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Investigating the welfare, management and human-animal interactions of cattle in four Indonesian abattoirs

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Abstract

This study reports novel information on the animal handling, management and human-animal interactions in Indonesian cattle abattoirs. The slaughter of 304 cattle was observed and there was a high percentage of re-stuns in all abattoirs (range: 8–18.9%) when compared to a variety of international auditing guidelines. The average stun-to-neck cut time was within international recommendations (average: 9 s; range: 4–15 s). Time spent in lairage varied between animals and facilities and was compliant with international guidelines. Handling times were extremely variable (2 s–23 min 40 s), but were only weakly correlated with a variety of handler techniques including the total number of handler interactions (sum of visual, auditory and tactile interactions, suggesting that long handling time does not increase handler interactions. There was a moderate correlation between the subjective handling scale and most of the objective behaviours, indicating that this may be a useful way to summarise handler behaviour in future assessments. The current study provides novel information about animal welfare in Indonesian abattoirs and highlights that management practices at the four abattoirs generally comply with international standards. The results also suggest that the subjective handling scale was moderately associated with the frequency of handler interactions, and so may be a useful measure of handler behaviour.

Keywords: *animal welfare, cattle, handling, human-animal interactions, live export, slaughter*

Introduction

The management and handling of animals prior to slaughter has the potential to significantly compromise welfare before death. Factors affecting an animal's welfare at the abattoir can include poor handling, mixing with unfamiliar animals, novel, intense and startling stimuli and confinement in transport and lairage (Gregory 2005; Terlouw *et al* 2008; Miranda de la Lama *et al* 2012). Poor handling presents a particular risk to animal welfare (Seng & Laporte 2005) and the knowledge, experience and attitudes of the handler influence handler behaviour and, as a consequence, cattle behaviour (Coleman & Hemsworth 2014). Similarly, the fear, temperament and behaviour of the animal influence what the handler does (Coleman *et al* 2012). This relationship has been repeatedly demonstrated in a variety of livestock species both on-farm and at the abattoir (Hemsworth *et al* 2011). Understanding these human and animal interactions can help to identify what situations are likely to result in welfare compromise.

Internationally, animal welfare is recognised as being of increasing importance (Gerber 2010). This increased focus on animal welfare is being driven from a variety of perspectives including economic and productivity benefits to farmers, improved trade access and social and consumer expectations (Fraser 2008; Mellor & Bayvel 2008; Gerber 2010). Guidelines on animal welfare set by the World Organisation for Animal Health (OIE 2014) address factors that may affect an animal's welfare at slaughter. The OIE's guidelines are not binding, nor are they enforced by the OIE; however, they provide an internationally agreed set of science-based recommendations as to how animals should be managed to limit compromises to their welfare (Bayvel 2004; Fraser 2008).

Animal welfare and human-animal relationships in European and English-speaking abattoirs have been evaluated and reported broadly (Grandin 2007; Ferguson & Warner 2008). However, such data are relatively sparse in other countries. The way animals are managed and processed outside European and English-speaking markets can be markedly different in terms of scale of production, infrastructure, market requirements, the availability of manual labour and technology. As a result, research in these regions is necessary (Fraser 2008). Initial investigations that give an overview of the situation are a valuable first step to understanding regional welfare issues. With this in mind, the aim of this study was to evaluate the handling, welfare and management of cattle in four Indonesian abattoirs from

Table 1 List and definitions of the objective behaviours recorded.

Measure	Description
Duration of handling (s)	The total observed time of the behavioural interaction between the animal and handler
Cattle talker use	A binary description of whether a cattle talker was used by the handler or not
Contact with sensitive areas	The number of tactile interactions with sensitive areas, including nose, eyes, mouths, ears and genitals
Tactile interactions: human	The number of tactile interactions from handler. Tactile interactions included touches, pats, pushes and hits
Tactile interactions: objects	The number of times an object was used on the animal by the handler. The majority of these measures involved the use of the cattle talker
Auditory interactions: human	The number of auditory interactions made by the handler. An auditory interaction included talking, whistles and shouts
Auditory interactions: artificial	The number of auditory interactions made by the handler from artificial sources. An artificial auditory interaction included hitting metal fixtures
Visual interactions	The number of visual interactions made by the handler. A visual interaction included waving arms or flapping objects including, but not restricted to, a cattle talker
Total interactions	The sum of interactions used by the handler to move the animal. This includes all tactile, auditory and visual interactions

a specific supply chain. This was done by collecting facility metrics around handling and slaughter, including handler interactions with each animal.

The four abattoirs met the international standards for animal welfare (OIE 2014) as determined by the Exporter Supply Chain Assurance System (ESCAS). ESCAS is an Australian Government scheme that was developed to increase community confidence that Australian-bred livestock are treated in accordance with international standards of animal welfare (Commonwealth of Australia 2015). The facilities at these study abattoirs are representative of this type of supply chain, but not others in Indonesia (Blaszak 2011) or Asia (for an example from Bangladesh, see Ahsan *et al* 2014).

Materials and methods

Four Indonesian abattoirs, two in Java (numbers 1 and 2) and two in Sumatra (3 and 4), were recruited for the current study. All four abattoirs were ESCAS-approved and had requested animal handling training provided by Meat and Livestock Australia. This provided the research team with the opportunity to collect data while the training was being delivered. A formal letter outlining the aim of the study, the type of data that would be collected and the methods for doing this was given to each facility manager in the month prior to data collection.

Data were collected from each abattoir for six days, and so a total of 24 days of data were collected across all abattoirs during the experimental period. All cattle were *Bos indicus* or *Bos indicus* cross, bred in free-moving systems in Australia and kept in Indonesian feedlots for approximately 100 days prior to slaughter.

Cattle processing

The number of days each animal spent in lairage was calculated from abattoir records. At slaughter, the number of times each animal had to be stunned before rendered unconscious was recorded and the stun-to-cut interval was recorded at abattoirs 1 and 4. This was not possible at abattoirs 2 and 3 because of the positioning of the stunning box and slaughter point. Over the six observation days, the average slaughter shifts were: facility 1 = 4 h 6 min; facility 2 = 4 h 11 min; facility 3 = 1 h 33 min; and facility 4 = 2 h 19 min.

Objective behavioural observations

GoPro® cameras (San Mateo, CA, USA) were set up in the raceway and lairage to record the entire duration of each evening's slaughter run. Individual animal handling was assessed when an animal was moved from the forcing yard to the raceway. Due to structural differences in each abattoir, the observable length of the raceway differed for each abattoir. The approximate lengths of each assessed area of the raceway were: abattoir 1, 9 m; abattoir 2, 7 m; abattoir 3, 9 m; and abattoir 4, 3 m. Similarly, each abattoir had a different protocol for selecting animals for slaughter from the lairage and how they moved them from the yards to the slaughter box. For example, butchers in abattoirs 1, 2 and 4 were allowed to select whichever animal they wanted from lairage for slaughter, whereas this was not the case for abattoir 3.

Frequencies of a variety of behaviours were measured from the videos. A detailed list of the behaviours scored in the analysis is included in Table 1, and all specified behaviours were mutually exclusive. A 'cattle talker' is a 1.2 m green pipe with orange plastic strips at one end and is used as a handling aid. They were present at all four abattoirs. Vocalisations of the cattle and electric goad use were included in the original list, but neither was observed during the course of the study.

Subjective behavioural assessments

Two subjective assessments were conducted by the same observer from video records. A subjective handler scale was modified from a scale published by Petherick *et al* (2009). Scored from one to four: 1 = handler uses positioning and his own movement to move cattle with minimal or no vocal or physical encouragement; 2 = handler uses positioning and own movements to move cattle with some vocal encouragement; 3 = handler uses vocal and physical (hand/cattle talker) encouragement to move cattle; and 4 = handler fails to use his own positioning and movement to move animals, relying on significant vocal or/and heavy physical inputs.

A subjective cattle temperament scale was modified from a scale published by Voisinet *et al* (1997). Scored from one to four, 1 = head is in the neutral position, calm with limited movement; 2 = some head movement and ear movement; 3 = frequent head and ear movement; and 4 = constant movement.

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Table 2 Mean objective and subjective behavioural results for each abattoir; minimum and maximums are presented in parentheses.

	Abattoir 1	Abattoir 2	Abattoir 3	Abattoir 4
Duration of handling (s)	135 (2–1,268)	258 (6–1,420)	19 (4–249)	44 (2–578)
Contacts with sensitive areas	0.4 (0–6)	0.2 (0–3)	0.0 (0–0)	0.5 (0–23)
Tactile interactions: human	13.2 (0–336)	1.6 (0–18)	0.8 (0–10)	1.0 (0–23)
Tactile interactions: objects	1.1 (0–44)	3.8 (0–48)	0.1 (0–2)	1.2 (0–44)
Auditory interactions: human	5.3 (0–155)	5.0 (0–20)	2.3 (0–6)	1.1 (0–40)
Auditory interactions: artificial	0.8 (0–26)	0.7 (0–21)	0.1 (0–3)	0.0 (0–0)
Visual interactions	0.2 (0–4)	0.4 (0–5)	0.8 (0–10)	0.0 (0–1)
Total interactions	20.2 (0–503)	11.7 (0–81)	4.0 (0–27)	3.7 (0–130)
Subjective handling score	2.1 (1–4)	2.3 (1–4)	1.6 (1–3)	1.7 (1–4)
Subjective cattle score	2.1 (1–4)	2.3 (1–4)	1.4 (1–3)	1.5 (1–4)

Statistical analysis

Statistical analyses were performed to evaluate relationships between handling behaviours; in a two-step process. There were naturally existing differences between facilities, including race design and length and handling method, which would have affected handling, and thus affected the handling results. Therefore, using the data from 284 animals (facility 1, 57; facility 2, 124; facility 3, 52; and facility 4, 51) a multivariate analysis of variance (MANOVA) was performed for all of the recorded objective variables (artificial auditory interactions, auditory interactions, cattle talker use, contact with sensitive areas, duration of handling, object interactions, tactile interactions, visual interactions) with facility (abattoir) as the independent variable. With facility as an independent variable, the analysis was able to account for the facility differences (eg race design) and then calculate 'effects' of each animal for each objective, providing 'standardised estimates' for each of the objective variables that could then be used for further analysis (Krzanowski 1988). These standardised estimates were then used to perform correlations between all objective variables, allowing for overall relationships to be investigated, without relationships being masked by facility differences. Correlations were also performed between the standardised objective variables and the two subjective handling scores. Correlations were classified as strong if coefficients were ≥ 0.5 and moderate if between 0.3 and 0.49 (Cohen 2013). Correlations of binary or ordinal variables with each other or variables were calculated by using the Spearman's rank correlations and correlation between continuous and count variables were calculated using Pearson's correlations, and all were assessed for outliers that may have skewed the data set. Both the MANOVA and the subsequent correlations were performed in R (Version 3.1.1; R Core Team 2015).

Results

The slaughter of 304 cattle was observed: 59 from abattoir 1; 138 from abattoir 2; 54 from abattoir 3; and 53 from abattoir 4. The average duration an animal was kept in the lairage was two days, but each abattoir managed animals differently. The average for abattoir 1 was two days (range: 0–11 days), abattoir 2 was two days (0–57 days), less than one day (0–2 days) for abattoir 3, and one day (1–2 days) for abattoir 4. All lairage pens in each abattoir had water troughs and all animals in lairage for longer than one day had access to feed.

All four abattoirs stunned animals prior to slaughter: handheld, non penetrative captive-bolt guns were used at abattoirs 1, 3 and 4, and a pneumatic non-penetrative stunner at abattoir 2. The number and percentage of failed initial stuns were: abattoir 1, 6 (10.2%); abattoir 2, 11 (8.0%); abattoir 3, 4 (7.4%) and abattoir 4, 10 (18.9%). The average intervals from effective stun to neck cut were 9 s (range: 4–14 s) and 10 s (range 7–15 s) at abattoirs 1 and 4, respectively. All animals were killed with a single cut to the throat that severed the carotid arteries. Time from throat cut to further processing was not recorded.

Objective and subjective behavioural data from a total of 284 (of the 304) cattle were collected during this study: 57 from abattoir 1; 124 from abattoir 2; 52 from abattoir 3; and 51 from abattoir 4. A summary of the behavioural data is presented in Table 2. 'Cattle talkers' were used in abattoir 1 30% of the time, abattoir 2 50% of the time and abattoir 4 10% of the time. Cattle talkers were not used in abattoir 3, despite them being available.

Out of the 55 correlations, a total of 25 were statistically significant, with eleven being moderately correlated and eight strongly correlated (Table 3). The subjective handling scale was correlated with all handler behaviours apart from contacts with sensitive areas, visual interactions and total interactions, whereas the subjective cattle score was only

Table 3 Correlations within and between objective and subjective behavioural measures for all abattoirs using 'standardised estimates' following a MANOVA.

Measure	2	3	4	5	6	7	8	9	10	11
1. Duration of handling	0.26	0.11	0.14	**0.26**	**0.27**	0.12	0.11	**0.28**	***0.37***	**0.25**
2. Cattle talker use		–0.08	0.13	**0.78**	0.13	***0.30***	***–0.34***	***0.41***	***0.48***	0.13
3. Contacts with sensitive areas			0.18	***0.42***	**0.52**	0.04	–0.05	***0.48***	0.10	0.15
4. Tactile interactions: human				0.10	**0.57**	0.05	–0.03	**0.84**	***0.40***	0.01
5. Tactile interactions: objects					***0.37***	0.07	–0.11	**0.55**	**0.61**	0.13
6. Auditory interactions: human						0.01	0.05	**0.80**	***0.42***	**0.24**
7. Auditory interactions: artificial							–0.05	0.19	0.15	–0.07
8. Visual interactions								0.00	0.10	0.17
9. Total interactions									**0.72**	**0.25**
10. Subjective handling score										***0.35***
11. Subjective cattle score										

Statistically significant correlations are presented in bold; those that were of moderate association are italicised, and those that are strongly correlated are underlined.

weakly correlated with duration of handling, auditory interactions and total interactions. A moderate correlation existed between the two subjective scores. When comparing the objective measures, duration of handling showed weak correlations with tactile (artificial), auditory (human) and total interactions. As expected, total interactions were correlated with all handling interactions. Contacts to sensitive areas were correlated with tactile (object), auditory (human) and total interactions, but independent of handling duration.

Discussion

These current results provide novel information on the management of cattle in a specific type of supply chain in Indonesian abattoirs. Here, we analyse the resource- and animal-based measures in the current study in relation to published guidelines and recommendations to draw conclusions on the welfare status and welfare risks in the facilities.

The management of animals in lairage varied across the four study abattoirs. During extended periods in lairage, cattle had access to feed and shelter, and this was in accordance with stipulated requirements in the OIE guidelines (OIE 2014). While lairage conditions met the international welfare standards, other factors have previously been associated with negative welfare outcomes. These include an animal's previous experience, environmental conditions (specifically heat and humidity), inadequate stocking densities, exposure to excessive noise and mixing with unfamiliar animals (Weeks 2008). In all four facilities, cattle were stocked at a rate that allowed individuals to stand, turn around and lie down, all of which indicate adequate space allowance per animal (Weeks 2008). Tropical conditions in Indonesia may lead to a risk of heat stress experienced by animals kept in lairage; as observations were carried out at night there were no signs of heat stress in the cattle, so conclusions on this cannot be drawn. Those abattoirs that had animals in lairage for longer than two days had shelter available, which would assist cattle with their thermoregulation (Blackshaw & Blackshaw 1994). Noise would likely negatively affect the cattle in all four abattoirs in the study as the single-file raceways and stunning box were in close proximity to the processing area where carcases were butchered. The butchering process involves a large number of people and metallic objects in close proximity to live animals, both of which have been shown to be aversive (Weeks 2008). It is not known whether unfamiliar animals were mixed in the four observed abattoirs. It could be reasonably presumed that the likelihood of mixing occurring, or animals being kept in isolation, would increase as time spent in lairage increases.

All of the abattoirs observed processed an average of 25 animals or less on each of the six observed days. This classifies them as 'very small plants' from an auditing perspective (Grandin 2012a). For abattoirs of this size, it is recommended that all animals are effectively stunned on three out of four observed days (Grandin 2012a), however none reached this recommendation. Several factors are likely to contribute to this high rate of failed stunning. Non-penetrative stunning is effective at rendering cattle unconscious (Gibson *et al* 2011), but it has been noted that this method requires more precision than penetrative stunning in order to be effective (Pleiter 2010; Grandin 2012b). As none of the abattoirs had head restraints in the stunning box, the position of the cattle's head could not be controlled, and so the accuracy of stunner placement may have been reduced (Miranda de la Lama *et al* 2012). Data on the maintenance of stunning devices were not known, but inadequate main-

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tenance has been associated with frequent stunning failures (Terlouw *et al* 2008). It is possible that addressing one or both of these factors would improve stunning rates. The abattoirs where stun-to-slaughter interval was measured were compliant with the Compassion in World Farming's recommendation of an interval of 15 s or less (CIWF 2010), so once stunning was effective animals were likely unconscious for the slaughter process.

Vocalisations can be used to assess the welfare of cattle in abattoirs (Grandin 1998). None of the 304 cattle in the current study vocalised during the handling and slaughter process. Research conducted by Grandin (1998) identified that faulty equipment design, excessive pressures during restraint and electric prodder use were all associated with vocalisations in cattle. None of these three risk factors existed in any of the four abattoirs, likely explaining the lack of vocalisations. While excessive pressure from restraint can lead to vocalisations in cattle, indicating distress, a lack of restraint may have contributed to a higher number of failed first-time stunning, as outlined in the paragraph above. Grandin (1998) also noted that vocalisations occurred in cattle in response to failed stunning, but this was not observed in the current study.

The infrastructure (raceways, stunning boxes, stunning equipment) and the type of animal (larger flight zone, untethered) in these four abattoirs are not common in abattoirs in Indonesia (Blaszak 2011), or Asia more broadly (Ahsan *et al* 2014), which usually do not stun animals prior to slaughter, and with limited races and infrastructure involve the use of ropes and head tethers to restrain cattle and pull them into lateral recumbency for slaughter. As such, the management of cattle in the current study can be considered to be an improvement on previous reports and studies (Bangledeshi cattle: Ahsan *et al* 2014, Australian-bred cattle in Indonesia: Blaszak 2011; Jones 2011; Islam 2014) thus suggesting improved animal welfare. As all four abattoirs were accredited according to the ESCAS system, which assesses performance based on OIE guidelines, this result was expected. The results of the current study may provide evidence that supply chain integration and auditing may positively affect abattoir performance, and indeed this is used to assess welfare commonly (Barnett & Hemsworth 2009; Grandin 2010); however, broader data collection and longitudinal studies would be needed to confirm this. Similar studies in other kinds of supply chains would give a broader picture of cattle welfare at slaughter in Indonesia.

According to previously published data on animal handling in Asian abattoirs, the frequency of contacts with sensitive areas (eyes, nose, tails) seen in the current study were lower compared to other investigations, with no animals presenting with any physical injury, or obtaining any during the handling process (Alam *et al* 2010; Ahsan *et al* 2014).

While contact with sensitive areas was infrequent, it was correlated with tactile (object) and auditory (human) interactions, suggesting that all three handling methods are used to move specific animals. The frequencies of tactile and auditory interactions were also variable; previous studies have shown that increased handler interaction is correlated with an increased physiological stress response in cattle, and that tactile interactions and high-pitched or loud noises are associated with fear or stress cattle (Breuer *et al* 2000; Weeks 2008; Hemsworth *et al* 2011). These types of interactions have been demonstrated to affect stunning efficacy as well, with one study identifying a relationship between repeated stunning and aroused cattle behaviour (Bourguet *et al* 2011). Human-generated or artificial auditory interactions have also been shown to generate increased heart rate and movement in cattle as well (Waynert *et al* 1999). It is likely that these two types of interactions are more likely to compromise welfare than visual interactions, and so while the most negative type of interaction was low (sensitive contacts), reducing overall handling would improve welfare.

In the current study, duration of handling was weakly correlated with only a few interactions, suggesting in this case that handling duration is not associated with increased handling pressure. Cattle talker use was positively correlated with tactile (object) and auditory (object) interactions, suggesting that the talker was used as both the object to contact the animals with and to hit metal fixtures to create the noise. While cattle talkers are provided to assist in moving cattle, they may cause stress when used this manner. This is supported by the correlation between cattle talker use and the subjective handling score, indicating that handling was perceived to be more negative when the talker was used, despite it not being included in the subjective definition.

The subjective handling and subjective temperament scores were moderately correlated with each other, but subjective temperament score was not correlated with any of the objective behaviours, suggesting that observer-rated temperament was not related to how the animal was actually treated. In comparison to the subjective temperament score, the subjective handling score was well correlated with the majority of handler behaviours, which suggests that this may be a quick yet reliable way to assess handler behaviour. This supports some findings of Qualitative Behavioural Analysis studies where short observations were associated with more measures of stress in cattle around slaughter (Stockman *et al* 2012). Further validation of the subjective scoring is required however; for example, intra-observer reliability was not tested in the present study, and nor was the observer assessing the subjective handling scale blinded to the objective behaviour results (Meagher 2009), which can act as a potential source of bias in the study (Tuyttens *et al* 2014). Nevertheless, these data indicate that the subjective handling scale could be used in the abattoir environment to accurately reflect handler behaviour.

Animal welfare implications

This study highlights management practices that may affect cattle welfare in four Indonesian abattoirs that represent the ESCAS supply chain. While direct comparisons have not been made, the welfare of cattle in these abattoirs seems to be higher than those in previously reported studies. The presence of cattle talkers and pre-slaughter stunning represents examples of this. The integrated supply chain and external

auditing that occur in all of these abattoirs are likely to play a role in this. The relatively high incidences of re-stuns in all abattoirs need to be addressed. Finally, the subjective handling scale may be a useful way to record handler behaviour, and so providing a fast but effective technique that may be useful for assessment or auditing. Further research is needed to confirm the rigour of this measure, including validation and reliability, test-retest reliability, correlations with welfare outcomes, and handler attitude behaviour studies.

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