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Animal welfare at slaughter: perceptions and knowledge across cultures

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Most people around the world eat meat and billions of animals are slaughtered
each year to meet that demand. For many, eating meat is a biocultural activity
steeped in tradition and formative in cuisines and identity. Eating meat, however,
comes with a myriad of ethical and practical considerations. In tandem with
animal rights and environmental sustainability concerns surrounding the impact
of animal slaughter for meat, animal welfare science has identified numerous
ways animals may suffer on an individual level during various methods of
slaughter. Practices of slaughter differ around the world and the degree to
which culture and regional interpretations of religion impact consumer
expectations and perceptions of suffering at slaughter are relatively unknown.
We begin to address some of these gaps by conducting a survey of 4,291
members of the general public to assess knowledge and attitudes around
animal welfare at slaughter and religious slaughter, across 14 culturally and
religiously diverse countries in local languages; Australia, Philippines, Nigeria,
United Kingdom and United States (English), Bangladesh (Bengali), Brazil
(Portuguese), Chile (Spanish), China (Traditional Chinese), India (Hindi and
English), Malaysia (Bahasa Malay, Chinese and English), Pakistan (Urdu), Sudan
(Arabic) and Thailand (Thai). Our results demonstrate that in highly developed
countries where exposure to slaughter is low, comfort witnessing slaughter and
knowledge about animal welfare at slaughter and the local application of
stunning is also low. Cultural and religious differences exist by country,
however in all countries except Bangladesh, the majority of participants stated
that it mattered to them that animals do not suffer during slaughter, and in most

countries, participants would prefer that animals be rendered unconscious before they are slaughtered (preslaughter stunning); including in countries where this practice is not currently widespread. These findings suggest that concern for the reduction of animal suffering during slaughter is a universal human tendency, rather than a cultural development, while opinion of how best to achieve this (i.e., to stun or not to stun) may be cultural and tied to local interpretations of religious slaughter requirements. The findings of this study serve as an indication for meat industries and governments that continual review and improvement of animal welfare processes at slaughter are required to continue to meet evolving general public sentiment.

1 Introduction

Meat eaters account for an estimated 86% of the human population (Buchholz, 2021), collectively consuming over 337 million tonnes each year (Food and Agricultural Organisation, 2020). Conventionally, science has attributed the path of human evolution and the development of larger brains of *Homo-Sapiens* as opposed to *Homo-Erectus* to the practice of eating other animals (Leroy and Praet, 2015). In a contemporary context, the industrialised and intensive farming systems that have developed to achieve the scale needed to meet demands for meat eating have been at the centre of environmental, ethical, nutritional and agronomical criticisms both in a growing body of scientific literature and in some societies more generally (Smil, 2004; Henning, 2011; Bramble and Fischer, 2015; Machovinaab et al., 2015). Once credited as the practice that allowed us to evolve into the species we are today, the structures created to support modern meat-eating are now presented as a key contributor to the demise of our species through climate change.

Aside from evolutionary, scientific and ethical debate, meat-eating remains a commonplace human activity. Over 73 billion non-human animals (hereafter animals, excluding fish) are slaughtered to supply the demand of humans each year, and that number is increasing for much of the world (Organisation for Economic Cooperation and Development, and Food and Agricultural Organisation, 2022; Orzechowski, 2022).

Eating meat is a biocultural activity (Leroy and Praet, 2015) steeped in tradition, at the foundation of cuisines, and formative in identity and the experience of heritage. Slaughter, as the active process of ending the life of an animal, is variably approached with rites, rituals, utility and stigma, depending on the culture. What remains consistent in the process is that an animal will have their life brought to an end and, most frequently, this will be in a commercial slaughterhouse at the conclusion of an intensive farming process. Slaughter of animals for human food is an ethical issue, but whether the slaughter of a healthy animal without pain and suffering is a

welfare issue is still open to debate and is discussed in detail elsewhere (Yeates, 2010). Although human societies and beliefs that influence slaughter vary across the world, the physiology and ability to experience pain and suffering within species subjected to slaughter tends to be similar. The experience of the animal during this process can be approached with the application of animal welfare science, using investigatory methods based on physiology and behaviour. As such, animal welfare scientists can also provide key information on approaches that may mitigate some of the suffering experienced by animals during the processes to which we subject them. One such method is the introduction of pre-slaughter stunning. The process of pre-slaughter stunning, usually via the application of a sudden electrical current or cranial bolt, aims to instantaneously render an animal unconscious and insensible until death (Fletcher, 1999; European Food Safety Authority (EFSA), 2004). Applied correctly, preslaughter stunning eradicates pain and suffering for individual animals. It is currently considered 'best practice' to increase animal welfare during slaughter (Federation of Veterinarian of Europe (FVE), 2002; Gibson et al., 2009; Gregory et al., 2010), and in some areas of the world such as Australia (Wood, 2013), Europe (European Commission, 2013), United Kingdom (UK Statutory Instruments, 1995), New Zealand (Ministry for Primary Industries, N.Z 2018), Brazil (Hötzel and Vandresen, 2022) and the United States of America (United States Department of Agriculture, 1958) required by law in most instances. Conversely, the slaughter of fully conscious animals is a common practice in lesser developed areas of the world mainly due to economic reasons (Fuseini and Sulemana, 2018) but also due to strict religious beliefs most commonly associated with Islam and Judaism (Jalil et al., 2018). This practice is also allowed by derogation in countries with stunning legislation in place. This manuscript assumes the position of current animal welfare and neurophysiological science consensus that correctly applied pre-slaughter stunning measures reduce suffering during slaughter.

Although the animal has the most to lose as a result of the common human practice of slaughter, the animals themselves are

obviously not afforded input. Choices surrounding the manner in which they are raised, and die, are made by humans, and humans are not always guided by science (Hornsey, 2020; Lewandowsky and Oberauer, 2021). Meat consumption and, importantly, slaughter processes are varied by way of culture and are impacted by religion, power dynamics, social dynamics, biocultural cuisines and identity. It is therefore important to understand perceptions according to socio-political region (Neo and Emel, 2017).

A study conducted with university students in Malaysia, Thailand, The People's Republic of China (henceforth China) and Vietnam found that regional religion had a large impact on attitudes to slaughter, but that in general these stakeholders cared about animal welfare at slaughter (Ling et al., 2016). This finding is echoed in Europe, where members of the public overwhelmingly stated that they care about welfare at slaughter (Kjærnes and Lavik, 2008). 'Humane slaughter practices' feature as a top concern for citizens in most European countries (Miele et al., 2011), and they believe that slaughter processes need improvement (Tomasevic et al., 2020). Likewise, members of the public in Spain and Mexico converge on animal welfare as a value in considering meat production (Estévez-Moreno et al., 2021). Additionally, some previous studies demonstrate that livestock industry stakeholders also express concern for animal welfare during slaughter (World Animal Protection, 2016; Sinclair et al., 2017; Sinclair et al., 2019b). In China, where pre-slaughter stunning is not mandated and often not conducted, livestock stakeholders identified pre-slaughter stunning as the one most important livestock animal welfare issue to be addressed during slaughter and transport (Li et al., 2018), and in another study in Bangladesh, China, India, Malaysia, Thailand and Vietnam, livestock leaders were mostly willing to embrace pre-slaughter stunning in a variety of pre-determined conditions (Sinclair et al., 2019a). During this latter study, livestock stakeholders in Malaysia, a predominantly Muslim nation, made the point that members of the public were largely unaware of farming processes, including slaughter (Sinclair et al., 2019a). This perceived lack of knowledge of the general public is not limited to one nation, and particularly seems to be the case when considering the practices of religious slaughter (Jalil et al., 2018). Despite regional differences, the fact that consumers in Europe expect meat production processes to take animal welfare and other social and ethical attributes into account (Boogaard et al., 2011; Van Loo et al., 2014; European Commission, 2016; Grunert et al., 2018) remains important for world trade and for predicting the transformative nature of trends in animal industries outside of Europe.

In general, little is known about the knowledge and preferences of the general public in relation to slaughter and animal welfare outside of Europe, and even less so in regard to the process of pre-slaughter stunning. The present study seeks to address this gap by surveying members of the public in 14 countries selected for their geographical dispersion, cultural diversity and varied predominant religions; Australia, Bangladesh, Brazil, Chile, China, India, Malaysia, Nigeria, Pakistan, Philippines, Sudan, Thailand, the United Kingdom (henceforth UK) and the United States of America (henceforth USA). We present our general findings in relation to declared meat eating, the perceived importance of

reducing suffering during slaughter, knowledge and perceptions of pre-slaughter stunning and comfort levels in witnessing slaughter, and then present nation-specific contextual discussions and a legislation reference table. It is anticipated that the findings of this study will offer a useful resource to domestic livestock industries and governments in each nation, and to domestic and international advocates for improved animal protection and welfare.

2 Method

The findings presented in this manuscript pertain to our survey questions relating to meat, slaughter and pre-slaughter stunning. Findings associated with general perceptions to animal welfare and analysed by species are presented in an earlier companion manuscript (Sinclair et al., 2022a), with another manuscript presenting findings relating to hen welfare and egg production systems (Sinclair et al., 2022b).

2.1 Research ethics

This research was granted ethical approval by the University of Queensland in Australia (2020002752). Data collection was conducted between April and October 2021. Due to the active COVID-19 pandemic, additional precautions were taken, and some regional variations in data collection methods were required. Potential participants were presented with a statement of consent which they were required to agree to (verbally or physically by clicking a box) before commencing the survey.

2.2 Research tool

A survey was hosted online on the Google Forms platform and consisted of 24 items and four demographic questions (identified gender, age group, education level and religion) <supplementary file>. Participants were first asked if they understood the meaning of 'animal welfare', after which the following definition was provided:

"The welfare of animals' refers to how well an animal is coping with the conditions in which it lives. An animal has good welfare if its needs are being met and hence it is healthy, comfortable, well nourished, safe, able to express important behaviour and not suffering from unpleasant states such as pain, fear and distress" - adapted from World Organisation for Animal Health (OIE, 2016).

The 24 research items were designed to reveal participants' knowledge and perceptions and consisted of a range of question styles. Some animal welfare-related statements required the participant to attribute a level of agreement utilising a 7-point Likert scale (1 – strongly disagree, 4 – neither agree nor disagree, 7 – strongly agree), or a level of importance to the welfare of various species (1 – extremely unimportant, 4 – I don't have an opinion/ don't know the species, 7 – extremely important). All research items were pilot tested and revised with research team consultation to ensure they could be clearly translated and were appropriate within each of the countries where the study was being conducted. As a

result of this consultation, some alterations were made to the research tool, to enable the identical question to be used across all countries. One example of this was in question 3 (see supplementary file), where 'animal welfare friendly products' was replaced with 'products kinder to animals', as some countries do not have a concept of the former (largely due to availability). In the versions that were completed by individuals at home facilitated through Mechanical Turk and Instagram (see 2.3 Data collection for a full description of methods), the research tool included the addition of a "mid-way attention tool" to assess that participants were answering accurately and not randomly clicking. The 'mid-way attention tool' took the form of an additional question (11b) in which participants were asked 'How important is reading a question instead of simply clicking numbers to finish quickly?', with the accompanying instruction 'As you are at the midway point this is a check to ensure you are still reading the questions. Please select 4'. Responses other than '4' were removed from the dataset prior to analysis. Once programmed online in English for use in Australia, Nigeria, Philippines, UK and USA, the survey tool was replicated for each of the countries and translated by bilingual translators in-country into other languages as suitable to each general population as follows; Bangladesh (Bengali), Brazil (Portuguese), Chile (Spanish), China (Traditional Chinese/Mandarin), India (Hindi and English), Malaysia (Bahasa Malay, Chinese and English), Pakistan (Urdu), Sudan (Arabic) and Thailand (Thai).

2.3 Data collection

The main method of data collection in this study was face-to-face-collection in public spaces. Effort was made to gain varied samples within each country, city and rural areas and geographical regions and demographics were collected (Table 1). Data collectors in each country were instructed and supervised by local research familiar 'Country Collaborators', who are also co-authors of this study. Once randomly selected and approached by data collectors, prospective participants were asked if they were willing to complete a 5-minute survey of opinions about animals for an international academic study. If the request was accepted, the data collectors ensured the participants were over 18 and that they identified themselves as residents of the country they were in. If they did not fulfill the required criteria they were thanked for their time and collection was ceased. If they did fulfill the criteria and agreed to participate, they were advised of the confidential and anonymous nature of the research and advised that they could cease their involvement at any time during the survey. In this method of face-to-face collection, the data collectors then verbally presented each question to the participants and entered the response into the online survey tool where it was anonymously stored. While this method of collection was highly demanding of human resources, it was adopted in an attempt to reduce the biases of self-selection of animal-leaning participants. As with all methods of data collection, however, face-to-face methods of collection do carry the risk of other bias. In this instance it is important to acknowledge the 'enumerator effect', whereby the behaviour or characteristics of the researcher approaching the respondent impacts both the likelihood

to engage with the research and the responses they may give (Meta Di Maio and Fiala, 2018). The eleven countries in which this face-to-face method was used were Australia, Bangladesh, Chile, China, India, Malaysia, Nigeria, Pakistan, Philippines, Sudan and Thailand.

In addition to the random approach in public spaces, in some countries, it was necessary to adopt additional methods of recruitment to ensure a sufficient number of responses. Pandemic lockdowns during the data collection period sometimes limited numbers in public spaces and direct contact presented a safety risk. In Malaysia and Australia, a QR code linked to the survey tool was randomly given to members of the public with a brief explanation of the study so that they could complete the survey without being in close proximity to the data collector. Recruitment of participants in Brazil, the USA and the UK was conducted entirely online. Recruitment in Brazil was conducted utilising the social media platform Instagram (Meta Platforms et al., 2010), where an advertisement (in Portuguese) saying "We want to hear from you. Access the link to collaborate with our research on the relationship between people and animals" invited the public to participate in the survey. The Instagram account was created exclusively to share the questionnaire and had no information on the identity of the authors or the research group. We strategically targeted participants to match the age and gender distribution of the Brazilian population and the questionnaire was initially pilot tested using 20 randomly recruited participants to ensure representative distribution was achieved. Participant recruitment for data collection in the USA and the UK was exclusively conducted utilising the online platform Amazon Mechanical Turk (Bezos, 2005). Amazon Mechanical Turk offers a small payment (in this study, a scaled proportion of minimum salary for five minutes of participation time) to 'workers' previously enlisted with the platform in exchange for completing the survey. Amazon Mechanical Turk has been validated as a survey participant recruitment tool (Robbins et al., 2016), with samples providing more diversity with comparable quality measured against standard samples (Paolacci and Chandler, 2014).

2.4 Data analysis

The data were initially collated, organised and cleansed by removing incomplete datasets and all data from participants who did not pass the midway attention test (see 2.2 Research tool). Data were imported into Microsoft SQL Server and Microsoft Excel for cleaning, and IBM SPSS and Minitab (Minitab Statistical Software LLC, 1972) where descriptive statistics were obtained for the demographics and research items. Based on the Likert scale (1-7), all attitudinal questions were assessed for means to approximate the magnitude of agreement for statement items, or associated importance for species-specific animal welfare perceptions (Norman, 2010). Variance between countries for each question was assessed with a one-way ANOVA in addition to variance between meat-eaters and non-meat-eaters, with a *post hoc* Tukey pairwise analysis test performed to assess homogeneity between countries. Significance was considered at $p < 0.05$. Where means of question responses or groups were compared, a Student's t-test was used. Percentages of

TABLE 1 Demographic characteristics of respondents (n = 4,291) in Australia, Bangladesh, Brazil, Chile, China, India, Malaysia, Nigeria, Pakistan, Philippines, Sudan, Thailand, United Kingdom and United States.

	Australia	Bangladesh	Brazil	Chile	China	India	Malaysia	Nigeria	Pakistan	Philippines	Sudan	Thailand	United Kingdom	United States	Total mean
TOTAL	250	286	302	252	249	455	262	298	501	309	327	255	254	291	4,291
Gender															
Male	76 30.4%	182 63.6%	143 47.4%	87 34.5%	130 52.2%	210 46.2%	75 28.6%	173 58.1%	341 68.0%	83 26.9%	247 75.5%	93 36.5%	161 63.4%	191 65.6%	49.8%
Female	171 68.4%	102 35.7%	154 51.0%	159 63.1%	114 45.8%	231 50.8%	180 68.7%	118 39.6%	157 31.3%	204 66.0%	65 19.9%	157 61.6%	89 35.0%	97 33.3%	47.9%
Prefer not to say	3 1.2%	2 0.7%	5 1.7%	6 2.4%	5 2.0%	14 3.1%	7 2.7%	7 2.3%	3 0.6%	22 7.1%	15 4.6%	5 2.0%	4 1.6%	3 1.0%	2.4%
Education level															
None		41 14.3%				9 2.0%	2 0.8%		112 22.4%	1 0.3%	5 1.5%		2 0.8%	2 0.7%	5.3%
Primary school	3 1.2%	40 14.0%	2 0.7%	3 1.2%	2 0.8%	12 2.6%			4 1.3%	111 22.2%	3 1.0%	7 2.1%		2 0.7%	4.3%
Secondary school	43 17.2%	74 25.9%	26 8.6%	47 18.7%	8 3.2%	61 13.4%	29 11.1%	30 10.1%	97 19.4%	27 8.7%	12 3.7%	9 3.5%	28 11.0%	24 8.2%	11.6%
Vocational course	60 24.0%	50 17.5%	37 12.3%	24 9.5%	27 10.8%	49 10.8%	51 19.5%	35 11.7%	42 8.4%	38 12.3%	24 7.3%	18 7.1%	55 21.7%	69 23.6%	14.0%
University	144 57.6%	78 27.3%	237 78.5%	177 70.2%	212 85.1%	316 69.5%	179 68.3%	229 76.8%	137 27.3%	239 77.3%	277 84.7%	226 88.6%	168 66.1%	194 66.8%	67.4%
Undisclosed		3 1.0%		1 0.4%		8 1.8%	1 0.4%		2 0.4%	1 0.3%	2 0.6%	2 0.8%	1 0.4%		0.6%
Age group															
18-29	90 36.0%	94 32.9%	58 19.2%	156 61.9%	159 63.9%	233 51.2%	46 17.6%	154 51.7%	194 38.7%	113 36.6%	139 42.5%	38 14.9%	92 36.2%	58 20.2%	37.4%
30-39	62 24.8%	93 32.5%	61 20.2%	42 16.7%	69 27.7%	104 22.9%	99 37.8%	75 25.2%	125 25.0%	107 34.6%	98 30.0%	107 42.0%	90 35.4%	114 39.0%	29.6%
40-49	33 13.2%	53 18.5%	74 24.5%	16 6.3%	11 4.4%	81 17.8%	77 29.4%	44 14.8%	92 18.4%	54 17.5%	52 15.9%	56 22.0%	38 15.0%	68 23.3%	17.2%
50-59	37 14.8%	27 9.4%	68 22.5%	17 6.7%	7 2.8%	15 3.3%	25 9.5%	23 7.7%	67 13.4%	28 9.1%	29 8.9%	44 17.3%	22 8.7%	33 11.3%	10.4%
60+	28 11.2%	18 6.3%	41 13.6%	21 8.3%	3 1.2%	14 3.1%	14 5.3%	2 0.7%	23 4.6%	7 2.3%	7 2.1%	9 3.5%	12 4.7%	18 6.2%	5.2%
Undisclosed		1 0.3%				8 1.8%	1 0.4%				2 0.6%	1 0.4%			0.70%
Religion															
None	175 70.0%		94 31.1%	118 46.8%	211 84.7%	30 6.6%	24 9.2%	3 1.0%		10 3.2%	7 2.1%	5 2.0%	136 53.5%	35 12.0%	26.8%
Buddhism	1 0.4%		2 0.7%		21 8.4%	6 1.3%	84 32.1%			1 0.3%	1 0.3%	238 93.3%	1 0.4%		15.2%
Catholicism	13 5.2%		83 27.5%	89 35.3%	1 0.4%	3 0.7%	7 2.7%	2 0.7%		194 62.8%		1 0.4%	10 3.9%	41 14.4%	14.00%
Christianity	43 17.2%		70 23.2%	28 11.1%	8 3.2%	2 0.4%	37 14.1%	237 79.5%	3 0.6%	93 30.1%		4 1.6%	78 30.7%	184 63.0%	22.9%
Hinduism		25 9.7%				392 86.2%	11 4.2%		1 0.2%		5 1.5%		10 3.9%	3 1.0%	0.15%
Islam	2 0.8%	260 90.9%	1 0.3%		2 0.8%	2 0.4%	85 32.4%	52 17.4%	494 98.6%	2 0.6%	305 93.3%	7 2.7%	8 3.1%	4 1.4%	26.7%
Taoism	1 0.4%				3 1.2%		5 1.9%						2 0.8%		1.1%
Other	15 6.0%	1 0.3%	52 17.2%	17 6.7%	3 1.2%	17 3.7%	8 3.0%	4 1.3%			7 2.3%	9 2.8%	9 3.54%	24 8.2%	4.7%
Undisclosed						3 0.7%	1 0.3%		3 0.6%	2 0.6%					0.5%

Where less than 10 participants across all countries denoted adhering to a specific religion, the data was included into "other". This includes Jainism, Judaism, Sikhism, Chinese Folk Religion, Confucianism and Bahai Faith.

agreement were calculated by identifying and quantifying the number of participants who expressed some level of agreement (Likert scale values 5, 6 or 7), against those who expressed disagreement (Likert scale values 1, 2 or 3) or neutrality (Likert scale value 4). Both calculations are presented together in results tables to build a picture of general agreement/associated importance, and the strength of that agreement/associated importance.

3 Results

A total of 4,291 participants engaged in this study across 14 geographically and culturally diverse countries (Australia, Bangladesh, Brazil, Chile, China, India, Malaysia, Nigeria, Pakistan, Philippines, Sudan, Thailand, UK and USA). Demographic distribution within these countries is presented in Table 1. Although distribution varies across countries, the total sample was closely split by gender (49.6% were male, 47.9% were female). Most participants were between 18 and 49 years of age. Participants with a university education are overrepresented as compared to the general population, and this is a consistent effect across countries.

3.1 Do you eat meat?"

Most respondents in most countries stated that they eat meat, with an average international aggregate of 89.5% (see Table 2). Nigeria had the highest rate of meat-eating (99%), followed by Sudan (98.8%), Thailand (98.8%), and China (98.4%). India was an outlier, with only 45% eating meat, with the second and third lowest being Australia (76.4%) and the UK (87.4%).

TABLE 2 Percentage of respondents that eat meat, by country.

"Do you eat meat?"	Yes (%, n)	No (%, n)
Australia (250)	76.4% (191)	23.6% (59)
Bangladesh (286)	97.9% (280)	2.1% (6)
Brazil (302)	83.8% (253)	16.2% (49)
Chile (252)	86.1% (217)	13.9% (35)
China (249)	98.4% (245)	1.6% (4)
India (455)	44.8% (204)	55.2% (251)
Malaysia (262)	96.2% (252)	3.8% (10)
Nigeria (298)	99.0% (295)	1.0% (3)
Pakistan	96.6% (484)	3.4% (17)
Philippines (309)	96.4% (298)	3.6% (11)
Sudan (327)	98.8% (323)	1.2% (4)
Thailand (255)	98.8% (252)	1.2% (3)
United Kingdom (254)	87.4% (222)	12.6% (32)
United States (291)	93.1% (271)	6.8% (20)
International aggregate	88.25% (3,787)	11.74% (504)

3.2 General knowledge around slaughter and stunning

The statement "I think that most of the animals in <country> are fully conscious and aware at the moment they are slaughtered" was met with a large degree of uncertainty, receiving comparatively high levels of 'I don't know' across most countries (see Table 3; Figure 1). Uncertainty was highest in Thailand, Malaysia, the UK, Brazil and Australia, where approximately a third of participants selected 'I don't know'. Participants in Pakistan, China, the USA and Bangladesh were most likely to agree with this statement.

"I think that stunning an animal unconscious in the moments before they are slaughtered is better for the animal" received less uncertainty, but did vary significantly by country (p<0.001), with a very large disparity of agreement between Pakistan and Sudan at the lowest levels of agreement, and Australia, the USA, the UK, Chile, Thailand and China at the highest levels – the latter, China, being the highest (see Table 4; Figure 2).

3.3 Animal welfare at slaughter

Most participants in all countries except Bangladesh agreed that animal welfare at slaughter mattered to them (see Table 4; Figure 3). The highest levels of agreement were found, in descending order, in Chile, Brazil, Australia, the UK and Thailand. The lowest level of agreement was in Bangladesh, with a neutral mean of 4.09 (neither agree or disagree). Interestingly, ANOVA analysis for responses to "it matters to me that animals do not suffer during slaughter" found no significant difference between meat-eaters and non-meat-eaters across all countries, meaning meat-eaters were not less likely to agree that reduction of suffering was important to them. 'It matters to me that animals do not suffer during slaughter' presented a country effect (p<0.001), meaning that participants in each country tended to answer in the same way as their fellow citizens, which was different from most other countries.

One of the more polarising statements by country was 'I am comfortable to watch an animal slaughtered for meat'. Participants in Thailand, Brazil, Chile, Australia, India and the Philippines had the highest rates of disagreement, with a mean below 2.5 (disagree). The most likely to state they were comfortable to watch slaughter were participants from Pakistan, followed by the USA and China (see Table 4; Figure 4). A significant country effect is present in regard to this statement (p<0.001), and a test for homogeneity of variances confirmed the significance for both mean and median responses.

3.4 Preferences around stunning and religious slaughter

In response to the statement "I think stunning animals unconscious will reduce the taste of the meat", participants in all countries disagreed, except for those in Pakistan, Bangladesh, the USA and Sudan, listed in order from highest strength of

TABLE 3 Percentage of respondents that believe most animals are fully conscious and aware at the moment they are slaughtered, by country.

	Yes % (n)	No % (n)	I don't know % (n)
Australia (250)	60% (150)	7.6% (19)	32.4% (81)
Bangladesh (286)	75.5% (216)	7.7% (22)	16.8% (48)
Brazil (302)	49.3% (149)	15.2% (46)	35.4% (107)
Chile (252)	67.1% (169)	13.9% (35)	19% (48)
China (249)	79.1% (197)	4.8% (12)	16.1% (40)
India (455)	60.8% (277)	9.8% (45)	29.2% (133)
Malaysia (262)	54.9% (144)	9.2% (24)	35.9% (94)
Nigeria (298)	74.8% (223)	87.2% (26)	16.4% (49)
Pakistan (501)	94.8% (475)	3.6% (18)	1.6% (8)
Philippines (309)	62.1% (192)	10.7% (33)	27.2% (84)
Sudan (327)	66.0% (216)	14.0% (46)	19.9% (65)
Thailand (255)	44.3% (113)	13.3% (34)	42.3% (108)
United Kingdom (254)	44.1% (112)	20.1% (51)	35.8% (91)
United States (291)	78.0% (227)	6.8% (20)	15.1% (44)

disagreement (see Table 4; Figure 5). Similarly, participants in Bangladesh, Pakistan, Sudan and Nigeria stated that they would not prefer to eat meat from animals that are stunned before slaughter (see Table 4; Figure 6), again listed in order from highest strength of disagreement. All of these countries have majority or significant Muslim populations, as reflected in the demographics table (see Table 1). The highest rate of agreement regarding a preference for meat from animals that have been stunned prior to slaughter is again found in Chile, Australia, the UK, the USA, China, Thailand and Brazil (see Table 4; Figure 6).

Given that slaughter and killing are often approached from a religious lens in addition to, and sometimes interwoven with, the cultural context, we also applied additional analysis by religion

FIGURE 1
Responses to statement *"I believe most animals are fully conscious and aware at the moment they are slaughtered"* sorted by general agreement.

across countries. When considering the statement "I would prefer to eat meat from animals that are killed using religious method of slaughter", a Tukey post-hoc analysis demonstrated that similar responses could be identified by three distinct groups; (1) Atheist and non-Abrahamic religions, (2) Christians and (3) Muslims. When considering the earlier statement "I think that stunning an animal unconscious the moments before they are slaughtered is better for the animal" those similarities were reduced to two groups: (1) Muslims and (2) all others including atheists. Unsurprisingly, participants in Pakistan, Bangladesh and Sudan agreed that "I would prefer to eat meat from animals that are killed using religious methods for slaughter", with Malaysian participants also leaning this way, along with, surprisingly, US Americans (see Table 4; Figure 7). The preference for eating meat from religiously slaughtered animals was closely correlated with the perception that stunning would affect meat quality, in particular, its taste ($R^2 = 0.789$, p<0.001, Figure 8).

4 Discussion

The welfare state of farmed animals is directly determined by on-farm, transportation and peri-slaughter practices; however, those practices are influenced by consumer attitudes expressed in supermarkets, voting booths and societal culture at large (Bell et al., 2017; Alonso et al., 2020). This study is the first research to illuminate consumer attitudes and societal culture around animal slaughter within many of the countries included herein. To the awareness of the authors, this is also the first time a comparative analysis has been conducted on attitudes to slaughter across culturally-diverse, key world regions. To acknowledge the impact
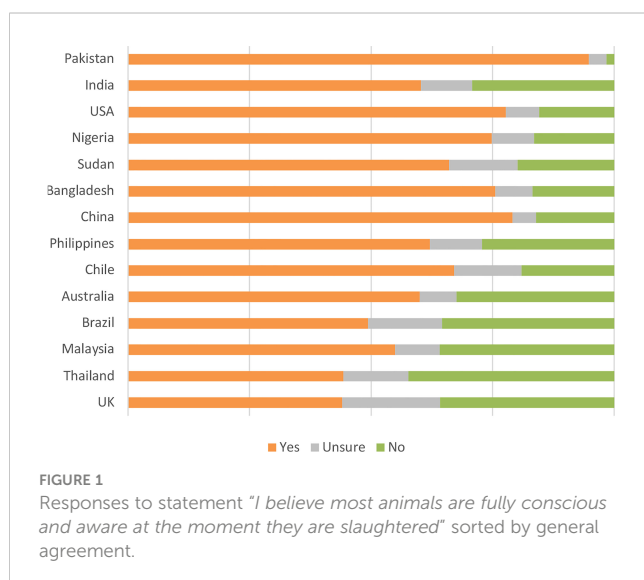
TABLE 4 Means and standard deviations for the level of agreement to statements regarding slaughter, by country.

	N	"I am comfortable to watch an animal slaughtered for meat"			"It matters to me that animals do not suffer during slaughter"			"I think that stunning an animal unconscious the moments before they are slaughtered is better for the animal"		
		Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
Australia	250	2.22	1.8600	0.1176	6.51	1.1021	0.0697	5.11	1.7549	0.1110
Bangladesh	286	3.36	2.0019	0.1184	4.09	2.2183	0.1312	4.63	1.7758	0.1050
Brazil	302	2.13	1.8165	0.1045	6.74	0.6913	0.0398	4.83	1.9970	0.1149
Chile	252	2.15	1.7707	0.1115	6.81	0.6232	0.0393	5.64	1.9821	0.1249
China	249	4.00	2.1127	0.1339	5.82	1.3808	0.0875	6.07	1.2993	0.0823
India	455	2.23	1.7569	0.0824	5.08	2.2439	0.1052	4.76	1.9418	0.0910
Malaysia	262	2.79	2.0907	0.1292	5.65	1.7805	0.1100	4.79	1.9981	0.1234
Nigeria	298	3.54	2.0547	0.1190	5.05	1.9807	0.1147	5.01	1.9210	0.1113
Pakistan	501	5.31	1.8347	0.0820	5.99	1.2272	0.0548	3.57	2.2937	0.1025
Philippines	309	2.29	1.7397	0.0990	5.20	1.9581	0.1114	4.88	1.7549	0.0998
Sudan	327	3.82	2.1410	0.1184	5.35	2.0742	0.1147	3.90	2.2571	0.1248
Thailand	255	1.60	1.2375	0.0775	6.00	1.6217	0.1016	5.89	1.4566	0.0912
UK	254	3.07	1.9987	0.1254	6.02	1.3291	0.0834	5.36	1.6107	0.1011
USA	291	4.25	2.1517	0.1259	5.39	1.5310	0.0896	5.23	1.3953	0.0817
Total	4292	3.05	2.1936	0.0335	5.69	1.7999	0.0275	4.97	2.0013	0.0305

	N	"I think stunning animals unconscious will reduce the taste of the meat"			"I would prefer to eat meat from animals that are made unconscious for slaughter"			"I would prefer to eat meat from animals that are killed using religious methods for slaughter"		
		Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
Australia	250	2.14	1.5841	0.1002	5.22	1.7771	0.1124	2.60	1.7167	0.1086
Bangladesh	286	4.38	1.3733	0.0812	3.30	1.8027	0.1066	6.58	0.7761	0.0459
Brazil	302	2.73	1.8492	0.1064	4.96	1.9025	0.1095	2.90	1.8490	0.1064
Chile	252	2.21	1.7851	0.1125	5.92	1.7710	0.1116	3.06	2.3175	0.1460
China	249	3.46	2.0099	0.1274	5.11	1.7414	0.1104	3.34	1.8618	0.1180
India	455	2.77	1.6634	0.0780	4.09	2.1223	0.0995	2.40	1.6862	0.0790
Malaysia	262	3.07	1.6674	0.1030	4.44	1.9085	0.1179	4.42	2.0282	0.1253
Nigeria	298	2.79	1.6960	0.0982	3.85	1.8259	0.1058	3.36	2.0158	0.1168
Pakistan	501	5.24	1.6219	0.0725	3.33	2.2477	0.1004	6.25	1.2568	0.0562
Philippines	309	2.95	1.7059	0.0970	4.72	1.7460	0.0993	3.95	1.7583	0.1000
Sudan	327	4.03	2.0669	0.1143	3.41	2.0685	0.1144	5.85	1.8675	0.1033
Thailand	255	2.21	1.4114	0.0884	5.09	1.6931	0.1060	2.85	1.9376	0.1213
UK	254	2.52	1.7842	0.1119	5.22	1.7829	0.1119	2.89	1.9277	0.1210
USA	291	4.17	2.1502	0.1258	5.20	1.5874	0.0929	4.44	1.8708	0.1095
Total	4291	3.19	1.9992	0.0305	4.56	2.0650	0.0315	3.92	2.2793	0.0348

(1: Strongly disagree; 2: Disagree; 3: Somewhat disagree; 4: Neither agree nor disagree; 5: Somewhat agree; 6: Agree; 7: Strongly agree).

of individual cultures we need to compare and understand across cultures, so this approach is important. Although efforts were made to obtain samples across geographical regions and residential zonings (rural vs metropolitan) the samples are not fully representative of the entire community within country. For this reason, full demographics are reported (Table 1), and the results and following discussion is designed to serve as a generalized snapshot of perceptions to slaughter across countries. Likewise, in
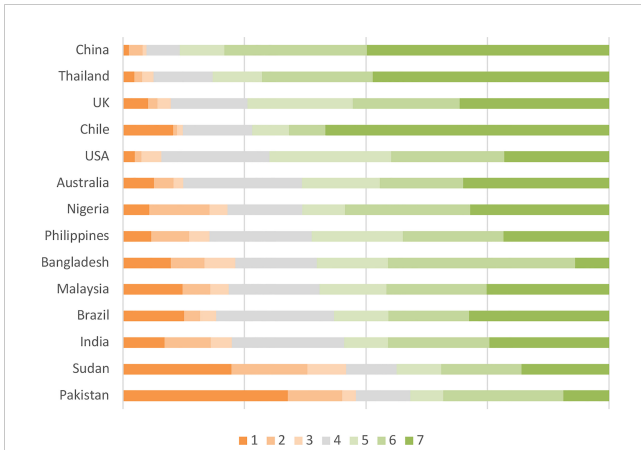
FIGURE 2

Responses to statement *"I think that stunning an animal unconscious the moments before they are slaughtered is better for the animal"* sorted by general agreement and graded by strength (1 – Strongly Disagree, 2 – Disagree, 3 – Somewhat Disagree, 4 – Neutral, 5 – Somewhat Agree, 6 – Agree, 7 – Somewhat Agree).

FIGURE 4

Level of agreement to statement *"I am comfortable to watch an animal slaughtered for meat"* sorted by general agreement and graded by strength (1 – Strongly Disagree, 2 – Disagree, 3 – Somewhat Disagree, 4 – Neutral, 5 – Somewhat Agree, 6 – Agree, 7 – Somewhat Agree).

some areas of the world the methods and practices of slaughter are diverse, largely depending on the size of establishment, but also depending on customs, technical skills and tools. While acknowledging the existence of domestic diversity of practice this study aimed to understand awareness and perspectives on the what is understood to be the most common practices of slaughter (Table 5).

Although some of our findings are in line with known phenomena, such as generalised discomfort when witnessing slaughter, a significant proportion of findings serve to challenge any practice of applying perceived general sentiment across borders and specifically, into regions that host agricultural industries in earlier stages of development. Similarities of response across all of the diverse countries in this study may be considered commonalities of being human, and the many differences in which there was a significant country effect may be considered a product of culture together with socio-political and economic region.
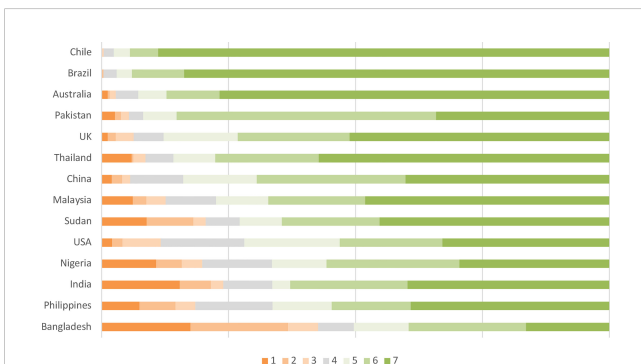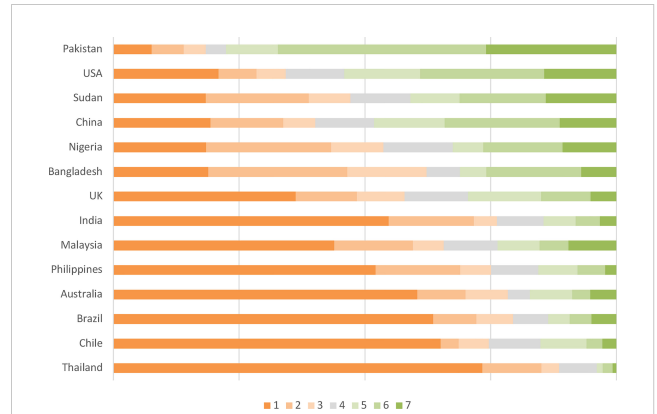
With the exception of a mean neutral response from participants in Bangladesh, most participants agreed that avoiding suffering during slaughter mattered to them. How to achieve a reduction of suffering and what role religious slaughter plays was far less clear for participants in general, and knowledge levels regarding actual practice were very low in some countries. Crucially, reported comfort levels in witnessing slaughter varied considerably by culture.

4.1 General understanding around slaughter and stunning

The disparity between participants who believed that animals were most frequently slaughtered while fully conscious in their country (i.e., not rendered unconscious through stunning) versus the respective local practices that are believed to be most common and the legislative mandate status of the practice demonstrated a particular disconnection in some countries. For reference, we
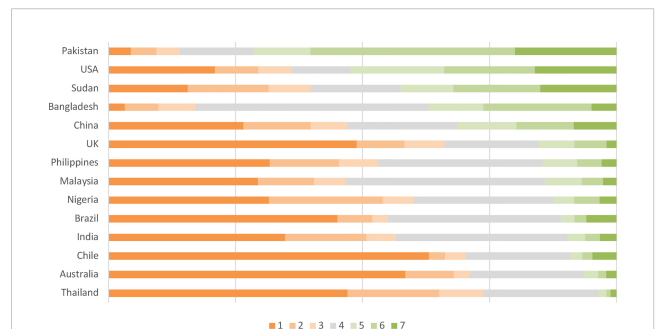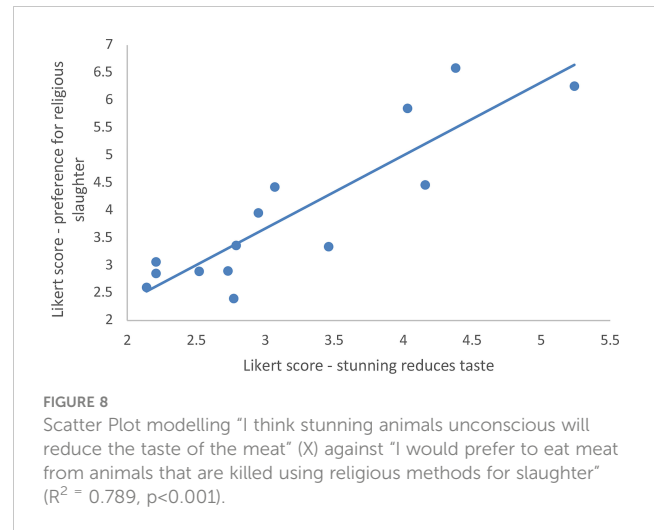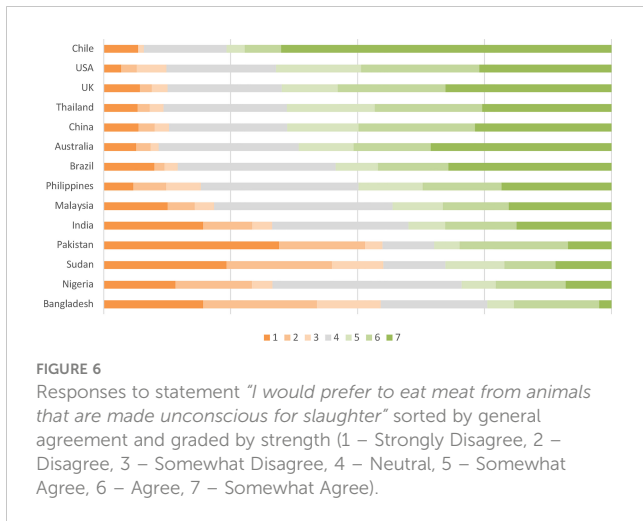

FIGURE 3

Level of agreement to statement *"It matters to me that animals do not suffer during slaughter"* sorted by general agreement and graded by strength (1 – Strongly Disagree, 2 – Disagree, 3 – Somewhat Disagree, 4 – Neutral, 5 – Somewhat Agree, 6 – Agree, 7 – Somewhat Agree).

FIGURE 5

Responses to statement *"I think stunning animals unconscious prior to slaughter will reduce the taste of the meat"* sorted by general agreement and graded by strength (1 – Strongly Disagree, 2 – Disagree, 3 – Somewhat Disagree, 4 – Neutral, 5 – Somewhat Agree, 6 – Agree, 7 – Somewhat Agree).

FIGURE 6
Responses to statement *"I would prefer to eat meat from animals that are made unconscious for slaughter"* sorted by general agreement and graded by strength (1 − Strongly Disagree, 2 − Disagree, 3 − Somewhat Disagree, 4 − Neutral, 5 − Somewhat Agree, 6 − Agree, 7 − Somewhat Agree).

FIGURE 8
Scatter Plot modelling "I think stunning animals unconscious will reduce the taste of the meat" (X) against "I would prefer to eat meat from animals that are killed using religious methods for slaughter" ($R^2 = 0.789$, $p<0.001$).

tabulated in-country perceptions of pre-slaughter stunning use against what we understand to be the most frequent actual use in-country, in addition to relevant federal law, to present further information by country (see Table 5).

In the USA, Australia and the UK most participants (between 79.9%-93.2%) assumed animals were fully conscious at slaughter when in reality, with a small exception of religiously slaughtered animals, pre-slaughter stunning is mandated by law and routinely practiced in all of these countries. Most participants in Pakistan, China, Nigeria and Bangladesh (between 74.8%-98.4%), also tended to agree that stunning is not routinely applied in their countries. In each of these countries, however, stunning is not believed to be routinely conducted or mandated. In each of these countries slaughter on occasion is conducted openly and exposure to slaughter both visually and practically is comparatively more common and therefore awareness around the process is increased. In contrast, slaughter in the USA, Australia and the UK is strictly legislated in highly industrialised processes than remain almost entirely hidden from public view (Leroy and Praet, 2017).

Many participants stated that they 'don't know' if pre-slaughter stunning is frequently conducted in their country, particularly in

FIGURE 7
Responses to statement *"I would prefer to eat meat from animals that are killed using religious methods for slaughter"* sorted by general agreement and graded by strength (1 − Strongly Disagree, 2 − Disagree, 3 − Somewhat Disagree, 4 − Neutral, 5 − Somewhat Agree, 6 − Agree, 7 − Somewhat Agree).

Australia, Brazil, India, Malaysia, Philippines and the UK. This may suggest that confusion or purposeful ignorance plays a large role in perceptions of slaughter for many people, coupled with low levels of exposure and awareness around the slaughter process and, for these countries, a willingness to admit that. A notable exception to this was the USA and, to a lesser degree, Chile. Participants in the USA were particularly confident that animals weren't stunned prior to slaughter (77.7%) when in fact it is legislated, with comparatively few stating 'I don't know'. This could be attributable to an individualism-tied, cultural tendency towards generalized self-competence (the belief in personal ability and efficacy) (Tafarodi and Swann, 1996), generalized confidence (Handy, 2001) and self-esteem that is not necessarily accurately correlated with ability or knowledge (Shtulman, 2010; Zoller Booth and Gerard, 2011), and therefore a strong preference against declaring ignorance. It is also possible that the use of the word 'slaughter' in the USA has connotations beyond large-scale slaughter operations and is instead understood as 'killing' in general, rather than the specific meaning of slaughter in terms of killing of livestock for meat. The term 'slaughter' is used in media hyperbole to describe killing via regular mass shooting events and may also be biased by exposure to the national pastime of wild game hunting.

In response to the statement that pre-slaughter stunning was better for the welfare of the animals, as current scientific understanding suggests, general disagreement existed in Pakistan and Sudan (see below for the role of religion), and neutrality and uncertainty led the way in Bangladesh, Brazil, India, Malaysia and the Philippines. This is not clearly explainable by ways of exposure and may in part be due to exposure to pre-slaughter stunning being incorrectly applied, or the connotation that the practice itself is violent and cruel; for example, by the addition of electronarcosis and thus extending what could be a one-step process of violence into two steps. Incorrect application of pre-slaughter stunning significantly reduces welfare and increases suffering, and witnessing unsuccessful or even successful attempts to stun animals using blunt instruments such as pipes, wooden logs or otherwise could result in the conclusion that pre-slaughter stunning is violent and cruel. In addition to the consideration of exposure, a
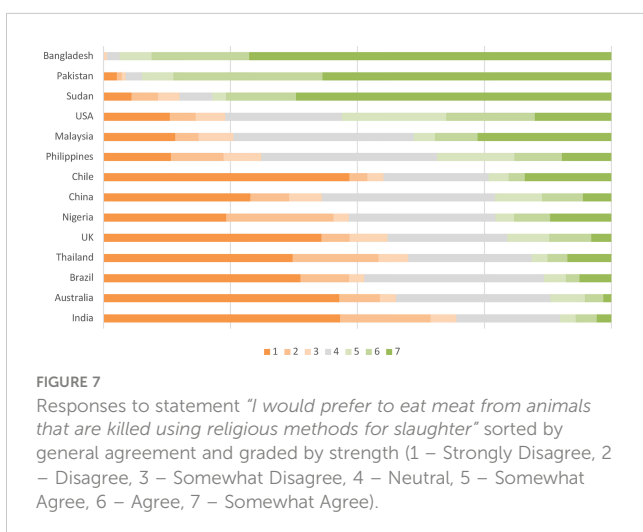
TABLE 5 Current 'state of play' summary reference table regarding the incorporation of pre-slaughter stunning in legislation and practice in each of the countries included in this study.

	Pre-slaughter stunning is routine*	% participants responses aligned with most common practice	Legislation exists that mandates pre-slaughter stunning*	Specific legislation
Australia	Yes	7.6%	Yes (exception for religious slaughter)	Commonwealth Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption (AS4996:2007)—("The Meat Standard"). Enacted and enforced through state-based regulation.
Bangladesh	No	75.5%	No	N/A
Brazil	Yes	15.2%	Yes (exception for religious slaughter)	Brasil, 2021. Portaria N° 365, DE 16/07/2021, Ministry of Agriculture, Livestock and Supply/Secretariat of Agricultural Defense. Diário Oficial da União, Brasília.
Chile	Yes	13.9%	Yes	Chile, 2009. Reglamento sobre estructura y funcionamiento de mataderos, establecimientos frigoríficos, cámaras frigoríficas y plantas de despiece, y fija equipamiento mínimo para tales establecimientos. Decreto N° 94, DEL 26/22/2008, Ministerio de Agricultura de Chile. Diario Oficial el 2 de junio de 2009.
China	No	79.1%	No	N/A
India	No	60.8%	Yes	Section 6: Rule 4 of 'The Prevention of Cruelty to Animals Rules' (2001), Union Government of India.
Malaysia	Yes* *for poultry and swine, not for cattle	54.9%* *mostly (see species delineation)	No	N/A
Nigeria	No	74.8%	No	N/A
Pakistan	No	94.8%	No	N/A
Philippines	Yes	10.7%	Yes	Administrative Order No. 18 Series of 2008. Rules and Regulations of Humane Handling in the Slaughter of Animals for Food (Section 7: Stunning). Department of Agriculture.
Sudan	No	66.0%	No	N/A
Thailand	No	44.3%	No	N/A
United Kingdom (UK)	Yes	20.1%	Yes (exceptions for religious slaughter)	The Welfare of Animals at the Time of Killing (Scotland) Regulations (2012). Scottish Statute Instruments No 321. * The Welfare of Animals at the Time of Killing (Wales) Regulations (2014). Wales Statutory Instruments No. 951 (W. 92). * The Welfare of Animals at the Time of Killing (Northern Ireland) Regulations (2014). Northern Ireland Statutory Rules No. 107. * The Welfare of Animals at the Time of Killing (England) Regulations (2015). UK Statutory Instruments No. 1782. All legislation in line with European Council (EC) Regulation No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing.
United States (USA)	Yes	6.8%	Yes (exception for religious slaughter)	Pub. L. 95–445, §1902. Oct. 10, 1978, 92 Stat. 1069, 'Humane Methods of Slaughter Act' (1978). Federal Government of the United States of America.

*at the time of data collection.

lack of advocacy for pre-slaughter stunning or laws often result in reduced knowledge of the role pre-slaughter stunning can play in the mitigation of some suffering, and methods employed to achieve instantaneous insensibility (Riaz et al., 2021). The lack of knowledge and understanding of animal welfare problems facing farmed animals more generally as demonstrated in this study is reminiscent of findings in Europe, where the general public receives most of their information from the media (Miele, 2010), and in the very few studies conducted outside of Europe that

investigate knowledge around slaughter and pre-slaughter stunning (Fuseini and Sulemana, 2018; Jalil et al., 2018).

4.2 Comfort witnessing slaughter

Although most participants state that they care that animals do not suffer, the purported levels of comfort, and conversely, uneasiness in witnessing slaughter was highly polarised by

country. In this regard, the findings of this study could support an assumption of the universality of compassion or empathy as a human trait, while suggesting that approaches to death and killing are deeply cultural.

Participants in Thailand stated they were not comfortable witnessing slaughter; 93.3% of total Thai participants identified as Buddhist, a philosophical way of life that aims to practice non-violence and underpins the gentle culture frequently associated with Thailand (Phelps, 2004). Likewise, 86.2% of total participants from India identified as Hindu, a karmic world religion that teaches the principle of 'ahimsa' – non-harm, which includes violence to people, animals and oneself (Kumar, 2021). In addition to Thailand and India, participants in Australia, Brazil, Chile and the UK were the most likely to report feeling uncomfortable about witnessing slaughter. Considering participants in these countries were also the most likely to lead a vegetarian diet, report that avoiding suffering at slaughter mattered to them, and to report high levels of concern for farmed and companion animal welfare in general (Sinclair et al., 2022a), this is not surprising. In many of these countries exposure to animal slaughter of animals is less frequent as generations become more distant from rural upbringing. With slaughter largely conducted by large scale licensed facilities away from public view in Australia, Brazil, Chile and the UK, participants in these countries are also the least likely to have witnessed slaughter. Witnessing, and thus possibly becoming desensitised to slaughter, is more likely in Pakistan and China where participants were first and third most likely to state that they were comfortable watching slaughter. Although most animals in China are processed in large scale slaughter operations, wet markets in which live animals are purchased and slaughtered directly for members of the public are relatively common (Zhong et al., 2020), as is urban slaughter and ritual slaughter at celebratory festivals such as Eid in Pakistan (Mallhi et al., 2020). Transparency around trade of healthy animals and assurances of food safety, meat quality and freshness may also motivate meat-eaters in China to witness slaughter (Zhong et al., 2020), and the same is true in Pakistan (Waqas and Hong, 2019). Likewise, the celebratory association of sacrificial slaughter at the completion of the Hajj pilgrimage (the religion of Islam's Fifth Pillar of worship) could contribute to higher comfort levels in witnessing slaughter. Underpinned by cognitive dissonance in western-based cultures (Rothgerber, 2020), this avoidance of thinking about or seeing the animals before, during or after slaughter (until the resulting unrecognisable packaged meat products) is not always shared in other countries. In addition to the existence of wet markets whereby animals are openly slaughtered in front of the public, this sentiment is further illustrated by successful institutions in China such as pork industry operated 'Pig Planet' in Jiaxing City, Zhejiang Province, which connects the animal to the end product (Qinglian Food Co. Ltd., 2021). At Pig Planet, families are invited to learn about pigs, build an appreciation for their intelligence and likability, and then safely move through walkways in the slaughter plant to observe the slaughter process, and able to purchase fresh meat products (Qinglian Food Co. Ltd., 2021). Given the lack of need to turn away, this cultural difference presents a substantial opportunity to establish animal welfare as a key element of product quality. From

this, the unique opportunity presented by this desire to personally ensure the quality and value of purchases through transparency also places discerning Chinese consumers in a power position to keep domestic industry accountable.

In following a logic-based trend that considers exposure, resulting in desensitisation and culturally-driven consumer demands and celebrations, the USA was an outlier. Surprisingly, a majority of participants from the USA stated that they were comfortable witnessing slaughter; however, slaughter is rarely incorporated into daily life in this country and exposure is low. Although the reason for this divergent result is unclear, it could be associated with pride in the potential perception of a 'frontiersman' heritage and associated with game hunting, in which many members of the public participate in shooting animals as recreation (Bellesiles, 2000) or as an activity in self-sufficiency. The familiar nature of game hunting may also underpin a misinformed perception that 'slaughter' entails shooting at a distance and not intimate, close quarters, cut-and-bleed that is routine in slaughter operations. The popularity of permaculture and trending survivalist shows in the USA may also create a perception of slaughter tied to a social desirability to demonstrate self-sufficiency and capability to slaughter animals that stems from this.

4.3 The role of religion

Humans do not have a universal way of dealing with the issue of death; the construct and process of death is approached in variable ways around the globe (Palgi and Abramovitch, 1984). For this reason, many of the findings in relation to this study are unsurprising.

By way of reductive summary, religious slaughter varies from slaughter that is mainstream in highly developed countries. The two most commercially relevant types of religious slaughter are Shechita for Kosher ("ritually pure") in Judaism and Halal ("lawful") in Islam (Anil, 2012), with the latter being highly relevant to the present study. Both of these processes of religious slaughter involve the reciting of rites and cutting the carotid artery of restrained animals who die as a result of exsanguination. In Islam, the belief that the animals need to be well at the time of their ritual death causes disagreement amongst Muslim authorities as to the acceptability of rendering animals unconscious before the cut. Many Muslim authorities deem reversible methods of pre-slaughter stunning (such as percussive stun bolt to the skull or electrical stun) acceptable, as the animal is otherwise in full health and could theoretically recover from the stun; however, this acceptance is not universal (Farouk et al., 2014; Sinclair et al., 2019a). Perceived meat quality is impacted by 'spiritual quality' for Kosher and Halal consumers (Farouk et al., 2014) and, as supported by the findings of this study, participants in some Muslim majority nations (Bangladesh, Pakistan and Sudan) prefer meat from religiously slaughtered animals that have not been stunned and also believe that stunning adversely affects taste (see Table 4).

Muslim-majority Malaysia presented interesting findings in relation to religious slaughter that did not fit this trend. A notable proportion of Malaysians agreed they prefer animals to be

unconscious and would prefer meat from animals made unconscious prior to slaughter; however, a similar proportion also agreed that they would prefer to eat meat from animals that have been subject to religious slaughter. Although some animals are routinely pre-slaughter stunned in Malaysia, a large amount are not, and this conflicting finding echoes previous findings that Malaysians are generally confused about halal slaughter and what it entails (Jalil et al., 2018; Sinclair et al., 2019a). Malaysia is a more developed Muslim country and exposure to slaughter is low in most areas, which is likely to contribute to this difference when compared with the lesser developed Muslim countries of Bangladesh, Pakistan and Sudan.

In considering Muslim-majority countries, participants in Bangladesh deviated from those in Malaysia, Pakistan and Sudan by reporting low levels of agreement that animal welfare during slaughter mattered to them. Only 50% of Bangladeshi participants stated it matters compared with 80% of participants in the other three countries. This could be due to the belief that strict 'halal' slaughter is not only better for humans and their spiritual selves but also for the animals in that the divinely mandated process, and the local interpretation of it, could not possibly cause unavoidable harm. In this way, personal responsibility, and therefore concern, to avoid suffering could have been diffused and instead allocated to divine powers. This hypothesis is supported by the findings of previous research with livestock leaders in Bangladesh, where sentiment was shared that Halal methods were unquestionably 'better for the animals' (Sinclair et al., 2019a).

While religiosity is likely to contribute to reduced levels of concern, this could also be impacted by developmental status. Bangladesh has the lowest rating on the United Nations 'Human Development Index' of the countries included in this study, with higher levels of poverty (United Nations Development Programme, 2018); therefore, animal welfare during slaughter may be considered less important than issues such as reliable sources of dietary sustenance and human welfare. Bangladeshis may simply not have the luxury of developing discussions about animal welfare during slaughter or engaging with the possibility of higher welfare products.

Personal preference to place trust in the perceived unquestionable correctness of a religious belief over the relative consensus of current animal welfare science is also supported by our findings in Sudan, Pakistan and to some degree Bangladesh again, whereby participants mostly disagreed that rendering animals unconscious prior to slaughter was better for the animals. The preference to be guided by religion may also explain unexpected findings in the USA, where a majority of participants identified as Christian (63%). Although Christianity does not contain religious slaughter rites or processes, a notable proportion of Americans stated that they would prefer to eat meat from animals subject to religious slaughter, suggesting a connotation that 'religious' is better, or more correct. USA participants, however, also mostly agreed that pre-slaughter stunning was better for the animals and that they would prefer meat from stunned animals although, in line with most Muslim countries in our study, USA participants also agreed that stunning reduced the taste of the meat. This potentially suggests that, as with Malaysia, understanding of what religious

slaughter is may be reduced and that exposure to slaughter is low, despite a large portion of Americans stating that they are comfortable to watch slaughter.

In considering religious slaughter in the context of trade, Brazil and Australia are lead exporters of halal meat. This study presents attitudes of citizens within these countries towards animal suffering during slaughter as inconsistent with the abstaining of pre-slaughter stunning required to attend these markets. This indicates a risk to the social license of the meat industry in these countries, as the public becomes growingly aware of the practices used in animal production and slaughter.

Generally, religion clearly plays a significant role in the perception of animal welfare during slaughter, and that perception may diverge from scientific understanding that conscious animals suffer considerably more during slaughter. Special understanding and respect should be applied in collaboration and dialogue with religious leaders when looking to improve animal welfare during religious slaughter around the world, with the goal of applying scientific knowledge and advancements in ways that can be eventually embraced by the community. Ensuring respectful conversations regarding religious slaughter that are inclusive of interest groups with diverging attitudes will be integral to any solution-focussed collaboration.

4.4 Trending towards higher welfare globally

In many areas of the world, citizens are increasingly expressing concern for the welfare of farm animals (Thiermann and Babcock, 2005; European Commission, 2007; European Commission, 2016). This can compel governments to introduce minimum requirements to protect animals and industries to shift practices or become burdened with negative brand associations or abandonment (Hansen and Østerås, 2019). In many countries, the increased concern is thought to be fueled by a mixture of increasing intensification and industrialization of animal industries and animal abuse scandals, alongside shifting socio-ethical considerations, strong human bonds with companion animals, and the increasing scientific body of knowledge around the physiological and psychological states of animals (Clark et al., 2016; Robbins et al., 2016; Vargas-Bello-Pérez et al., 2017). Our previously published findings support the notion that animal welfare for both farmed and companion animals is receiving groundswell support (Sinclair et al., 2022a), including in lesser-developed nations and nations in which the dedicated scientific field of animal welfare has not yet become widespread.

These findings are echoed when considering the limited studies that specifically address attitudes to slaughter in the countries we have investigated. In Brazil, 72% of study participants believe fish should also be included in humane slaughter regulations (Rucinque et al., 2017), and Chinese consumers self-report a willingness to pay for animal welfare improved meat products (Lai et al., 2018; Xu et al., 2019) and Brazilian (Hötzel and Vandresen, 2022) and Chilean (Schnettler et al., 2009) consumers are generally opposed to controversial management practices in beef production.

The findings in this manuscript support this trend, with a large cross-cultural dataset demonstrating that most participants all over the world declare that it matters to them that animals do not suffer during slaughter. The findings also draw attention to the significant amount of trust the general public place in meat processors to ensure animal welfare standards are continually improved. Given this diffusion of great responsibility onto meat industries to uphold the evolving expectations of constituents and consumers everywhere, they have a responsibility and a sustainability imperative to continue serving their customers in a way that meets their evolving expectations. These expectations involve ensuring the industries provide the animals they raise and slaughter with the highest welfare interventions possible in their locale. Depending on the developmental status of domestic agricultural industries, this may look different. This could include tailored consultation with agricultural experts in animal welfare, implementing slaughter training programs, upgrading and exchanging slaughter and lairage processes and equipment, and monitoring for animal welfare and quality. If adopting the position that correctly applied pre-slaughter stunning techniques can eradicate suffering during slaughter, then applying these techniques is one crucial way to meet customer expectations. This could be specifically indicated in countries where participants readily agreed that the application of pre-slaughter stunning was better for the animals, yet, the practice has not been adopted into practice or introduced into legislation (China, Nigeria and Thailand).

It is important to note that although participants in this study state that it matters to them that animals do not suffer during slaughter, this does not equate to any knowledge regarding how to mitigate this suffering. This dynamic draws attention to the need for clear communication with consumers through reliable and transparent labelling. It is also clear that customers place large amounts of trust in producers, retailers and governments to act on their interests to the best of current scientific knowledge. Livestock stakeholders are encouraged to consult local and international resources on improving welfare during slaughter and best practices according to species. In regions and operations with budget constraints, in addition to the application of pre-slaughter stunning techniques, considerable improvements can be made for little to no additional cost, such as improving stockmanship (Hemsworth et al., 2009; Grandin, 2020b), and ensuring slaughter implements such as knives are sharp and well maintained to increase the speed of exsanguaniation and reducing the time to unconsciousness. Although measures such as the latter can serve to reduce time in suffering, it is important to note that a critical period of acute suffering (ie. approximately 14 seconds in sheep and 20 seconds in cattle after cleanly and swiftly severing both jugular and carotid arteries) in which the animals are still conscious remains present where slaughter is devoid of stunning (Gibson et al., 2009; Gregory et al., 2010).

Taking measures to improve welfare at slaughter begins to address the evolving interests of citizens and consumers and can also bring benefits to operations. Although the purchase of equipment to apply pre-slaughter stunning, for example, involves an outlay of expenditure, it has the capacity to increase efficiencies, reduce injuries to workers otherwise tasked with slaughtering stressed and unpredictable animals,

and meat quality is increased in animals not subject to severe stress (Linares et al., 2007; D'Eath et al., 2010; Paranhos da Costa et al., 2012; Schwartzkopf-Genswein et al., 2012; Grandin, 2020a).

4.5 Limitations

Some of the limitations of this study are common to survey methodologies. The data collected in surveys rely on self-reporting, which can be impacted by social desirability bias, and other biases. Survey respondents in some Asian nations, such as China, have a tendency to avoid extreme responses (Harzing et al., 2012), which may impact the findings. Additionally, in many countries participant demographics are not directly representative of the general population, with a balance in favour of more educated and younger participants, and a varied balance of male to female depending on the country. Particular limitation is noted with the dataset of Australian participants, and the self-selection of participants in Brazil. Despite randomized participant recruitment in Australia, a higher than societally representative sample of participants who do not eat meat (23%) was included (compared to 12.1% in reality). This is likely to have slightly skewed results in Australia towards pro-animal responses, and therefore caution is advised in interpreting the results for this country. Lastly, this study focusses on perceptions by country, based on previous research that demonstrates culture as a significant factor in attitudes to animal welfare. The authors acknowledge that regional and sub cultures can differ, and that geographical difference occur within countries. This could also be considered the case between rural and urban participants within geographical regions, and we did not measure for residential zoning in this present study. The authors also wish to draw attention to the diversity of language; although translations were careful and a definition of animal welfare was shared, connotations of specific translations may vary across regions. For example, 'animal welfare', 'suffering', 'slaughter' and 'stunning' may translate into a generic or existing concepts in local language that slightly differ. The subtlety of language is an important consideration specifically for international organizations interpreting these findings and developing training, awareness or campaign initiatives. Local collaboration is urged and a deeper investigation of language and meanings as they are locally understood is recommended. This study is designed as generalized snapshot of perceptions to slaughter across countries, and therefore findings should be interpreted as such.

5 Conclusion

Although important key differences exist in knowledge around slaughter, comfort witnessing slaughter, and sentiments towards religious slaughter and pre-slaughter stunning, one important commonality existed. Most participants, despite their cultural, geographical and religious differences, stated that it mattered to them that animals do not suffer as they are slaughtered. Although slaughter is met with potentially purposeful confusion in a bid to maintain cognitive dissonance and protection from vicarious traumas

of suffering, this finding suggests that compassion and empathetic aversion to the suffering of animals is an underlying human trait.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by University of Queensland Human Ethics Committee. The participants provided their informed consent to participate in this study.

Author contributions

MS conceptualised the study, sourced funding, recruited the research team, administered the project, developed the research tool, analysed the data and wrote the paper. NL, ML, AS, MI, OI, GN, and AA coordinated local data collection, provided advice on the localisation of methodologies, provided interpretation of results within the local context and proof-read the paper. MH coordinated local data collection, provided advice on the localisation of methodologies, provided interpretation of results within the local context and edited the paper. MC conducted deeper analysis of the data and contributed to data interpretation. GB conducted data collection, provided methodological advice and edited the paper. JM gave methodological advice, provided interpretation of results within the local context, contributed to writing the paper and edited the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

Author NL was employed by Asia Animal Happiness Consultancy. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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