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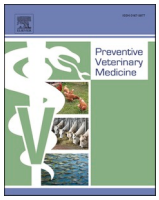

Conventional cooked and raw dog diets: Swiss owners' risk perception and knowledge

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ABSTRACT

An increasing number of dog owners are opting for raw, homemade meat diets over commercial feed. However, these diets pose two major risks: pathogens on raw meat can pose health risks to humans and dogs and an incorrect nutrient balance can affect dog health. Research has highlighted knowledge gaps regarding pathogens and hygiene practices and misunderstandings regarding the risks of conventional cooked vs. raw diets. The present study aims to gain specific insights into owners' risk awareness and perceptions, needed to design targeted risk communication. This mixed methods, cross-sectional study included qualitative interviews with six experts and ten raw-feeding dog owners. A total of 601 dog owners from Switzerland completed a quantitative survey focused on owners' perceptions of seven microbiological and nutritional risks across four diets (commercial dry, wet, and ready-made raw, and homemade raw). Subjective and objective knowledge of nutrition and hygiene were assessed. Dog owners feeding raw meat diet at least twice per week were less aware of the health risks of raw meat than those that did not, and exhibited lower knowledge about pathogenic hazards. Additionally, they perceived commercial dry diets as nutritionally riskier than raw diets. Nutritional knowledge might help mitigate some, but not all, of the risks associated with incorrect feed composition. Based on these findings, risk communication should emphasise the relevant microbiological facts, the complexities of composing balanced diets, and the nutritional safety of commercial diets. Collaboration between dog owners and nutrition experts can address misconceptions and support safer feeding practices.

1. Introduction

1.1. Review of the literature

In 2022, over 100 million dogs lived in Europe, with 25 % of households owning at least one dog (FEDIAF, 2024a). Pets are becoming increasingly important household members in Western Europe (Boya et al., 2012; Irvine and Cilia, 2017). Thus, it is not surprising to see that in recent years, the variety of pet feeding practices has expanded (Dodd et al., 2020). Not only are there more different protein sources available to meet the different requirements of dogs and owners, but also a wide buffet of textures and processing stages, such as dry, semi-wet, wet, or fresh/frozen feed, are on the market. Next to commercially available conventional diets such as dry kibble or wet canned feeds, which will further be referred to as conventional cooked diets (CCDs)), alternative diets are available, such as home-made, grain-free, or raw diets. Feeding with raw protein sources is becoming increasingly popular among dog owners (Dodd et al., 2020; Empert-Gallegos et al., 2020; Laflamme et al., 2008; Schlesinger and Joffe, 2011). Raw meat-based diets (RMDs) include uncooked ingredients from wild animals or livestock (often slaughter by-products). Such diets can take the form of commercially available ready-made meals (typically sold frozen), partly ready-made meals with the owner required to add additional ingredients to fulfil nutritionary needs, or completely homemade meals (Davies et al., 2019). In the latter case, pet owners choose different raw animal ingredients (including muscle meat, offal, bones, as well as dairy and egg products; bought fresh or frozen) and add fruits, vegetables, starches, and supplements (Freeman et al., 2013). The composition of RMDs can follow different regimens and appear under different names, such as 'bones and raw food' or 'biologically appropriate raw food' ('BARF', the

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latter also being a translation of the German use of the acronym).

Although RMDs are increasing in popularity (Davies et al., 2019; Empert-Gallegos et al., 2020), RMD feeders still represent a minority of pet owners in previous studies, with 80–90 % of dogs in English-speaking countries being fed commercial (mainly dry) feed (Dodd et al., 2020; Laflamme et al., 2008). However, in the same study, nearly a quarter of dogs also received raw meats as part of the main meal, as a snack, or a treat. The diverse range of available feed choices is represented by the different ways in which owners feed or add components to the main diet of their pets. What seems to be the case, however, is that only a small number of pets are *exclusively* offered CCDs. In a study in Australia, Canada, New Zealand, the United Kingdom (UK), and the United States of America (USA), only 13 % of dogs were exclusively offered conventional or commercial diets, with over 64 % of dogs also offered raw and/or homemade feed (Dodd et al., 2020). In the same study, of those owners feeding RMD, 89 % chose homemade raw diets over ready-made raw diets. Among dog breeders in the USA and Canada, approximately 15 % fed homemade diets and one-third fed RMD or raw bones (Connolly et al., 2014).

1.2. Risks associated with feeding and risk perception

1.2.1. Nutritional risks

Whether the diet is a combination of CCD with additional ingredients or a completely homemade diet, it should meet the nutritional needs of the dog at that stage of its life and be adapted to meet energy and possibly medical needs, such as a low-fat diet for pancreatitis. The packaging of commercial dog feed is legally required to specify the ingredient composition and additives, the species and age group the feed is intended for, and whether its composition is sufficient to fulfil the requirements for a daily ration ('complete feed', as opposed to 'complementary feed', which needs to be supplemented or combined with other feed) (European Union, 2009; FEDIAF, 2024b; Swiss Federal Council, 2011). This provides dog owners with a level of assurance that their dogs' nutritional needs are being met. However, when feeding homemade diets, pet owners need to combine various ingredients to meet these nutrient requirements. For this purpose, they can rely on professional advice, books, calculators, and online resources. Several studies have demonstrated that this task is often inadequately achieved. Sixty percent of 95 rations in a German study showed major imbalances, especially in terms of calcium and phosphorus content and ratio, Vitamin D and A, zinc, copper, and iodine supply (Dillitzer et al., 2011). Other studies have also demonstrated nutritionally imbalanced homemade or commercial raw diets (Freeman and Michel, 2001; Mack and Kienzle, 2016; Pedrinelli et al., 2017; Stockman et al., 2013) or homemade cooked diets (Heinze et al., 2012; Larsen et al., 2012). Significant health impacts are possibly associated with imbalanced nutrition: frequent reports include dietary hyperthyroidism (by feeding fresh or dried gullets), also in commercially sold RMD, where buyers are likely to assume that the composition is correct and complete (Broome et al., 2015; Cornelissen et al., 2014; Köhler et al., 2012; Zeugswetter et al., 2013). Another issue is secondary hyperparathyroidism resulting from Vitamin D deficiency or from an incorrect calcium-to-phosphorus ratio (Kawaguchi et al., 1993; Krook and Whalen, 2010; Nowak et al., 2024).

In growing dogs, the consequences of malnutrition can be severe, including skeletal and neurological problems (Hall et al., 2020; Taylor et al., 2009). However, in adult dogs, depending on the type of malnutrition, the consequences can take up to two years to manifest and are often clinically unspecific, making them difficult to diagnose (Strodtbeck and Schröder, 2021). For some deficiencies, there is a very limited possibility for diagnosis. For many trace elements and minerals, the information gained from blood panels is insufficient or will provide a misguided sense of safety to the owner and possibly the veterinarian. For instance, calcium levels in a blood panel will remain in a normal physiological range, even though it is being mobilised from the bones when nutritional supply is lacking, whereas copper status can only be determined by liver biopsy (Strodtbeck and Schröder, 2021). 'BARF profiles' from blood sampling, although available from veterinary laboratories, are therefore not sufficient to determine whether the current diet is adequate. To ensure a nutritionally balanced diet, it is necessary to create a ration plan and calculate the exact amount of each ingredient to be added. However, there still remains some difficulty, as the same ingredient can vary in its content of different components; for example, muscle meat might vary in fat and water content, thus changing its energy provision. Additionally, these plans must be adapted to the animal's life stage and other changes in the nutrient and energy requirements. Even if nutrient contents are met, this does not ensure an optimal profile for an individual animal; for example, a high fat content could result in a glossy coat, but also in obesity and gastrointestinal issues for some individuals (Freeman et al., 2013).

Additional general health risks associated with feeding are the potential of toxic ingredients arising from mycotoxins in the products or from the toxicity of feed items (e.g. garlic, onions, avocado, grapes, or macadamia nuts) (Kang and Park, 2010; Meyer and Zentek, 2010). Another health risk is feeding bones, which can lead to tooth and gastrointestinal injuries and obstruction (Freeman et al., 2013).

1.2.2. Microbiological risks

In addition to the potential nutritional risk, which can be mitigated by an adequate diet plan, the provision of raw meat is associated with infectious diseases. Raw meat, even when derived from healthy animals for human consumption, can become contaminated with pathogens during slaughter, evisceration, processing, and packaging (LeJeune and Hancock, 2001; Zhao et al., 2001). Therefore, it is not surprising that bacterial contamination is common in commercial RMD. A Dutch study analysing 35 commercial frozen raw meat diets found that the majority had bacterial contamination (mainly *Escherichia coli*, but also *Listeria* and *Salmonella* spp.) (van Bree et al., 2018). This is in line with other studies, identifying between 23 % and 64 % *E. coli*, and 20 % *Clostridium perfringens* and *C. difficile*, as well as occasional *Staphylococcus aureus* and *Campylobacter jejuni* contamination (Bojanić et al., 2017; Hellgren et al., 2019; Nilsson, 2015; Weese et al., 2005). *Salmonella* spp. prevalence varied between 6 % and 20 %, especially diets containing raw chicken are more likely to be associated with *Salmonella* spp. contamination than raw diets without chicken (Finley et al., 2008; Joffe and Schlesinger, 2002; Strohmeyer et al., 2006; Weese et al., 2005). Bacteria on raw products can also carry antimicrobial-resistant genes, such as extended-spectrum beta-lactamase (ESBL) resistance among *E. coli* and other Enterobacteriaceae (Davies et al., 2019; Nilsson, 2015; Nüesch-Inderbinen et al., 2019). These resistances render bacteria less susceptible to extended-spectrum cephalosporins, which are considered critical in human medicine (WHO, 2018).

Several studies have shown that dogs fed RMDs were much more likely to shed *Salmonella* spp. and antimicrobial-resistant *E. coli* than dogs fed a non-raw commercial diet (Finley et al., 2007; Groat et al., 2022; Lefebvre et al., 2008; Leonard et al., 2011; Schlesinger and Joffe, 2011). In addition to bacteria, raw meat products can transmit parasitic pathogens (including zoonotic parasites such as *Toxoplasma gondii*, *Sarcocystis* species, *Echinococcus granulosis*, and *multilocularis*) unless they are frozen at the retail or consumer level, a process that kills parasites (Deplazes et al., 2016; Hinney, 2018; Meyer and Zentek, 2010; Strohmeyer et al., 2006; van Bree et al., 2018).

These pathogens can either directly infect raw meat-handling persons, especially when hygienic procedures are lacking, or be shed by pets that have ingested contaminated meat, posing a clinical risk to the owner and others, especially young, old, pregnant, and immunocompromised individuals (Behravesh et al., 2010; Finley et al., 2007; KuKanich, 2011; Sato et al., 2000). Although previous research found only a very low pathogen transmission rate from an RMD to a family member, this may underestimate the true rate, as foodborne illnesses are widely underdiagnosed and underreported (Anturaniemi et al., 2019; Havelaar et al., 2013). Parasites potentially present in raw meat, if not

frozen at one stage before feeding, can potentially be shed via faeces and enable parasitic life cycles by infecting livestock, thus also affecting food production (Hinney, 2018). The European Food Safety Authority has consequently recognised the feeding of raw meat to pets as an emerging public health risk (European Food Safety Authority (EFSA) et al., 2020).

Dogs do not necessarily show symptoms when carrying and shedding *Salmonella*; however, immunodepression and very young and old age can facilitate the development of clinical diseases (Carter and Quinn, 2000; Joffe and Schlesinger, 2002; Leonard et al., 2011). Therefore, it remains important to handle raw meat products and dogs fed on an RMD with appropriate care and hygiene, both for human and animal health (Runesvärd et al., 2020). However, risks remain, as a previous study has shown how *Salmonella* spp. from raw meat can persist in dog bowls even after cleaning (Weese and Rousseau, 2006). Heat treatment in CCDs is an efficient step in eliminating these pathogens. Although contamination can also occur in dry and semi-moist pet feeds, these are much less common, and dogs on CCDs are less likely to shed these pathogens (Bojanić et al., 2017; Joffe and Schlesinger, 2002; Nemser et al., 2014; Runesvärd et al., 2020).

1.2.3. Risk perception

Risk perception and safe handling of feed are related to several factors, including risk awareness, beliefs, and knowledge of how to mitigate these risks (de Andrade et al., 2019; Machado Nardi et al., 2020; Ovca et al., 2024; Zanin et al., 2017). Pet owners' perceptions of RMDs differed from the actual nutritional and health risks. In a study by Empert-Gallegos et al. (2020), over 70 % of raw feeders rated their commercial or homemade RMDs as highly nutritious and were not likely to rate RMD as risky to human or animal health. Similar findings from another study reported that almost all RMD feeders thought that RMDs were safe for pets, and almost two-thirds thought that dogs could not get sick from consuming RMDs (Morelli et al., 2019). In a study with North American dog breeders feeding various diets, 41 % did not think healthy adult dogs and puppies had a health risk when eating RMD (Connolly et al., 2014). On the other hand, CCDs were rated as highly risky to canine health by 65 % of RMD feeders and even by 25 % of CCD feeders (Empert-Gallegos et al., 2020). However, it remains unclear which health risks, in particular, they perceived. Additionally, only about half of the CCD feeders in the same study rated CCDs as highly nutritious.

1.3. Study Aim

To help dog owners make informed decisions regarding dog feed in light of recent trends, it is important to understand their risk perceptions and develop appropriate communication formats. Especially when choosing raw diets, the risks associated with these diets need to be understood by dog owners and they need sufficient knowledge to mitigate these risks. The discrepancy between risk and risk perception emphasises the need for targeted risk communication. The present study consisted of two parts: a pilot study with qualitative interviews and a main study with a quantitative survey. The pilot study consisted of interviews with experts and dog owners with the goal of identifying and understanding common beliefs and perceived risks associated with different diets, especially raw feeding. It was intended to uncover discrepancies between expert knowledge or recommended behaviours and dog owners' self-reported behaviour.

The main study involved a quantitative survey. The first aim of the survey was to understand the extent to which dog owners perceived the risks associated with different diets. It was designed to identify and describe dog owners' feeding behaviour in Switzerland. By recruiting a sample of Swiss dog owners feeding any diet and an additional sample of dog owners feeding specifically a raw diet, the present study intended to understand the differences in risk perceptions between the 'conventional diet' and 'raw diet' groups. For this, the focus was on both microbiological risks for handlers and dogs, as well as nutritional risks for dogs. The second aim was to identify and quantify the knowledge and beliefs that are predominant in dog owners feeding alternative diets and that may differ from expert advice.

2. Methods

2.1. Study Design

The mental model approach was used as a framework for the present study, as it provides a structured approach to developing risk communication (Morgan, 2002). It consists of several steps aimed at ensuring an encompassing view of the risks (Table 1).

In the present study, which was conducted in Switzerland, the first and second steps involved the creation of an expert model of risks through expert interviews and interviews with dog owners who feed raw meat diets.

The interviews with experts and dog owners constituted the pilot phase of the present study. The results of the interviews were then used to aid in the development of the confirmatory questionnaire, which represents the third step of the mental models approach and is the main part of the present study. Based on the results of this confirmatory questionnaire, the fourth step of the mental models approach of developing risk communication is outlined in the discussion.

2.2. Pilot Study

Methods. Participants for the interviews ($n = 10$ dog owners and $n = 6$ experts) were recruited via personal contacts of the researcher for the expert interviews and the distribution of flyers with basic information on the interview topic to pet-shops, dog schools, and a veterinary clinic for the dog owner interviews. The experts were researchers and veterinarians in the fields of small animal health, food safety and hygiene, microbiology, animal nutrition, and animal gastrointestinal diseases. Dog owners were required to either feed a raw homemade or a raw commercially available diet. All interview participants provided informed consent prior to the interview recording. Semi-structured interviews with expert and dog owners were conducted by two different interviewers, accompanied by regular exchanges between the interviewers, with each interview taking 45–60 min. The expert interviews focused on the risks associated with raw feeding and measures to mitigate these risks. Dog owners were asked to describe their feeding habits and reasons for feeding and to answer open questions about the advantages and disadvantages of different feed types, as well as about behaviours related to food hygiene. Emphasis was placed on risks associated with feeding, beliefs about them, and mitigation strategies.

Data Analysis. Each interview was transcribed for analysis. A reflexive thematic analysis approach (Braun and Clarke, 2021, 2006) was used to analyse the transcripts. Each interview was coded using NVivo 13 (Lumivero, 2013). Codes were generated in an inductive way and later refined in a deductive way based on the research questions with a focus on the following topics: behaviour description, beliefs and

Table 1
The mental models approach to risk communication.

Mental model steps		Implementation in the present study
Step 1	Development of an expert model (literature review, expert interviews)	Introduction and pilot study
Step 2	Lay people interviews	Pilot study
Step 3	Confirmatory questionnaire	Main study
Step 4	Risk communication – Development and implementation	Discussion
Step 5	Risk communication – Evaluation	

Source. Morgan, 2002

motivations, risks and disadvantages, trust, and information sources. The codes were then analysed to find shared patterns and meaningful connections, which led to several overall themes.

Results. The first theme concerned the convictions of owners about raw feeding for optimal health and naturalness. Most dog owners chose RMDs for their perceived nutritional benefits ($n = 10$) and their higher naturalness ($n = 9$) compared to CCDs, with six participants comparing them to the diets of wild wolves. The second theme focused on the practices of raw feeding and implementation efforts. Participants reported a variety of feeding practices, including ready-made RMDs and homemade diets with several types of meat, offal, and raw bones. Home-prepared diets often included vegetables and some added dried premixes. Most added different types of supplements to the diet ($n = 7$), including garlic ($n = 1$). The added oils included premixed BARF oil, and all types of oils used in human cooking. Three participants also added raw eggs (only egg white, yolk, or complete eggs). One participant avoided carbohydrates, while the others included rice or potatoes in their dogs' meals. Only one participant strictly followed a feeding plan; the others reported feeding based on experience or intuition. The third theme pertained to the health risks of raw diets and ensuring safety and correct diet composition. Knowledge about the possibility of bacterial presence in raw meat products and the severe consequences of food-borne diseases and risk groups was common among the participants ($n = 9$). All dog owners were confident in their ability to handle raw meat safely and saw little risk of infection for themselves or their dogs. They relied on their own and their dogs' visual and olfactory assessments to determine meat quality, and many believed that if meat was 'human grade', it would be safe to be consumed raw by humans. Four participants believed that the bacteria in raw meat were natural and could boost the immune system of dogs. While most participants knew about the importance of maintaining a cold chain ($n = 9$), some believed that freezing meat would eliminate bacteria. They often subjected meat to multiple freeze-thaw cycles for easier mixing and portioning, and defrosting methods varied from the fridge to room temperature to hot water. Regarding health monitoring, only four dog owners conducted regular blood checks on their dogs. Those who did were primarily concerned with ensuring that the diet was nutritionally sufficient. Four participants acknowledged the risk of nutritional imbalance if the diet was not well planned, and one stressed the importance of professional guidance.

The first theme identified in the expert interviews pertained to the challenge of achieving the correct nutritional composition. Two experts mentioned that many raw feeders oversupply their dogs with bones, resulting in an incorrect calcium-phosphorus ratio. They also mentioned the necessity of feeding dietary fibre to prevent diarrhoea. One expert stated the importance of using the correct oils, as coconut and olive oils are suboptimal for supplying essential fatty acids. Additionally, providing whole raw eggs or raw egg whites can result in biotin deficiency. All experts stressed the importance of calculating and adapting rations to ensure correct diet composition. Three experts mentioned that feeding an unbalanced diet had more serious consequences in young dogs than in adult dogs. Two experts emphasised the fact that both RMDs and CCDs can be of low nutritional quality and that there are good and bad diets in every category of feed, but they also emphasised that they would recommend a conventional diet for the adequate life stage rather than a raw meat diet. The second theme concerned the health risks associated with pathogens. Regarding microbiological risks, experts' unified opinion was that dogs can shed bacteria and transmit antimicrobial resistance via faeces and saliva. Three experts highlighted the risk of feeding raw meat to young dogs, as the permeability of the intestinal barrier is higher than that in adult dogs, increasing their risk of infection.

In the development of the main survey, the results obtained in this pilot study were used to phrase items focusing on the theme of health risks of raw diets and ensuring safety and correct diet composition. This included knowledge items on specific nutritional and hygiene topics, as well as risk perception and belief items.

2.3. Main Study

2.3.1. Questionnaire

The survey was programmed using Qualtrics (Qualtrics, Provo, UT, USA). After clicking on the link to the questionnaire, participants were asked to provide informed consent before being able to continue with the questionnaire. At the beginning of the questionnaire, participants were asked about their age and information about the dog(s) they owned: number, age, weight, and breed. Participants were informed that they should only think of one of their dogs to answer all the remaining questions to ensure that their responses were based on the feeding habits, preferences, and needs of a single dog, providing a consistent frame of reference for analysis. The first part of the questionnaire was developed to understand current feeding habits. Participants were asked to indicate how frequently they used which main feed for their dog on a 6-point scale (1 = never, 2 = rarely, 3 = 1–3 times per month, 4 = 1–3 times per week, 5 = 4–6 times per week, 6 = (several times) daily). The five feed types were three types of commercially available feed (dry, wet, raw), homemade raw feed, and other, for example, homemade cooked feed. They were asked how long they had been feeding this way (1 = less than 6 months, 2 = 6 months to 2 years, 3 = 2–5 years, 4 = more than 5 years). Next, they were asked how frequently (with the same 6- point Likert scale as for the main feed) they added the following items to the diets: raw meat, whole raw bones, raw fish, whole raw eggs, food supplements and additives: oil, powders, capsules (e.g. vitamins, trace elements, etc.). They could indicate whether their dog had special dietary requirements (no / allergy or intolerance / gastro-intestinal issues, e.g. diarrhoea, vomiting, obstipation, pancreatitis / over- or underweight / general disease, e.g. diabetes, liver, kidney, heart or other disease). An open question asked participants to state their main reason for their diet choice. Four behavioural questions related to preventive measures were asked: one about weighing or measuring the dogs' feed to ensure the correct amount (5-point Likert scale from never to always) and three questions about medical examinations: whether they did laboratory testing of blood, faeces, or other examinations (1 = never, 2 = once, 3 = once per year, 4 = more often, 5 = in case of illness/ symptoms).

In the second part of the questionnaire, all participants (independent of their own feeding habits) answered questions regarding the risks associated with the four different types of dog feed. The four different types of dog feed rated by the participants were as follows: 1) dry commercial diet, 2) wet commercial diet, 3) raw frozen commercial diet, and 4) raw homemade diet. Each diet was presented with a picture and label indicating its ingredients (Fig. 1). This part started with a vignette in which participants were introduced to an imaginary person and their dog, who were in the process of choosing a diet and worried about problems that could arise through feeding. This setting was chosen so that participants had to think about the diets in a general way by recommending them to a virtual stranger and not considering their personal situation (e.g. financial) or necessities (e.g. allergies of their dog).

All diets contained the same ingredients to ensure that variability in participants' responses would not be due to preferences for or aversion to specific ingredients or differences in nutritional quality. All but the homemade raw diet also had similar additives indicated and were labelled as 'complete feed for dogs'. This label was not used for the home-made diet, as an analysis of whether this diet would be a complete diet is not usually done. Every participant replied to all four types of diet, with the order of presenting the diets randomised. For each type of diet, participants were asked to imagine that the person from the vignette fed exclusively with this diet and to rate the risks on a 5-point Likert scale from 1 = very low, 2 = rather low, 3 = moderate, 4 = rather high to 5 = very high. There were seven types of risks: 1) digestive problems (obstipation, bloating, injuries), 2) disease of the dog because of bacteria, parasites, or virus, 3) disease of the owner or other

Fig. 1. Pictures and information provided for the risk assessment of four different diets Note. The risk assessment was introduced with a vignette: 'Below we describe a fictitious dog owner. Please try to empathise with the situation as best you can. Alex has a dog called Sam who should stay healthy and happy. Now Alex is faced with the challenge of choosing the right food for Sam and asks you for advice. Alex wants to do everything right and is therefore worried about various problems that can arise from feeding. On the following pages you will see some of the foods Alex is considering. We ask you to assess them.' The pictures of the diets were associated with the question 'Imagine Alex wants to feed Sam exclusively with the diet described. What do you think?', followed by items related to different potential risks.

people because of bacteria, parasites, or virus; risk of inadequate nutrition because of 4) unnecessary or unwanted ingredients, 5) lack of ingredients (e.g. vitamins, proteins, minerals), 6) oversupply with ingredients (e.g. vitamins, proteins, minerals), and 7) quality defects due to the manufacturing process (e.g. cooking, drying, freezing).

The third part of the questionnaire was intended to evaluate participants' beliefs and knowledge. They were asked how much they agreed (1 = not at all, 5 = completely agree) with two beliefs: 'Ideally, a dog should eat like a wolf.' and 'Dog owners that only open a bag or can do not take good care of their dogs.' Knowledge assessment was divided into subjective and objective knowledge. Participants were asked to rate their own knowledge on a 5-point Likert scale (1 = am not familiar with it, 5 = know it very well) for four topics: kitchen hygiene with raw meat, foodborne diseases in dogs and humans, compilation of feed for dogs that meet their nutritional needs, and consequences and symptoms of nutrient deficiency/oversupply in dogs. Following this subjective assessment, 14 objective knowledge statements were presented to the participants in a randomised order. Participants were asked to choose whether the statements were 'Correct' or 'Incorrect', with the option of answering 'Do not know'. Half of these items concerned hygiene and microbiological hazards associated with raw meat, while the other half concerned the nutritional aspects of dog feeding. The complete wording of the items can be found in the results section.

In the final part of the questionnaire, participants provided personal information, including gender, country, living environment, education, diet, and frequency of meat preparation. They also provided information on whether they worked in an animal or nutrition-associated field. This study was approved by the (redacted for review).

2.3.2. Sample

The recruitment for the questionnaire was implemented using a twofold approach. To obtain a heterogeneous sample of dog owners, a commercial panel provider was used to collect data in Switzerland (Bilendi GmbH, Berlin, Germany). Age quotas (three groups: 18–35, 36–50, > 50 years) were designed to meet an even distribution. Additional oversampling for raw feeding dog owners in Switzerland, Germany, and Austria was conducted via flyers in pet shops, on social media for German-speaking dog owners (X, Facebook), and through personal contacts of the researcher. Even with additional recruitment, reaching equal sample sizes in both groups of conventional and raw-feeding dog owners was assumed beforehand to be difficult. Therefore, in calculating the sample sizes with the conventional group about 3x larger than the raw diet group and medium effect sizes, the power analysis for *t*-test comparing the means of two independent groups reached the following results: The total required sample size ranges from approximately 438 participants for an effect size of 0.4 (Group 1: 329, Group 2: 109) to 776 participants for an effect size of 0.3 (Group 1: 583, Group 2: 193). Data were collected in October 2024.

Prior to completing the questionnaire, all participants provided informed consent. After excluding 19 participants who completed the survey in less than half of the median completion time (351 s), the final sample consisted of $n = 601$ participants, of which $n = 525$ were recruited by the market research panel and $n = 76$ by additional recruitment. Participant characteristics and information on their dogs are displayed in Table 2.

2.3.3. Data analysis

The prevalence of feeding different diets was analysed in the sample provided by the market research panel ($n = 525$) to ensure the best possible representation of feeding habits in Switzerland. For the remainder of the analyses, the entire sample was used ($n = 601$). Based on answers to the questions asking for the main diet that they fed, participants were allocated to a 'RMD' (raw meat diet) group ($n = 142$) if they indicated to feed *either* a homemade raw *or* a commercially available raw diet at least four times per week, or if they indicated on *both* these diets to be feeding them at least one to three times per week.

Table 2
Participant characteristics, n = 601 dog owners.

Variable		Total Sample ($n = 601$)	CCD ($n = 459$)	RMD ($n = 142$)
Age, years (*M* [*SD*])		44 (14.2)	44 (14.5)	43 (12.9)
Gender	Female	426 (71 %)	312 (68 %)	113 (80 %)
	Male	173 (29 %)	146 (32 %)	27 (19 %)
	Diverse	2 (0.3 %)	1 (0 %)	1 (1 %)
Residence	Countryside	342 (57 %)	265 (58 %)	77 (54 %)
	Suburbs	147 (24 %)	112 (24 %)	35 (25 %)
	City	112 (19 %)	82 (18 %)	30 (21 %)
Education Level	Low/None (compulsory formal education)	36 (6 %)	34 (7 %)	2 (2 %)
	Medium (e.g. vocational training)	404 (67 %)	313 (68 %)	91 (64 %)
	High (university education)	161 (27 %)	112 (25 %)	49 (35 %)
Country[1]	Switzerland	543 (90 %)	455 (99 %)	87 (61 %)
	Germany	51 (8 %)	4 (1 %)	47 (33 %)
	Austria	7 (2 %)	-	7 (5 %)
	Other (Ukraine)	1 (-)	-	1 (1 %)
Diet	Omnivorous	516 (86 %)	390 (85 %)	126 (89 %)
	Vegetarian	51 (9 %)	43 (9 %)	8 (6 %)
	Pescetarian	20 (3 %)	14 (3 %)	6 (4 %)
	Vegan	14 (2 %)	12 (3 %)	2 (1 %)
Raw Meat Preparation	Several times weekly/daily	433 (72 %)	302 (66 %)	131 (92 %)
	At least monthly	123 (20.5 %)	112 (24 %)	11 (8 %)
	Less often/never	45 (7.5 %)	45 (10 %)	-
Profession	Unrelated	560 (93 %)	440 (96 %)	120 (85 %)
	Related (e.g. animal nutrition, veterinary)	41 (7 %)	19 (4 %)	22 (15 %)
Dog, Number owned (Median [Range])		1 (1 – 11)	1 (1–6)	1 (1–11)
Dog, Age in years (*M* [*SD*])		7 (0.3 – 21)	7 (0.3 – 21)	5 (0.3 – 15)
Dog, Weight in kg (*M* [*SD*])		18 (1 – 66)	18 (1–65)	20 (3.5 – 66)
Dog, Breed	Mongrel	224 (37 %)	178 (39 %)	46 (32 %)
	Pedigree	377 (63 %)	281 (61 %)	96 (68 %)

Note. CCD - Conventional Cooked Diet group ($n = 459$); RMD - Raw Meat Diet group ($n = 142$). The table describes the participant characteristics displaying *n* (%), unless otherwise specified. *M* - Mean, *SD* - Standard Deviation.
A large group reported having fed in the same way for more than 5 years ($n = 262$, 44 %) and 30 % ($n = 182$) between 2 and 5 years. Only 20 % ($n = 118$) had fed in the chosen manner for 6 months up to 2 years, and 6 % ($n = 39$) had started in the last 6 months.

All other participants ($n = 459$) were allocated to the 'CCD' (conventional cooked diet) group.

Differences in preventive behaviour between the two groups was analysed using Pearson's chi-square tests of independence. To understand the differences between participant groups and risk ratings of the four different diets, a series of independent t-tests were conducted. Given that multiple comparisons were made, Bonferroni correction was applied to adjust for the increased risk of Type I errors. To explore the two groups' differences in subjective knowledge and beliefs, independent t-tests were conducted, and Hedges' g was calculated as a measure of the effect size. The relationship between the participants' responses to the objective knowledge questions across the two participant groups was examined using Pearson's chi-square tests for each question. Goodman and Kruskal's gamma statistic (Goodman and Kruskal, 1979) was used as a measure of association to assess the strength and direction of the

relationship between the variables. For this, the responses were ordered in the following way: correct, do not know, incorrect. Therefore, acknowledging the lack of knowledge was considered preferable to a false conviction.

Statistical significance was set at a p-value < 0.05. All statistical analyses were performed using the R software (R Core Team, 2023).

3. Results

3.1. Prevalence of raw meat diets

The results reported in this paragraph are based on the sample provided by the market research panel ($n = 525$). Using the groups described above, 15 % ($n = 70$) of the panel belonged

to the RMD group; that is, they were feeding raw main meals at least twice per week. Fig. 2 shows the percentages and frequencies for feeding main and additional feed.

While raw meat was not the main diet fed by the majority of participants, 66 % ($n = 437$) reported adding raw meat elements to the feed, at least sometimes. In addition, raw bones seemed to be regularly added, with 26 % of the participants ($n = 135$) adding them at least monthly. Raw fish were used less, with 73 % ($n = 381$) never adding it. It is worth noting that feeding whole raw eggs was only reported at a high frequency, more than 4x per week, by eight participants, but many participants gave it sometimes ($n = 125$, 24 % at least monthly and 18 % ($n = 93$) who provided it seldom). Supplementation with oils, powders, and capsules was frequently reported, with 37 % ($n = 196$) providing supplements at least monthly. Participants stated health, digestibility, and the quality of the ingredients as the main reasons for their diet choice. A detailed table listing the reasons by participant group can be found in Table S1 of the Supplementary Material.

To assess behaviour associated with different feeding habits (CCD and RMD groups), the answers for the behavioural items in the entire sample were analysed ($n = 601$). The results of the Chi Square tests (Table 3) indicated a significant association between participant group and the distribution of responses for weighing feed, as well as blood and faecal examinations, but not for other examinations. Weighing of the dog's feed was common among both groups, with approximately half of the participants in each group always doing so. In the CCD group, a slightly higher proportion of participants never weighed or measured

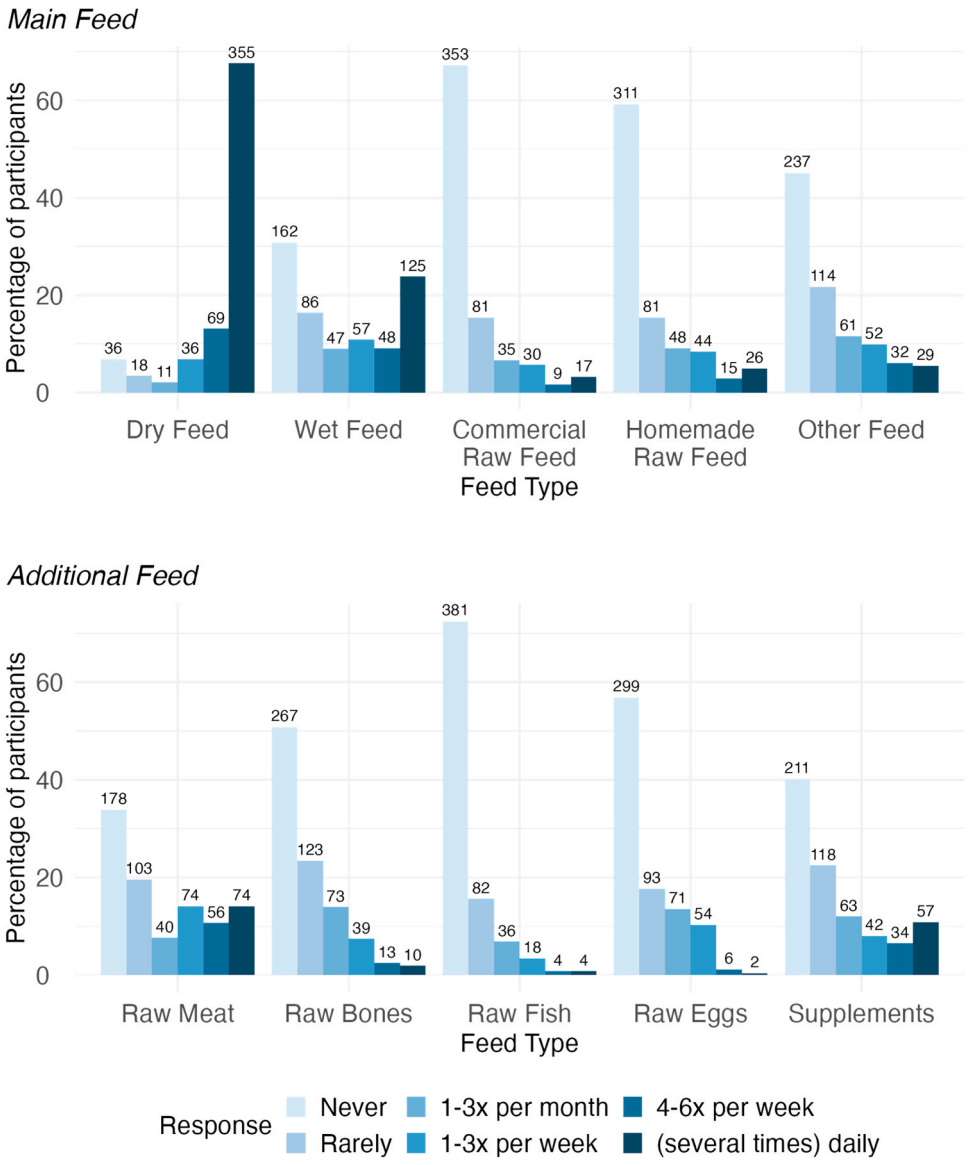

Fig. 2. Percentages and frequencies of Swiss dog owners ($n = 525$) using different main and additional feed Note. $n = 525$. The 96 participants of the additional sample feeding raw diets were not included. Numbers on the bars indicate response frequencies.

Table 3
Frequencies, percentages and group comparisons of preventive behaviour, $n = 601$.

	Never	Rarely	Sometimes	Often	Always
I weigh my dog's feed or use a measuring jug.					
CCD	101 (22 %)	40 (9 %)	38 (8 %)	51 (11 %)	229 (50 %)
RMD	19 (13 %)	12 (9 %)	9 (6 %)	27 (19 %)	75 (53 %)
$\chi2(4) = 9.9$, $p = .041$					
	Never	**Once**	**Yearly**	**More often**	**Only when sick**
To check my dog's health, I do a blood test.					
CCD	101 (22 %)	50 (11 %)	143 (31 %)	16 (4 %)	149 (33 %)
RMD	19 (13 %)	10 (7 %)	55 (39 %)	11 (8 %)	47 (33 %)
$\chi2(4) = 11.9$, $p = .018$					
To check my dog's health, I do a faecal examination					
CCD	145 (32 %)	50 (11 %)	66 (14 %)	18 (4 %)	180 (39 %)
RMD	22 (16 %)	8 (6 %)	28 (20 %)	23 (16 %)	61 (43 %)
$\chi2(4) = 39.5$, $p < .001$					
I do other examinations.					
CCD	195 (43 %)	12 (3 %)	66 (14 %)	19 (4 %)	167 (36 %)
RMD	55 (39 %)	3 (2 %)	18 (13 %)	5 (4 %)	61 (43 %)
$\chi2(4) = 2.0$, $p = .728$					

Note. Participant Groups: CCD – Conventional Cooked Diet ($n = 459$), RMD – Raw Meat Diet ($n = 142$).

their dog's feed. A higher proportion of RMD participants reported conducting blood and faecal examinations yearly or more often than in the CCD group.

Risk

Nutritional Risks. The participants' responses to the nutritional risk evaluations of the four feed types are shown in Fig. 3.

For dry feed, the RMD participants perceived all five nutritional risks to be significantly higher than the CCD participants. The reverse was true for homemade raw feed: CCD participants perceived significantly higher risks across the five risk types than RMD participants. The differences between participant groups were not significant for wet feed across all five risks, and only 13–20 % of all participants perceived wet feed to be a rather high or very high risk for any of the nutritional risks. For risk perception of lack or oversupply with ingredients in commercial raw feed, the group comparisons also did not result in significant differences. However, concerning quality defects, inclusion of unnecessary or unwanted ingredients, and digestive problems associated with commercial raw feed, the *t*-test revealed a significantly higher risk perception of CCD participants compared to that of RMD participants.

Microbiological risks. The results for the two microbiological risks are shown in Fig. 4. Less than 9 % of all participants perceived dry feed as a high risk to either dog or human health. CCD participants perceived wet feed to be associated with a significantly higher risk for the dog, but not for the owner, than RMD participants. Overall, risk perception showed an increasing pattern from dry feed to wet, commercial raw, and homemade raw feed in both groups. For homemade raw feed, nearly half of the CCD participants perceived the disease risk for the dog as rather high or very high, while only 14 % of the RMD participants answered with these options. Fewer CCD participants perceived homemade raw feed as a risk to humans compared to dogs, whereas about the same percentage of RMD participants perceived the disease risk for dogs and humans to be high or very high (14 % resp. 13 %). Risks for humans and dogs associated with both types of raw feed were perceived as significantly lower by RMD participants than by CCD participants.

Knowledge and beliefs

When evaluating their own knowledge of four different nutrition and hygiene related topics, participants in the RMD group rated their knowledge higher than participants in the CCD group. This was the case among all four subjective knowledge items, with medium effect sizes for knowledge about hygiene, disease, and nutritional consequences (Table 4). Strong effect sizes were observed in the differences in subjective knowledge of nutritionally correct diet composition.

Seven objective knowledge questions contained incorrect statements (marked with a star (*) in Figs. 5 and 6). The figures do not show the original responses but rather indicate whether the response provided was correct.

The hygiene knowledge items are shown in Fig. 5. Chi-square tests revealed significant differences in four of the seven items. The RMD group had a significantly higher proportion of incorrect answers in the three items regarding the potential presence and dangers of pathogens for humans and dogs. The positive Gamma values indicate that participants in the RMD group were more likely to choose 'do not know' or give an incorrect response than participants in the CCD group. The item concerning the best defrosting practices elicited significantly more correct answers in the RMD group, with RMD participants more likely to choose a correct answer. No significant differences were found between the two groups for the other hygiene statements.

For the nutrition knowledge items (Fig. 6), the RMD group had significantly more correct answers on the four statements regarding ingredient knowledge. The negative Gamma values indicate that participants in the RMD group were more likely to choose a correct answer than participants in the CCD group. All four items had a high percentage of 'Do not know' responses (35 % or higher) in the CCD group. Most participants in both groups answered incorrectly to the item regarding the possibility of detecting nutritional deficiencies, but more participants in the RMD group than in the CCD group chose the correct answer. The question about labelling was answered correctly by more participants in the CCD group than in the RMD group. A large majority in both groups correctly answered *'The wrong feed composition can have long-term health consequences'* with no significant difference between the groups.

In addition to the knowledge questions, two beliefs about feeding were assessed, with one referring to its association with care and the other comparing dogs to wolves (Table 5). The results of the independent t-tests suggest that there is a significantly higher agreement for both statements in the RMD group than in the CCD group, with moderate to high effect sizes.

4. Discussion

4.1. General

The present study aimed to elucidate the differences in risk perception and knowledge between Swiss dog owners feeding commercial cooked diets and those feeding raw diets. The findings revealed an opposing trend in nutritional risk perception, with CCD participants perceiving an increase from dry to homemade raw diets and RMD participants perceiving a decrease. Both CCD and RMD feeders had a higher microbiological risk perception for homemade raw diets than for commercial dry diets. However, RMD participants perceived the microbiological risk for humans and dogs associated with raw diets to be lower than CCD participants did. Regarding knowledge, RMD feeders perceived themselves as significantly more knowledgeable than CCD feeders; however, objective knowledge measurements revealed specific gaps in nutrition and hygiene.

4.2. Prevalence and feed choice

Raw feeding is prevalent in Switzerland, and while raw meat was not the main diet for most participants' dogs, adding raw meat elements to the feed was common. Data on feeding practices in Switzerland are scarce, and previous studies in other countries have shown wide ranges (between 10 % and 60 % of raw meat feeding) among dog owners and breeders, depending on whether it was the main feed or added to the diet (Connolly et al., 2014; Dodd et al., 2020; Laflamme et al., 2008).

The present study found that health, digestibility, and ingredients were the main reasons for feed choice. In a study by Morgan et al.

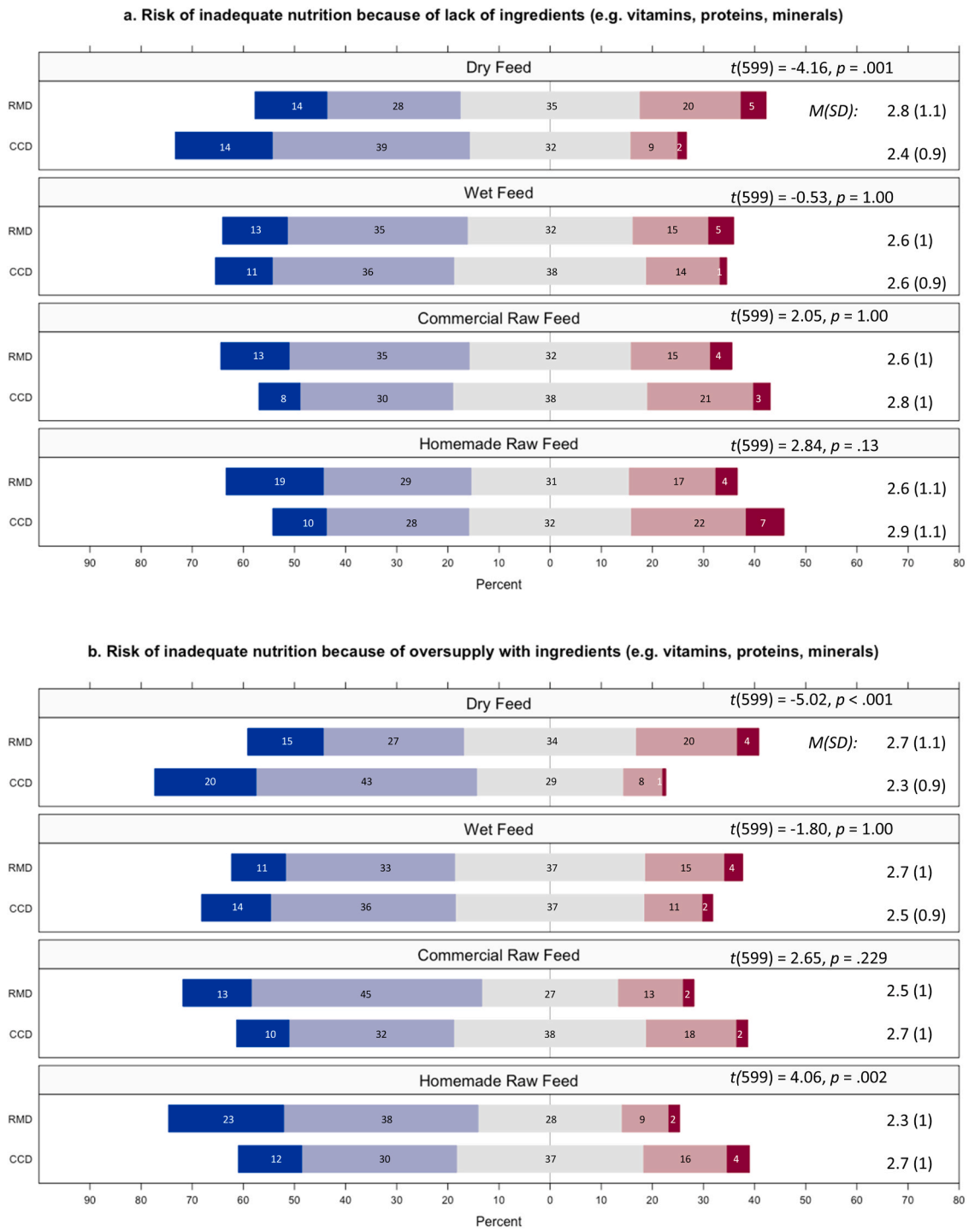

Fig. 3. Nutrition risk ratings means, standard deviations and t-tests, by feed type and participant group, $n = 601$ dog owners Note. Participant Groups: CCD – Conventional Cooked Diet ($n = 459$), RMD – Raw Meat Diet ($n = 142$). M – Mean, SD – Standard deviation. Participants were asked to rate each risk on a 5-point Likert scale from 1 = very low to 5 = very high. Numbers on the bars indicate percentages; any differences to 100 % are due to rounding.

(2022), raw meat feeders frequently mentioned naturalness as a reason for their diet choice. Feeding more naturally is associated with preferring feed with a lower level of processing (for example, physical, heat) or rejecting the inclusion of synthetic additives (for example, vitamins) and preservatives, as this is seen as unhealthy (Billinghurst, 1993; Empert-Gallegos et al., 2020; Freeman et al., 2013; Morelli et al., 2019). In a US study, more than two-thirds of dog owners feeding raw stated concerns about the safety, quality control, or nutritional value of commercial feeds as a reason for feeding raw (Morgan et al., 2017).

4.3. Risk perception

For nutritional risks, CCD participants showed an increase in nutritional risk perception from dry diets to homemade raw diets, while the RMD participants showed a decrease. This is in line with findings from Empert-Gallegos et al. (2020), where a high proportion of RMD feeders

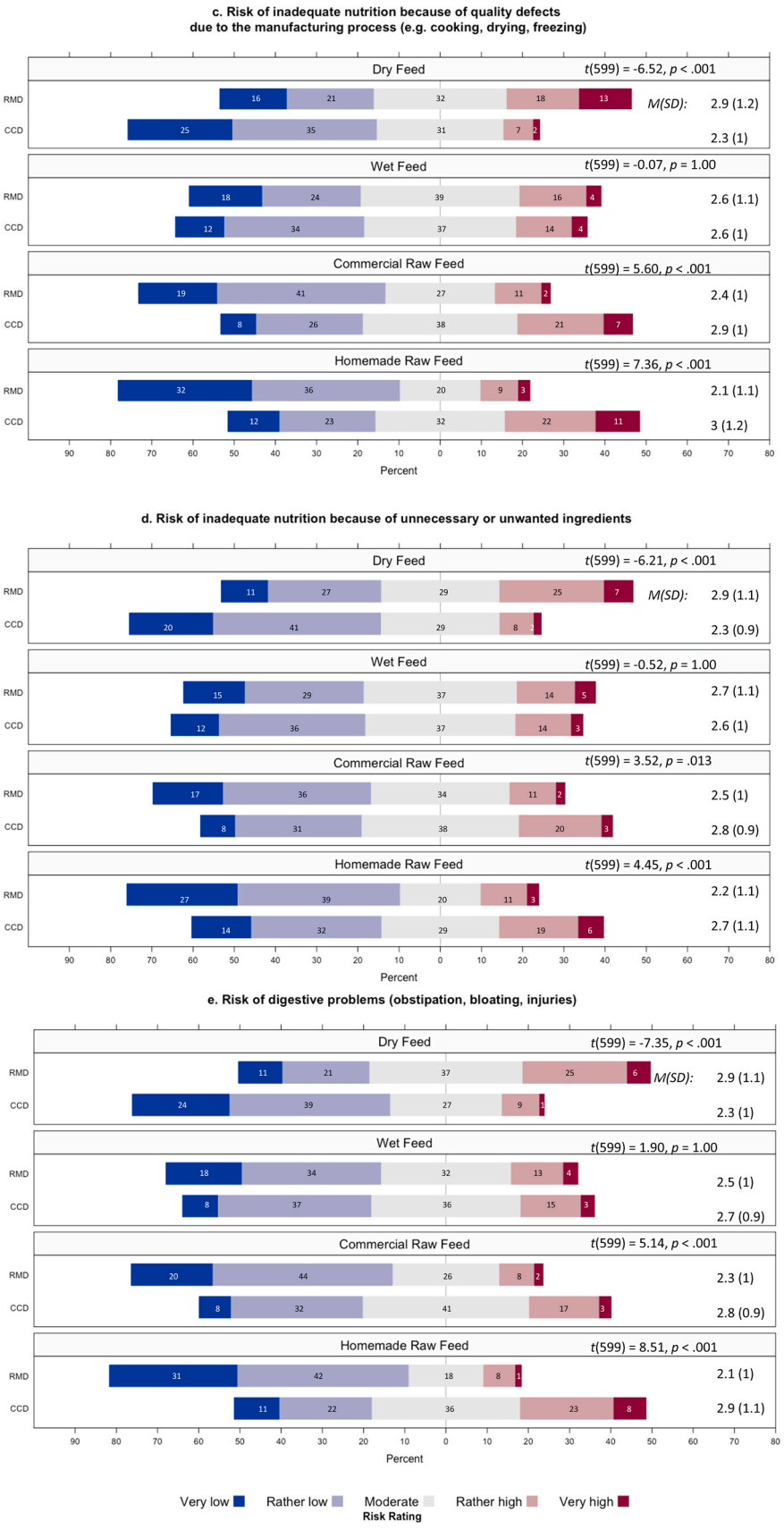

Fig. 3. (*continued*).

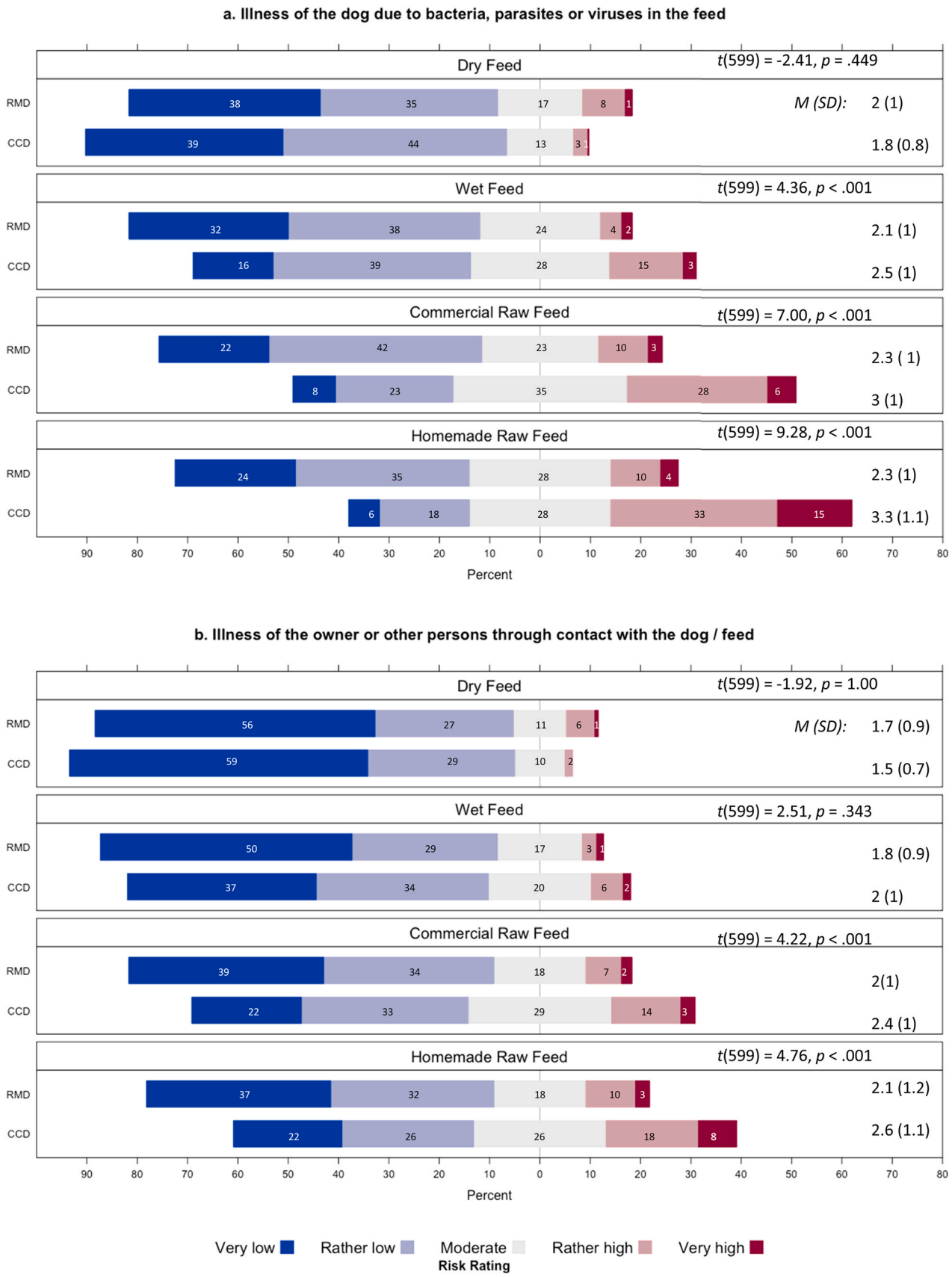

Fig. 4. Microbiological risk ratings means, standard deviations and t-tests, by feed type and participant group, $n = 601$ dog owners Note. Participant Groups: CCD – Conventional Cooked Diet ($n = 459$), RMD – Raw Meat Diet ($n = 142$). M – Mean, SD – Standard deviation. Participants were asked to rate each risk on a 5-point Likert scale from 1 = very low to 5 = very high. Numbers on the bars indicate percentages; any differences to 100 % are due to rounding.

Table 4
Objective knowledge: self-evaluation of participants ($n = 601$).

Variable	Participant Group *M (SD)*		*t*(599)	*p*	Hedges' g
	CCD	RMD			
Kitchen hygiene when handling raw meat.	3.8 (1.1)	4.2 (0.9)	−4.27	< .001	0.41
Foodborne diseases in dogs and humans.	3.2 (1.1)	3.6 (1.0)	−4.63	< .001	0.45
Compilation of feed for dogs that meets their nutritional needs.	3.1 (1.0)	3.8 (0.9)	−7.88	< .001	0.76
Consequences and symptoms of nutrient deficiency and oversupply in dogs.	3.0 (1.0)	3.6 (1.0)	−5.53	< .001	0.53

Note. CCD - Conventional Cooked Diet group ($n = 459$); RMD - Raw Meat Diet group ($n = 142$); M – Mean, SD – Standard deviation. Participants were asked to rate their own knowledge on a 5-point Likert scale (1 = am not familiar with it, 5 = know it very well) for four topics

rated CCDs as risky to canine health. Although the actual risk of lack or oversupply of nutrients in a dry diet labelled 'complete' was low, about a quarter of RMD participants perceived the risk to be rather or very high. This is in line with the fact that the knowledge question about 'complete diets' was answered correctly by less than two-thirds of participants. However, risk perception is not only dependent on knowledge and scientific literacy but also subjective and influenced by trust in authorities and emotional responses to potential hazards (Slovic, 2010, 1999). Additionally, cultural identity and worldview influence the interpretation of scientific information, risk perception, and decision making (Kahan et al., 2012).

As the four diets were designed to be identical, except for no added artificial vitamins and trace elements in the homemade raw diet, the differences in nutritional risk perception between the three commercial diets (dry, wet, and frozen raw diet) are solely attributable to their processing and preservation status. The nutritional risks related to quality defects, unnecessary ingredients, and digestive problems were rated much higher for the dry compared to the commercial raw diet by the RMD participants. This is in line with reports from dog owners in the pilot study. Although some stated that there might be some commercial cooked dry feed that could also have the same high quality that they perceived in fresh and raw diets, most stated that they did not believe this. With the answer pattern in this study, RMD feeders did not seem to have one specific nutritional risk that worried them. The processing and conservation of commercial dry and wet dog feed could lead to reduced perceived naturalness and result in a halo effect when evaluating different risks. A halo effect would suggest that the negative perception of commercial dog feed led RMD participants to rate all five nutritional risks for commercial cooked diets measured in the present study higher than CCD participants (Nisbett and Wilson, 1977).

For human and dog health risks associated with pathogens, both CCD feeders and RMD feeders rated the risks associated with a raw homemade diet higher than for a dry commercial diet. Previous research has shown that pet owners know that microbiological contamination of raw meat can be a food safety risk (Thomas and Feng, 2020). This is in line with expert opinion and previous findings that found higher pathogen contamination in raw diets than in cooked diets and higher bacterial shedding in dogs fed such diets (Bojanić et al., 2017; Joffe and Schlesinger, 2002; Nemser et al., 2014; Runesvärd et al., 2020). However, this increase in risk perception was less pronounced in the RMD group, which rated the health risks of commercial and homemade raw diets significantly lower than the CCD group. Nearly half of the CCD participants saw a rather high or high risk for dog health in homemade raw diets, which is surprising, as previous research has indicated that foodborne pathogenic diseases in dogs are not very common (Carter and Quinn, 2000; Leonard et al., 2011; Schlesinger and Joffe, 2011). The low risk perception of dry commercial dog feed is in line with previous findings, where less than a quarter of participants considered dry diets as a source of foodborne disease (Thomas and Feng, 2020). Some risk remains in cooked diets, such as contamination or spoilage during production or of the opened product (Behravesh et al., 2010; Freeman et al., 2013).

4.4. Behaviour, Knowledge and Beliefs

Measuring dog feed is important to ensure the correct supply of nutrition and energy. Although it is a common behaviour among both CCD and RMD participants, there are participants who hardly report doing this, which could result in energy oversupply or undersupply. Especially among raw feeders who compose dog diets at home, the absence of a measuring implement for feed distribution can lead to both inaccurate energy supply and deficient nutrient composition.

RMD participants rated their subjective knowledge about kitchen hygiene and foodborne diseases higher than CCD participants, although the effect sizes were small, and the means suggest that both groups thought to have at least some knowledge. For objective knowledge about nutrition in dogs, the effect sizes were larger, and the RMD group perceived their own knowledge about diet composition and the consequences of deficiency and oversupply to be good. As this participant group was more likely to be composing their dogs' diets themselves, it is not surprising that they perceived themselves to be knowledgeable in this area. This is in line with previous findings, where raw feeders rated their own knowledge as high or very high (Empert-Gallegos et al., 2020). This high level of subjective knowledge contrasts with the relatively low level of objective knowledge. Although most RMD participants knew that dogs are able to digest carbohydrates, the incorrect belief that carbohydrates were the major cause of allergies in dogs was still common. In fact, most allergies are caused by proteins, and carbohydrates are the least concerning (Bolbecher and Dillitzer, 2020; Meyer and Zentek, 2010). Similarly, there are incorrect beliefs about whether raw egg whites could cause deficiencies (Bolbecher and Dillitzer, 2020; Meyer and Zentek, 2010). Both carbohydrates and eggs are basic ingredients in homemade diets, and their inclusion is likely to be considered by dog owners when compiling a diet. Therefore, some knowledge of them is essential in the effort to formulate correct diets. Over 88 % of the participants were aware that an incorrect feed composition could have health consequences. Therefore, their preventive health behaviours could be associated with an effort at risk mitigation, where satisfactory veterinary test results could provide them with information that their pet's health was not negatively affected by feed choice. However, this might also give them a false sense of safety regarding the nutritional adequacy of their diet. This lack of knowledge about the inadequacy of laboratory examinations for the evaluation of nutrition was higher in CCD participants than in RMD participants. This shows that owners feeding their dogs commercial diets also lacked knowledge. However, this knowledge deficit has potentially fewer consequences, as in RMD participants, because the composition of commercial diets ensures the correct nutritional supply. Furthermore, the interpretation of blood and faecal sample results should be conducted by veterinarians, not the owners, and take into account the dog's diet. Therefore, the lack of knowledge of owners in this domain may be counterbalanced by the professional support of veterinarians. Even though RMD participants were more knowledgeable than CCD participants, they still seemed to lack essential knowledge regarding nutrition, which could be mitigated by expert advice. Although this was not measured in the present study, previous research has shown that only a small percentage of dog owners formulated raw diets with nutritional experts or veterinarians who could provide adequate information (Morelli et al., 2019). Additionally, raw feeders rated their veterinarians' knowledge lower than non-raw feeders in a previous study (Empert-Gallegos et al., 2020).

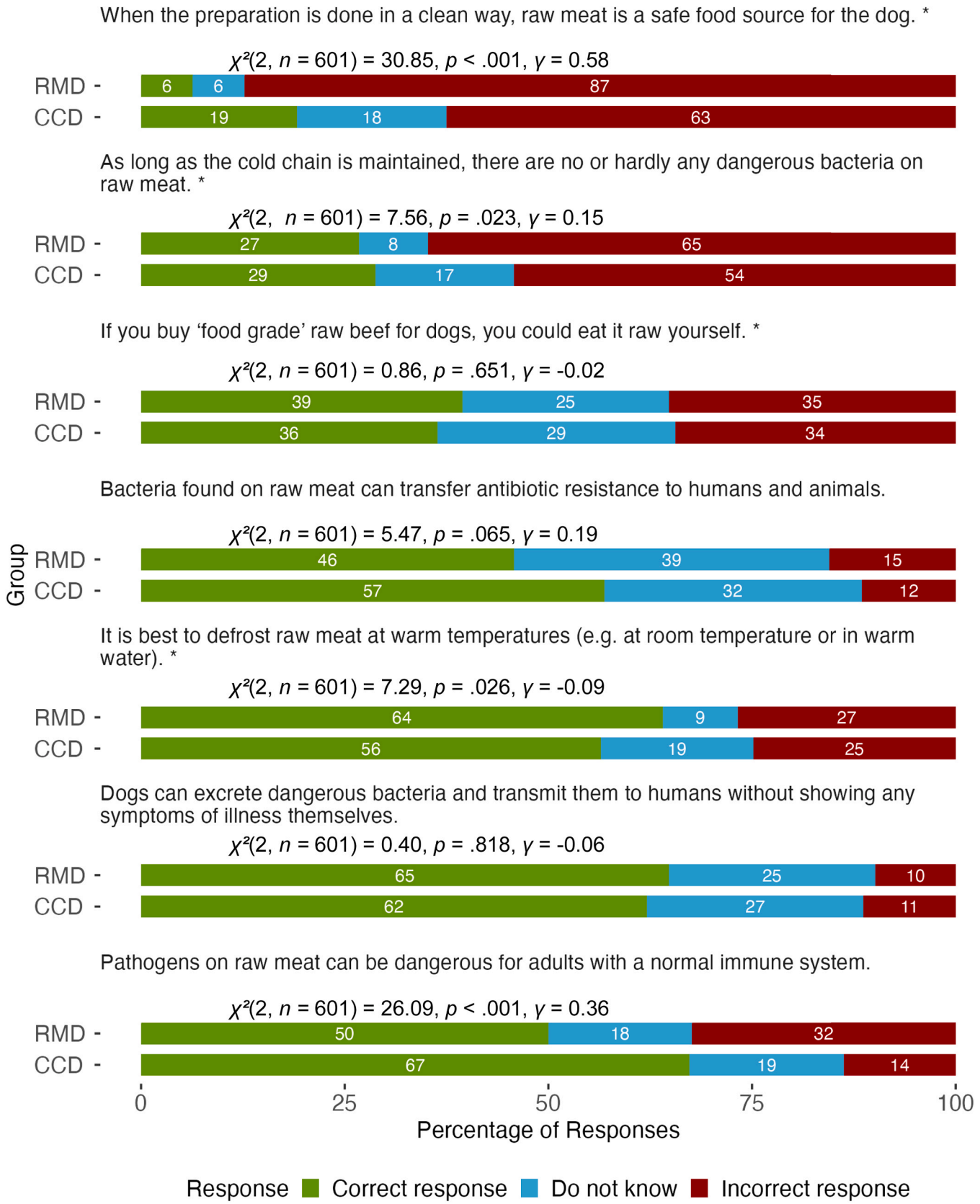

Fig. 5. Responses to hygiene knowledge questions ($n = 601$) Note. CCD – Conventional Cooked Diet group ($n = 459$), RMD – Raw Meat Diet group ($n = 142$). Participants were asked to choose whether the statements were 'Correct' or 'Incorrect' with the option of answering 'Do not know'. Incorrect items are marked with stars(*). Chi-square tests of independence (χ^2) and Goodman-Kruskal's Gamma (γ) were used to assess the association between the participant group (CCD vs. RMD) and knowledge.

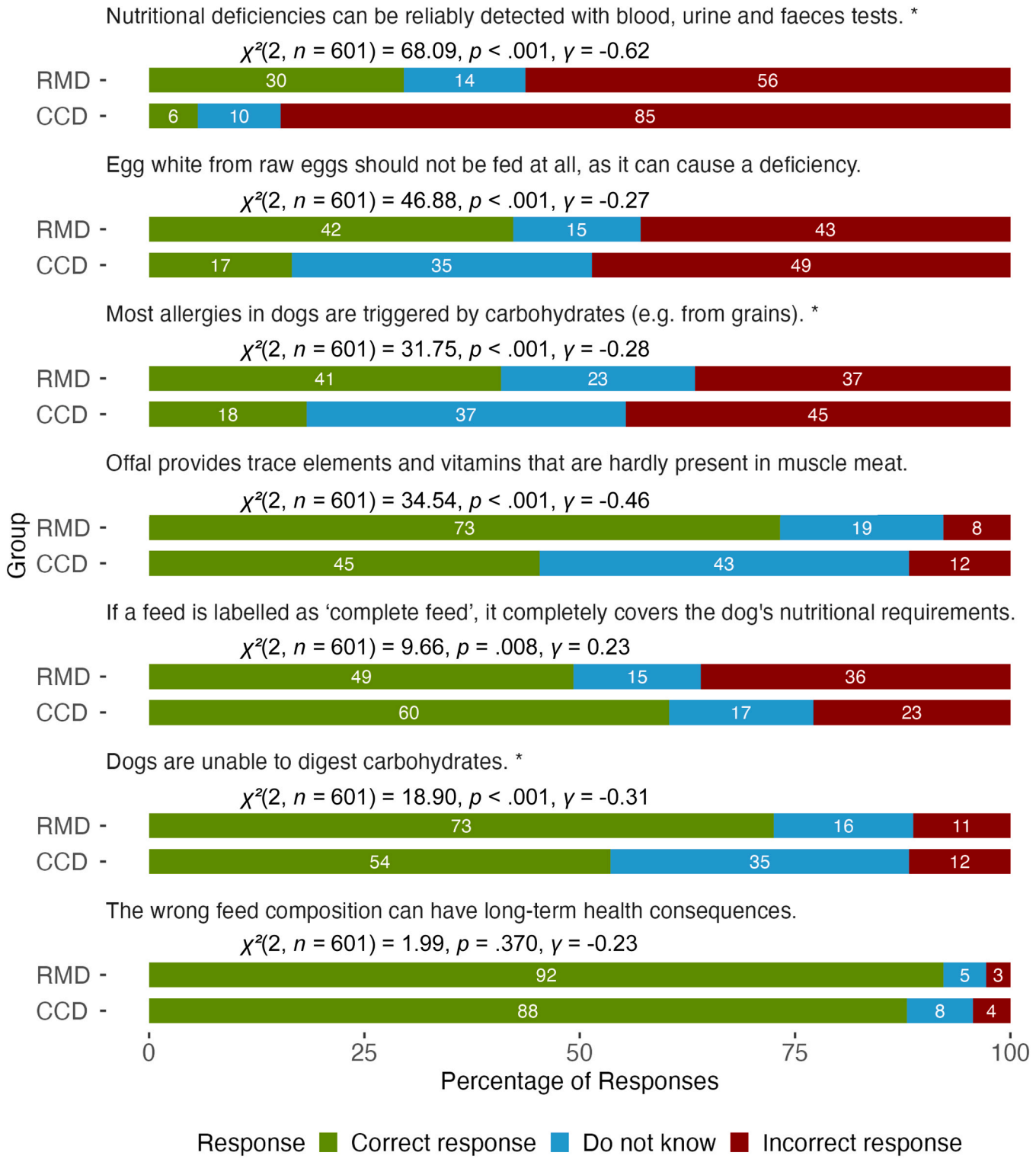

Fig. 6. Responses to Nutrition Knowledge Questions ($n = 601$) Note. CCD – Conventional Cooked Diet group ($n = 459$), RMD – Raw Meat Diet group ($n = 142$). Participants were asked to choose whether the statements were 'Correct' or 'False' with the option of answering 'Do not know'. Incorrect items are marked with stars (*). Chi-square tests of independence (χ^2) and Goodman-Kruskal's Gamma (γ) were used to assess the association between the participant group (CCD vs. RMD) and knowledge.

In addition to nutritional risks, raw meat diets have inherent microbiological risks, and knowledge of the associated risks can help in handling them correctly. Uncertainty about correct defrosting practices and the meaning of the cold chain remains prevalent, which is in line with previous research that has also reported risky defrosting practices among consumers (Bearth et al., 2014; Byrd-Bredbenner et al., 2013; Kennedy et al., 2011). Although participants knew that dogs can be asymptomatic carriers of pathogens and transmit them (Carter and Quinn, 2000), less knew about the transmittance of antimicrobial resistance. This is in line with a Swiss study in which the role of pets as a source of antimicrobial resistance was underestimated by consumers (Lechner et al., 2020). The risks associated with pathogens in raw meat

Table 5
Beliefs about dog feeding ($n = 601$).

Variable	Participant Group *M (SD)*		*t* (599)	*p*	Hedges' g
	CCD	RMD			
Dog owners who only open a can or bag are not looking after their dog as well.	2.1 (1.1)	2.6 (1.2)	−4.76	< .001	0.46
Ideally, a dog should eat like a wolf.	2.4 (1.0)	3.2 (1.2)	−6.68	< .001	0.76

Note. CCD - Conventional Cooked Diet group ($n = 459$); RMD - Raw Meat Diet group ($n = 142$); M – Mean, SD – Standard deviation. Participants were asked how much they agreed (1 = not at all to 5 = completely agree) with the two statements.

were underestimated by participants, and there were misconceptions about the meaning of 'food grade' beef for raw consumption by humans. Much fewer RMD participants than CCD participants knew that pathogens could be dangerous for healthy adults, which is in line with dog owners in the pilot study reporting pathogenic bacteria to be unproblematic or even good for the immune system. This underestimation of risks can pose a danger not only to the owner and household, but can also help spread bacteria and antimicrobial resistance in the environment.

Participants in the RMD group agreed to a greater extent that only opening a can or bag is indicative of not looking after one's dog as well, although overall agreement with this statement was not high. Diet choice is influenced by cultural and social factors (Michel, 2006). It is not only representative of a nutritiously adequate diet but is interwoven into the complexities of humanising dogs as family members, one's personal ideologies of food choice (e.g. vegan, vegetarian, or gluten-free diets), and cultural norms (which influences preference and disgust associated with offal or insects, for example) (Michel, 2006; Monterrosa et al., 2020). An example of this is pet feed made from by-products of human meat production (potentially highly nutritious), which could be associated with lower acceptance, as the pet owner would not eat these products themselves (Michel, 2006). With the perception of pets as part of the family, the process of feeding and the preparation of meals as well as giving treats represents an act of care and a symbol of the amount of love and affection the owner feels for its furry family member (Clemens, 2014; Freeman et al., 2013).

In the present study, only a medium overall level of agreement was found with the statement that dogs should ideally eat like wolves. However, there was a higher agreement among RMD participants than among CCD participants. In the case of dog feeding, a more 'natural' diet is often thought to mirror the diet of canids in the wild, specifically wolves, for example, by excluding cereals from the diet or food-depriving the dog one day per week (Rooney and Bradshaw, 2014). These approaches ignore the fact that dogs are, like wolves, natural omnivores, but have evolved a different starch digestion and fat metabolism as a result of domestication (Axelsson et al., 2013). In addition to domestication, selective breeding has changed dogs' behaviour and created animals that have different requirements and behaviours than their ancestry (Rooney and Bradshaw, 2014). The comparison to presently living wolves poses another problem: research has shown a complex genetic history of dogs which probably arose from a now-extinct wolf population, consequently making the comparison to today's wolves inadequate (Bergström et al., 2020). In addition, dog owners' expectations differ from those that a wild living wolf could fulfil: most owners wish for their pet to have a long and healthy life and not die at a young age from intraspecies conflicts and starvation after having produced as many offspring as possible (Sillero-Zubiri et al., 2004; Strodtbeck and Schröder, 2021).

4.5. Information pathways and risk communication

Previous research has found a high level of mistrust towards pet feed manufacturers among RMD feeders, and they consider themselves to be more knowledgeable than veterinarians (Bulochova and Evans, 2021; Freeman et al., 2013; Morgan et al., 2017). As a result, veterinarians are rarely consulted for dietary advice, with family, friends, breeders, online forums, and websites used instead (Morelli et al., 2019; Morgan et al., 2022). Non-CCD feeders trust their veterinarians less for nutritional advice than CCD feeders (Connolly et al., 2014; Michel et al., 2008). Considering these information pathways, risk communication should include several independent approaches. While veterinarians and veterinary nutritionists are central to communicating health and nutrition risks, risk communication from governmental veterinary authorities, dog schools, and breeders could also play a role. Because dog owners in many Swiss cantons are required to complete a mandatory training course, this poses a chance to educate them about essential nutritional information. An additional approach could involve social media campaigns. However, this communication needs to appreciate the fact that the public's risk perception is intertwined with issues of trust and cultural dimensions (Wynne, 1993). Therefore, care needs to be taken regarding how to approach this communication, and narrative or storytelling techniques could be useful for communicating the risks associated with hygiene and nutrition. Previous research has shown that a lack of acknowledgement of public concerns can undermine trust in experts, manufacturers, and regulatory bodies (Manyweathers et al., 2020).

Differences in knowledge are not sufficient to explain the differences in risk perception. Nevertheless, knowledge and clear information are crucial for effective risk mitigation. The presence of knowledge is elementary for dog owners' ability to turn their intentions into good decisions and provide their dogs with nutritious, balanced, and safe diets. Therefore, there is a need for accessible, understandable, and actionable information, provided by trusted sources, to empower dog owners to make informed decisions regarding their dogs' diets (Fischhoff, 2013).

To ensure efficient risk communication, the mental models approach emphasises focusing only on identified misconceptions and gaps instead of communicating all risks (Morgan, 2002). For nutritional risks, communication should emphasise the difficulties associated with correct rations. Raw feeding per se is not a nutritional risk if performed correctly. However, the present study showed that nutrition and ingredient knowledge in RMD participants was lacking. The correct composition of a diet takes time, effort, and knowledge about ingredients and amounts. Owners engaging in this feeding style should be willing to seek professional guidance, and risk communication should emphasise the necessity of this guidance and ideally recommend local contact points, such as veterinary nutritionists. Owing to the multitude of possible ingredients, as well as the different nutritional requirements of individual animals, it is not advisable to recommend specific diet compositions in general risk communication. Health risk communication should consider several factors. The general risks associated with raw meat products should be emphasised, as many participants in the present study were not aware of the presence and potential dangers of bacteria in raw meat. Hygienic procedures should be discussed (e.g. cold chain management). Additionally, owners need to be aware that dogs fed raw can be potential transmitters of pathogens and antimicrobial resistance, thereby posing a danger to susceptible contact animals and humans.

The present research further proposes extending this communication to include a correction for misconceptions regarding commercial diets. In particular, a better understanding of the uses of carbohydrates, which can be a good source of energy for dogs and are often included in commercial diets, can reduce the rejection of these diets. A 'natural' raw diet is not inevitably better, neither is a cooked and commercial diet worse. There are better and worse diets in each of these categories. What remains most important is the quality and correct composition of the

ingredients, not the method of preparation and presentation (Strodtbeck and Schröder, 2021).

4.6. Limitations and implication for further research

The qualitative pilot study showed that there is a large heterogeneity in beliefs about dog diets and feeding methods. While not all aspects that were uncovered in the qualitative section could be included in the survey, using a quantitative approach allowed for a focus on the main topics. In particular, considering the large variety of feeding methods and ingredients, this approach has to oversimplify the available diets. However, by using hypothetical diets instead of asking participants about their own diet, this was counterbalanced to some extent. Nevertheless, this quantitative approach is subject to potential bias. The recruitment strategy of using social media to find dog owners feeding raw diets might have inadvertently selected for those owners who had strong opinions about this topic, thus limiting the generalisability of the findings. Information bias could have arisen when participants misinterpreted the diet descriptions, or social desirability could have influenced their stated risk perceptions. The interpretation and evaluation of the diets could also have been influenced by confirmation bias through participants' pre-existing beliefs and established views. The relationship between diet type and risk perception could have been influenced by confounding variables, such as education level, socioeconomic background, or prior experience with specific diets. In future studies, the choice of the four diets could be extended to other ingredient lists, particularly to different protein sources, to understand the influence of individual ingredients on participants' risk perception. When choosing to alter the ingredient list, future research should focus on measuring whether participants actually read the ingredients and captured the information provided in the diet description, which was not done in the present study. Future research could also look more closely at the impact of labelling as 'complete' or 'supplementary' on feed choices. Additionally, some risks associated with dog feeding were not explored in the present study. For example, although injuries were included in the digestive risks, physical hazards such as feed contamination with foreign bodies were not further explored. Additionally, toxic risks that could stem from both mycotoxins present in commercial products or from the toxicity of feed items such as garlic, onions, avocado, raisins, or macadamia nuts were not included in the present study. A similar problem arose from the dichotomization of the two diet groups in the present study (RMD or CCD). As described above, feeding styles and combinations of diets vary among dog owners, with most participants not following the same daily routine. Future research could look into smaller (sub)groups defined by varying diet choices; however, due to the limited sample size, this was not feasible for the present study. In the main quantitative study, the use of veterinary or nutritionist advice for diet composition and participants' information sources was not assessed. This has been evaluated in previous research, and as most participants use a variety of information sources, a detailed account would have extended the length of the questionnaire too much. Future efforts in this field should include the implementation of risk communication measures and subsequent evaluation of the effectiveness of different communication strategies.

5. Conclusion

Although dog owners feeding raw meat were aware of the risks associated with this practice, they underestimated them compared to non-raw feeders. Targeted risk communication ought to address several aspects: it should highlight the difficulties associated with the composition of homemade raw diets which can be addressed by consulting nutrition experts. Additionally, the microbiological risks associated with raw meat and the nutritional benefits and safety of commercial diets should be emphasised. However, targeted messaging should not only present facts but also build a relationship of trust and mutual respect between dog owners and communicators, as these are essential for successful risk reduction. The importance of this cooperation becomes evident in view of the global spread and relevance of zoonoses and antimicrobial resistance.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Swiss Federal Institute of Technology, ETH Zurich (EK-2024-N-216-A).

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CRediT authorship contribution statement

Xiao Zhou: Writing – review & editing, Conceptualization. **Angela Bearth:** Writing – review & editing, Conceptualization. **Michael Siegrist:** Writing – review & editing, Resources, Conceptualization. **Roger Stephan:** Writing – review & editing. **Andrea Knörr:** Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

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

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.prevetmed.2025.106609.

References

de Andrade, M.L., Rodrigues, R.R., Antongiovanni, N., da Cunha, D.T., 2019. Knowledge and risk perceptions of foodborne disease by consumers and food handlers at restaurants with different food safety profiles. Food Res. Int. 121, 845–853. https://doi.org/10.1016/j.foodres.2019.01.006.

Anturaniemi, J., Barrouin-Melo, S.M., Zaldivar-López, S., Sinkko, H., Hielm-Björkman, A., 2019. Owners' perception of acquiring infections through raw pet food: a comprehensive internet-based survey, 658 Vet. Rec. 185, 658. https://doi.org/10.1136/vr.105122.

Axelsson, E., Ratnakumar, A., Arendt, M.-L., Maqbool, K., Webster, M.T., Perloski, M., Liberg, O., Arnemo, J.M., Hedhammar, Å., Lindblad-Toh, K., 2013. The genomic signature of dog domestication reveals adaptation to a starch-rich diet. Nature 495, 360–364. https://doi.org/10.1038/nature11837.

Bearth, A., Cousin, M.E., Siegrist, M., 2014. Poultry consumers' behaviour, risk perception and knowledge related to campylobacteriosis and domestic food safety. Food Control 44, 166–176. https://doi.org/10.1016/j.foodcont.2014.03.055.

Behravesh, C.B., Ferraro, A., Deasy, M., III, Dato, V., Moll, M., Sandt, C., Rea, N.K., Rickert, R., Marriott, C., Warren, K., Urdaneta, V., Salehi, E., Villamil, E., Ayers, T., Hoekstra, R.M., Austin, J.L., Ostroff, S., Williams, I.T., the Salmonella Schwarzengrund Outbreak Investigation Team, 2010. Human Salmonella Infections Linked to Contaminated Dry Dog and Cat Food, 2006–2008. Pediatrics 126, 477–483. https://doi.org/10.1542/peds.2009-3273.

Bergström, A., Frantz, L., Schmidt, R., Ersmark, E., Lebrasseur, O., Girdland-Flink, L., Lin, A.T., Storå, J., Sjögren, K.-G., Anthony, D., Antipina, E., Amiri, S., Bar-Oz, G., Bazaliiskii, V.I., Bulatović, J., Brown, D., Carmagnini, A., Davy, T., Fedorov, S., Fiore, I., Fulton, D., Germonpré, M., Haile, J., Irving-Pease, E.K., Jamieson, A., Janssens, L., Kirillova, I., Horwitz, L.K., Kuzmanovic-Cvetković, J., Kuzmin, Y., Losey, R.J., Dizdar, D.L., Mashkour, M., Novak, M., Onar, V., Orton, D., Pasarić, M., Radivojević, M., Rajković, D., Roberts, B., Ryan, H., Sablin, M., Shidlovskiy, F., Stojanović, I., Tagliacozzo, A., Trantalidou, K., Ullén, I., Villaluenga, A., Wapnish, P., Dobney, K., Götherström, A., Linderholm, A., Dalén, L., Pinhasi, R., Larson, G., Skoglund, P., 2020. Origins and genetic legacy of prehistoric dogs. Science 370, 557–564. https://doi.org/10.1126/science.aba9572.

Billinghurst, I., 1993. Give your dog a bone. Dogwise Publishing, Bathhurst.

Bojanić, K., Midwinter, A.C., Marshall, J.C., Rogers, L.E., Biggs, P.J., Acke, E., 2017. Isolation of Campylobacter spp. from Client-Owned Dogs and Cats, and Retail Raw Meat Pet Food in the Manawatu, New Zealand. Zoonoses Public Health 64, 438–449. https://doi.org/10.1111/zph.12323.

Bolbecher, G., Dillitzer, N., 2020. Ganzheitliche Ernährung für Hund und Katze: individuell - typgerecht - natürlich [Holistic nutrition for dogs and cats: individual -

type-appropriate - natural]. Georg Thieme Verlag, Stuttgart. https://doi.org/10.1055/b-006-161675.
Boya, U.O., Dotson, M.J., Hyatt, E.M., 2012. Dimensions of the dog–human relationship: A segmentation approach. J. Target. Meas. Anal. Mark. 20, 133–143. https://doi.org/10.1057/jt.2012.8.
Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3, 77–101. https://doi.org/10.1191/1478088706qp063oa.
Braun, V., Clarke, V., 2021. Thematic analysis: a practical guide. SAGE, London.
van Bree, F.P.J., Bokken, G.C.A.M., Mineur, R., Franssen, F., Opsteegh, M., van der Giessen, J.W.B., Lipman, L.J.A., Overgaauw, P.A.M., 2018. Zoonotic bacteria and parasites found in raw meat-based diets for cats and dogs, 50 Vet. Rec. 182, 50. https://doi.org/10.1136/vr.104535.
Broome, M.R., Peterson, M.E., Kemppainen, R.J., Parker, V.J., Richter, K.P., 2015. Exogenous thyrotoxicosis in dogs attributable to consumption of all-meat commercial dog food or treats containing excessive thyroid hormone: 14 cases (2008–2013). J. Am. Vet. Med. Assoc. 246, 105–111. https://doi.org/10.2460/javma.246.1.105.
Bulochova, V., Evans, E.W., 2021. Raw Meat-Based Pet Feeding and Food Safety: Netnography Study of Pet Owner Comments and Review of Manufacturers' Information Provision. J. Food Prot. 84, 2099–2108. https://doi.org/10.4315/JFP-21-158.
Byrd-Bredbenner, C., Berning, J., Martin-Biggers, J., Quick, V., 2013. Food Safety in Home Kitchens: A Synthesis of the Literature. Int. J. Environ. Res. Public. Health 10, 4060–4085. https://doi.org/10.3390/ijerph10094060.
Carter, M.E., Quinn, P.J., 2000. Salmonella infections in dogs and cats. in: Salmonella in Domestic Animals. CABI Books, pp. 231–244. https://doi.org/10.1079/9780851992617.0231.
Clemens, R., 2014. The 'Humanization' of Pet Food. Food Technol. 68, 20.
Connolly, K.M., Heinze, C.R., Freeman, L.M., 2014. Feeding practices of dog breeders in the United States and Canada. J. Am. Vet. Med. Assoc. 245, 669–676. https://doi.org/10.2460/javma.245.6.669.
Cornelissen, S., Roover, K.D., Paepe, D., Hesta, M., Meulen, E.V. der, Daminet, S., 2014. Dietary hyperthyroidism in a Rottweiler. Vlaams Diergeneeskd. Tijdschr. 83. https://doi.org/10.21825/vdt.v83i6.16629.
Davies, R.H., Lawes, J.R., Wales, A.D., 2019. Raw diets for dogs and cats: a review, with particular reference to microbiological hazards. J. Small Anim. Pr. 60, 329–339. https://doi.org/10.1111/jsap.13000.
Deplazes, P., Eckert, J., Mathis, A., Samson-Himmelstjerna, G. von, Zahner, H., 2016. Parasitology in Veterinary Medicine. Wageningen Academic.
Dillitzer, N., Becker, N., Kienzle, E., 2011. Intake of minerals, trace elements and vitamins in bone and raw food rations in adult dogs. Br. J. Nutr. 106 (1), S53–56. https://doi.org/10.1017/S0007114511002765.
Dodd, S., Cave, N., Abood, S., Shoveller, A.-K., Adolphe, J., Verbrugghe, A., 2020. An observational study of pet feeding practices and how these have changed between 2008 and 2018, 643 Vet. Rec. 186, 643. https://doi.org/10.1136/vr.105828.
Empert-Gallegos, A., Hill, S., Yam, P.S., 2020. Insights into dog owner perspectives on risks, benefits, and nutritional value of raw diets compared to commercial cooked diets. e10383 PeerJ 8, e10383. https://doi.org/10.7717/PEERJ.10383/SUPP-1.
European Food Safety Authority (EFSA), Ana, A., Raquel, G.M., Georgia, G., Angelo, M., Caroline, M., Agnes, R., Tobin, R., 2020. EFSA's activities on emerging risks in 2019. EFSA Support. Publ. 17, 1924E. https://doi.org/10.2903/sp.efsa.2020.EN-1924.
European Union, 2009. REGULATION (EC) No 767/2009 on the placing on the market and use of feed. In: Off. J. Eur. Union, 229, pp. 1–41.
FEDIAF, 2024a. Facts and Figures 2022.
FEDIAF, 2024b. Nutritional Guidelines for Complete and Complementary Pet Food for Cats and Dogs.
Finley, R., Ribble, C., Aramini, J., Vandermeer, M., Popa, M., Litman, M., Reid-Smith, R., 2007. The risk of salmonellae shedding by dogs fed Salmonella-contaminated commercial raw food diets. Can. Vet. J. 48, 69–75.
Finley, R., Reid-Smith, R., Ribble, C., Popa, M., Vandermeer, M., Aramini, J., 2008. The Occurrence and Antimicrobial Susceptibility of Salmonellae Isolated from Commercially Available Canine Raw Food Diets in Three Canadian Cities. Zoonoses Public Health 55, 462–469. https://doi.org/10.1111/j.1863-2378.2008.01147.x.
Fischhoff, B., 2013. The sciences of science communication. Proc. Natl. Acad. Sci. 110, 14033–14039. https://doi.org/10.1073/pnas.1213273110.
Freeman, L.M., Michel, K.E., 2001. Evaluation of raw food diets for dogs. J. Am. Vet. Med. Assoc. 218, 705–709. https://doi.org/10.2460/javma.2001.218.705.
Freeman, L.M., Chandler, M.L., Hamper, B.A., Weeth, L.P., 2013. Current knowledge about the risks and benefits of raw meat–based diets for dogs and cats. J. Am. Vet. Med. Assoc. 243, 1549–1558. https://doi.org/10.2460/javma.243.11.1549.
Goodman, L.A., Kruskal, W.H., 1979. Measures of Association for Cross Classifications. Springer Series in Statistics. Springer, New York, NY. https://doi.org/10.1007/978-1-4612-9995-0.
Groat, E.F., Williams, N.J., Pinchbeck, G., Warner, B., Simpson, A., Schmidt, V.M., 2022. UK dogs eating raw meat diets have higher risk of Salmonella and antimicrobial-resistant Escherichia coli faecal carriage. J. Small Anim. Pr. 63, 435–441. https://doi.org/10.1111/jsap.13488.
Hall, G., Breheny, C., Khan, Z., Schwarz, T., Mellanby, R.J., 2020. Severe nutritional deficiencies and osteopenia in a dog fed a homemade raw diet. Vet. Rec. Case Rep. 8, e001038. https://doi.org/10.1136/vetreccr-2019-001038.
Havelaar, A.H., Ivarsson, S., Löfdahl, M., Nauta, M.J., 2013. Estimating the true incidence of campylobacteriosis and salmonellosis in the European Union, 2009. Epidemiol. Infect. 141, 293–302. https://doi.org/10.1017/S0950268812000568.
Heinze, C.R., Gomez, F.C., Freeman, L.M., 2012. Assessment of commercial diets and recipes for home-prepared diets recommended for dogs with cancer. J. Am. Vet. Med. Assoc. 241, 1453–1460. https://doi.org/10.2460/javma.241.11.1453.
Hellgren, J., Hästö, L.S., Wikström, C., Fernström, L.-L., Hansson, I., 2019. Occurrence of Salmonella, Campylobacter, Clostridium and Enterobacteriaceae in raw meat-based diets for dogs. Vet. Rec. 184, 442. https://doi.org/10.1136/vr.105199.
Hinney, B., 2018. The trend of raw meat-based diets: risks to people and animals. Vet. Rec. 182, 47–49. https://doi.org/10.1136/vr.k71.
Irvine, L., Cilia, L., 2017. More-than-human families: Pets, people, and practices in multispecies households. Sociol. Compass 11, e12455. https://doi.org/10.1111/soc4.12455.
Joffe, D.J., Schlesinger, D.P., 2002. Preliminary assessment of the risk of Salmonella infection in dogs fed raw chicken diets. Can. Vet. J. 43, 441–442.
Kahan, D.M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L.L., Braman, D., Mandel, G., 2012. The polarizing impact of science literacy and numeracy on perceived climate change risks. Nat. Clim. Change 2, 732–735. https://doi.org/10.1038/nclimate1547.
Kang, M.-H., Park, H.-M., 2010. Hypertension after Ingestion of Baked Garlic (Allium sativum) in a Dog. J. Vet. Med. Sci. 72, 515–518. https://doi.org/10.1292/jvms.09-0434.
Kawaguchi, K., Braga, I.S., Takahashi, A., Ochiai, K., Itakura, C., 1993. Nutritional secondary hyperparathyroidism occurring in a strain of German shepherd puppies. Jpn. J. Vet. Res. 41, 89–96.
Kennedy, J., Gibney, S., Nolan, A., OBrien, S., Mcmahon, A., Mcdowell, D., Fanning, S., Wall, P., 2011. Identification of critical points during domestic food preparation: An observational study. Br. Food J. 113, 766–783. https://doi.org/10.1108/00070701111140106.
Köhler, B., Stengel, C., Neiger, R., 2012. Dietary hyperthyroidism in dogs. J. Small Anim. Pr. 53, 182–184. https://doi.org/10.1111/j.1748-5827.2011.01189.x.
Krook, L., Whalen, J.P., 2010. Nutritional secondary hyperparathyroidism in the animal kingdom: report of two cases. Clin. Imaging 34, 458–461. https://doi.org/10.1016/j.clinimag.2010.08.010.
KuKanich, K.S., 2011. Update on Salmonella spp contamination of pet food, treats, and nutritional products and safe feeding recommendations. J. Am. Vet. Med. Assoc. 238, 1430–1434. https://doi.org/10.2460/javma.238.11.1430.
Laflamme, D.P., Abood, S.K., Fascetti, A.J., Fleeman, L.M., Freeman, L.M., Michel, K.E., Bauer, C., Kemp, B.L.E., Doren, J.R.V., Willoughby, K.N., 2008. Pet feeding practices of dog and cat owners in the United States and Australia. J. Am. Vet. Med. Assoc. 232, 687–694. https://doi.org/10.2460/javma.232.5.687.
Larsen, J.A., Parks, E.M., Heinze, C.R., Fascetti, A.J., 2012. Evaluation of recipes for home-prepared diets for dogs and cats with chronic kidney disease. J. Am. Vet. Med. Assoc. 240, 532–538. https://doi.org/10.2460/javma.240.5.532.
Lechner, I., Freivogel, C., Stärk, K.D.C., Visschers, V.H.M., 2020. Exposure Pathways to Antimicrobial Resistance at the Human-Animal Interface—A Qualitative Comparison of Swiss Expert and Consumer Opinions. Front. Public Health 8. https://doi.org/10.3389/fpubh.2020.00345.
Lefebvre, S.L., Reid-Smith, R., Boerlin, P., Weese, J.S., 2008. Evaluation of the Risks of Shedding Salmonellae and Other Potential Pathogens by Therapy Dogs Fed Raw Diets in Ontario and Alberta. Zoonoses Public Health 55, 470–480. https://doi.org/10.1111/j.1863-2378.2008.01145.x.
LeJeune, J.T., Hancock, D.D., 2001. Public health concerns associated with feeding raw meat diets to dogs. J. Am. Vet. Med. Assoc. 219, 1222–1225. https://doi.org/10.2460/javma.2001.219.1222.
Leonard, E.K., Pearl, D.L., Finley, R.L., Janecko, N., Peregrine, A.S., Reid-Smith, R.J., Weese, J.S., 2011. Evaluation of Pet-Related Management Factors and the Risk of Salmonella spp. Carriage in Pet Dogs from Volunteer Households in Ontario (2005–2006). Zoonoses Public Health 58, 140–149. https://doi.org/10.1111/j.1863-2378.2009.01320.x.
Lumivero. NVivo (Version 13) [Computer software].
Machado Nardi, V.A., Teixeira, R., Ladeira, W.J., de Oliveira Santini, F., 2020. A meta-analytic review of food safety risk perception. Food Control 112, 107089. https://doi.org/10.1016/j.foodcont.2020.107089.
Mack, J.K., Kienzle, E., 2016. Fehlversorgungen in „BARF"-Futterplänen für einen Wurf Berner-Sennenhund-Welpen [Incorrect supplies in 'BARF' feeding plans for a litter of Bernese Mountain Dog puppies]. Tier. ärztl. Prax. Ausg. K. Kleintier Heimtiere 44, 341–347. https://doi.org/10.15654/TPK-151091.
Manyweathers, J., Taylor, M., Longnecker, N., 2020. Expertise and communicating about infectious disease: a case study of uncertainty and rejection of local knowledge in discourse of experts and decision makers. J. Sci. Commun. 19, A01. https://doi.org/10.22323/2.19040201.
Meyer, H., Zentek, J., 2010. Ernährung des Hundes: Grundlagen - Fütterung - Diätetik [Nutrition of the dog: Basics - Feeding - Dietetics]. Georg Thieme Verlag.
Michel, K.E., 2006. Unconventional Diets for Dogs and Cats. Vet. Clin. North Am. Small Anim. Pract. Diet. Manag. Nutr. 36, 1269–1281. https://doi.org/10.1016/j.cvsm.2006.08.003.
Michel, K.E., Willoughby, K.N., Abood, S.K., Fascetti, A.J., Fleeman, L.M., Freeman, L.M., Laflamme, D.P., Bauer, C., Kemp, B.L.E., Doren, J.R.V., 2008. Attitudes of pet owners toward pet foods and feeding management of cats and dogs. J. Am. Vet. Med. Assoc. 233, 1699–1703. https://doi.org/10.2460/javma.233.11.1699.
Monterrosa, E.C., Frongillo, E.A., Drewnowski, A., de Pee, S., Vandevijvere, S., 2020. Sociocultural Influences on Food Choices and Implications for Sustainable Healthy Diets. Food Nutr. Bull. 41, 59S–73S. https://doi.org/10.1177/0379572120975874.
Morelli, G., Bastianello, S., Catellani, P., Ricci, R., 2019. Raw meat-based diets for dogs: survey of owners' motivations, attitudes and practices. BMC Vet. Res. 15, 74. https://doi.org/10.1186/s12917-019-1824-x.
Morgan, G., Williams, N., Schmidt, V., Cookson, D., Symington, C., Pinchbeck, G., 2022. A Dog's Dinner: Factors affecting food choice and feeding practices for UK dog owners feeding raw meat-based or conventional cooked diets. Prev. Vet. Med. 208, 105741. https://doi.org/10.1016/j.prevetmed.2022.105741.

Morgan, M.G., 2002. Risk Communication: A Mental Models Approach. Cambridge University Press.
Morgan, S.K., Willis, S., Shepherd, M.L., 2017. Survey of owner motivations and veterinary input of owners feeding diets containing raw animal products. e3031 PeerJ 2017, e3031. https://doi.org/10.7717/PEERJ.3031/SUPP-1.
Nemser, S.M., Doran, T., Grabenstein, M., McConnell, T., McGrath, T., Pamboukian, R., Smith, A.C., Achen, M., Danzeisen, G., Kim, S., Liu, Y., Robeson, S., Rosario, G., McWilliams Wilson, K., Reimschuessel, R., 2014. Investigation of Listeria, Salmonella, and toxigenic Escherichia coli in various pet foods. Foodborne Pathog. Dis. 11, 706–709. https://doi.org/10.1089/fpd.2014.1748.
Nilsson, O., 2015. Hygiene quality and presence of ESBL-producing Escherichia coli in raw food diets for dogs. Infect. Ecol. Epidemiol. 5, 10.3402/iee.v5.28758. https://doi.org/10.3402/iee.v5.28758.
Nisbett, R.E., Wilson, T.D., 1977. The Halo Effect: Evidence for Unconscious Alteration of Judgments. J. Pers. Soc. Psychol. 35, 250–256. https://doi.org/10.1037/0022-3514.35.4.250.
Nowak, L., Van Loon, S., Hagen-Plantinga, E., Bergknut, N., 2024. A Case Series of Four Dogs Presenting with Neurological Deficits Due to Suspected Nutritional Secondary Hyperparathyroidism after Being Fed an Exclusive Diet of Raw Meat. Animals 14, 1783. https://doi.org/10.3390/ani14121783.
Nüesch-Inderbinen, M., Treier, A., Zurfluh, K., Stephan, R., 2019. Raw meat-based diets for companion animals: a potential source of transmission of pathogenic and antimicrobial-resistant Enterobacteriaceae. R. Soc. Open Sci. 6, 191170. https://doi.org/10.1098/rsos.191170.
Ovca, A., Bulochova, V., Pirnat, T., Evans, E.W., 2024. Risk perception and food safety practices among Slovenian pet owners: does raw meat feeding of pets make a difference? J. Consum. Prot. Food Saf. https://doi.org/10.1007/s00003-024-01505-9.
Pedrinelli, V., Gomes, M. de O.S., Carciofi, A.C., 2017. Analysis of recipes of home-prepared diets for dogs and cats published in Portuguese. J. Nutr. Sci. 6, e33. https://doi.org/10.1017/jns.2017.31.
R Core Team, 2023. _R: A Language and Environment for Statistical Computing_ [Computer software]. R Foundation for Statistical Computing. https://www.R-project.org/.
Rooney, N., Bradshaw, J., 2014. Canine Welfare Science: An Antidote to Sentiment and Myth. In: Horowitz, A. (Ed.), Domestic Dog Cognition and Behavior: The Scientific Study of Canis Familiaris. Springer, Berlin, Heidelberg, pp. 241–274. https://doi.org/10.1007/978-3-642-53994-7_11.
Runesvärd, E., Wikström, C., Fernström, L.-L., Hansson, I., 2020. Presence of pathogenic bacteria in faeces from dogs fed raw meat-based diets or dry kibble. Vet. Rec. 187, e71. https://doi.org/10.1136/vr.105644.
Sato, Y., Mori, T., Koyama, T., Nagase, H., 2000. Salmonella virchow infection in an infant transmitted by household dogs. J. Vet. Med. Sci. 62, 767–769. https://doi.org/10.1292/jvms.62.767.
Schlesinger, D.P., Joffe, D.J., 2011. Raw food diets in companion animals: A critical review. Can. Vet. J. 52, 50.
Sillero-Zubiri, C., Hoffmann, M., Macdonald, D.W., 2004. IUCN - The World Conservation Union. Canids: foxes, wolves, jackals, and dogs. Gland.
Slovic, P., 1999. Trust, emotion, sex, politics, and science: surveying the risk-assessment battlefield. Risk Anal. Off. Publ. Soc. Risk Anal. 19, 689–701. https://doi.org/10.1023/a:1007041821623.
Slovic, P., 2010. The feeling of risk: new perspectives on risk perception, Earthscan risk in society series. Earthscan, London; Washington, DC.
Stockman, J., Fascetti, A.J., Kass, P.H., Larsen, J.A., 2013. Evaluation of recipes of home-prepared maintenance diets for dogs. J. Am. Vet. Med. Assoc. 242, 1500–1505. https://doi.org/10.2460/javma.242.11.1500.
Strodtbeck, S., Schröder, B., 2021. Ernährung & Verhalten beim Hund: Verhalten beeinflussen durch eine typgerechte Fütterung [Nutrition & behaviour in dogs: Influencing behaviour through type-appropriate feeding], 3rd ed. Müller Rüschlikon, Stuttgart.
Strohmeyer, R.A., Morley, P.S., Hyatt, D.R., Dargatz, D.A., Scorza, A.V., Lappin, M.R., 2006. Evaluation of bacterial and protozoal contamination of commercially available raw meat diets for dogs. J. Am. Vet. Med. Assoc. 228, 537–542. https://doi.org/10.2460/javma.228.4.537.
Swiss Federal Council, 2011. Verordnung vom 26. Oktober 2011 über die Produktion und das Inverkehrbringen von Futtermitteln [Regulation of 26 October 2011 on the production and placing on the market of animal feed] SR 916.307.
Taylor, M.B., Geiger, D.A., Saker, K.E., Larson, M.M., 2009. Diffuse osteopenia and myelopathy in a puppy fed a diet composed of an organic premix and raw ground beef. J. Am. Vet. Med. Assoc. 234, 1041–1048. https://doi.org/10.2460/javma.234.8.1041.
Thomas, M., Feng, Y., 2020. Risk of Foodborne Illness from Pet Food: Assessing Pet Owners' Knowledge, Behavior, and Risk Perception. J. Food Prot. 83, 1998–2007. https://doi.org/10.4315/JFP-20-108.
Weese, J.S., Rousseau, J., 2006. Survival of Salmonella Copenhagen in food bowls following contamination with experimentally inoculated raw meat: Effects of time, cleaning, and disinfection. Can. Vet. J. 47, 887–889.
Weese, J.S., Rousseau, J., Arroyo, L., 2005. Bacteriological evaluation of commercial canine and feline raw diets. Can. Vet. J. 46, 513–516.
WHO, 2018. Critically important antimicrobials for human medicine: 6th revision [WWW Document]. URL ⟨https://www.who.int/publications/i/item/9789241515528⟩ (accessed 12.10.24).
Wynne, B., 1993. Public uptake of science: a case for institutional reflexivity. Public Underst. Sci. 2, 321–337. https://doi.org/10.1088/0963-6625/2/4/003.
Zanin, L.M., da Cunha, D.T., de Rosso, V.V., Capriles, V.D., Stedefeldt, E., 2017. Knowledge, attitudes and practices of food handlers in food safety: An integrative review. Food Res. Int. 100, 53–62. https://doi.org/10.1016/j.foodres.2017.07.042.
Zeugswetter, K.F., Vogelsinger, K., Handl, S., 2013. Hyperthyroidism in dogs caused by consumption of thyroid-containing head meat. Schweiz. Arch. F. üR. Tierheilkd. 155, 149–152. https://doi.org/10.1024/0036-7281/a000432.
Zhao, C., Ge, B., De Villena, J., Sudler, R., Yeh, E., Zhao, S., White, D.G., Wagner, D., Meng, J., 2001. Prevalence of Campylobacter spp., Escherichia coli, and Salmonella Serovars in Retail Chicken, Turkey, Pork, and Beef from the Greater Washington, D. C., Area. Appl. Environ. Microbiol 67, 5431–5436. https://doi.org/10.1128/AEM.67.12.5431-5436.2001.