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A Welfare Review of Different Stunning Methods in Poultry Slaughter

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Abstract

With poultry species being one of the most numerous of any sentient animal facing slaughter for human consumption, their protection especially at the time of slaughter is greatly important in the development of animal welfare. Electrical water bath stunning involves birds being consciously shackled before having their heads dropped into an electrically charged water bath, CAS involves exposing the birds to a possible mixture of gasses and increasing the concentration and mechanical stunning includes the use of captive bolts and Cervical Neck Dislocation. The main current issues predominantly surround pre-stun shackling, insufficient training for slaughterhouse operators, and the degree of effectiveness of the method. Through research aimed at the reduction of these issues, future poultry welfare can be protected.

Absztrakt

A különféle baromfifajok jelenleg az egyik legnépesebb állatcsoport, melyeket emberi fogyasztásra tenyésztünk és vágunk le, így védelmük - különösen a levágás során - nagy jelentőséggel bír az állatjóllét szempontjából. Az elektromos vízfürdős kábítás során az állatokat éber állapotban lábbilincs segítségével fejjel lefelé rögzítik, majd fejüket elektromos vízfürdőbe merítik. A gázzal történő kábítás során a madarakat különféle gázok emelkedő koncentrációjának teszik ki, míg a mechanikai kábítás a rögzített závárzatú eszközök használatát, és a nyaki diszlokációt jelenti. A kábítás és vágás során a fő aggodalmat a kábítás előtti lábbilincses rögzítés, a vágóhídi dolgozók elégtelen szakképzése és a módszerek kétséges hatékonysága jelentik. Ezen problémák megfelelő tudományos alapokon nyugvó megoldása fontos lépés a baromfik jóllétének garantálásához.

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1. List of abbreviations

AFBF (American Farm Bureau Federation)

BBC (British Broadcasting Corporation)

CAS (controlled atmosphere stunning)

CND (Cervical neck dislocation)

CO_2 (Carbon dioxide)

DXE (Direct Action Everywhere)

EMN (European Meat Network)

EU (European Union)

FMD (Foot and mouth disease)

FRN (Neuroticism factorial scale)

FVE (Federation of Veterinarians of Europe)

KED (Koechner euthanizing device)

LAPS (Low atmosphere pressure stunning)

NFU (National Farmers Union)

NGO (non-governmental organization)

NSAID (Non-steroidal anti-inflammatory drug)

PITS (Perpetrator induced traumatic syndrome)

PTSD (Post traumatic stress disorder)

RVC (Royal Veterinary College)

UK (United Kingdom)

2. Introduction

Each year, an estimated of 50 billion chickens are slaughtered worldwide for human consumption, a number which excludes male chicks, non-producing hens in egg production and of course other poultry species [1]. The most recently published data from EUROSTAT shows that in 2019 the United Kingdom (UK) alone slaughtered 1899 thousand tonnes of poultry and in Hungary a further 533 thousand tonnes were slaughtered. The largest producer of poultry in this year was Poland which slaughtered approximately 2593.45 thousand tonnes of animals [2]. Being the largest produced species, they are also the most slaughtered which has driven great development for efficient and high-volume slaughter methods. Numerous current methods of slaughter, and more importantly in my dissertation, stunning, have been implemented in recent years, and in this strive for speed and efficiency, it is important to evaluate the impact of these methods on the animal's welfare. To make changes if necessary, and to ensure no compromise for efficiency over welfare.

There is a common misconception surrounding poultry. Being so different from ourselves and as people are becoming more and more disconnected from the process of food production, there is an opinion that these birds are essentially non-feeling commodities. Which is far from reality. The skin of chickens is composed of many receptors for pressure, temperature, and pain. The beak is composed of many sensory nerve endings. At the tip of the beak is the bill tip organ which is a group of mechanoreceptors. When damaged (a frequent consequence of beak clipping), birds display many pain related behaviours which include guarding, tucking their beaks below the wing, decreased pecking as well as more stereotypic behaviours, some of these behaviours are present for months after the beak damage [3].

Birds are also able to differentiate positive and negative experiences. Birds anticipating a negative experience after a specific que show increased head movements, stepping and pacing. Whereas birds anticipating a positive experience have no increase in the number of steps and showed an increase in comfort behaviours which include preening and body scratching [4]. This ability for poultry to anticipate and more importantly, differentiate between positive and negative experiences is important in the design of pre-stunning and stunning methods to minimize distress and fear.

In 2012, the treaty of the functioning of the European Union (2012) stated in article 13 "the Union and the Member States shall, since animals are sentient beings, pay full regard to the welfare requirements of animals" [5]. Council regulation (EC) No 1099/2009 on the protection of animals at the time of killing states that the killing of animals may "induce pain, distress, fear

or other forms of suffering to the animals even under the best available technical conditions" and that anyone involved in the killing of animals must ensure "necessary measures to avoid pain and minimize the distress and suffering of animal" [6].

Most of the current stunning methods of poultry require shackling the birds (figure 1). This inversion is problematic since without having a diaphragm, the inversion puts a lot of pressure on the animal's lungs and can cause suffocation. Pain is also caused by the compression of the bird's legs in the shackling line and incorrect handling by untrained workers also pose a risk to welfare.

Figure 1: Broiler chickens on a shackle line

In Jersey (the island where I live), I was able to speak to the state veterinary officer who informed me that there is currently no slaughter facility for poultry on the island. Therefore, the laying birds on the island are culled by cervical dislocation on an independent farm basis. A method that is hard to regulate and has its drawbacks. As well as being unpleasant for the person performing the dislocation, this method is restricted to birds weighing below 3 kg and a single person is only allowed to perform 70 dislocations a day under European Union (EU) law [7]. Therefore, the government of Jersey is hoping to seek alternative methods to manage this in the future.

The anatomy of birds is an important consideration when evaluating stunning methods. Something that varies between different poultry species is the number of cervical vertebrae, for example, chickens have 15, ducks have up to 16 and geese can have between 17 and 23 cervical vertebrae. These differences and the knowledge of this is important regarding manual cervical dislocation as different species require different handling techniques and different exertional

force. Birds also have many nociceptors in the skin and periosteum of their metatarsus, therefore the pressure exerted on the birds' legs by the shackles can easily activate these receptors leading to pain sensation [8]. Since heavier birds are likely to have wider legs, it is also important that birds are shackled appropriately according to their size, the shackles must be of the correct size to prevent excessive movement and escape, but also not overly tight as this would cause compression injuries and pain. With selective breeding over the past couple of decades, poultry species, especially broiler chickens, have been positively selected for increased breast meat production. Broiler growth rate has increased by 400% between the years of 1950 and 2005 [9] (figure 2).

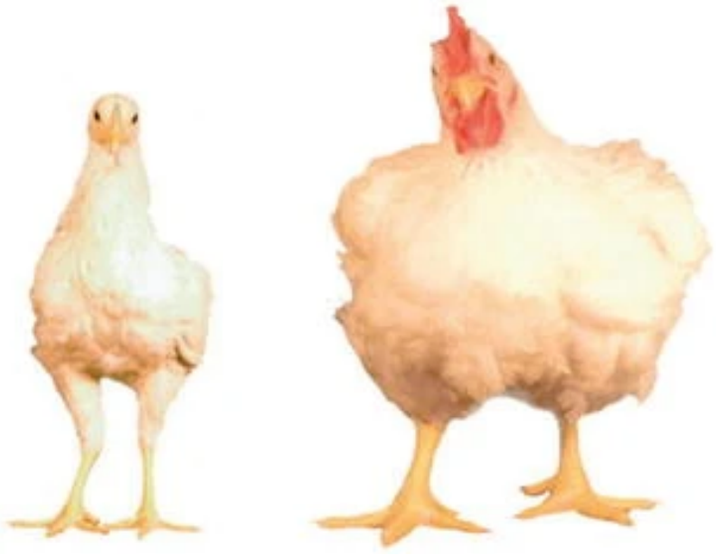


Figure 2: A photograph comparing the commercial broiler genotype in the 1950s (left) and 2005 (right) in two 56 year old chickens fed on identical diets [9]

This large increase in body weight in a relatively short period of time puts the chicken's legs under a lot more strain and can result in decreased locomotor ability. Also, when you then consider how shackling inverts the birds, this large increase in body weight puts even more tension on the birds' supporting legs which can further increase pain and discomfort. Birds have a very unique respiratory system; they have highly efficient lungs and seven air sacs which allow for a continuous flow of air through the lungs. With their absence of a diaphragm, inversion of birds puts a lot of pressure on their air sacs and lungs and can make it difficult for birds to breath [8], this led to breast supports being implemented in many shackle lines to help improve welfare before exsanguination.

3. Literature review

Current stunning methods can be grouped into three main categories: electrical, controlled atmosphere and mechanical. Electrical stunning such as water bath methods involve the application of an electrical current to the bird which passes to the brain rendering the bird unconscious. Controlled atmosphere stunning (CAS) exposes the bird to either a mixture of inert gasses or carbon dioxide (CO_2), the time from exposure to loss of sensation is known as the "induction of insensibility" and must be monitored to minimize problems. Finally, mechanical stunning, cervical dislocation and the use of captive-bolt devices which involve a bolt driven into the animal's brain to induce immediate unconsciousness.

3.1. EU Reports

Many of the papers I have referenced in my dissertation were published by the EU, specifically in the Official Journal for the European Union. The EU has a platform for animal welfare which has many different types of members. Type A members are individual experts in their field of work/research, there are 15 people making up this group and they are from many different nationalities. Type C members are organizations, this group consists of 30 different non-governmental organizations (NGOs) such as Compassion in World Farming, trade and business associations such as the European Meat Network (EMN) and professional associations such as the Federation of Veterinarians of Europe (FVE). Type D members are the member state authorities for each EU country and type E members are other public entities consisting of three different reference centres for animal welfare [10]. This platform and its members have a great influence in the legislation passed and are very important in protecting/updating animal welfare in the EU. Since 2017, when the platform for animal welfare was commissioned, the members have held approximately 20 meetings that cover a variety of issues. The first in 2018 discussed the welfare in animal transport, in 2019 this followed with discussion on pig welfare and from 2020 to 2021, a total of six subgroup meetings on animal welfare labelling were held. COUNCIL REGULATION (EC) No. 1099/2009 of 24 September 2009 on the protection of animals at the time of killing states that the slaughter of animals can "induce pain, distress, fear or other forms of suffering" even under the best available conditions. It also states that stunning is "necessary to induce a lack of consciousness and sensibility before, or at the same time as, the animals are killed" and that well trained and skilled workers are important in improving the conditions that animals are treated. I have noticed the fast-paced development in animal welfare laws in the past few decades, this seems hopeful for the future, with animals being recognised as sentient in the EU, many traditional systems have been forced to change.

In the UK we have many different schemes which exist to reassure consumers that the animal products that they buy and consume come from regulated farms that function to a high level of animal welfare. One of the most well-known of them all is the Red Tractor stamp, it approves farms that it believes to offer good living conditions to their animals, however, I discovered that this organization was actually set up and partly owned by the National Farmers Union (NFU). Also, board members in charge of setting the Red Tractor welfare standards consist of some of the largest poultry product producing companies in the UK, this lack of independent review seems greatly susceptible to industry bias. Since discovering this I have kept in mind the possibility of industry bias when reviewing articles from welfare organizations such as Red Tractor and have ensured articles I referenced were only written by impartial researchers.

3.2. Sentience Studies

An important part to my thesis is the legislation that currently exists stating that animals are sentient beings. But while this is something many people just inherently believe; it took numerous scientific research projects to prove. Sentience in its most simplistic form refers to the depth of self-awareness and the ability to feel both pleasure and pain [11]. Studies to prove pain sensation vary from histopathology, where tissue samples prove the presence of many types of temperature, pressure, and pain receptors and how damage to a bird's bill tip organ (a group of very sensitive mechanoreceptors) induces many pain related behaviours that can be seen for a long time after the damage occurred [3]. In another study, researchers trained broiler chickens to differentiate between two different coloured feed pellets, with one of them containing carprofen, a non-steroidal anti-inflammatory drug (NSAID) used to decrease pain and inflammation. Through observation of the broilers, it was apparent that those birds exhibiting signs of lameness not only selected the pellets containing the carprofen, but also that as lameness and pain increased, the birds would select pellets containing higher concentrations of the drug. This ability of the broilers in pain to select the analgesic containing foods showed that the broilers were capable of feeling pain [12]. This study from the year 2000 has since been reproduced with many researchers reaching the same conclusion. A follow-on study in 2003 which also was co-written by academics involved in the 2000 study assessed the effects of NSAIDs on thermal nociception in lame broilers. This study used carprofen and meloxicam NSAIDs and saline as a control, which were injected into the birds left intertarsal joint. These birds then had a thermal stimulus applied to their left metatarsals and their responsive skin temperatures were then measured as they were associated with an inflammatory response. The

study found a significant link between the use of NSAIDs and a decrease in inflammation in these broilers. The reproducibility of the concept of these studies made them good and reliable resources to use [13].

In 460 BC, ancient physicians and philosophers such as Hippocrates and Pythagoras believed that animals were capable of feeling pain and suffering, and therefore deserving of fair treatment from people. Later in 17th century philosophy, Rene Descartes and his greatly oppositional views were founded. He perceived animals as mechanisms which he referred to as automata, in his opinion they were purely reflex-driven machines with no intellectual capacity. In the 18th century, commonly known as the Age of Enlightenment, views shifted again and many philosophers focused on animals' ability to suffer. English philosopher Jeremy Bentham notably wrote: “The question is not, Can they reason? nor Can they talk? but Can they suffer?” [14]. In the 19th century, Charles Darwin frequently wrote about his compassion for animals and even proposed that some animals were capable of self-consciousness. Darwin also acknowledged that there were times that harming animals was a necessity, for physiological investigation and certain experiments. He wrote “I quite agree that it is justifiable for real investigations on physiology; but not for mere damnable and detestable curiosity. It is a subject which makes me sick with horror, so I will not say another word about it, else I shall not sleep to -night” [15]. In the 20th century, the behaviourist movement started. John Watson (who founded Behaviourism) believed that subjective emotions should be removed from actual observed animal behaviours. McDougall at a similar time proposed that emotions such as fear and pain motivate the activities of animals [14]. In the 1960’s, in her book ‘Animal Machines’, Ruth Harrison first drew attention to the welfare of animals inside modernized intensive agriculture. In this book, Harrison discusses the use of battery cages, veal cages and many other major concepts that were/are in need of major reform [16]. In response to ‘Animal Machines', the UK Government set up the Brambell Committee to focus on many problems of animal welfare that had been raised in the book. Today, there are vast individual differences when it comes to animal welfare. It is a highly emotive topic of discussion for many and the opinions of farmers, animal welfare activists, veterinarians and the general public frequently contradict each other. The media is well known for sensationalizing many welfare stories. In 2018, the British Broadcasting Corporation (BBC) published an article on a cow in Poland that escaped slaughter and swam to seek safety on a Polish island. The cow was named the ‘Hero Cow’ by members of the public, and when attempts were made to return the cow to his owner, there was a huge public outcry, local politicians even stepped in offering to save the ‘Hero Cow’ from

inevitable slaughter [17]. Stories like this draw public attention to one key point, that animals are sentient beings who value their own lives, and put harshly, don't want to be killed. It is clear to see that the views towards animal sentience have changed greatly throughout history, and that the majority of people today do not discredit the sentience of animals.

3.3. Mental Health of Slaughterhouse Workers, Veterinarians and Farmers

Slaughterhouse work is a very unique occupation involving the routine and constant involvement with the killing of animals. I felt that whilst spending lots of time looking into the welfare of poultry species, the welfare of those tasked with performing the slaughter was equally as important. A study into the working conditions and mental illness in slaughterhouse workers in Southern Brazil used The Neuroticism Factorial Scale (EFN), as a self-assessment questionnaire focused on vulnerability, psychosocial disadjustment, anxiety, and depression. The questionnaire was completed by slaughterhouse workers, university workers, and university students. The results showed that in all four areas evaluated by the EFN, slaughterhouse workers (specifically those in the cutting sector) ranked the highest in vulnerability, psychosocial disadjustment, anxiety and depression [18]. Supporting this study is the work of Lander and colleagues who concluded depression in the meatpacking industry is four times higher than the national average [19]. Throughout many studies the link between depression, post-traumatic stress disorder (PTSD), perpetrator induced traumatic syndrome (PITS), anxiety, paranoia and fear has been well researched and is shown to be reproducible.

Another important aspect to include when talking about mental health, is the mental health of veterinarians who have a four times higher suicide rate than the general public. Although their work too involves the killing of animals and many similar mental health problems, they are not always faced with the same stigma as many slaughterhouse workers. Veterinary medicine is one of the only professions worldwide authorized to euthanise animals, and while this is in the majority of cases to relieve great suffering, it still has a great impact on the vet performing the euthanasia. There are thought to be three main ways in which performing euthanasia links to depression. The first way draws the distinction between euthanasia to relieve suffering, and euthanasia at the request of the owner (for reasons such as financial constraints or inability to deliver the necessary care to the animal), cases of the latter apply moral stress to the practicing vet which can lead to physiological stress. Secondly is the situation when both owner and vet agree that euthanasia is appropriate. In these cases, the time between the agreement to euthanasia and the appointment for euthanasia vary. In this time period where the owner comes

to terms with what will happen, the loss and grief, the vet can often experience distress and frustration. And finally, vets are often tasked with comforting the owner, before, during and even after the euthanasia. Vets take on the responsibility to help the owner process their grief, this is very difficult for a person in any case, whilst in this profession, it is a constant necessity and the skills required are rarely taught in vet schools. It is also suggested that performing euthanasia can favour attitudes towards euthanasia and the expendability of life [20].

Another big problem facing veterinarians is compassion fatigue (also known as vicarious trauma). Compassion fatigue is the result of the unique relationship caregivers have with their patients. Vets work daily with cases of animal neglect, deliver bad news to owners, and are constantly surrounded by death and illness. Constant exposure to this environment gradually dampens the ability to care and emphasize with others through overuse of compassion. Symptoms of compassion fatigue can be mild and include sadness/apathy, isolation, and a lack of self-care, but can be more severe and include chronic pain and substance abuse. The American Veterinary Medical Association advises vets experiencing compassion fatigue to engage with colleagues, take time to oneself and offers free webinars and resource lists to help vets dealing with these issues [21].

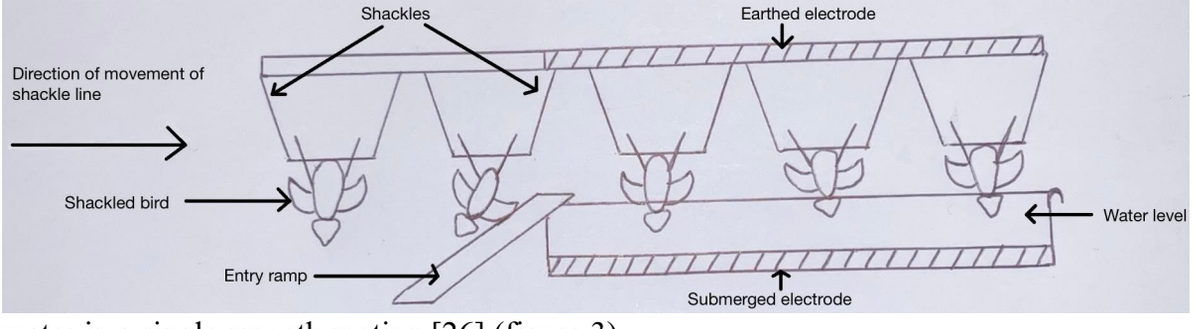
We also must not forget the potential mental health difficulties facing farmers. In cases of notifiable disease outbreaks, such as the 2001 foot and mouth disease (FMD) outbreak in England, farmers were faced with the complete loss of their cattle herds. At the peak of the outbreak, 18,000 animals were being slaughtered daily, often using unregulated methods and with little emphasis on the animals' welfare. To keep up with this large number of cattle needing to be culled, the UK government recruited lots of people from different backgrounds to help with the culling, disposal and record keeping. Many of these people reported feeling traumatized by the experience, and farmers faced not only the loss of their cattle, but the loss of economic stability and the loss of their livelihood [22]. This is also true when we consider recent outbreaks of avian influenza, where huge numbers of birds are authorized to be culled leaving farmers with empty poultry houses and pockets. There are many factors in the animal agriculture sector that have the potential to negatively impact farmers' mental health: fluctuating meat prices, ongoing consolidation, and variable public views towards some of their routine practices all have potential to negatively impact. There is also a certain stigma around mental health in farming, many farmers feel expected to handle any situation alone (even mental health problems), and many find it difficult to access fundamental health resources in their rural communities [23]. A study performed by the American Farm Bureau Federation

(AFBF) showed that in a sample of 2002 rural adults, 91% agreed that mental health was important to them and/or their families. When these individuals were asked what they thought the main obstacles were to them in accessing help and treatment for mental health conditions, 70% said costs, 65% said embarrassment and 63% said stigma was an obstacle for them [24]. The mental health of farmers is an important consideration in animal welfare, we cannot expect gold standard treatment of animals when those involved in their care are suffering.

3.4. Electrical Stunning: Water Bath & head only

Electrical stunning involves the application of an electric current as a means to induce unconsciousness in the bird. It has become much more common in recent years partly due to its efficiency and high capacity for stunning poultry.

Electrical stunning is based on the concept that applying a sufficient electric current to the brain induces generalized epilepsy which is incompatible with consciousness and cardiac ventricular fibrillation. In waterbath stunning the birds are first shackled, and then led towards an electrified water bath, the birds head enters the water and this exposure induces unconsciousness [25]. To ensure the bird's head comes into contact with the water and to minimize pre-stun shocks, angled entry ramps are installed and therefore ensure the bird enters



the water in a single smooth motion [26] (figure 3).

Figure 3: Use of angled entry ramps to reduce pre-stun electrical shocks in electric water bath stunning

Insensibility can be achieved by an electric current of 100-150 mA per bird in a bath supplied by either a 50, 400 or 1500 Hz sine alternating current [27]. The main cause of concern with regards to this method is not so much the stunning itself, but the pre-stunning handling and shackling of the birds. Incorrect handling of birds can lead to fractured bones, haemorrhage and undoubtedly a lot of pain. Therefore, having workers sufficiently trained in the correct handling techniques is an important first step towards improving welfare. Shackling is also a very unpleasant experience, since having pain receptors in their legs, long time spent on the shackling line can cause pain and distress. This is worsened since their inversion puts pressure

on their lungs and can lead to suffocation if left for too long. Although breast supporters have been introduced in a hope to alleviate this latter problem, it is still a problem, and the birds still experience pain from the metal shackles themself. Incorrect design at the entrance to the electrified water bath can also cause painful pre-stunning shocks to the birds and heterogeneity among flock sizes in a multiple bird water bath can affect the individual current each bird receives. So different birds receive different shocks which have different effects on their level of consciousness. It is for these exact reasoning that the European Food Safety Authority (EFSA) upon review of multiple bird water bath stunning systems stated "The complexity of multiple bird electrical waterbath stunning systems in poultry slaughterhouses, such as the one assessed here, are not conducive to maintaining good animal welfare" [28].

Head-only electrical stunning involves the birds being inverted into a cone and having their head placed between two electrodes that deliver a direct electrical current to the bird's head, the birds are then moved to a shackling line and taken for exsanguination (figure 4). The fact that birds are stunned with a known and controlled current reduces the chance of partially stunned birds being bled, another improvement of this method is that the birds are not shackled whilst conscious. Therefore, the pain of the shackling experiences is removed. The problem does however still remain that the birds are inverted into the cones to be stunned and therefore they still have increased pressure on their lungs.

Figure 4: large scale head only electric stunning of poultry [25].

3.5. Controlled Atmosphere Stunning (CAS)

CAS involves the birds being exposed to a CO_2 or a mixture of inert gasses to gradually induce unconsciousness as concentrations are raised and hypoxia develops. CO_2 is frequently used since it is relatively cheap and capable of inducing unconsciousness at high concentrations.

However, CO_2 when exposed to water, which can be found lining the birds' airways and conjunctiva, can react to form carbonic acid and cause distress, pain, and irritation to the birds before full unconsciousness has been reached [29]. Birds also have chemoreceptors sensitive to CO_2 in their lungs and can be seen to react by head shaking and gasping even at lower concentrations of this gas. It is important to note that chemoreceptors sensitive for the inert gasses used (argon and nitrogen), do not exist in birds, so these responses are not observed [30]. A major advantage to gas stunning is that there is no need for live shackling or inversion of any kind before stunning. There is no risk of pre-stun shock associated with waterbath stunning and no problems due to the variability of electric current exposure. It has also been observed that this method is associated with a lower occurrence of broken bones in the birds, this is advantageous for two reasons, firstly from a welfare perspective, the pain of fractures and breaks is reduced, and secondly from a meat quality perspective where carcass quality is increased [31]. Finally, a study comparing CAS and electrical stunning based on two blood stress indicators (blood glucose and corticosterone) showed that both these indicators were reduced in CAS [32].

3.6. Mechanical Stunning: captive bolts, cervical dislocation, and percussive blow to the head

Captive bolts can be either penetrating (pervissibe) or non-penetrating (concussive). They render the bird unconscious by inducing brain concussion and in case of penetrative bolts, causing structural damage to the brain itself [33]. It is a manually performed stunning method which means that workers are able to almost instantaneously assess whether the stunning has been effective or not, and in unsuccessful cases the birds can be identified before exsanguination. However, being a manual method means it is also susceptible to human error. The captive bolt devices must be checked routinely for appropriate charge and pressure, and in case of non-penetrative devices, the head of the device differs between species. For example, in chickens a flat head should be used, whereas in ducks, geese and turkeys, a convex head should be used. Therefore, the method relies greatly on well trained workers to enable it to be carried out correctly.

Cervical dislocation works by rupturing both the spinal cord and blood vessels supplying the brain. This stops breathing and causes hypoxia in the brain leading to unconsciousness. This can be done manually by trained slaughterhouse workers, however, similar in the case of captive bolts, in this case it is susceptible to human error. Also, variations in poultry sizes require extra knowledge in the process. Cervical dislocation of smaller poultry species can

result in decapitation which can be distressing for the workers, whereas in larger species (e.g. turkeys), extra musculature and body size makes the process more difficult in case of handling the bird appropriately and in providing the correct force required for a successful dislocation. It can also be achieved mechanically using devices such as the Koechner euthanizing device (KED) [34]. The KED divide resembles a pair of scissors and is used by first inverting the bird in a cone and then sealing the scissors around the neck of the bird; it works by crushing the spinal cord of the bird rendering the bird unconscious. However, as in the cases of electrical stunning, the inversion of the bird in the cone is not ideal from a welfare perspective. It is also important to note that this method is not very pleasant for the slaughterhouse operators.

Percussive blows to the back of the bird's head also induce unconsciousness. However, this has a couple welfare implications. Firstly, is once again the inversion of the bird, which as previously stated puts pressure on the birds' lungs (due to their anatomical absence of a diaphragm) and can cause discomfort, it is worth noting though that birds do not spend as much time inverted before stunning in this method as compared to the electrical stunning methods. Secondly, this method undoubtable can be most unsettling for the workers to perform. It is written in EU law that no worker can kill more than 70 birds a day with this method, since it can be physically and mentally exhausting and above this number, mistakes are more likely to be made.

4. Aims

Poultry production has changed greatly in the last century, with a great increase in the human population, the demand for food and therefore the demand on the poultry industry has increased. New techniques of farming have strived for efficiency in order to meet this demand, however, it is important that the animals' welfare is not compromised in our doing so. Stunning poultry species is very important from a welfare perspective, it induces unconsciousness in the animals before exsanguination, which if done consciously would be a very traumatic experience for the birds. For each technique of poultry stunning, there are ways they can go wrong, usually at the expense of the animal. Shackling birds before stunning puts great pressure on the animals' lungs when inverted since they have no diaphragm. There are time restraints between stunning and bleeding, if left for too long there is the possibility that the birds regain consciousness and may even be conscious for bleeding. There is also great room for human error in the slaughterhouse, error at the bird's expense. Cervical dislocation is the best example of this: EU law states that one person may only ever dislocate the necks of 70 birds a day, the

reason for this being that with time, there comes exhaustion, and mistakes are made which through incorrect dislocation cause great pain to the birds. This is also regulated due to the impact which cervical dislocation can have on the mental health of the operator. I want to evaluate all these methods of stunning (electrical, controlled atmosphere, mechanical), to see the areas in which they perform well, and the areas in which they don't. I want to explore the development of future stunning methods such as trans-cranial magnetic stimulation and the use of microwaves and see how these can improve upon our current methods to better the welfare of the increasing poultry population. Better methods also mean better mental health for workers as they are less likely to experience guilt and traumatic events if the conditions the birds are stunned improve. I will gather my own evidence via the distribution of a questionnaire that will be aimed at veterinarians, veterinary students, and other people with knowledge of the poultry industry. The questions will ask respondents about their opinion towards current EU laws and regulations, poultry sentience, shackling and different stunning methods. After considering the results of my questionnaire and through my own research, I would like to deduce which of these methods would perhaps be appropriate for use in my home island of Jersey.

5. Materials and method

To make my questionnaire I used Google Forms. I chose this online tool as opposed to other survey software's (e.g. SurveyMonkey) for its ease and efficiency in data collection. It also only requires you to sign in with a google account, and the link sharing made distribution of my questionnaire much easier. I made two copies of the questionnaire, one in English and one in Hungarian. In writing the introduction to the survey I was sure to include a couple things in order to make my results valid. I included my university email address to allow respondents to contact me in case they had problems completing my survey or for other reasons. I know that the right to withdraw is an important part in any questionnaire from an ethics standpoint, and since the whole survey was 100% anonymous, I stated that withdrawal and changes of answers after submission was not possible. I stated that my questionnaire was approved by the Lab Animal Science and Animal Protection Department of the University of Veterinary Medicine Budapest. The questionnaire was not meant to take any longer than 10 minutes, I planned this early on since I knew a lengthy questionnaire would not attract many respondents.

The questionnaire was aimed at veterinarians, veterinary students, poultry farmers, slaughterhouse workers and any other people with knowledge of the poultry industry. I also want to obtain my own first-hand experience of the poultry stunning process. Since Jersey does

not have any poultry slaughter and processing facilities, I had aimed to visit a Hungarian poultry slaughter and processing unit, however, I was sadly unable to visit due to Covid-19 restrictions at the time.

An important part to writing a good questionnaire is to avoid bias in the questions, this is especially important with topics relating to animal welfare as it can be quite an emotive conversation and I do not wish to let my own views affect how the questions are interpreted.

My questionnaire consisted of 17 questions that covered the basic information of the respondent, such as their occupation and current country of work/study. This was then followed by a couple questions about the legal recognition of poultry sentience and how people felt their country protected these animals' welfare. An interesting study conducted in 2015 asked undergraduate and veterinary students to use clicker training to teach chickens. The students were asked to complete pre-training and post-training surveys on their opinions of the bird's intelligence and individuality. The study showed that after spending time with the birds, more students agreed that the chickens were easy to teach, had individual personalities and were intelligent [35]. Therefore, I would like to see if the same is true for those working in constant close contact with the birds. If they also believe that they possess these same qualities?

Respondents were asked to select which of several different options they believed to be important areas of concern in the stated stunning method and were asked if they believed the process of shackling capable of causing pain and discomfort to the birds. I also asked if people believed slaughterhouse workers are vulnerable to an increased risk of mental health problems such as PTSD, depression, and PITS. It is easy to understand that when workers of any industry are experiencing problematic mental health it can negatively impact their work, and within the slaughterhouse, the animals are the ones who secondarily will suffer. It seems obvious that to keep animal welfare at a high standard, industries must protect their workers and in doing so, they will protect the poultry. I wanted to hear what people's opinions on this were, as there is unfortunately still an apparent stigma surrounding mental health, especially within farming, veterinary and related occupations (such as slaughterhouse work). One of the concluding questions asked people what they thought were key features of an ideal stunning technology and if they think it is important to develop better future methods to improve on our current stunning technologies?

The questionnaire was distributed with help from Compassion in World Farming, the University of Surrey, the Poultry Health Service and with the help of personal contacts at the Royal Veterinary College (RVC) and the University of Nottingham. It was also posted to the

online group VetWings on Facebook, a group of international vets and vet students whose aim is to offer free help and advice to students with clinical case work ups and diagnostics. The questionnaire was closed to respondents on the 15th of August 2022 after collecting a total of 81 responses. I had initially hoped to reach at least 100 responses, however, since the field I was sampling was relatively small this was the maximum number I was able to achieve.

Once closed, I used the data stored on Google Forms to create an excel sheet where I made pie charts that would feature in the results of my thesis. I calculated what percentage of people answered what in many of my questions, I did not find need for any more complex statistical methods in my data analysis as the results from my survey were mainly worded and therefore these statistical methods were not applicable.

6. Results:

In order to tell which was the primary demographic to whom my questionnaire had reached, respondents were asked to share their occupation. The majority of responses (47.5%) came from vet students and a further 22.5% from veterinarians. The remaining 30% of responses came from government officials, animal welfare scientists, ethologists, and other professions (Figure 5).

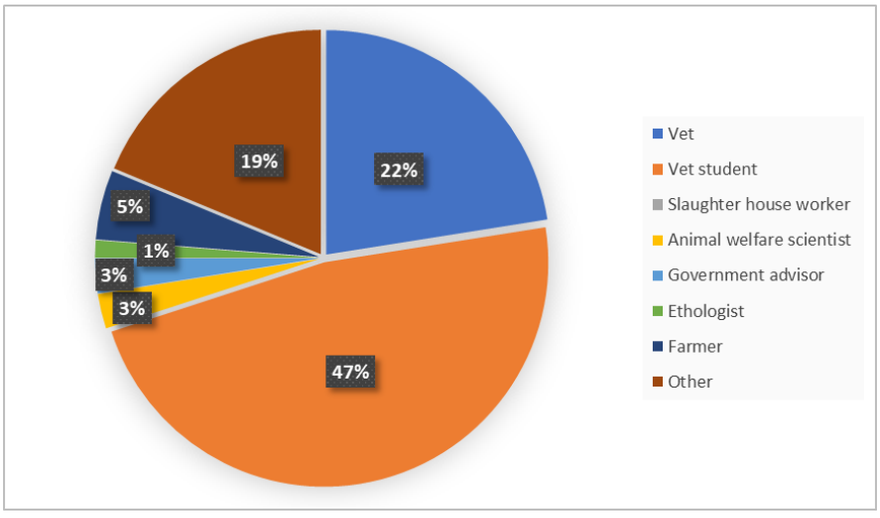


Figure 5: The current occupation of questionnaire respondents

I was interested to learn that 56.7% of respondents came from people working/studying in the UK, 29.6% from Hungary, and the remaining 13.7% from Poland, Norway, France, Denmark, Germany, and Slovakia (Figure 6).

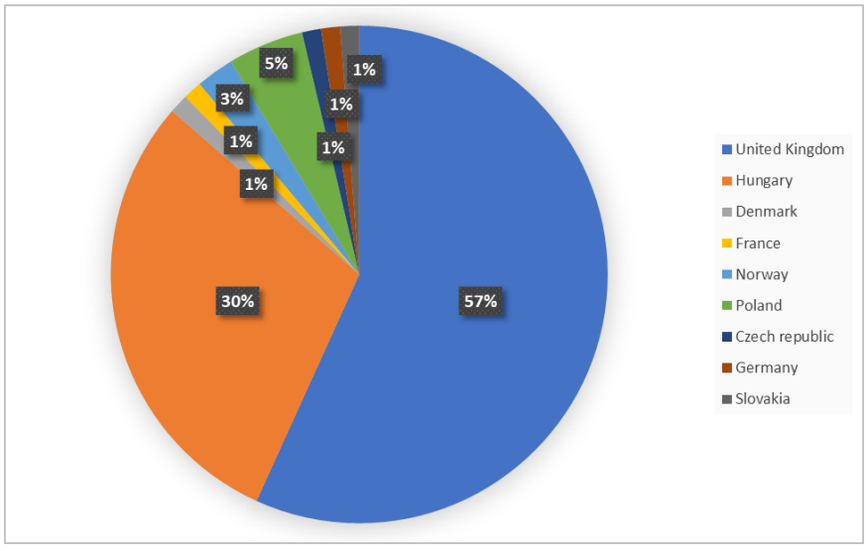


Figure 6: The current place of work/study of respondents

A huge aspect in any animal welfare argument is the recognition of animal sentience. Sentience being the ability to experience positive and negative experiences that matter to the animal on an individual level, is an especially important driving factor towards improved slaughterhouse design and procedure. Out of the 81 individuals who have to this point completed my questionnaire, 100% of them agreed that poultry are sentient animals who deserve better animal welfare standards.

I asked respondents if they believed that current UK/EU law is sufficient enough to protect the welfare of farmed poultry species. Secondly, I asked people if they thought this current legislation was sufficiently enforced by government officials in UK/EU slaughterhouses. 62.9% of people believed that the current laws were not sufficient enough to adequately protect welfare, 21.0% thought they were, and 16.1% didn't know (Figure 7). This does not come as a surprise with recent trends showing how many people are becoming increasingly concerned about the welfare standards of the products they buy. A consequence of this trend being that producers are forced to improve their current standards of operation to ensure the continued trust and loyalty of their customers. When asked about the enforcement of these current laws and regulations, 40.7% of people were of the opinion that these laws were not sufficiently enforced, 30.9% thought they were and a further 28.4% of people did not know (Figure 8). The UK authority responsible for monitoring and ensuring compliance with welfare regulations on behalf of the Department of Environment, Food and Rural Affairs (DEFRA), is the Food Standards Agency (FSA). This organization implements official veterinarian checks on the animals presented for slaughter, this may be on farm, during transport or at the slaughterhouse. Their vets also ensure that suffering is minimized by monitoring operational

staff/slaughterhouse workers in their unloading, handling, restraint, and effectiveness of stunning and bleeding efficiency. As of May 2018, the British government made it mandatory that all slaughterhouses must have functional closed-circuit television (CCTV) which can be made available to inspectors and that images must be kept for 90 days [36]. However, in 2018, a report into the effective slaughter of poultry in British slaughterhouses estimated that 180 million poultry birds were slaughtered with an ineffective stun. This figure shocked many vets and DEFRA officials, as it suggested that the supposedly high welfare standards in Britain were perhaps not so [37].

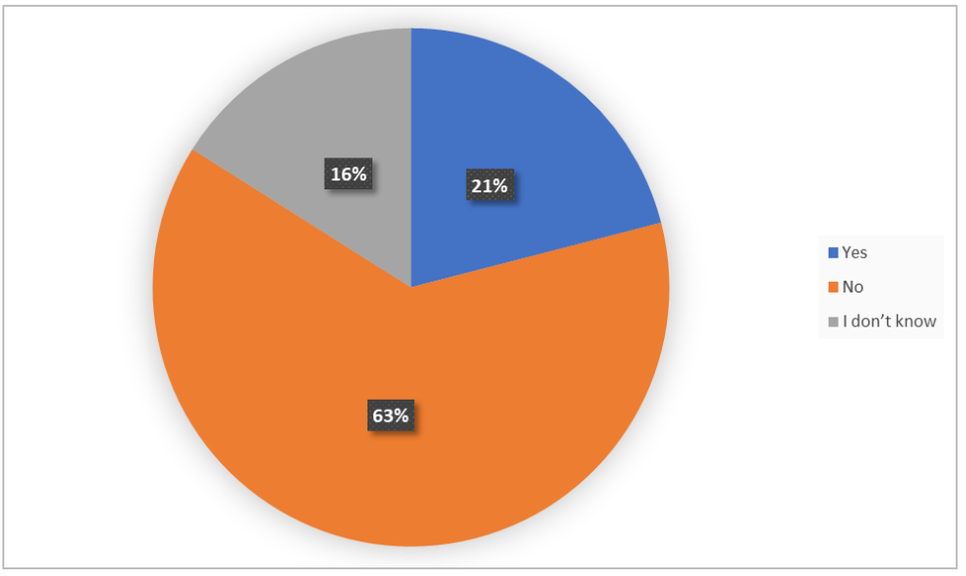


Figure 7: Do you believe that current EU/UK legislation is sufficient enough to protect the welfare of farmed poultry species?

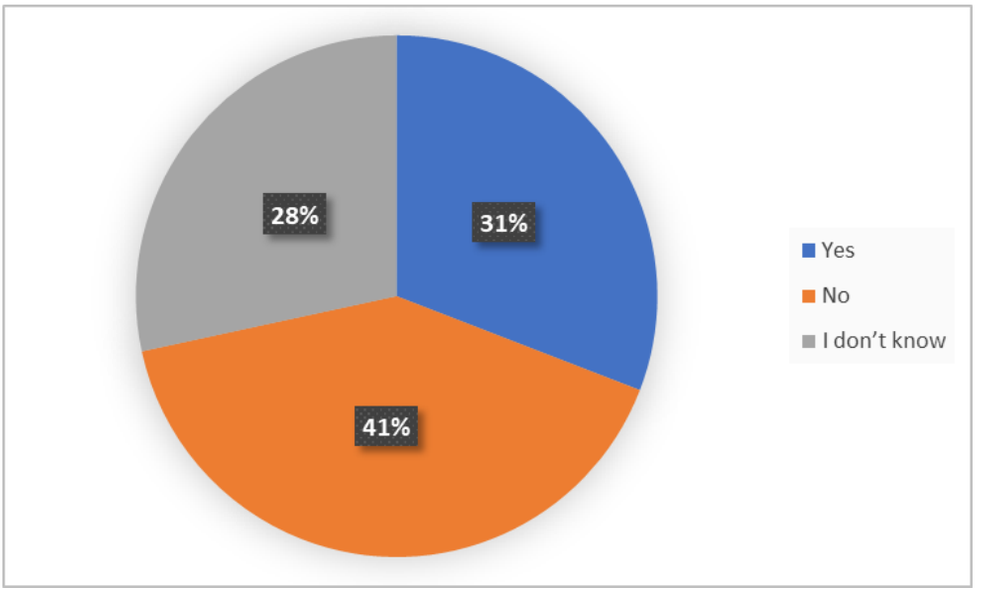


Figure 8: Do you believe that the current legislation is sufficiently enforced by government officials in EU/UK slaughterhouses?

I was interested in what people answering "No" to this previous question thought the government/ officials could do to ensure better adherence to guidelines. Many people said better and more CCTV as well as more regular inspections by independent organizations and harsher sanctions would help. Another person commented that reducing the time pressure on workers for slaughtering animals would be beneficial. Tremendously large numbers of animals enter the average slaughterhouse every day, and they all need slaughtering by the limited workforce within the limited working hours of the employees. This respondent made the interesting point that reducing this stress on workers would allow them to ensure the job is done correctly with minimal mistakes. This may be achieved by increasing the number of slaughterhouses and slaughterhouse workers, however for the latter to increase, conditions and protection for people working in this industry must be improved. Others suggested better training for slaughterhouse workers regarding animal welfare.

People were then asked if they believed that shackling poultry can cause harm or discomfort to the birds. The vast majority (96%) of people said yes, 3% said no, and a further 1% answered that they didn't know (Figure 9). When asked to elaborate, one respondent stated that from their research into Low Atmosphere Pressure Stunning (LAPS) that shackling causes a spike in the bird's adrenaline and cortisone levels, another stated that many of these poultry species already have leg problems/injuries related to their intensive growth and that shackling only worsens the pain through nociceptor activation. Two people commented on how inversion can create breathing difficulties in birds in the absence of an anatomical diaphragm. One respondent also wrote how the range in poultry size means that one size shackle which may fit one bird, may be extremely painful to another of a different species.

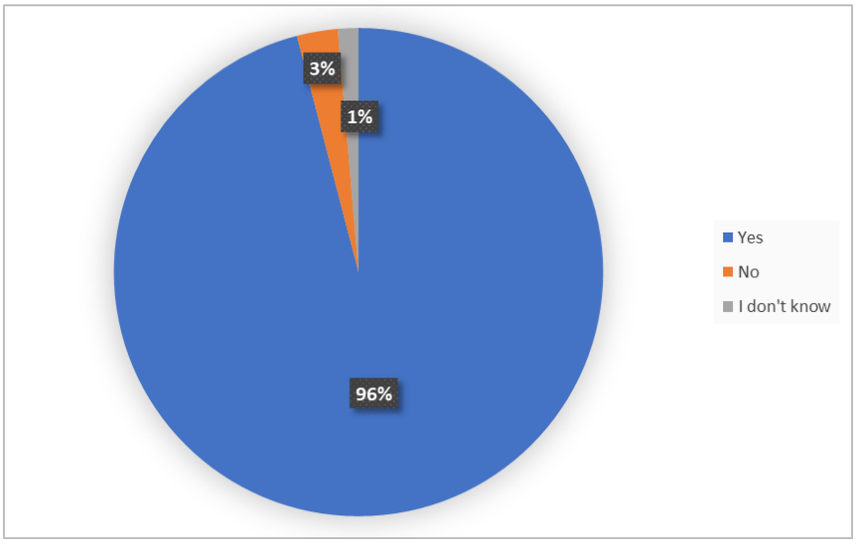


Figure 9: Do you believe that the shackling of poultry species can cause harm or discomfort to the birds?

People were then asked if they believed that poultry species could anticipate and differentiating positive and negative experiences. This is an important area of concern regarding poultry slaughter, a study from Zimmermen et al. [4] studied the emotional states of domestic fowl, it showed that the animals behaviours changed in anticipation of positive, neutral, and negative events. The welfare of animals at slaughter must undeniably consider these emotional states and capabilities of animals in order to be considered welfare. 82.5% of people responded “Yes”, 16.3% of people responded “No” and the remaining 1.2% of people answered “I don’t know” (Figure 10). Although I did not explore the respondents' reasoning for the answers they gave, it is clear from the results that the majority of people believe that poultry are capable of these emotional states.

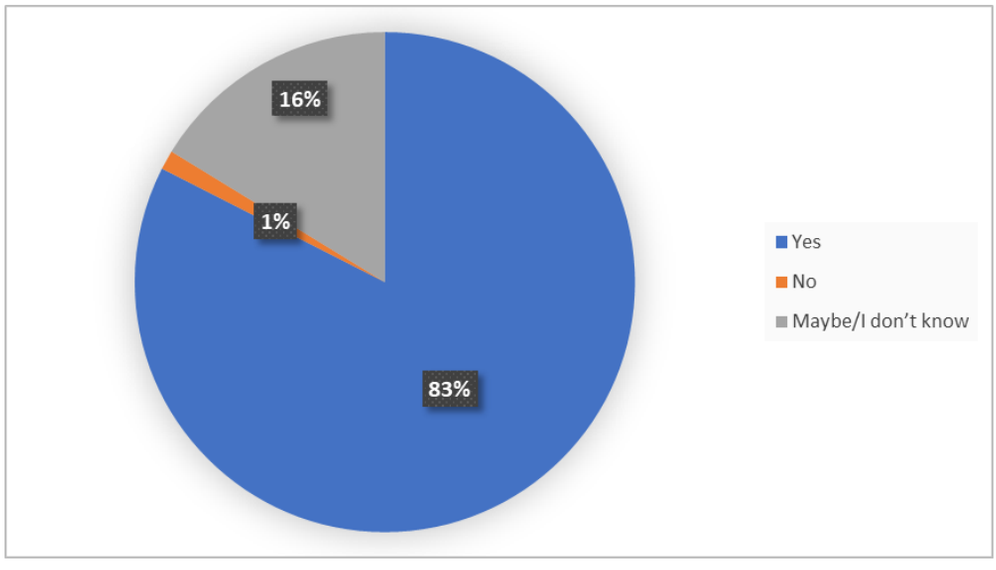


Figure 10: Do you believe that poultry species are capable of anticipating and differentiating positive and negative experiences?

I then asked people about the mental health problems faced by slaughterhouse workers. I know through my own research what a big problem this is in the industry, but I was interested about the awareness of others. The main three mental health conditions I researched were depression, PTSD and PITS. 73% of respondents agreed that slaughterhouse workers were at an increased risk of developing such mental health conditions, a further 20% of people didn't know and the

remaining 7% disagreed (Figure 11).

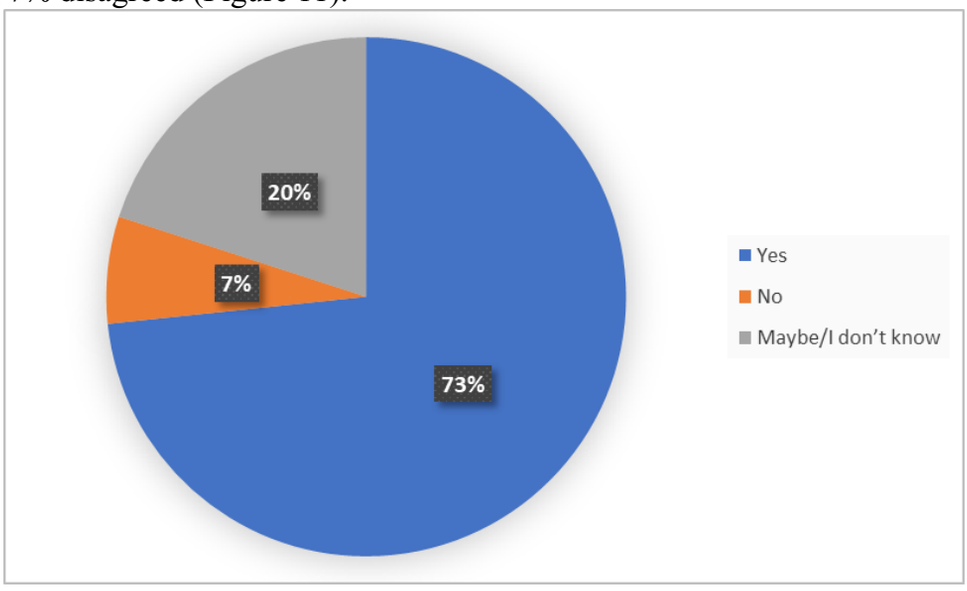


Figure 11: Do you believe that slaughterhouse workers are vulnerable to an increased risk of depression, post-traumatic stress disorder, perpetration-induced traumatic syndrome, and other mental health conditions?

In a more generalized sense, I then asked respondents what they believe would help improve poultry welfare inside the slaughterhouse. I listed 5 possible answers but also left the question open for people to give their opinion. 88.9% of people agreed that increased training of slaughterhouse workers would help improve welfare. 63% agreed that legal presence of a veterinarian would be beneficial, 66.7% agreed on increasing slaughterhouse inspections by independent organizations, 70.4% agreed that provision of mental health support and services to workers was important and 79% believed that decreasing the time between stunning and exsanguination was beneficial. Among the open answers people wrote, three individuals commented on the reduction of "aversive handling" and "live inversion" for shackling. One individual commented on better wages and treatment of workers.

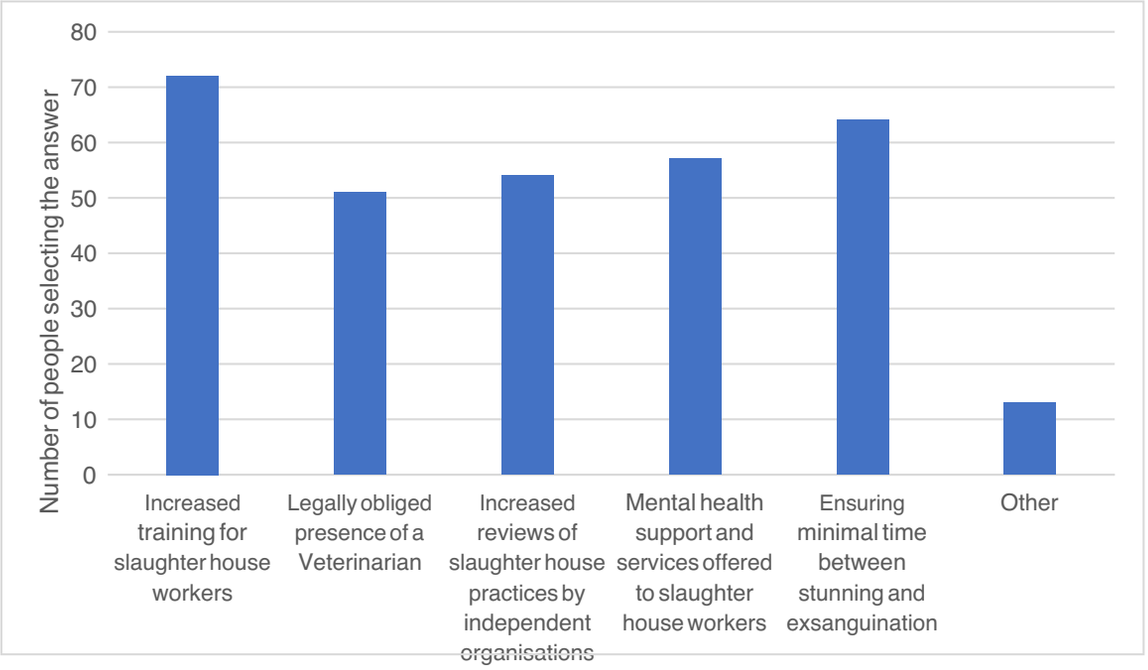


Figure 12: Ways to improve poultry welfare in the slaughterhouse

In the UK, minimum wage in the year 2022 is £9.50 for workers aged 23 and over [38]. A figure recorded in the same year stated that the annual salary of operative abattoir workers in the UK was approximately £24,707, or £12,67 per hour. This however is an average, the disadvantage being that its result is swayed by very high and low values, therefore we must view this average hourly salary with a degree of caution as it may not be representative of all workers, a better option would have been to record the median hour salary of workers, but I was unable to find this information. In the UK the average annual salary of all workers is £31,447, the median salary is £25,971 [39]. The mean annual salary of slaughterhouse workers is £6740 less than the average salary of all workers in the UK. In such a mentally and physically demanding job with so many unique obstacles, I believe that workers are underpaid for the work they do, and it is possible that raising the average salary could improve animal welfare as a direct knock-on effect of better worker conditions.

Since the respondents for my questionnaire came from various places across Europe. I then asked what stunning methods people had experience with. 56.8% of people had experience with electric stunning methods, 36.5% had experience with controlled atmosphere stunning and 63.5% had experience with mechanical stunning. A remaining 12.5% of people said they had no experience with any of these methods.

Then came my more specific questions regarding areas of concern for each method of stunning. This was important as to gauge the depth of understanding and awareness of those in the

industry. Firstly, I asked people what they thought were areas of concern regarding electrical waterbath stunning. Similarly as to what I had done earlier, I listed a couple examples for people to choose from but also left the question open to hear people's individual concerns. From my possible four answers, 62 people agreed that inefficient electrical current was a concern, 57 put untrained workers, 55 put shackling time and a further 49 said pre-stun shocks (Figure 12). Many people commented on inefficient stunning due to either smaller birds not contacting the water, birds head movement in avoidance of the water and incorrectly raised water levels preventing all birds from exposure to the current. One person also commented how shackler fatigue and the environment of the shackling area is a point of concern, this once again reiterated how important the protection of workers mental health is in protecting animal welfare.

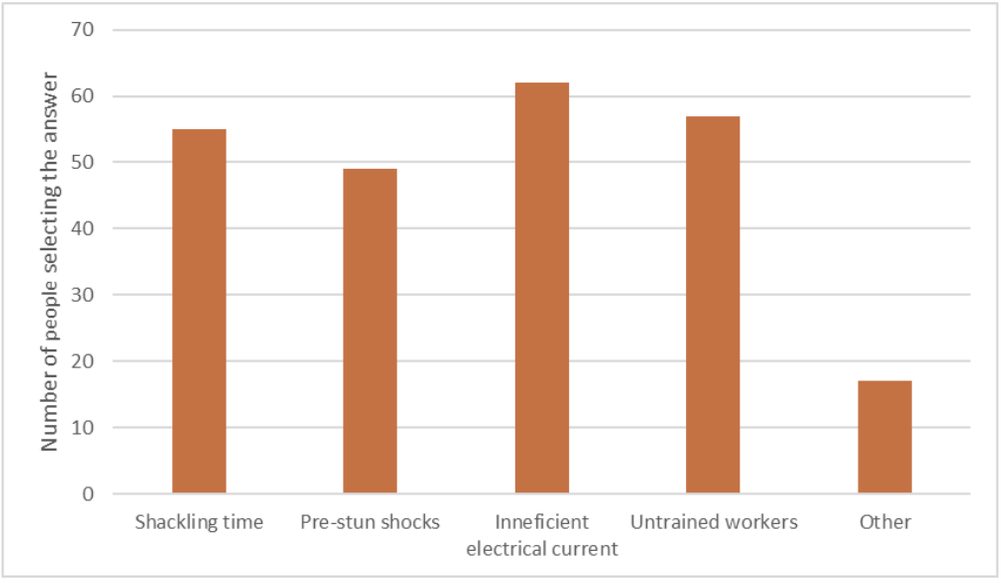


Figure 13: Areas of concern regarding electrical waterbath stunning

Secondly, I asked about areas of concern regarding mechanical stunning, in this case I specified answers related to cervical neck dislocation (CND). Again, I listed four possible areas of concern but left the question open for people's comments. Of my four listed answers, 59 people selected untrained slaughterhouse workers and another 59 selected pain/suffering of the bird (which is especially important in cases of incomplete dislocation). Another 48 respondents said lack of standardization and 43 people overworked slaughterhouse workers (Figure 13). Among the further answers many people commented how CND should only be a last resort in the case of alternative equipment failure. One person also commented how EU law prevents any one person from more than 70 dislocations a day, another reason which made CND a less

appropriate option for large scale use.

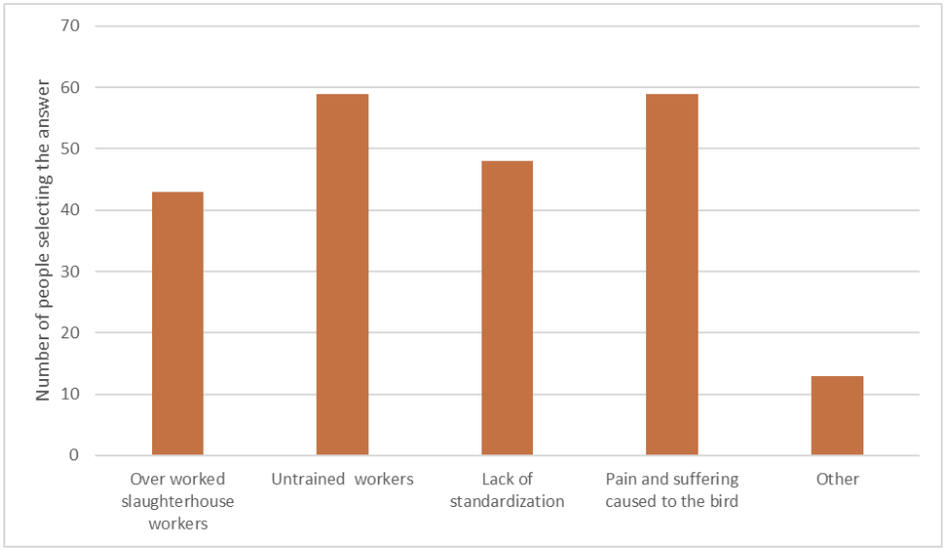


Figure 14: Areas of concern regarding CND

Thirdly I asked people for areas of concern regarding controlled atmosphere stunning, the question was of the same format as the previous two. Of the four answers I listed, 61 respondents selected the answer of pre-stun discomfort,44 people put the time from stunning to exsanguination as a concern, 43 people put how the methods ability to induce immediate unconsciousness was a concern, and a final 40 people put untrained slaughterhouse workers (Figure 14). Among other answers two people commented on how inappropriately trained workers may cause harm upon moving the birds between cages for stunning, others disagreed and said that this method requires minimal physical influence and for this reason it was beneficial. People also reiterated the problem of respiratory distress which is a major concern from a welfare perspective as it is an unnecessary suffering and should therefore be minimized.

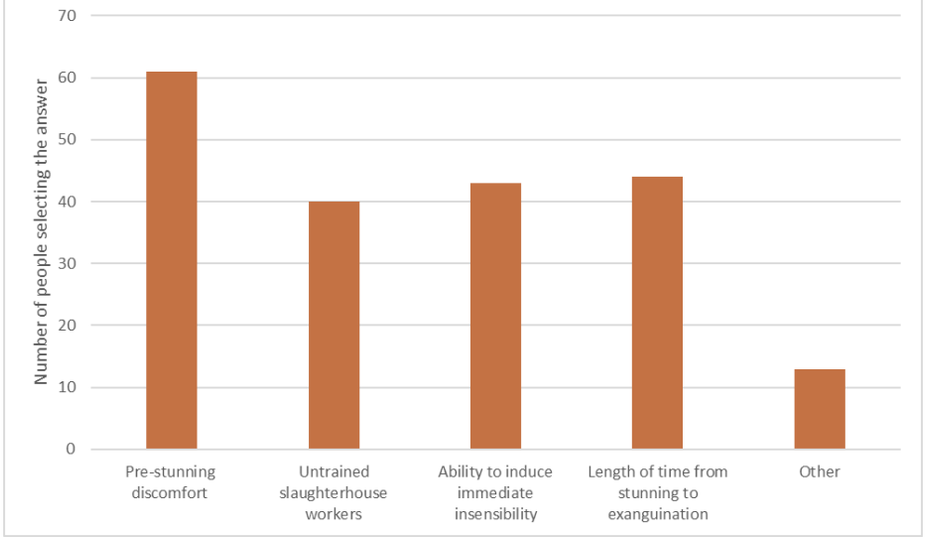


Figure 15: Areas of concern regarding CAS, specifically using CO_2

People were then asked if they would consider captive bolt devices suitable for poultry stunning. 30.4% of respondents said yes, that they agreed captive bolt devices to be suitable. 25.5% of people disagreed and a further 44.3% of people said they didn't know (Figure 15). My previous research suggested on one hand that captive bolt devices are good at inducing immediate unconsciousness. However, since this is a mechanical method of stunning its efficiency is largely dependent on the operator. In depth knowledge on which bolt to use for different poultry species, frequent maintenance and immediate assessment of unconsciousness are all aspects that fall on slaughterhouse workers. It is therefore a method greatly susceptible to human error and is a high workload for staff, these aspects make the method less desirable.

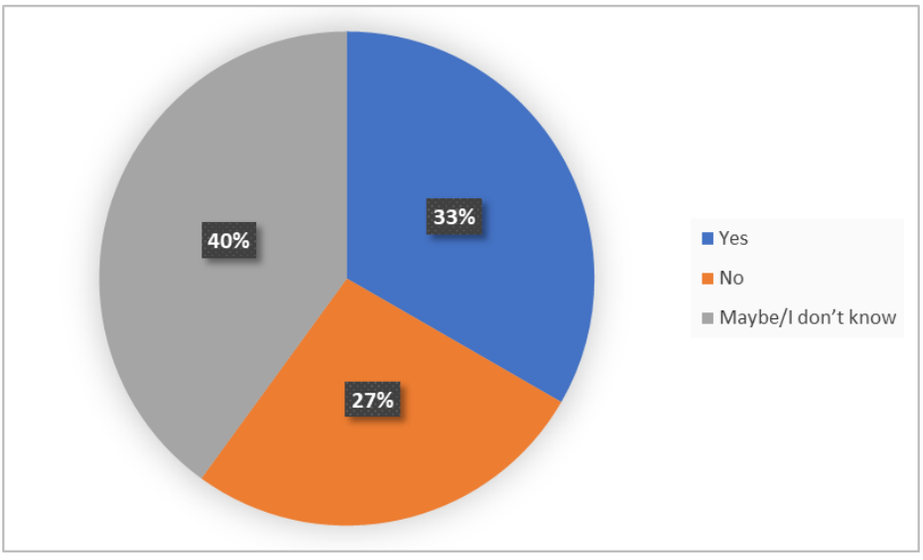


Figure 16: Do you consider captive bolt devices a suitable option when it comes to poultry stunning?

After this technique specific section of my questionnaire, I included an open question asking what people think are important features in an ideal stunning technology. The most frequent answers stressed the importance of a technology inducing the immediate loss of unconsciousness, minimal pre-stun stress (birds kept upright/not inverted), minimal shackling and technology being easy to operate and teach people (Figure 16). If I had been asked to answer this question these are the main four points I would have suggested as well. Although my questionnaire was aimed at people with knowledge/experience in the poultry sector, it is reassuring from a welfare perspective that these people are aware of the problems with current stunning techniques and know what we should aim for in future development.

Figure 17: A word cloud depicting answers of what people thought important in an ideal stunning technology

My final question asked whether respondents thought that research into improving stunning methods is important for the development of the poultry production industry. 96.3% of people answered “Yes” and 3.7% answered “No”.

7. Discussion

In my questionnaire 100% of respondents said they believe poultry species to be sentient beings who are deserving of better welfare standards. Despite the various reasons why respondents may agree with this statement, the results are consistent with the findings of Marino L. [3] in his review of the cognition, emotion, and behaviour of domestic chickens. His review stated how domestic chickens are capable of pain sensation via explanation of the bird's highly sensitive beak which he described as a “complex sensory organ with numerous nerve endings.” It also stated how debeaked chickens show an increase in pain-related behaviours like reduced preening and pecking after the procedure. Thanks to many similar reviews and studies, poultry species are now recognised in Council regulation (EC) No 1099/2009 of the protection of animals at the time of killing as “sentient beings” [5].

The majority of respondents (63%) stated that they don't believe current EU/UK legislation is sufficient to protect the welfare of farmed poultry species. With one recent investigation from

2018 suggesting that 180 million poultry were slaughtered without effective stunning in the previous year [37], and along with the recent publicity of so called “open-rescues” from animal rights organizations, it is not surprising that people don't believe current legislation is adequate. One animal rights activist organization known as Direct Action Anywhere (DXE) has recently made numerous headlines due to their manifesto of direct action which they show through live streamed open rescues. Some of these videos released show activists entering American poultry farms and revealing the cramped conditions and rather gruelling environment that these chickens are kept in. The publicity these videos have received has definitely opened many people’s eyes to the conditions some birds face in completely law-abiding farms, so it is not surprising that people are more aware and believe that chickens are not being protected sufficiently enough. This is consistent with the results of my survey in which 40.7% of respondents said that current legislation is not being sufficiently enforced by officials in EU/UK slaughterhouses. 30.9% said legislation is being sufficiently enforced and the remaining 28.4% stated that they did not know. But it is also not fair to say that this direct-action approach is doing only good things for the progression of animal welfare. Many poultry farmers have said that after the release of these videos many have been villainized by the public with some farmers even seeking police help after receiving death threats [40].

In my opinion, I do not believe current legislation is neither sufficient nor enforced enough to ensure poultry welfare. Governments need to update their laws and regulations to ensure birds do not unnecessarily suffer at any stage in the slaughterhouse. I believe that governments should aim to phase out pre-stun shackling and commit to increased research regarding the development of non-inversive stunning techniques. I also think that slaughterhouses should be more routinely monitored by independent organizations and that these organizations should be given governmental support to sanction slaughterhouses where necessary and work with them to improve their welfare standards.

In regard to shackling, many of the research papers I have read stress the negative impact that pre-stun shackling has in relation to animal welfare. For example, a review by Berg et al. [25] states that pre-stun shackling causes “distress and pain”, this among many reasons is due to the inversion of the birds and the subsequent breathing difficulties that follows. The results from my survey support these concerns since 96% of respondents agreed that shackling can cause harm or discomfort.

82.5% of respondents said they believe poultry species can anticipate and differentiate between positive and negative experiences. These results support the study from Zimmermen et al [4]

which concluded that birds anticipating a negative experience showed increased head movements, stepping and pacing. Whereas birds anticipating a positive experience showed an increase in comfort behaviours. The ability for birds to anticipate and differentiate between positive and negative experiences means we should ensure that poultry welfare is protected not just at stunning and exsanguination, but in the period before as well.

It is undeniable that mental health is currently a great area of concern, no matter what the industry. The veterinary profession and its unique tribulations have a suicide rate four times that of the general population [20], an unacceptable figure that is currently being tackled by many organisations such Vetlife in the UK that offers emotional support to everyone in the veterinary community. Another profession that is less talked about, perhaps because of its controversial and emotive nature, is that of slaughterhouse workers. 71.6% of people responding to my survey said they agreed that slaughterhouse workers were at an increased risk of mental health conditions including depression, PTSD and PITS. This is consistent with the results of a paper I read from Hutz et al [18] about the working conditions and mental illness in poultry slaughterhouses in southern Brazil. The paper showed that every production sector, be it cutting/exsanguination, evisceration, reception, packaging or freezing all face unique adverse conditions that the workers are routinely exposed to. The study concluded that slaughterhouse workers had high levels of depression, anxiety, disadjustment and vulnerability.

When asked what people thought could help improve the welfare inside poultry slaughterhouses, 88.9% of people said that increasing training for slaughterhouse workers was important, 79% said minimal time between stunning and exsanguination and 70.4% of people said that offering mental health support to slaughterhouse workers would be beneficial. This final option about offering mental health support to workers leads on from the comments made in my previous paragraph. It is also important that we recognise the important link between slaughterhouse worker welfare, and poultry welfare. When workers are provided with better working conditions and support, they are able to do their job in a better/more efficient way and this collaterally improves the welfare of the birds they handle.

Regardless of the stunning method, it is clear that they all have their own unique advantages and disadvantages. In the case of electrical waterbath stunning, inefficient electric currents, pre-stun shocks and shackling time are unique disadvantages to the method. However, under the supervision of well-trained workers who are familiar with the technique and equipment maintenance, it can induce immediate insensibility which is important from a welfare perspective. CND is only a good technique as long as it is being practiced by well trained

workers and is limited by EU law for any one person to a maximum of 70 dislocations per day [7]. However, its application is important as a backup measure for birds previously inefficiently stunned and it is perhaps most applicable for small scale poultry farms in areas without accessible poultry slaughterhouses. CAS with CO_2 is poor in its ability to induce immediate insensibility and its possible pre-stun discomfort/period of excitability. However, the method does not require any pre-stun inversion/shackling which reduces fear in these animals we know to be capable of anticipation of future events. All these points were suggested by respondents to my questionnaire and are compatible with issues raised in the review of stunning methods from Berg et al. [25]

Captive bolt devices and their use in poultry is another method discussed. In my survey, 30.4% of people said this method was suitable in its application to poultry, 25.3% of people disagreed and a remaining majority of 44.3% of people said they did not know. An experiment from Erasmus et al [41] used the time to insensibility and estimated time of death to evaluate a non-penetrating captive bolt as well as CND and blunt trauma for on farm killing of turkeys. The results stated that use of captive bolt and blunt trauma "consistently induced immediate insensibility leading to death" whilst all birds showed signs of sensibility after CND. It is important to note that this study was only based on turkeys who anatomically differ from other poultry species, captive bolt use requires trained workers to ensure the operators are aware of interspecies differences and their unique requirements in this method. There is reason to suggest that further research into captive bolt devices may be important in the improvement of poultry welfare.

In conclusion, I believe that there are three main areas of concern regarding current poultry slaughter techniques. Firstly, there is the social side of slaughterhouse workers, the high demand and emotional nature of the job they are underpaid to do has a significant effect on the quality of their work, and therefore on the welfare of the animals they handle. Research into future stunning technologies can only advance to such a level without the improvement of the work environment. Secondly, in my opinion live/conscious shackling is problematic. It is an undoubtedly stressful and painful practice. I must note that post-stun shackling has fewer welfare implications as the birds are/should be unconscious at this time. The only problem in post-stun shackling I am aware of is if the birds are not fully unconscious, they may still feel pain and distress. Future development should aim towards phasing out pre-stun shackling. Third, slaughterhouses should be subject to more frequent inspections to ensure the welfare of these birds is being protected. These inspections should be carried out by independent

organizations who are unrelated to the industry on any other than a welfare level. They should be able to enforce stricter sanctions in the case of failings and should also work with the slaughterhouses to help them improve upon their current practices. My last point concerns the individual stunning techniques. Electrical stunning (e.g. electric waterbath stunning) is problematic in its requirement for pre-stun shackling as well as the operator dependent success since it requires constant monitoring to ensure the water is kept at the appropriate current and to ensure that birds who manage to avoid the water are quickly and effectively re-stunned before exsanguination. Controlled atmosphere stunning is beneficial since it does not require pre-stun shackling, but on the other hand birds may still suffer in the excitatory period before unconsciousness. Finally mechanical stunning can be perceived as either beneficial or unbeneficial from the point of its highly manual nature. The manual nature means that if a bird is initially incorrectly/incompletely stunned, operators can re-stun the bird almost instantaneously and therefore less birds should reach exsanguination conscious (as long as the time from stun to exsanguination is appropriate). However, this manual nature also is much more physically demanding for operators and is highly dependent on operator skill and experience.

The development of stunning techniques has come a long way, but still has much room for improvement. Improvements that should be welcomed and endorsed by the poultry industry. The ideal technology should maintain efficiency in slaughterhouses at not great expense and should be coupled with increased training/support for workers. My research has shown the need for a multifactorial approach to stunning development, with great potential for improving welfare for poultry and for slaughterhouse workers. When considering the methods application to my home island of Jersey, I cannot say with 100% certainty which method I believe to be most applicable. I believe that the current CND technique used on island is perhaps the most appropriate and should continue in the short term until better facilities become available through research into the welfare improvement of other current methods. I do however think that some things can be done to improve the current mechanical stunning from a welfare perspective. Perhaps offering free education to island farmers to raise awareness about the welfare concerns involved and ensuring the farmers are well trained in the methods they perform would be beneficial. Inspection of stunning practices on island could also be introduced and managed by our on-island states vet who should be given authority by the Jersey government to issue sanctions in cases where poultry welfare isn't respected. These small adjustments could greatly improve the welfare of our island's poultry species and come with

little additional cost to the farmers themselves if appropriately backed by the government.

8. Summary

Each year, an estimated 50 billion chickens are slaughtered worldwide for human consumption, and with the global population only set to rise, this number undoubtedly shall too. Therefore, research and development in our current stunning methods must be improved to protect these sentient beings.

I constructed a questionnaire that focused on current EU/UK laws and regulations surrounding the protection of poultry species at the time of slaughter, as well individual methods of stunning, their pros and cons, shackling, sentience, and mental health in the slaughterhouse worker profession. The survey was aimed towards veterinarians, veterinary students, farmers, slaughterhouse workers and anyone with knowledge of the industry. It was distributed with help from the Poultry Health Service (UK), the University of Surrey as well as individual contacts I had at the RVC and the University of Nottingham. The questionnaire was closed on the 15th of August 2022 after gathering a total of 81 responses.

The results of my questionnaire showed that 100% of respondents believed poultry species to be sentient beings deserving of better welfare standards. When asked about the current protection of poultry welfare under EU/UK law, 63% of respondents said they believed current law was not sufficient, 21% said it was sufficient, and a further 16% said they didn't know. In a follow up question about how well current laws were enforced, 40.7% of people said they didn't believe these laws were enforced to a sufficient degree. Many people wrote that more frequent inspections of slaughterhouses conducted by independent organizations would help enforcement. A big part of many stunning techniques is pre-stun shackling which through my research is controversial from a welfare perspective because of its ability to induce pain in the birds. 96% of respondents to my survey agreed that pre-stun shackling can cause harm to the birds. When asked about the possible areas of concern regarding the three main categories of stunning (electrical, cervical dislocation and mechanical) most answers stressed how protection of slaughterhouse workers and their provision with appropriate training was in most cases a cause for concern, regardless of the technique being used. Mental health in the slaughterhouse operator profession is a great problem, 71.6% of respondents agreed with the statement that these workers are at an increased risk of depression, Post Traumatic Stress Disorder and Perpetrator Induced Traumatic Stress. Another common area of concern was the live shackling in electrical waterbath stunning as well as the chance of pre-stun electric shocks and inefficient

electric current. In Controlled Atmosphere Stunning, many stated that the period of excitability before the method indices insensibility was concerning as this is stressful and possibly painful for the birds.

To conclude, there are many areas where our current stunning technologies fail regarding poultry welfare. However, with dedicated research into these areas and a multifactorial approach to development that accounts for welfare as well as the increased demand in poultry consumption, the welfare of our poultry species can be improved without economic loss to the industry and farmers.

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Figures

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Appendix 5. **Declaration regarding TDK research paper-thesis equivalence**

DECLARATION

I hereby declare that the thesis entitled ……..…….....……..…....

A welfare review of different stunning methods in poultry slaughter

…….……...…...…....

is identical in terms of content and formal requirements to the TDK research paper submitted in ..……. (year).

Date: Budapest, …26…. day…..…August……month…2022….year

Cecily Marie Isabelle Boarder

Student name and signature

Thesis progress report for veterinary students

Name of student: Cecily Boarder

Neptun code of the student: UQ482N

Name and title of the supervisor: dr Gabriella Korsós

Department: Dep. of Lab.anim Sci and Animal Welfare

Thesis title: A Welfare review of different stunning methods in poultry slaughter

Consultation – 1st semester

	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2023	2	7	Literature review	
2.	2023	2	27	Consultation/Progress	
3.	2023	3	31	Progress	
4.	2023	5	4	Bibliography?	
5.	2023	6	22	Summer duties	

Grade achieved at the end of the first semester: 5 (excellent)

Consultation – 2nd semester

	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2023	09	07	Cons.	
2.	2023	05	22	Cons.	
3.	2023.	10.	03.	-11-	
4.	2023.	10.	17.	-11-	

5.					

Grade achieved at the end of the second semester: 5 (excellent)

The thesis meets the requirements of the Study and Examination Rules of the University and the Guide to Thesis Writing.

I accept the thesis and found suitable to defence,

.....
signature of the supervisor

Signature of the student: .....

Signature of the secretary of the department: .....

Date of handing the thesis in 17/10/23