

Restricting the ability of sows to move: a source of concern for some Brazilians

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Abstract

Gestation stall housing for pregnant sows (*Sus scrofa*) has been, or is being, phased out in many parts of the world in response to public criticism. However, in Brazil, one of the largest global producers and exporters of pork, gestation stall housing is still common. The objective of this study was to explore the views of Brazilians, including participants associated (ALP) or not with livestock production (NotALP), on gestation stall housing. Participants were provided the option of accessing a short text describing the housing system and a video of pregnant sows housed in either individual or group housing. Participants (ALP; $n = 176$, NotALP; $n = 173$) were asked to state their position on housing pregnant sows in individual stalls and to provide the reason(s) justifying their position. More NotALP (87%) participants than ALP (69%) participants rejected individual stalls. More participants (85%) that accessed the optional information rejected the stalls than those (71%) that did not. Qualitative analyses revealed that animal welfare, most often in reference to animal sentience, freedom of movement and ethics, was the main justification given for rejecting gestation stalls. Those in favour of individual stalls justified their position with statements such as improved production, handling and animal health, and reduced aggression. This qualitative, exploratory study, based on a convenience sample of participants, does not represent the views of Brazilian society; however, it identified some shared values between participants associated with livestock production and those that are not. Our findings highlight that opposition to gestation stalls for sows reflects an ethical position regarding the treatment of livestock and should not be interpreted as support for group housing in confined systems.

Keywords: animal welfare, gestation stalls, housing, pig production, public views, survey

Introduction

Throughout the world there has been growing public opposition to livestock production systems that citizens perceive as negative for the welfare of farm animals (Eurobarometer 2007; Centner 2010). One example is the case of gestation stalls, in which sows (*Sus scrofa*) are housed individually, unable to walk or turn around during pregnancy. Views' and attitudes' surveys suggest that the general public holds strong negative attitudes toward intensive farm production systems that currently dominate contemporary pork production (Ngapo *et al* 2004; Meuwissen *et al* 2007; Krystallis *et al* 2009). Not surprisingly, gestation stalls for sows have already been banned or are being phased out in much of the developed world, including the European Union, ten US States, Canada, New Zealand, Australia and South Africa; simultaneously, the largest food companies in the world are adopting cage-free purchasing policies (von Keyserlingk & Hötzel 2015). In Brazil, one of the largest pig producers and exporters in the world (Food and Agriculture Organisation [FAO] 2014),

almost without exception, gestating sows are reared in intensive commercial systems (approximately 2.1 million; Brazilian Association of Animal Protein [ABPA] 2015) and housed in individual stalls. Although there are no specific legislative initiatives to restrict such systems within Brazil (Cassuto & Eckhardt 2016), there is some evidence that Brazilian food companies are following international trends. For example, starting in 2014, the three largest pork producers BRF, JBS and Aurora announced their decision to transition to group housing for gestating sows in coming years. Interestingly, these announcements have been publicised in farm animal industry meetings and associated websites (Suinocultura Industrial 2015; BRF 2016) and on the websites of animal rights non-governmental organisations (HSI Brasil 2015), but with limited public outreach. The changes spearheaded by these producers appear to suggest interest within the Brazilian pork industry in following international standards and marketing strategies, possibly to secure potential import markets (von Keyserlingk & Hötzel 2015). Significant changes have taken place in Brazil since the World Animal Health

Organization (OIE) launched its animal welfare initiative in 2004 (Bayvel 2004), which included initial development of animal welfare legislation and industry involvement in the issue (Dias *et al* 2015; von Keyserlingk & Hötzel 2015). These changes were driven initially by factors external to Brazil, indicating little interest in addressing any concerns raised by Brazilian citizens, who are in fact the largest consumer of Brazilian-produced pork (ABPA 2015). However, as the socioeconomic status of Brazilians increases there is also great potential for expansion of the domestic consumption of pork (de Barcellos *et al* 2011a). Some major producers and retailers have started considering Brazilian consumers' demand for changes in animal production practices (eg A Hora do Ovo 2017; AviSite 2017), signaling an intention to include the public in the animal welfare debate (GPA 2017; HSI 2017).

Little is known about the interest, knowledge, views and attitudes of the Brazilian public regarding farm animal welfare. Some surveys conducted in the country (de Barcellos *et al* 2011b; Bonamigo *et al* 2012; Cardoso *et al* 2017; Gama 2017; Rucinke *et al* 2017; Yunes *et al* 2017) have reported low levels of knowledge among Brazilian citizens about specific animal production systems and practices; however, these surveys also provide some evidence suggesting that more informed Brazilian individuals tend to assign value to animal welfare and relate high animal welfare standards to better product quality. Thus, it is possible that awareness of the type of housing systems used by the industry may influence public views. Indeed, a recent Canadian study showed a drop in acceptance of gestation stalls when individuals viewed information on sow housing (Ryan *et al* 2015).

It is well established that stakeholders differ in their attitudes to the welfare of animals under human care. These differences also extend to groups that vary in terms of how involved they are in livestock production. For instance, many surveys have shown that citizens value the ability of the animal to move freely around, aspects that emphasise naturalness, social contact between conspecifics, and the absence of pain (Boogaard *et al* 2011a; Robbins *et al* 2015; Hötzel *et al* 2017; Sato *et al* 2017). In contrast, individuals that work with farm animals on a more routine basis such as extension agents, academics, and farmers consider basic needs like feeding and shelter to be central to maintaining high standards of welfare (Heleski *et al* 2004; Cantrell *et al* 2013). It is interesting is that individuals who perceive biological functioning to be central to welfare have also been reported as perceiving practices that cause pain acceptable in animal production systems (Spooner *et al* 2012; Tuytens *et al* 2012; Hötzel & Sneddon 2013).

A clear example of these differing views is seen with sows housed in gestation stalls. In surveys conducted in the US, the use of gestation stalls for sows was not an important

concern for almost half of the animal science and veterinary college faculty (Heleski *et al* 2004) and veterinary college students (Heleski *et al* 2005) surveyed. Other work, focusing on farmers and citizens, reported that these two stakeholders differed in their views of gestation stalls: the farmers finding them acceptable whilst the citizens stated that they were far from optimal (Te Velde *et al* 2002; Benard & de Cock Buning 2013). In another example, participants with an affiliation to livestock production (veterinarians, farmers, students or animal science teachers and dairy professionals) were more likely to support early cow-calf separation than lay citizens who rejected this practice (Ventura *et al* 2013). Clearly, different stakeholders emphasise different aspects when evaluating animal welfare (Pettersson *et al* 2016). The reasons for these differences are multifactorial, but it is predicted that these differences are explainable, partly by the knowledge and extent of contact individuals have with livestock production and, partly, by differences in demographic characteristics.

A series of studies have shown that differences in demographic characteristics contribute to people's attitudes towards animals, such as sex (Herzog 2007; Hazel *et al* 2011; Walker *et al* 2014b), previous experience with animals (Morris *et al* 2012; Walker *et al* 2014a), pet ownership (Wells & Hepper 1997; Kendall *et al* 2006; Binngiesser *et al* 2013), meat eating (Loughnan *et al* 2010), current (Kupsala *et al* 2013) and childhood residence (Kendall *et al* 2006). What remains unclear is whether professional involvement in livestock production can also shape attitudes towards animals; an area clearly needing more scholarship (see, for example, Paul & Podberscek 2000; Lassen *et al* 2016). The different interests of stakeholders regarding the use of animals and often contradictory political and ethical postures may have implications for the governance of animal welfare (Degeling & Johnson 2015). This disconnect can increase risks regarding the sustainability of an industry (von Keyserlingk & Hötzel 2015) and may generate distrust (Robbins *et al* 2016).

Societal acceptability and trust in the pork industry in other jurisdictions seem to be influenced by actions that the public perceives as related to animal welfare, such as providing farm animals with more space (Vanhonacker *et al* 2008), different types of housing and flooring (Millet *et al* 2005; Vanhonacker *et al* 2008; Krystallis *et al* 2009), or environments that allow pigs to express natural behaviour and social interaction (Lassen *et al* 2006; Ryan *et al* 2015). Thus, the objective of this study was to explore and contrast the views of Brazilian citizens who are associated (eg veterinarian, livestock production professional, consultant/manager, producer, student or faculty in any field of animal agriculture) or not with livestock production, regarding the use of individual gestation stall housing for sows.

Materials and methods

An online survey created using the FluidSurveys platform (<http://fluidsurveys.com/>) was conducted from December 2014 to March 2015. The survey was initially pilot-tested using 20 randomly recruited participants; their responses were used to refine the questionnaire prior to release. The 'pilot' participants were asked to do the survey and then provide critical feedback on the survey questions, specifically to articulate what they believed was being asked, and the flow of the survey. A recommendation raised by many of the participants was to have the viewing of the video optional (not mandatory). The pilot participants also clearly articulated the positive and negative aspects of the two contrasting systems when they viewed the videos, indicating that they were provided with a balanced view of each system. The video used in the survey was also tested to ensure that the images used represented the issue addressed and avoided any examples that participants may have considered to be 'extreme' of a given situation.

Participants' recruitment

The target participants were any members of the Brazilian public, 18 years or older, with and without prior knowledge of livestock production who had access to the internet. Recruitment of all participants for this online survey was carried out using a number of different vehicles including direct contact by approaching individuals working at governmental animal health surveillance and protection agencies or universities, and indirect contact through social media outlets (eg Twitter, Facebook) and websites and blogs that had either a food or lifestyle focus, science focus (ie science communication, higher education) or current event focus (ie local news) that operated across different parts of Brazil. All individuals approached were asked to redirect the invitation to others they thought might be interested in participating in the survey. In all cases, participation was voluntary and, without exception, all identities were kept anonymous. This study was approved by the Ethics Committee of Research with Human Beings of Federal University of Santa Catarina, Brazil (Protocol 904.849).

Survey methodology

The first question addressed socio-demographic information relating to sex (male, female), age (18–25, 26–35, 36–45, 46–55, 56–65, over 66 years), education (elementary school, high school, higher education, technical or higher education), the region of the country of residence (south, east, north, north-east, central-west), size of the city where the participant spent most of his or her life (rural, small town, medium town, large city, metropolis), if the participant had ever lived outside of Brazil (yes, no), and level of association with livestock production. They were identified as 'not associated' if they reported as having no professional ties with the animal industries, and as 'associated', when they declared that they maintained some sort of professional tie with the animal industries: veterinarian, livestock production professional, consultant/manager, producer, student or faculty in any field of animal agriculture.

Participants were also asked how informed they considered themselves to be regarding animal production (very informed, somewhat informed, intermediate, somewhat uninformed, totally uninformed) and regarding pig production (very informed, somewhat informed, intermediate, somewhat uninformed, totally uninformed), and if they consumed animal products (yes, no).

Participants were then provided a short text stating that the objective of the questionnaire was to know their opinion in relation to gestating sow housing in commercial production systems in Brazil. The participant could choose to access some information on the topic before answering or go straight to the next page and answer the questions. If the participant selected to access information they were then directed to a page containing a link to a video and the following explanation: "This video shows some examples of gestating sows in individual stalls or group housing systems and does not contain violent images". The 90-s video contained the same number, time and quality of pictures of sows housed in individual stalls and of sows housed in groups. The video was produced with images and video clips available online to the general public, depicting sows housed in both systems. It showed similar situations across both systems, eg of sows housed in facilities with different levels of cleanliness, and while feeding and resting. It also showed potential behaviour problems commonly associated with each of the systems (eg, stereotyped behaviours in sows housed in stalls and scenes of social tension in group-housed sows); also, it used images of group housing of different sizes, with and without access to substrate (bedding). The video was posted on YouTube with no text, words or any mention of animals, to avoid redirecting viewers to other videos posted by other parties (<https://www.youtube.com/watch?v=bLcsofD3BNk>).

On the following page the participant could read the following (219) words:

Brazil is one of the world's largest pork producers.

About 2 million gestating sows are reared in industrial production systems in the country. During the 114 days' gestation period, sows can be housed in different systems. One system consists of individual stalls, where the floor is usually made of concrete and the space is slightly larger than the animal body. In these stalls, the sows can get up and lie down, but cannot turn around or walk. Another system uses group housing; this promotes social interaction and provides enough room to walk. Usually the floors are concrete, although there is the possibility of using some form of organic bedding such as straw or wood shavings.

Those who support the individual housing system present the following arguments:

- The accommodation in individual stalls facilitates individual balanced nutrition, improving production rates.
- It eliminates problems related to aggression among the sows.
- It facilitates cleaning of the facilities.
- As an overall result, the system allows for a reduction in production costs.

Table 1 Emerging themes in response to the question: ‘What is your position regarding housing gestating sows in individual stalls?’

Participants not associated with livestock production				
	Rejected (n = 151)	Supported (n = 14)	Indifferent (n = 8)	Total (n = 173)
Animal welfare	143 (87%)	9 (53%)	2 (29%)	154 (80%)
Production	12 (7%)	6 (35%)	5 (71%)	23 (13%)
Production quality	10 (6%)	2 (12%)	–	12 (5%)
Total	165	17	7	189
Participants associated with livestock production*				
	Rejected (n = 124)	Supported (n = 40)	Indifferent (n = 12)	Total (n = 176)
Animal welfare	120 (83%)	8 (18%)	5 (45%)	133 (67%)
Production	18 (13%)	36 (82%)	6 (55%)	60 (30%)
Production quality	6 (4%)	–	–	6 (3%)
Total	144	44	11	199

* Veterinarian, livestock production professional, consultant/manager, producer, student or faculty in any field of animal agriculture.

Those opposed to the individual housing system present the following arguments:

- Sows in individual stalls exhibit behaviours that indicate anxiety or frustration.
- Cages prevent sow from moving around, causing inflammation in the joints and pain in the limbs.
- As an overall result, the system reduces the animals’ quality of life.

On the following page of the questionnaire the second question asked: ‘Regarding the housing of gestating sows in individual stalls, I am...’: ‘favourable’, ‘indifferent’ or ‘opposed’. Below this the participant was asked to justify the response that began with: ‘I am favourable/indifferent/opposed to housing of gestating sows in individual stalls, because...’ followed by a text box with unlimited space where the participant could write freely his or her opinion.

On the next page, the third question asked which system the participant considered to be the most common in Brazil, and offered as an answer the choices, ‘Indoors in individual stalls’, ‘Indoors in group housing’, ‘Indoors, in both individual stalls and group housing’, ‘In another system’, and ‘I do not know’.

On the same page, before proceeding with the next question, the participant was offered again the opportunity to access the video and the information text, with the options: ‘I have already watched it, I want to move forward’, ‘I do not want to watch, I want to move forward’ or ‘Yes, I would like to go to the video page’. The fourth question appeared on the next page: ‘In your opinion, how should gestating sows be housed in commercial production systems in Brazil?’ with the possible answers: ‘Inside a barn, in individual stalls’, ‘Inside a barn, in group housing’, ‘In another system’, and ‘I do not know’. On the same page, the fifth question asked whether the participant had read the text (yes, no) and had seen the video (yes, no). The sixth

question asked if the video had influenced the participants’ response, with the possible answers: ‘The video influenced my answer because...’, ‘The video did not influence my answer because... (space provided for an answer)’, ‘The video did not influence my answer because I already knew about it’, and ‘I chose not to watch the video’. The seventh and final question asked whether the participant was aware of any initiative of the Brazilian industry to change the system for group housing (with options no and yes, and which, with space for an answer). On the last page, the participant had the opportunity to leave any comments on the subject in an open text box.

The questionnaire did not allow the participant to go back to any of the previous pages/questions. Response options in questions 2 to 7 appeared in randomised order for each participant.

Data analysis

The questionnaire was considered as part of the final data set subjected to the analyses if the participant completed the questionnaire up to and including question 2. Closed answers were analysed by descriptive statistics and the open-ended responses by qualitative analysis. To assess the participants’ views, frequency distribution, access to information and its influence and the probability of independence of the distribution was tested by Pearson Chi-test using *R* (R Core Team 2017).

The qualitative analysis was based on the method described by Huberman and Miles (1994), which follows three stages: the reduction of the data, the encoding on themes of the information contained in the answers, allowing them to achieve a representation of the content and serving if necessary as an index; the data presentation, information organisation in order to allow analysis and interpretation; and the conclusion or data interpretation, which identifies the meaning of the data, its regularities, patterns and explanations.

To ensure that the coding themes were appropriate to the proposed objectives, and therefore valid, ie that it represented all content displayed on the information collected, four readers initially analysed 20 random responses, irrespective of demographics, turning them into codes used to identify themes. The four readers then compared their results and discussed any discrepancies and ambiguities until agreement was reached. The readers then jointly coded the first 100 answers to ensure agreement. From that point forward the lead author undertook the remaining encodings. The codes were organised, counted and grouped in major themes.

Three major themes were identified in the reasons presented by participants when they conveyed their support, opposition or indifference towards the use of housing gestating sows in individual stalls: i) animal welfare (mentioned 287 times; 73%); ii) production (mentioned 83 times; 21%); and iii) product quality (mentioned 18 times; 5%) (see Table 1). Please note that a given participant could cover more than one theme in their response.

The theme ‘animal welfare’ was identified each time a participant identified issues related to the quality of life of animals. Six sub-themes were identified: ‘freedom to move’ (including issues related to animal space or movement), ‘natural life’ (related to expression of natural behaviours and the natural habitat of the animal), ‘sentience’ (the ability of animals to express positive and negative feelings), ‘animal health’ (physical and biological; minimising animal suffering or pain or equivalent), ‘animal stress’ (physiological or psychological), and ‘ethics’ (related to the participant’s values regarding the use of animals by humans, references to the system as ‘cruel’ or ‘inhuman’, or beliefs about the existence of better alternatives for animal production).

The theme ‘production’ was identified when the reason provided by the participant was based on production issues. Four sub-themes identified: ‘productivity’ (cost and efficiency of the system, the cost of the resulting product to consumers, the area needed for pig production), ‘control’ (referring to management, hygiene, animal health and diseases — controlling diseases, easier to vaccinate and provide medical attention and other practices that enhance animal health as well as being more productive), ‘ethics’ (when participants expressed values regarding food production and food supply to the human population), and ‘natural living’ (allusions to the influence of sows’ social behaviour on productivity).

The theme ‘product quality’ included two sub-themes that were defined as ‘inputs’ (those used in animal feeding, including pesticides, hormones and antibiotics), and ‘human health’ (references to the influence of the product for human health).

Results

From the 472 responses received, 360 were complete and used in the subsequent analyses. In total, there were 112 incomplete responses: 17 were from individuals who were in favour of gestation stalls, six who were indifferent, and 39 that were opposed plus an additional 50 that only filled in a few demographic questions. Additionally, during the analyses, an additional eleven questionnaires were discarded for reasons including failure to present a coherent

Table 2 Participant demographics of individuals taking part in an online survey and of Brazilians overall according to IBGE (2011).

Demographics	Participants (n); (%)	IBGE census data (%)
<i>Sex</i>		
Female	221 (63)	51
Male	128 (37)	49
<i>Age</i>		
18–25	128 (37)	19
26–35	96 (27)	24
36–45	47 (14)	20
46–55	50 (14)	16
56–65	21 (6)	11
66+	7 (2)	10
<i>Education</i>		
Primary school	3 (1)	49
High school	39 (11)	15
University education	307 (88)	36
<i>Region of residence within Brazil</i>		
South	221 (63)	15
South-east	71 (21)	42
North and north-east	36 (10)	35
Centre west	18 (5)	7
<i>Area of residence</i>		
Rural area	45 (13)	16
Urban	304 (87)	84
Small city: < 20,000 inhabitants	50 (14)	
Medium city: 20,000–100,000 inhabitants	75 (22)	
Big city: > 100,000 inhabitants	108 (31)	
Metropolis: > 1,000,000 inhabitants	71 (20)	
<i>Association with livestock production</i>		
Associated*	176 (50)	
Not associated	173 (50)	

* Veterinarian, livestock production professional, consultant/manager, producer, student or faculty in any field of animal agriculture.

rational statement, the participant had selected a specific option but provided a reason that justified the other, or it was clear that the participant had confused the production system (eg referring to the maternity phase of pig production). Thus, 349 responses were included in the final analyses.

The demographics of participants are reported in Table 2. Compared to the Brazilian population, our sample had more females, young and educated people. Twenty-two

Table 3 Number and percentage of participants who rejected, supported or were indifferent to the practice of housing gestating sows in stalls[†]

	Not associated with livestock production				Associated with livestock production			
	Reject (n = 151)	Support (n = 14)	Indifferent (n = 8)	Total (%; 173)	Reject (n = 124)	Support (n = 40)	Indifferent (n = 12)	Total (%; 176)
<i>Sex</i>								
Female	108	7	3	118 (68)	83	15	6	104 (59)
Male	43	7	5	55 (32)	41	25	6	72 (41)
<i>Information about livestock production</i>								
Very informed	25	1	0	26 (15)	68	24	5	97 (56)
Somewhat informed	46	5	2	53 (30)	38	14	6	58 (33)
Intermediate	38	2	1	41 (24)	16	2	1	19 (11)
Somewhat uninformed	26	5	2	33 (19)	1	0	0	1 (0)
Totally uninformed	16	1	3	20 (12)	0	0	0	0 (0)
<i>Information about swine production</i>								
Very informed	21	1	0	22 (13)	46	24	13	88 (47)
Somewhat informed	28	3	2	33 (19)	53	9	3	65 (37)
Intermediate	25	3	0	28 (16)	17	7	2	26 (15)
Somewhat uninformed	36	4	1	41 (24)	0	0	0	0 (0)
Totally uninformed	41	3	5	49 (28)	2	0	0	2 (1)

[†] Responses are sorted by sex of the participant and their self-assessment of information they had about livestock production and about swine production.

Table 4 Number of participants associated and not associated with livestock production and access of information and influence of information.

	Not associated with livestock production (n = 173)	Associated with livestock* production (n = 176)	Total
<i>Accessed the information?[‡]</i>			
No	52	88	140
Yes (total)	112**	84	196
Accessed on the first opportunity	83	63	146
Accessed on the second opportunity	29	21	50
<i>Was influenced by information?[‡]</i>			
Yes [§]	50**	9	59
No (total)	57	68	125
Because they already knew	36	58	94
Gave a reason [#]	21	10	31

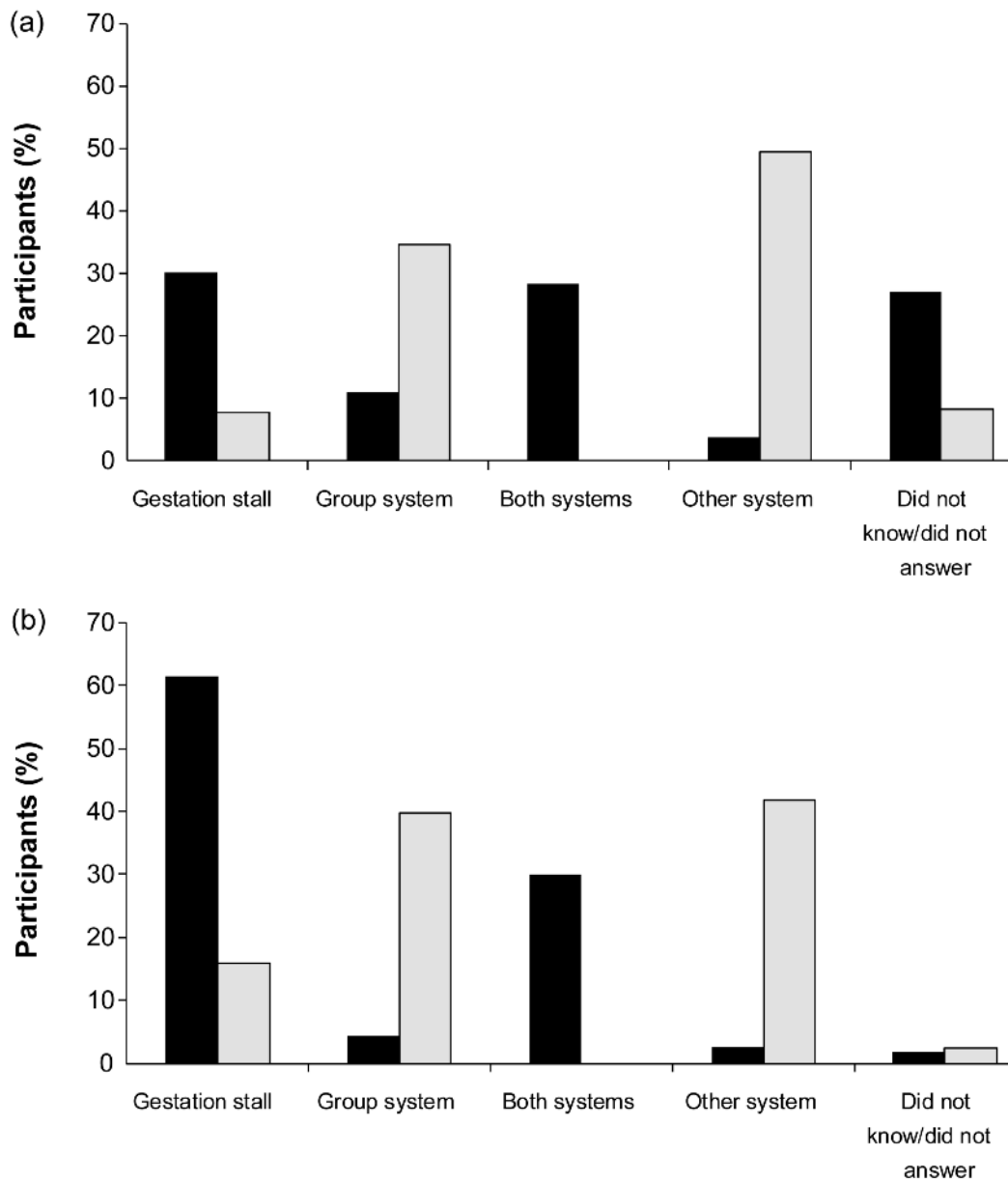
[†] 13 participants did not answer this question; [‡] 25 participants did not answer this question;

[§] Some explanations: Yes, because... "One can clearly see the reality of animals", (P107); "It shows a reality that we are not used to seeing and experiencing" (P154); "The visual observation makes you reflect on the issue" (P76); "I could see that in either way the animals suffer" (P281); "Watching the animals in those cages made me feel compassion..." (P58).

[#] Some explanations: No, because... "If the animals are already trapped, why see the rest..." (P231); "I already intuited that I would see abuses..." (P345); "(The video) showed what I already assumed or expected" (P277); "I already have a formed opinion against animal cruelty. Still, watching the video helps revealing this sad reality" (P257); "...because I had read about the issue and visited a farm" (P321); "I knew about the two rearing methods, but I had not thought that the group housing system does not seem to be ideal either" (P276).

** Statistically different mean scores between participants not associated and associated with livestock production at $P < 0.01$.

Figure 1



Participants' perception of the most common (black bars) and preferred system (grey bars) for gestating sows' housing in Brazil. The option 'Both systems' was only offered for question 'perception of the most common system'.

participants (6%) did not consume animal products. Of the participants that had some involvement with livestock production, 49% were university students, 13% consultants or outreach professionals, 14% producers, 8% were university staff, and 16% cited 'other type of association' (defined by participants as formerly students, producers or teachers in the area). Most participants associated with livestock production identified themselves as informed on animal production systems including pig production systems; most participants not associated with livestock production considered themselves informed about animal production systems but less informed about pig production systems (Table 3).

Participants' position regarding the use of gestation stalls

Considering all 349 participants, 79% rejected, 15% supported and 6% were indifferent to housing gestating sows in individual stalls. The level of support was different between participants associated and not associated with livestock production ($\chi^2 = 16.9$, $df = 2$; $P = 0.001$; Table 3).

Accessing the text and video information

The number of participants that chose to access the available information and whether or not they were influenced by the content is shown in Table 4. More participants not associated with livestock production accessed the text and video

($\chi^2 = 13.1$, $df = 1$; $P < 0.001$) compared to those with an association. Among the 196 participants that accessed the video, more participants not associated with livestock production said that they were influenced by the information ($\chi^2 = 25.2$, $df = 1$; $P < 0.001$) than participants associated with livestock production. More participants that accessed the information ($n = 167$; 85%) rejected the stalls than those that did not ($n = 99$; 71%; $\chi^2 = 17.3$, $df = 2$; $P = 0.001$).

Perception of popularity in Brazil and preference for gestating sow housing system

When asked which system participants considered the most common in Brazil, the most frequently chosen option was 'gestation stalls' (Figure 1). Preference for the systems differed between participants associated and not associated with livestock production ($\chi^2 = 13.1$, $df = 3$; $P = 0.005$; Figure 1), with both predominantly choosing 'another system'. Some justified their option for 'another system'; for instance, stating 'I don't know exactly what the (other) system is, but it should be something that allowed for greater mobility' (P40) or 'I think group housing is not ideal, because the animals cannot access the outdoors, I think that would be best for the animals' (P276). Finally, when asked if they were aware of any campaigns or proposals in Brazil to phase out gestation stalls, 21% responded 'yes'; of those, the majority (~80%) were associated with livestock production.

Participants' justification for the position regarding housing of gestating sows in individual stalls

The following section is organised by position of the participants (ie, opposed, favourable and indifferent) and the justifications of participants not associated with livestock production, followed by participants with an association.

Participants opposed to gestation stalls

Participants of both groups that rejected the gestation stall housing for sows justified their position mainly with statements related to the theme 'animal welfare'.

Participants not associated with livestock production

Most participants not associated with livestock production justified their position addressing one or more reasons related to the theme 'animal welfare'. They referred to animal sentience, "...it has been more than proven that animals have feelings" (P219); freedom, "...no animal should be stuck in a cage! Pregnant sows even less... the lack of movement, the discomfort..." (P24); "...because the right way to raise these animals is free range" (P90); natural living, "...to be able to interact with other sows, get into the mud, and have some of their natural behaviour" (P270); animal stress, "...sows practically can't move, they just lie down, get up and eat. Probably there is a high level of stress in these animals" (P105); animal health, "individual housing harms the health of the pregnant sows because they are unable to walk and lie comfortably..." (P1543), and ethics, "Treating sows like that is extremely inhumane. It is an unnecessary and unjustifiable cruelty" (P291). Some offered more elaborate justifications that covered several of the sub-themes, for example:

"[sows] are living beings and deserve respect and the right to come and go; they deserve to be in contact with other animals and have a quiet life, without factors that make them sick" (P22);

"...sows cannot express their natural behaviour... They should live free, in a natural environment, free from all stressors" (P19).

"...it is in an inappropriate system; I feel sorry for the animals that can't walk, can't be in contact with nature and have access to sunlight" (P196).

Reasons given by this group related to the theme 'production' were of an ethical nature, ie "I do not agree with 'optimisation of space' with regards to rearing animals; I believe it leads to the (unnecessary) over-production we have today, which in turn encourages over-consumption" (P340); "...what underlies this type of housing system is quite simple: increased production + cost reduction = profit growth... in my opinion, the quality of life of animals (which I eat or not) is as important as the quality of life of human beings" (P315), or related to productivity, "I have heard and read of producers who, with information and help, especially from research centres, had excellent results with group housing for pregnant sows" (P33); "There should be some other way to reduce costs, not that [referring to the stalls]" (P304).

Some participants covered more than one theme to justify their position. For instance, some covered the themes 'product quality' and 'animal welfare' together, associating a good quality of life for the animal with better product quality: "...better quality of life to the animal and healthy meat" (P76). Others referred negatively to the inputs used by the animal industry: "I am opposed [to the stalls] because of the suffering that this system causes to the animals, and also because I believe that drugs and hormones that are used can harm human health" (P89). Participants also frequently combined 'animal welfare' and 'production', associating the quality of life of animals with productivity, "...we must always seek the best win-win situation for society: quality of life for animals and the humans who get their food from these animals" (P350); "Even if they are reared and intended for slaughter, there must be respect for life..." (P78); "In my understanding the quality of life of these animals must be put above issues related to productivity" (P277); "Animal welfare should be more important than economic gains" (P276).

Participants associated with livestock production

Most participants associated with livestock production also justified their opposition to gestation stalls based on concerns regarding animal welfare. These participants often covered more than one sub-theme in their responses, including sentience, freedom, animal stress and ethics:

"I do not consider the animal just a product to be consumed... To me cages for pregnant sows are inhumane, knowing the behavioural needs that they have to make nests; besides, they cannot move inside the cage, and this is extremely stressful for any living creature" (P63);

“Clearly, factors such as high motivation to express their behaviour (which is associated with frustrations) and lack of social contact are important for these animals. We have a moral obligation to the animals, so we must seek production systems that provide better conditions for the welfare of individuals” (P144);

“...these animals are stressed and suffer from the lack of space to move around; I find it a cruel way to rear farm animals” (P250).

They also justified their negative opinion of gestation stalls based on ethics, “I support meat consumption. However, I am totally against this form of production. The way we treat animals for consumption [is] extremely cruel and unnecessary” (P25); “animals have their natural habitat and men have no right to interfere” (P39); animal sentience, “Animals are deprived from minimal welfare conditions, that is, they suffer and demonstrate it in a variety of ways” (P61); natural living and freedom, “...the housing system [individual stalls] does not allow animals to express their behaviours normally, and the space is greatly reduced, which can reduce their welfare. Besides, it affects the five freedoms” (P207); “...they [sows] must be well, healthy and in a suitable environment close to their natural habitat” (P91); animal stress, “Drastically restricts movement, normal behaviour and causes a lot of stress to the animal” (P203), and animal health, “... it promotes hoof problems, joint problems, stress, stereotypes...” (P288).

Some participants referred to ‘production’ aspects such as productivity, “It generates high release of catecholamines and reduces feed conversion...” (P186); and ethics, “In a country the size of Brazil nothing justifies such management” (P330). Some associated a better quality of life for animals with better production: “The stress on pigs is huge, in addition to diseases caused by the weight of the sows associated with lack of movement that ultimately results in high cost of medications, veterinary care and early culling of sows... Studies have already confirmed that during the gestating period group housed sows perform better than sows in cages” (P73). Others mentioned ‘product quality’ together with ‘animal welfare’, in a reference to a relationship between the quality of life of the animal and of the resulting product, “...for ethical reasons first, and for the interest in the quality of food, which is superior if the animals are not stressed” (P41).

Participants favourable to gestation stalls

To justify their support for gestation stalls, participants not associated with livestock production frequently referred to the theme ‘animal welfare’ in their statements; whereas, participants associated with livestock production referred more to the theme ‘production’ to support gestation stalls.

Participants not associated with livestock production

Participants not associated with livestock production who were supportive of gestation stalls justified their support for individual stalls using reasons that encompassed the theme ‘animal welfare’, frequently referring to animal sentience, “Because farm animals suffer, but not as much as vegans

would say...” (P37), animal stress, “I am in favour, because the pregnant sow should not suffer stress or irritations” (P246), animal health or comfort, “It must be safer and more comfortable for the sow to be alone” (P310). Others justified their responses based on the theme ‘production’, referring to hygiene and ease of handling, “...in individual cages it is more hygienic, and management is more efficient” (P182), and to productivity, “Ease of management, cost, area...” (P241).

Participants associated with livestock production

Those participants associated with livestock production that were in favour of gestation stalls justified their support primarily citing reasons related to the theme ‘production’, which encompassed issues related to animal health and management: “This prevents the sows from becoming contaminated or contaminate others with some kind of infection” (P60); “It facilitates individualised care, as supply of food or medication...” (P109); “Because of the ease of handling, better use of space, and besides the benefits of the group housing system are not that great” (P165); or associating ease of handling with greater economic gains: “...lower cost with facilities, less use of labour... lower reproductive losses” (P151). Some commented on issues related to the behaviour of the animals, specifically how it may affect productivity: “Pregnant sows are usually violent and may fight, abort and even kill other sows” (P235); “...we cannot risk housing gestating sows in a group where they may fight and risk having an abortion, premature birth and production losses” (P228). Others challenged the economic sustainability of group housing: “I do not see another economically sustainable production system, because this way [with stall housing] the producer has the lowest cost of production” (P104); “Being favourable [to gestation stalls] does not mean defending the use of individual housing, but I understand that in some production systems it is still unsustainable to use group housing, which occupies larger areas and generates more waste (especially when bedding is used). As both systems have advantages and disadvantages I do not believe that the Brazilian pig production system is fully prepared for the move to group accommodation, while I respect those who choose to adopt it” (P158).

A few participants in this group justified their support based solely on the theme ‘animal welfare’, reporting on issues such as animal stress, “I am in favour of individual cages because pregnant females need a different treatment compared to other animals, based in a relationship between animal welfare and the least amount of stress possible” (P171), and animal sentience, “...this makes the animal feel more relaxed, even at the time of feeding...” (P294). One participant supported his response on his disapproval of group housing: “I am in favour because papers published on group housing did not support improvements in animal welfare (fights, etc). Even American associations, such as pig farmers and pig veterinarians were against this method” (P44).

Participants indifferent to gestation stalls

Participants not associated with livestock production

Some participants justified their position using references related to ‘production’, especially productivity: “In the world we live in, the greatest interest is the economic/practical/functional” (P317), while some related it with ‘animal welfare’, “I believe housing sows in cages for a certain period of time (pregnancy) does not interfere in issues related to production or animal welfare” (P326). Two participants said that they did not have enough knowledge to answer the question or to have a position.

Participants associated with livestock production

Some participants justified their position based on ‘production’, “We must provide the population with sufficient and affordable food” (P185). Some covered the theme ‘animal welfare’, “I am indifferent to housing of pregnant sows in individual cages because both systems have their benefits, and both are acceptable provided there is a commitment to animal welfare” (P143), while others covered both themes, “There are several production systems to suit different situations. Animal welfare is not just associated to the fact that the animal is confined or not, but to the whole process involving these systems and that involve productivity directly” (P239). Three participants said that they did not have an interest on the question because it did not matter to them.

Discussion

Participants in our study were generally opposed to restrictive housing for sows. This included participants not associated with livestock production, who despite considering themselves uninformed about swine production, and being unaware of the widespread prevalence of gestation stalls for sows in Brazilian farms, were overwhelming in their rejection of this system. Interestingly, although to a lesser extent, most participants associated with livestock production were also opposed to gestation stalls. Reasons underlying the rejection of gestation stalls were mostly related to animal welfare concerns and a perception that this housing system is not capable of providing an animal the opportunity to live a reasonably good life.

Our findings do not support the contention that Brazilians are not interested in farm animal welfare despite many having a low awareness of animal production systems (de Barcellos *et al* 2011a; Bonamigo *et al* 2012; Poletto & Hötzel 2012). However, mention must also be made of our method of online recruiting which may have preferentially attracted people that were particularly interested and informed on farm animal welfare issues. Additionally, people that supported the use of gestation stalls may have not accepted the invitation to participate in the survey due to lack of interest, as previously commented on (Heleski *et al* 2005). Also, because it was a self-administered survey, it was not possible to ascertain how many participants may have only viewed the survey and chosen not to continue. In comparison to the Brazilian population (IBGE 2011) our sample contained a greater proportion of females, who are known to have greater empathy for animals (Heleski *et al*

2006; Maria 2006). The sample was also younger and more well educated which may represent a segment of the population that has greater purchasing power, which may ultimately influence changes in production practices (Weible *et al* 2016). This type of survey is, however, important as it provides novel information on an issue less studied in developing countries (Clark *et al* 2016), such as Brazil, a country with an ever-growing proportion of its GDP arising from food animal production systems and a population that is further and further removed from agriculture. Most importantly, this type of information can provide valuable insights into potential issues that have received much discussion in other countries.

Concern regarding animal welfare was the main reason cited by our participants irrespective of their choice of stall housing system and regardless of whether they viewed themselves as being associated with livestock production or not. Public concern with animal welfare is generally related to issues such as animal suffering, ability to express natural behaviours (Lassen *et al* 2006), freedom to move (Miele *et al* 2011; You *et al* 2014) and animal health and stress (MAF 2011). Accordingly, most statements provided by the participants in this study referred directly to some issue relating to the animals, such as freedom to move, animal sentience, natural living, animal stress and animal health which, collectively, accounted for over 65% of all reasons offered by participants that opposed gestation stalls. Ethical considerations were used by both groups of participants when answering the questions. For instance, many participants that rejected the use of gestation stalls used terms such as ‘not right’, ‘inhuman’, and ‘greedy’. Since moral values regarding the treatment of farm animals appear to have a greater impact on citizens’ negative attitudes towards farm animal welfare than factual knowledge (Boogaard *et al* 2011b; Hötzel 2016; Ventura *et al* 2016), this may explain why criticisms regarding certain production practices fail to wane over time.

Participants with and without association with livestock production shared many beliefs and values. Differences between the two groups were focused primarily on the fact that the participants associated with livestock production enriched their justifications with science-based arguments; their references tended to be factual and did not contradict but mirrored, in part, comments made by those not affiliated with animal agriculture. Previous research has shown that industry specialists (Cantrell *et al* 2013) and farmers (Te Velde *et al* 2002; Tuytens *et al* 2010; Spooner *et al* 2014) tend to associate farm animal welfare with animal’s health and biological functioning; in contrast, citizens’ values reflect aspects such as space to move, ability to engage in natural behaviours, pain and stress (Vanhonacker *et al* 2008; Prickett *et al* 2010; Cardoso *et al* 2016; Hötzel *et al* 2017). However, in our study, we identified only small differences between the views of participants associated with livestock production or not.

As expected, more participants associated with livestock production supported the use of gestation stalls than those not associated with livestock production. A US survey reported that participants associated with swine production rated the use of gestation stalls for sows as less of a concern

than participants lacking such background (Heleski *et al* 2004). Other studies have found that stakeholders associated with the livestock industry are more likely to rate the welfare of farm animals as positive compared to citizens (Benard & de Cock Buning 2013), and support husbandry practices that lay citizens reject (Tuytens *et al* 2012; Hötzel & Sneddon 2013; Ventura *et al* 2013; Spooner *et al* 2014). Reasons in support of gestation stalls also differed between the groups. Whereas participants not associated with livestock production argued primarily from the perspective of the welfare of the sows, participants associated with livestock production justified their position using arguments that transitioning to group housing would reduce production and cause economic losses. Interestingly, economic- and production-related arguments were not ignored by participants opposed to gestation stalls; on the contrary, many acknowledged these issues in their statements, but considered them insufficient to justify the harm caused to sows. Similarly, after reflecting on the perspectives of farmers, Dutch urban citizens acknowledged the economic and market pressures pig producers face but this did not change their negative attitudes towards intensive pig production for reasons mostly related to animal welfare (Benard & de Cock Buning 2013).

When asked about their preferred housing system for gestating sows, over 40% of the participants in our study chose the option 'another system', even surpassing the preference for group housing. This result may be criticised by many working in the pig industry as an unrealistic expectation of 'ignorant' people that do not understand the pig industry (Holloway 2004; Benard & de Cock Buning 2013). Indeed, in line with previous surveys (de Barcellos *et al* 2011a; Yunes *et al* 2017), 72% of the participants showed low awareness about pig production in Brazil, and not surprisingly underestimated the predominance of gestation stall system within Brazil (ABPA 2015). However, their preference for 'another system' is consistent with European citizens' preference for outdoor and free-range systems (Miele 2010; Pettersson *et al* 2016). A few participants mentioned a preference for outdoor and free-range systems explicitly, and many more justified their objection to the stalls by contrasting them to environments where animals are free to move and that allow them to express natural behaviours. Not surprisingly, given the emphasis placed on production and economics in Brazilian agricultural policies (Hötzel & Sneddon 2013), many of the participants associated with livestock production expressed dissatisfaction with group-housing systems, arguing that the disadvantages and risks — mainly regarding reduced reproductive rates related to increased aggression — do not justify the challenges associated with transition from stall to group housing. This may explain why these particular participants, most likely aware of mandates to ban gestation stall housing and thus, perhaps, restricting the future use of this type of housing, chose 'another system' as often as they did group housing. Opposition to housing systems that deprive animals from moving freely and expressing natural behaviours is central to this debate, but these findings also provide evidence that the rejection of gestation stalls should not be interpreted as

support for group housing in confined systems, as to do so may undermine the sustainability of the pig industry. Others (von Keyserlingk & Hötzel 2015; Weary *et al* 2016) have discussed the risk involved in developing and implementing changes in animal production practices and housing that do not resonate with public expectations.

The aim of the present study was not to assess the effect of providing information on the participants' views; rather, the objective of providing information was to give elements for participants to form a position regarding sow housing. This approach was based on previous studies that suggested that the Brazilian public is not familiar with livestock systems (de Barcellos *et al* 2011a; Bonamigo *et al* 2012; Cardoso *et al* 2017). Information may influence citizens' position regarding farm animal production; for example, one study (Tuytens *et al* 2011) showed that providing textual combined with audio-visual information improved attitudes toward immunocastration and raising intact male pigs as alternatives to surgical castration without anaesthesia. In contrast, a recent study showed a decline in support for gestation stalls for sows among Canadian and US American participants that accessed text and video information offered in the survey (Ryan *et al* 2015). Interestingly, most participants in our survey said that they were not influenced by the information provided; accordingly, their open responses indicate that their resulting position and justifications were, in a large part, based on previous knowledge of livestock production or a pre-established opinion that cages in general are not appropriate for housing animals. Apparently having factual knowledge of livestock production systems may not be essential for people to have an opinion regarding farm animal welfare (eg Macnaghten 2004). However, provision of information may contribute to a more critical, engaged public better able to discuss their views on specific issues.

During the time of this survey some pig producers in Brazil publicly committed to transition to group housing over the following few years (HSI Brasil 2015), but it appears that only a few participants, mostly associated with livestock production, were aware of these announcements. Moreover, none of the participants not associated with livestock production that said they had heard about these announcements could remember the contents of the message. This provides some evidence that these targeted announcements are primarily limited to industry-oriented media. Although the NGOs (non-governmental organisations) do, on occasion, relay this information in their communications, the broader public likely has few opportunities to receive this type of information. However, our responses also indicate that this lack of awareness of the phasing out of gestation stalls by some producers would have had little effect on our results. Some industry stakeholders believe that given the complexities associated with livestock production, the public should remain ignorant as a means of avoiding misunderstandings (Broad 2016). This may explain why the pork industry limited its announcements regarding its commitment to phase out gestation stalls to their own websites and other similar livestock production specialised sites, which are predominantly visited by commercial partners and other interested parties. However, it has been shown that lack of transparency from the industry may reduce citizens' trust in farmers (Robbins *et al* 2016).

Animal welfare implications and conclusion

Brazilian participants opposed to gestation stall housing expressed values and attitudes similar to those seen in previous work on citizens from different countries and cultures. These views, which were shared by participants both associated and not associated with livestock production, underlie the international trend towards implementing group housing systems for gestating sows. However, our work also indicates that our participants showed a generalised preference for some other, non-specified housing system, which differs from both gestation stalls and group housing. Therefore, these findings should be viewed with caution given that the transition from gestation stalls to group housing may prove unsatisfactory for the public in the long term. Given the qualitative, exploratory nature of this study, based on a convenience sample of participants, it cannot be interpreted as representing the overall views of Brazilian society in general. Further, understanding of public expectations regarding housing systems for sows and the underlying reasons for their preferences may help guide the necessary changes in the livestock industry.

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