger community.

Even though owners were encouraged to maintain social distance during the pandemic,

greetings from a distance or across-the-street conversations may have served to ameliorate further feelings of loneliness. Seeing the same group of people walking on multiple occasions may have facilitated new conversations and friendships. (Carr et al., 2021, p.11)

Implications

The findings of this literature review on HAI have several implications for future research, policy, and practice. Future research should expand on two of the three thematic areas in the qualitative data analysis—family- and community-level HAIs. As discussed in the results, these two areas have been under-researched compared to individual-level HAI. While individual, micro-level research is essential, it is critical to continue building toward a macro-level approach to HAI in order to support societal structures such as families and communities.

Future research projects on HAI should also focus on subject matter that has been ignored or absent in the literature. Although several marginalized populations have been included in HAI-specific research (e.g., LGBTQ+ individuals, veterans, incarcerated persons, and individuals experiencing violence), a more inclusive and more comprehensive approach is needed to identify those who need special support (e.g., adolescents and adults with autism spectrum disorder), promoting the development just societies. Additionally, a plethora of research focuses on common household pets and animals, but other types of animals are far less researched, including industry and exotic pets. These animals and the HAI that occurs can provide valuable insight that can benefit individuals, families, and communities in the future.

From a policy and practice standpoint, there needs to be a widespread examination of government policy and practice to ensure that there are animal-friendly options for people because of the enormous benefits of HAI on humans. Specifically, health and human services should examine the policies and procedures that are currently in place to consider the benefits HAI would have on individuals that use those services. Not only could the implementation of animal-friendly policy and practice have a positive, profound impact on individuals that need the services, but it could have widespread effects on families and communities at large. For example, the Department of Defence should evaluate how to best implement animal-friendly disaster sheltering for evacuees that have evacuated with their animals.

Finally, as Canada and the global community strive toward pandemic recovery, policymakers and practitioners should continue exploring the benefits of HAI interventions in

COVID-19 care and recovery. Based on the evidence provided in this review, the inclusion of HAI and AAT in COVID-19 recovery could profoundly benefit the resilience of individuals, families, and communities in Canada and beyond.

Conclusion

Human-animal interaction (HAI) has been empirically shown to play a critical role in the health and well-being of individuals and social institutions like families and communities. A wide range of research has been conducted on HAI's benefits in multidisciplinary fields. A recent addition to the research area has been public health research regarding COVID-19 and the impacts HAI has on resilience and recovery. Following the PRISMA approach, the research team identified 294 publications and applied a mixed-method approach for analysis. The quantitative results provided an overview of the frequencies and percentages of different research topics and metadata as coded by the researchers. The quantitative results showed that there had been extensive HAI-related research conducted at the individual level. The individual-level analysis provided insight into the types of studies conducted, including childhood development and education, physical and mental health and wellbeing, and different vulnerable and historically marginalized groups. The quantitative analysis also showed the geographic locations of the research projects, illustrating overarching gaps in research from different continents.

The quantitative data analysis provided a starting point for the researchers to determine what areas in HAI-related research have been extensively researched and which areas have deficits at the individual, family, and community levels of analysis. The qualitative data analysis expanded on the quantitative data by examining the selected articles in greater detail and developing further themes for analysis. Overall, the qualitative analysis pointed to individual-level themes such as overall health and well-being; children, adolescents, and emerging adults and their development and education; marginalized populations such as older adults, differently-abled persons, and the unhoused; and individuals who have faced adverse or traumatic events such as disaster survivors, military veterans, or those who are incarcerated. These individual-level subthemes were explored to determine the benefits and potential research gaps. This, combined with the quantitative data analysis, provided necessary insight into which HAI research topics are needed in the future.

The quantitative analysis helped inform the qualitative analysis for the family level as it was the least researched area regarding HAI. Therefore, the thematic elements in the qualitative analysis helped determine how family-level research interacted with the individual and community levels. The few research articles compiled and categorized at the family level showed the benefits of HAI to families. The thematic analysis further showed that family-level HAI may act as an intermediary between the individual and the community. The family unit acts as an intermediate position where the impact of HAI on individuals can grow and eventually impact the community that their family unit belongs.

Finally, at the community level, the qualitative analysis showed that HAI is a tool for creating strong, connected communities. The thematic analysis showed that in the community-based research, animals were used as a catalyst to spark conversation among individuals, thus building community through interactions *because* of the animals. Results also showed that community spaces that are built because of animals (e.g., dog parks, zoos, and aquariums) can also be a way to build strong communities because of the inquiry and interaction among the visitors to those spaces. Finally, a theme that emerged during the qualitative analysis was the impact of a One Health framework and approach.

As with any study, there are several limitations to this systematic literature review that must be discussed. First, only publications within the last ten years were examined. This severely limits the total number of articles that could have been selected. Due to the selection criteria, there could be classic research and literature on the topic of HAI that could have been omitted from the study but could have played a key role in the analysis. Another limitation regarding the selection criteria is that only publications written in English were reviewed. This may have resulted in a Eurocentric scope, thus omitting research conducted by researchers and scholars in Asian and African countries. Indeed, using published, peer-reviewed work could also omit important grey literature or research rooted in Indigenous knowledge or ways of knowing that may not be found in those databases. Finally, as with any study using qualitative analysis, intercoder reliability is of concern. For the qualitative analysis, it is helpful to have several coders to ensure that the coding process is consistent and accurate across each person. The qualitative portion of the analysis for this review would have benefitted from intercoder reliability for consistency in coding.

Knowledge mobilization activities

Built on Phipps and colleagues' (2016) "co-produced pathway" strategies for knowledge translation and mobilization, the following two knowledge mobilization (KM) activities are planned to advance the continual knowledge translation from academia to further inform practice, service, public education, and policy decision-making for governmental, private, and not-for-profit organizations in Canada and beyond.

KM Activity 1: Advancing Academic Research and Beyond. *(1) Open-access data (data management) and publications*. The final literature dataset will be published in Dalhousie Dataverse @ Borealis (an online data repository), promoting data reuse among researchers, educators, practitioners, policy decision-makers, and other stakeholders. Two open-access publications are planned in top-tier journals in the interdisciplinary field of public health and HAI, namely *Nature Human Behavior and American Journal of Public Health.* The open-access characteristic will promote the academic knowledge influence, especially on practitioners, policy decision-makers, and other end users. *(2) Multi-stakeholder conference presentation*. This project will be presented at the 2023 Congress of the Federation for the Humanities and Social Sciences, focusing on HAIs in a COVID-19 context, aiming to promote HAIs' role in building healthy, resilient, and sustainable Canadian communities.

KM Activity 2: Informing Non-Academic Stakeholders - An animation video. It has been found that viewers retain 95% of crucial messaging through video while retaining only 10% via text alone; notably, video attracts 12 times more viewers than text-based materials (Stafford, 2017). Based on the project's findings, this animation will apply a whiteboard approach to explain research outcomes, featuring the significant HAI-associated benefits, focusing on social and health contributions for individual, family, and community social development. This component will move beyond traditional academic knowledge mobilization channels to inform the non-academic stakeholders (e.g., the general public, service providers/users, and policy decision-makers).

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