



Livestock hauliers' attitudes, knowledge and current practices towards animal welfare, occupational wellbeing and transport risk factors: A Mexican survey[☆]

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The authors dedicate this article in the loving memory of DVM Jesús Wilfredo Miranda Zambrano, who passed away on November 05th 2017.

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ABSTRACT

Mexico is the 7th largest producer of beef in the world. The livestock transport is a vital component of today's world agrifood economy that directly impacts on the development of animal production, animal welfare, public policies, labor regulations, food safety, markets and consumers. In this study two aims were established; the first aim was to identify the attitudes and perceptions of commercial hauliers towards animal welfare and their influence on the accident risks. The second aim was to characterize the current practices of the commercial cattle transport in Mexico and to detect the risk factors for animal welfare and hauliers' wellbeing. The interviews were conducted individually at the hauliers' rest points, sanitary inspection points localized along the Federal Highway 57 or at the companies' offices of cattle transportation. We used univariate, bivariate and multivariate statistics based on a hierarchical cluster analysis. The results showed that cattle transport in Mexico is characterized for long travel distances because the cattle departed from farms in the southern states of Mexico to the feedlots located in central and northern regions of the country. The journeys of short and middle distances departed from the feedlots to the slaughterhouses. The hauliers' characteristics were: age from 29 to 48 years-old, elementary or secondary studies completed, 65% of hauliers mentioned six years of experience in cattle transport, they learned about cattle transportation by means of a family member who was already engaged in this activity. The cluster analysis identified four hauliers' groups: groups 1 and 3 were related to animal welfare and groups 2 and 4 less related to animal welfare. This study showed that empathy towards cattle was a key element in identifying hauliers at risk of road accidents during cattle transportation. Years of experience in cattle transport played an important role in emphasizing closer perceptions towards welfare. Considering current trends towards increased transport times and logistics stops, there is a need to develop systems of welfare assessment and decision-making that provide tools and protocols that can minimize the biological cost to animals and hauliers, which may have been underestimated in the past.

1. Introduction

Moving livestock safely between farms, auction markets, feedlots and abattoirs are essential links of modern animal production (Gilkeson et al., 2016). Additionally, the protection and improvement of

appropriate animal welfare during transport are priorities for the beef industry and for societies worldwide (Thomson et al., 2015). However, even under favourable conditions the stress of transportation can produce several negative consequences such as body weight and feed consumption losses, impairment of the immune system, morbidity and

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mortality caused by changes in the thermal micro-environment, weather conditions, animal mixing, handling, feed and water restrictions, vibrations, vehicle acceleration, associated fatigue, loading/unloading, injuries, extreme noises, environmental pollutants and human-animal interactions (Cernicchiaro et al., 2012; Miranda-de la Lama et al., 2014). Consequently, animal welfare during transport depends greatly on the attitudes and training of hauliers and the appropriate cattle facilities (Pulido et al., 2018). In this way, precise characterization of transport logistics and operational practices are required for developing animal welfare risk assessment guidelines for cattle transport (Marahrens et al., 2011).

Occupational performance is affected by several factors, including personality, job satisfaction, motivation, self-efficacy, achievement, physical and psychological fatigue, environment, and organization identification (Zhao et al., 2015). The professional hauliers are required to deliver live and healthy animals on time; they are under pressure to drive for long periods and irregular driving schedules. Therefore, hauliers are exposed to extended shifts, sleep restrictions, postural fatigue, exposure to noise-vibration, sedentary lifestyle, unhealthy diet, exposure to diesel exhaust fumes, handling for loading/unloading animals and other occupational stressors, which increase the risk of road accidents (Miranda-de la Lama et al., 2011). Hence, hauliers are of vital interest not only in the animal welfare perspective but also in the one-health perspective. The one-health concept has been extensively used to describe transdisciplinary actions that protect the health and welfare of animals, humans, and the environment, an approach that should be adopted by the veterinary science worldwide. Ironically, despite its potential scope, research about One-Health has focused frequently on surveillance and prevalence of zoonotic and vector-borne diseases. In the meat production, One-Health could help to promote key global objectives such as standards that guarantee the health and welfare of farm animals, preventing or reducing occupational hazards that may affect stock-persons (farmers, handlers, hauliers and abattoir operators), promotes sustainability in animal production and generate an integrative vision of the human-animal interactions.

A holistic approach must be adapted to meet present and future challenges by getting physicians, veterinarians, biologists, sociologists and many others to cooperate for the one-health approach closely linking human and veterinary medicine (Conraths et al., 2011). Much has been learned about stress during transport, but less attention has been paid to identify and correct risks factors from the point of view of interactions between hauliers and animals, partly because they vary widely both nationally and internationally (Herskin et al., 2017). Whereby, there is an increasing interest in understanding how the hauliers' attitudes towards animal welfare can affect the performance during the transport operations. It is therefore interesting to examine the operating procedures of Mexican hauliers to identify any detrimental effect that operations might have on animal welfare, to be able to recommend appropriate changes in handling protocols and to develop training programs that could minimize the biological cost of animals during transportation and thus minimize weight losses, morbidity, mortality and/or defects in carcass or meat quality. To promote and regulate policy targets for animal welfare during transport, it is important to gain knowledge on the current practices of hauliers in Mexico. Therefore, two aims were established; the first aim was to identify the attitudes and perceptions of commercial hauliers towards animal welfare and their influence on the risk of accidents. The second aim was to characterize the current practices of the commercial cattle transport in Mexico and to detect the risk factors for animal welfare and hauliers' wellbeing.

2. Material and methods

The study was carried out in the State of Queretaro (north-central Mexico) from February to July 2017 because it represents one of the largest feedlots regions in Mexico. The interviews were conducted

individually at the hauliers' rest points (restaurants and gas stations), at the sanitary inspection points of cattle localized along the Federal Highway 57 or at the companies' offices of cattle transportation. The Federal highway 57 crosses Queretaro State and links many major highways that connect four main roads across the Mexican Republic and it is an obligatory State to move cattle from the south to north and from east to west of the country. The study protocols were approved by the Institutional Animal Ethics Committee for the Care and Animal Use (CICUAE) of the National Autonomous University of Mexico (UNAM).

2.1. Study description

Snow-ball sampling was followed for the enrolment of participants because it has been documented as a helpful technique to target samples that may be hard-to-reach (Faugier and Sargeant, 1997), briefly the procedure sampling was as follows; the hauliers that accepted initially being surveyed linked us with other colleagues that were willing to collaborate in the study by means of "WhatsApp" and "social networks". The sample size was determined based on the project time and the willingness of hauliers to provide information. The surveyed hauliers drove "pot-belly" trailers only because this type of trucks mobilize 70% of the commercial cattle in the country. In Mexico, there are at least 1100 pot-belly trailers (AMIS, 2013). The pot-belly trailers are part of the agrifood chain because of the insertion of Mexico (especially in cattle) in the North American Free Trade Agreement (NAFTA) in the past 30 years with the U.S.A. and Canada, in part because of larger loading capacities give as a result low transportation cost per animal.

A face-to-face survey was carried out with 74 male professional hauliers between 18 and 62 years-old (mean = 40, SD = 10.7) from 38 cattle transport companies. There were no women working as hauliers in this activity. Demographic features of participants are presented in Table 1. The interview lasted between 30 to 40 min. To minimize the bias, we ensure that the participants had not known the main objectives of the study (Daros et al., 2017). The interested hauliers in the study were informed that: "participation is voluntary, the information collected is confidential" and if they finally do not participate or if the participants decide to leave the study "their future employment conditions won't be affected". No financial remuneration was offered to the participants. The participants had the heavy lorry driver's license.

2.2. Questionnaire and measurement scales

The questionnaire for this survey was designed to ensure that the

Table 1

Demographic characteristics of Mexican hauliers that participated in the survey, expressed as a percentage (n = 74).

Haulier	n	%
<i>Age (years-old)</i>		
18–28	10	13.5
29–38	28	37.8
39–48	24	32.5
> 49	12	16.2
<i>Haulier education level</i>		
Elementary school	15	20.3
Junior High-school	38	51.3
High school	21	28.4
<i>Experience as driver of livestock trucks (years)</i>		
1–3	8	10.8
4–6	16	21.6
7–10	14	19
> 10	36	48.6
<i>Who taught you, how to be a cattle haulier?</i>		
A family member	36	49
A colleague at work	23	31
Other	15	20

interview process did not overwhelm the hauliers and questions were written down to ensure consistent interpretation among participants (Cherry and Adelakun, 2012). A pilot study was carried out in January 2017 using a draft questionnaire and it was applied to 7 hauliers (these participants were excluded from subsequent questionnaires), then the results were used for the development of the final questionnaire that contained 51 questions divided into four sections. The first section (S1) "Demographic profile" focused on determining the profile of hauliers' population; the second section (S2) was related to "accidents and occupational risk"; the third section (S3) covered "livestock transport logistics" and finally the fourth section (S4) "animal welfare attitudes", related with hauliers' attitudes and perceptions towards livestock welfare. The sections S2 and S3 consisted of questions about operational and logistic practices during transport; the operational part considered time to unload animals, vehicle load capacity, number of kilometres of the journey, transportation time during a journey, occupational hazards, number of inspections carried out during the transport of cattle in a journey, loading time of cattle, transportation cost per head, body weight loss of cattle during the journey, percentages of dead and injured cattle. The logistic chain of cattle transport considered the following questions; origin of the journey, methods used by hauliers for minimising sleepiness, cattle classification during pre-loading, cattle handling during loading and unloading, aggressive handling. The fourth section considered perceptions and attitudes towards animal welfare; the responses were based on a 5-point Likert scale (Miranda-de la Lama et al., 2017). Questions in this section included perceptions of hauliers towards animal welfare and whether new animal welfare laws are required to prevent animal abuses during transport operations. The information was obtained by the initial statement 'Do you think that ...' and measured with an ordinal scale of five points (1 = surely not, 2 = probably not, 3 = it does not matter to me, 4 = probably yes, and 5 = definitely yes). In the same section, the participants were asked about their perception of three aspects of animal welfare based on a literature review (pain, suffering, feelings and fear).

2.3. Specifications of statistical analyses

Descriptive statistic, univariate, bivariate and multivariate statistic were used for data analysis. A hierarchical cluster analysis (using Ward's method and the Squared Euclidian distance) was used to identify hauliers' profiles (types or groups), variables associated to attitudes and emotions towards animal welfare were used for this analysis. The groups were defined based on the observation of the dendrogram. A cluster name was assigned to each group of hauliers and a dummy variable called "cluster membership" was created to identify the haulier's group. Chi-squared and Kruskal–Wallis tests were used to test significant differences ($P < 0.05$) between groups of hauliers on a set of socioeconomic and production variables (both qualitative and quantitative) that were not used in the cluster analysis. Thus, the final clusters were profiled by cross-tabulating the variable "cluster membership" with the variables mentioned earlier. All statistical analyses were performed with the IBM®-SPSS® 22 version.

3. Results and discussion

Although it is generally accepted that hauliers have an influence on the suffering of animals during transport, there is no significant research that investigates the relationships between animal welfare, occupational wellbeing and operational risk factors. Therefore, our study is a pioneer in clarifying these relationships using a national case to understand a phenomenon with broad international implications. It is conceivable that cattle welfare during transport may be interpreted differently from country to country due to culture and tradition. With this in mind, future research should focus on international cooperation and training of all parts of the cattle logistic chain in order to secure more uniform interpretation of cattle welfare during transport (Dahl-

Pedersen et al., 2018) across international borders between Mexico, United States of America and Canada.

3.1. Hauliers perceptions towards cattle welfare and their influence on the risk of accidents

Recently some studies used the multivariate perspective to understand the role of attitudes and personality on the behaviour of hauliers towards animal welfare (Pulido et al., 2018). Whereby, there is an increasing interest in understanding haulier's attitude with respect to management of the transported cattle (Herskin et al., 2017). The cluster analysis suggested the existence of four clusters or hauliers' profiles (G1, G2, G3, G4; Table 3). The four factors corresponding to attitudes towards animal welfare showed differences ($P < 0.05$) among groups. The four profiles were determined by three questions about the recognition of emotions in animals and the need to express their natural behaviour in addition to three other questions about information, legal regulations and the impact of stress on the meat quality. The level of education and age did not influence the hauliers' profiles. However, there was an association between hauliers' perceptions with years of driving experience and the risk of accidents on the road. The G1 and G3 groups showed a high positive empathy and recognition of the emotions experienced by the cattle, on the other hand, low values of acceptance were observed in G2 and G4. In all profiles it was recognized that animals experience pain sometimes during transport. Although years of experience in the profession, education and age did not affect this perception, it is likely that everyday experiences during transportation will confront drivers with situations of animal suffering. Although there are no studies in the scientific literature about the perception and opinions of hauliers about animal pain, studies on farmers of dairy cattle in Norway (Kielland et al., 2010) and pigs in the United Kingdom (Ison and Rutherford, 2014) coincide generally with our results.

The recognition of animals as perceptive beings that can suffer unless handled properly resulted in farm animal welfare regulations of both a public and private nature worldwide (Hansson and Lagerkvist, 2016). There is now a substantive body of evidence to support the central and crucial role of such emotional experiences and processes (both positive and negative) in human decision-making (O'Kane et al., 2017). Kielland et al. (2010), reported that farmers who perceive that animals feel pain as humans do have greater empathy towards cattle and better welfare outcomes on their farms. Our study showed that in Latin America (Vargas-Bello-Pérez et al., 2017), and specifically in Mexico, there are evidence of some favorable perceptions of animal welfare not only in citizens and consumers (Miranda-de la Lama et al., 2017) but also in sectors that work directly in animal production systems such as hauliers. The degree of empathy towards animal welfare is a key element to develop intervention strategies for the prevention of risks for animal welfare and occupational welfare of hauliers. Interventions should also include multiple components that target several risk factors (and not only one factor) to better understand which risk factors should be modified for a better welfare outcome in addition to the cost savings. For example, a change in behavior related to one risk factor can improve the outcomes of another (Crizzle et al., 2017). Training in animal welfare and ethological handling, for instance, can lead to empathy towards animals and better handling practices, thus reducing risks of road accidents. The addition of cost-effectiveness and benefit analysis will determine whether the interventions on animal welfare could lead to cost savings for the employer and to improve carcass and meat quality (Schwartzkopf-Genswein et al., 2008).

3.1.1. Hauliers groups 1 and 3: empathy towards animal welfare

Animal welfare involves societal and human values, ethical concerns and moral considerations since it incorporates the belief of what is right or what is wrong in animal management and care (Cembalo et al., 2016). In this context, G1 and G3 were characterized by showing a high empathy towards animals and recognized that cattle should have

the opportunity to display their natural behaviors, like feeling pain and experiencing positive and negative emotions. They were highly aware of the effect of stress on the quality of meat during transport and pre-slaughter operations. Although both groups were empathic towards cattle, the differences between the two groups were notable about the information and the need for new animal welfare laws that regulate transportation. There was a concern in G3 about the lack of information and the need for new laws, this profile was self-critical and reflective more than G1, which was closer to conformism and a neutral attitude to legal change. In Mexico, the information about this issue is scarce, although the social pressure is forcing some companies to incorporate these policies. It is likely that G1 is worried about animal welfare but not to the extent of making important changes that could affect them, although they may feel socially under pressure and may have a "politically correct" position. Recently, Mexican consumers are concerned and there is a tendency to demand products that guarantee humane treatment of farm animals (Miranda-de la Lama et al., 2018a), part of this concern has been encouraged by national and especially international animal protection groups that operate in the country (Vargas-Bello-Pérez et al., 2017). Previous research has found that animal protection groups are more credible sources of information than livestock industry groups and this positive perception tends to increase following animal abuse scandals (Robbins et al., 2016).

The G3 group is undoubtedly an interesting profile, they were empathic towards cattle, but at the same time, they were the most realistic of the animal welfare situation in Mexico, even compared to G1. It is probable that the experience of more than six years in the profession was a determining factor for this result. One explanation could be that experience will cause a change in perception which will enable a new level of thinking that is based on each situation along with more holistic knowledge compared to the beginner's abstract knowledge (Pfrunder et al., 2017). Finally, G1 and G3 showed the lowest accidents on the road; however, G3 perceived road accidents as the most serious risk in their activity.

3.1.2. Hauliers groups 2 and 4: skepticism towards animal welfare

Attitudes are reflected in human's behaviour towards cattle, which in turn, affects animal behavior, welfare and productivity (Kauppinen et al., 2012). We observed that G2 was a transition between G1 and G3, recognizing pain and emotional states in cattle, but they were neutral in relation to the need of animals to express natural behaviors of the species. In the case of G4, they neither recognized that animals could feel emotions nor the need to express natural behaviors. The lack of empathy of the hauliers is a risky situation because it can trigger bad management practices, indolence and even abuse towards animals (Grandin, 1988). The main priority for animal welfare at a livestock transport company is to avoid either animal abuse or obvious pain and suffering (Grandin, 2014). Additionally, animal welfare during transport operations is a point of concern to consumers and animal abuse results in public outrage (Small and Hewitt, 2017).

Both groups coincided with the insufficient information about animal welfare in Mexico and the absence of new laws regulating cattle transport. However, hauliers in G4 were aware that stress during transport could affect the quality of the carcass and meat (mainly hauliers with more than 6 years of experience), while hauliers in G2 denied this could be true (mainly hauliers with less than 6 years of experience). Hauliers in both groups suffered more accidents on the road than G1 and G3, especially rollover in G4 (the most frequent cause of accidents). The rollovers were accidents related to the variables of empathy towards the animals and the driving experience. Scientific literature indicates that fatigue has a detrimental effect on driving even when the driver does not fall asleep, cognitive and psychomotor function decreases as manifested by distraction, poor concentration, slow reactions and performance errors (Hadas et al., 2017). Several studies have shown that personality traits are associated with risky driving behaviors and traffic accidents (Tao et al., 2017). To overcome these

constraints, hauliers must be actively involved to raise awareness. A contribution of the present work to the literature is that our findings clarified and emphasized the role of driving experience and perceptions towards animal welfare in risky driving behaviors and accidents.

3.2. Cattle transport characterization in Mexico: operations and risk factors

Beef production in Mexico is characterized by calves that typically start their lives on breeding farms in the tropical regions of Mexico and Central American countries; in these areas the calves remain with the mother for seven months or even more in some cases and after being weaned they are transported to feedlots located in the semiarid regions of Mexico. In Mexico, there is free movement of animals from one state to another and this has stimulated an increase in long journeys between farms or from farms to slaughterhouses (Miranda-de la Lama et al., 2012, 2018b).

3.2.1. Operational issues and logistic practices

According to the information collected in the surveys, hauliers make different routes according to the supply and demand for livestock throughout the year. A total of 40 cattle mobilization routes were identified (Fig. 2). Seven of these routes corresponded to short-distance journeys (less than eight hours) according to the European Parliament's declaration that supports a limit of eight hours for cattle transport (Miranda-de la Lama et al., 2014) and 33 remaining routes corresponded to long-distance journeys from southern region of Mexico because lower production costs and a high cattle inventory (SIAP, 2015) were found in the southeast of Mexico (70.8%). The region of central Mexico was mentioned as a center of re-distribution of cattle brought from the south that represented 16.9% of total journeys, while the northern region showed 12.4% of the journeys. The State of Chiapas concentrated 29.4% of total journeys from the southern region, followed by Tabasco state (23.8%) and Veracruz state (11.3%), other Mexican states were mentioned as less frequent. Differences in salary were observed depending on the haulier's experience, independently of the journey time (71.63 ± 27.18 h) to collect cattle in southern Mexico. The average salary was \$191 US dollars for hauliers with 4–6 years of experience and \$313 US dollars for hauliers with more than 10 years of experience for the same journey.

Transportation and loading operations for several hours is a physically demanding factor; animals must maintain balance and the contact between animals produces fatigue and bruises that affect animal homeostasis (Losada-Espinosa et al., 2018). The journeys' time was measured in two ways; the first approach considered total hours that took a haulier to do a round-journey, the time included spent hours at the animal health inspection and verification points, toilet, meals and mechanical failures. The second approach considered spent hours once the cattle were shipped and delivered to the fattening centres at the destination point. Both approaches showed that hauliers spent more than eight hours driving when cattle were shipped in the southern region of Mexico, journey time for the northern and central regions were less than eight hours. About the collection points, 51.4% of the hauliers collected cattle at specific farms while 48.6% shipped cattle in a collection centre. More than 22% of the surveyed hauliers have ever transported animals for Halal or Kosher certifications. Hauliers mentioned a delay in the shipment of cattle that extended journey time (53.5%), the main cause of delay was the lack of cattle to complete the maximum capacity of the trailer to minimise transportation cost per head, however hauliers mentioned to solve this problem on the same day or up to three days later.

The participants mentioned that they did cattle selection and accommodation prior to the shipment (90.5%), which according to them facilitated cattle management during the journey. Cattle accommodation was based on the size of the animal (86.6%), always locating the smaller cattle on the second floor and the biggest on the first floor for balancing the load. The hauliers who did this type of selection also

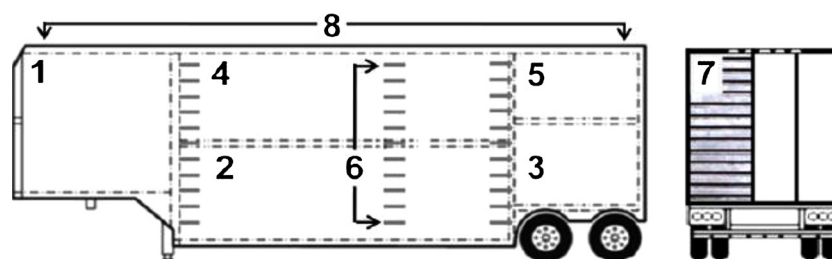


Fig. 1. Design of the trailer used to transport livestock in Mexico (draw modified from Schwartzkopf-Genswein and Grandin, 2014). (1) Tip or nose; (2) belly; (3) backend; (4) deck; (5) doghouse or kitchen; (6) stairs; (7) back door; (8) roof.

mentioned the risk involved for cattle and for themselves when the mixture of cattle from different places and sizes was performed. The time required for cattle accommodation during loading was longer than unloading (Fig. 3). Significant differences were observed in the loading and unloading times according to hauliers' age. Younger hauliers showed shorter loading ($P = 0.019$) and unloading ($P = 0.005$) times; the time increased according to haulier's age increased. The latter could be explained by older people, who took greater care during this activity due to their experience with cattle management or it may be related to a deterioration in their ability to conduct this activity.

To move cattle during loading and unloading and during the journey, hauliers used electric prods as a first option (56.8%), shouting (20.3%) and others (10.8%). The use of the electric prods was justified as a necessary tool to avoid the death of cattle that fell down during the journey. However, electric prods are very stressful for cattle. According to Grandin and Shivley (2015), the use of electric prods is the main problem observed by private industry and some governments when auditing animal welfare at transport operations and slaughter plants. 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 suffering, carcass bruising and high meat pH (Miranda-de la Lama et al., 2011; Probst et al., 2014; Romero et al., 2017).

Hauliers mentioned to carry out long travel distances without assistants (58.9%) and 41.1% mentioned an assistant for general activities. It was found that participation of an assistant in journeys from the southern region represented an advantage within the logistic chain because a significant decrease of more than four hours was found ($P = 0.026$). Those hauliers who did cattle selection and accommodation prior to the shipment ($P = 0.008$) as well as loading and unloading activities showed greater concern for cattle and they mentioned the need to create new laws about animal welfare ($P = 0.028$) than those who were not involved in the handling of cattle. Cattle transported throughout the country were a mixture of commercial hybrids (F1; *Bos indicus* x *Bos taurus*) that represented 81.1%, *Bos indicus* (14.9%) and *Bos taurus* (4.0%). Hauliers transported males (63.5%) and both males and females (36.5%). The size of the livestock that was shipped at the collection points was variable, however, 58.1% of the hauliers were dedicated to collect cattle of 350 kg BW or less with an average of 80 ± 16 heads per trailer; 40.5% collected cattle between 351 and 450 kg BW with an average of 68 ± 6 heads per trailer and only 1.4% transported cattle with more than 450 kg BW with an average of 48 ± 4 heads per trailer. Despite the number of heads per trailer mentioned above; 86.5% of the hauliers mentioned no mortality during the journey, 12.2% mentioned that one animal died due to long journeys and 1.4% mentioned to have a mortality of two animals per trailer. The participants mentioned (51.4%), that cattle did not show visible lesions caused during the journey while 48.6% observed up to five animals with injuries caused during the transportation. A probable explanation for these results is the poor ability of drivers to recognise pain and injuries in animals. Well-trained personnel and hauliers can favor a good human-animal interaction and can promptly recognise early signs of lesions and diseases (Bertocchi et al., 2018).

3.2.2. Risk factors for the occupational wellbeing and animal welfare

Driving is a risky occupation; it shows high rates of injuries and illnesses from all occupations in the world (Versteeg et al., 2018). In our study, the transport of "live cargo" (as hauliers referred to cattle transportation) involves other types of risks during mobilization and handling of livestock; 28.4% of the hauliers said they had suffered accidents during handling of livestock. The most common were falls (71.4%), followed by knocks (23.8%) and body injuries like body twists and muscle contractures (4.8%). These accidents occurred more frequently due to cattle handling (61.5%), while the second cause perceived by hauliers was a poor design of transport (23.1%), 7.7% mentioned a poor maintenance of the trailers and the remaining 7.7% mentioned the rainfall as a cause. To evaluate the perception of hauliers about the design of this type of trailer, an image of a commercial trailer was inserted in the survey (Fig. 1). Hauliers mentioned that compartment four known as "deck" was the most unsafe, because 47.6% of the accidents occurred due to the difficulty of getting in and getting out, 19.0% occurred in the stairs, 14.3% in the ramps located inside the trailer, 4.8% occurred in the back door and the remaining 14.3% in other sections. According to hauliers' experience; 43.2% considered that compartment one (also is known as "front") was the section of the trailer where livestock management was complicated because for cattle was difficult getting in without getting back at least once, another 43.2% considered that the difficulty with cattle handling was not related with the compartment and the remaining 13.6% mentioned "other" compartments. Hauliers (4.1%) considered that cattle injuries were frequent in compartment one, 2.7% in compartment two, 2.7% in compartment four and 4.1% mentioned "others"; nonetheless, 86.5% assured that the compartment was not the main cause but a deficient accommodation of cattle.

Hauliers could be under high levels of stress and fatigue due to excessive traffic, extended periods away from home (Boyce, 2016) and handling of animals (Pulido et al., 2018). According to our survey, cattle transport in Mexico increased the risk associated with this activity. These risks were extended beyond the possibility of suffering an accident during the journey or suffering illnesses associated with extended working hours. The working hours of hauliers in Mexico were variable; it depends on the type of service required by producers as well as the distance in the journey according to the region of origin and final destination of the cattle (north, middle or south of the country) (Table 2). It was found that once the animals were shipped for departing, hauliers stop only at the animal health inspection and verification points during the journey and while animal inspection was carried out hauliers had their lunch and used the toilets at these points; therefore 63.5% of the hauliers mentioned to stop seven times or more and 29.7% four or six stops. In both cases hauliers mentioned to collect cattle from the north and south of the country, the rest of the hauliers (6.8%) mentioned stopping three times because the journey was carried out in the central region of Mexico.

Five risk factors for hauliers were identified; 37.8% mentioned that the main risk was cattle theft which has become very common in recent years and could happen in each journey, 18.9% mentioned road accidents and money-belongings thefts, 12.2% mentioned government

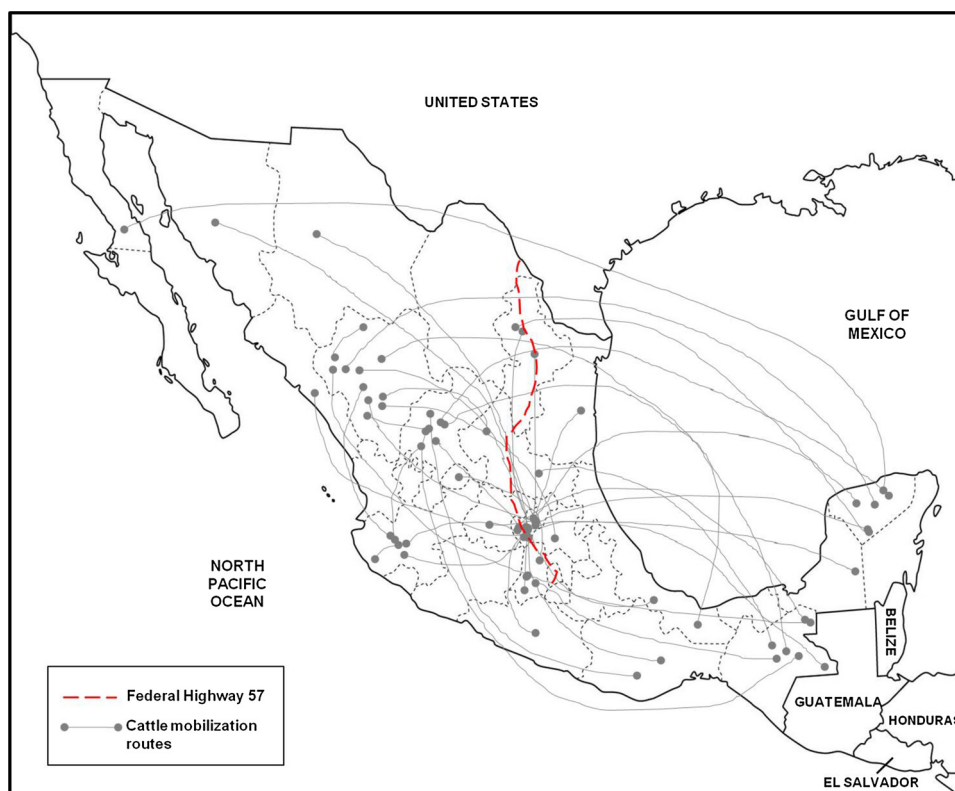


Fig. 2. Cattle collection points and transport routes in different regions of Mexico.

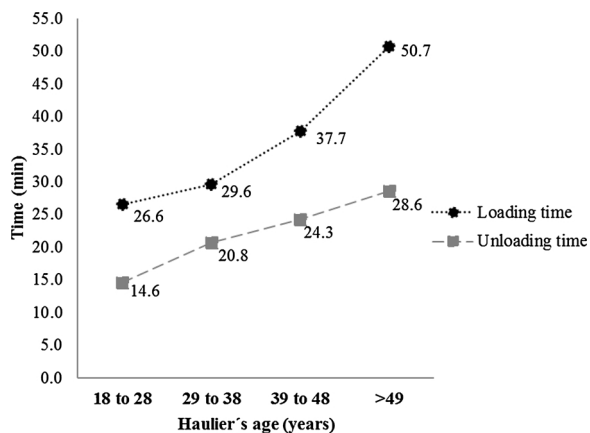


Fig. 3. Influence of the hauliers' age on the time for cattle loading and unloading. Means with different lowercase letter differ (Kruskal–Wallis test, $P < 0.05$).

extortions, 10.8% mentioned truck thefts and finally 1.4% mentioned hauliers' murders. According to the participants and the Mexican Institute for the Competitiveness A.C. (2017), Guerrero State is considered one of the most dangerous places to collect cattle, therefore, cattle transport companies do not want to collect cattle from Guerrero State or might be carried out occasionally. Accidents involving hauliers represented a serious threat of working safely, public health and animal welfare. There are many causes for traffic accidents, such as mechanical failure on vehicles, human failure and problems on the roads beside the use of psychoactive substances that decreases the hauliers' capability to drive safely (Bombana et al., 2017). Our results showed that 23.0% of the participants were involved in road accidents of different types and causes. The commonest accidents reported in this study were rollover (58.8%), collision with another vehicle (29.4%) and 11.8% trucks off-road without damages.

The main cause of the accidents was fatigue (29.4%), other driver's fault (23.5%), distraction while driving (17.6%), mechanical failures (11.8%) and the rest (17.6%) mentioned other causes. In Mexico, there are no records of road accidents involving livestock trucks, the most affected species, and vehicle type are unknown, in the United States of America and Canada the species frequently involved in an accident is cattle (Woods and Grandin, 2008), swine and cattle in Spain (Miranda-de la Lama et al., 2011). It was mentioned that 58.8% of the accidents occurred between 20:00 and 05:05 h, all of them occurred because the hauliers were driving continuously for more than 10 h which is common in Mexico, 29.4% of the accidents occurred between 06:00 and 12:59 h and only 11.8% between 13:00 and 19:59 h. Fatigue during driving has been acknowledged as a major contributor to road accidents among long travel distances (Woods and Grandin, 2008). The incidence is greater for hauliers of articulated trucks (i.e. Pot-belly trailers) because delivery schedules affect the hauliers' resting time. Bigger size and mass of these trucks concomitantly increases the severity of injuries and/or the likelihood of fatality (Darwent et al., 2012). From the total accidents recorded, 82.4% occurred when hauliers were transporting cattle to the slaughterhouse and only 17.6% occurred without cattle. The average cattle injured were 8.3 animals per trailer and the body weight at the time of the accident was 350–450 kg (85.7%) and 550 kg (finished cattle, 14.3%). The animals that survived to the accident were transported in another vehicle (57.1%), while 14.3% continued the journey in the same trailer when the vehicle damage was not severe, 14.3% reported cattle theft at the accident site and the remaining 14.3% did not specify what happened with cattle that survived. In Mexico, there are no specific protocols for livestock transport accidents that specify how to get cattle out of the vehicle if survived to the accident or in case of animal suffering (Pulido et al., 2018). These situations may occur in other countries around the world; however, specifically Mexico is facing bureaucracy challenges and crime situations that represent a risk for hauliers and transport companies, therefore protocols for these situations are required.

Table 2
Hauliers' profiles based on perceptions and attitudes towards animal welfare, demographic characteristics and risk of accidents on road (n = 74).

Variables	G1 (n = 13)	G2 (n = 14)	G3 (n = 31)	G4 (n = 16)	P
<i>Attitudes and emotions towards farm animal welfare - ordinal scale of 5 points¹ - (Average)^A</i>					
Should cattle be able to express the natural behaviours of their species?	4.5a	3.4b	4.6a	2.5c	***
Are cattle capable of feeling pain?	5.0	4.8	5.0	4.9	NS
Are cattle capable of feeling emotions (positive or negative)?	4.7a	4.9a	4.8a	2.8b	***
<i>Opinions towards animal welfare - ordinal scale of 5 points¹ - (Average)^A</i>					
Do you think that in Mexico there is sufficient information about livestock welfare?	4.6a	2.9b	1.6c	2.6b	***
Do you think stress in livestock during production and transport affects the quality of the meat you consume?	4.7a	1.4b	4.7a	4.0c	***
Do you think that new laws on animal welfare are necessary to avoid abuses about management of animals during transport?	3.5a	2.9b	4.0c	2.4b	**
<i>Demographic issues (Hauliers %)^B</i>					
<i>Driving experience</i>					
< 6 years	46.2x	57.1x	17.9x	31.3x	*
> 6 years	53.9y	42.9y	82.2y	68.7y	
<i>Age (years-old)</i>					
18–28	0.00	28.5	10.7	18.8	N.S.
29–38	38.5	42.9	35.7	43.7	
39–48	30.8	28.6	35.7	31.3	
> 49	30.8	0.00	17.9	6.2	
<i>Haulier education level</i>					
Elementary school	23.1	14.3	17.9	25.0	N.S.
Junior High-school	61.5	57.1	46.4	50.0	
High school	15.8	28.7	35.7	25.0	
<i>Accidents on road (Hauliers %)^B</i>					
Percentage of hauliers who suffered accidents	15.4a	28.6b	14.3a	37.5c	*
Percentage of drivers who think road accidents are the most important risk in their profession	7.7a	35.7b	39.3b	62.5c	*
Truck rollover is the most frequent accident (Percentage of hauliers) ^a	0.0a	28.6b	12.5c	25.0b	*

¹Ordinal scale: 1 Surely not; 2 Probably not; 3 It does not matter to me; 4 Probably yes and 5 Definitely yes. P values correspond to Kruskal–Wallis (A) and Chi-squared (B) tests, N.S.: Not significant differences between the groups, * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

a, b, c and d indicate the differences between the groups.

x, y, at the same column mean significant difference between group composition.

Table 3
Logistic of cattle transport (350–450 kg live weight) in different regions of the country.

Cattle to be sent to feedlots or slaughterhouses	Collecting region		
	North	Central	South
<i>Journeys for collecting cattle</i>			
Number of drivers for each region ^a	9	18	47
Journeys for collecting cattle (%)	12.4	16.8	70.8
Main states for collecting cattle	Chihuahua Durango Sonora Sinaloa Tamaulipas	Querétaro Zacatecas Jalisco Aguascalientes Hidalgo	Chiapas Tabasco Veracruz Yucatán Oaxaca
<i>Journey time for collecting cattle</i>			
Total journey time (h)	53.9 ± 26.8	23.7 ± 13.4	71.6 ± 27.2
Journey time after cattle loading (h)	15.7 ± 5.7	10.8 ± 6.9	24.4 ± 11.3
<i>Stops during the journey after cattle loading (%)^b</i>			
1 a 3	0	27.8	6.8
4 a 6	33.3	38.9	29.7
≥7	66.7	33.3	63.5

^a The same driver can go to different regions.

^b Stops at the animal health inspection and verification points (AHIP).

Hauliers work in an environment that requires long periods of relative immobility in the driver seat of a vehicle. This can contribute to an inactive lifestyle that may ultimately lead to poor health. This is especially true when coupled with a poor diet, which many truck hauliers face due to unhealthy foods (Boyce, 2016). The health status and consumption habits of Mexican hauliers during the journey were evaluated. In relation to health condition; 47.3% of hauliers mentioned "good health" and highlighted that they must be checked at the

national health service every two years, therefore hauliers should approve health tests if they want to renew the driver license, 10.8% mentioned "do not know" if they present a health problem, 12.2% mentioned overweight and obesity problems, 10.8% mentioned back problems, 9.5% sleep disorders, 9.5% gastritis, 4.1% arterial hypertension, 4.1% diabetes, 2.7% colitis, 2.7% high levels of cholesterol and 1.4% kidney disease. From the later health problems, only 14.3% of hauliers mentioned being under medical prescription. There is a tendency to consume certain products among hauliers during long journeys. The consumption of products that could have harmful effects for health was mentioned, including soft drinks (85.1%), coffee (77%) and cigarettes (70.3%). These two latter products and energy drinks (56.8%) were consumed to minimize sleepiness. On the other hand, 37.8% consumed "junk food" while driving to reduce the number of stops during the journey. Only significant differences ($P < 0.001$) were found between age and smoking cigarettes; hauliers reduced smoking cigarettes in the range of 39–48 years-old and after 49 years-old increased considerably.

To combat the detrimental effects of fatigue, some hauliers used licit and illicit stimulants (Davey et al., 2007). Little research exists on the prevalence of stimulant use among livestock hauliers. From our results, 77% of the hauliers affirmed to consume drugs that help them to stay awake and alert during long journeys. The active substance of these drugs was "clobenzorex hydrochloride" which is an anorexigenic medication for prolonged release to lose weight that according to Espinosa-Franco and Morín-Zaragoza, 2013 causes adverse effects such as insomnia. For this reason, its consumption was common not only in cattle hauliers but also hauliers of other types of cargo. According to the participants they consumed 30–900 mg in periods of 24 and 72 h. The side effects of these drugs have been studied in doses lower than those found in this study, so the effects of these doses on health are still unknown. Research suggests stimulants might improve both cognitive performance and driving performance when used to combat fatigue.

Even though stimulants can enhance cognitive functions such as vigilance, attention, psychomotor functioning, memory, and visuospatial/visuomotor capabilities, however, research suggests they could develop driving impairments (Gates et al., 2013). The different risks of this activity and its possible causes should be studied carefully to work on prevention because not only live's integrity and health of hauliers are compromised, but also other people's lives and cattle welfare.

4. Conclusions

Our results showed the need to generate an integrative vision in the livestock industry that is a symbiosis between sustainability, human and animal welfare, that means "One-Health". Cattle welfare during transport should be a priority for the livestock industry, without leaving aside wellbeing, health and labor rights of hauliers. It is likely that a company does not meet acceptable standards of operational quality in animal welfare without establishing a social responsibility policy that creates a healthy working environment for hauliers and related personnel. A motivated, trained and concerned worker towards cattle will be committed to the quality of their work and avoid practices that put cattle welfare and transport operations at risk. In Mexico, there are no specific laws for cattle welfare during transport. This study has been the first attempt for the development of the first Mexican national protocol (perhaps extrapolated to Latin American countries) for the prevention of operational risk factors, haulier's occupational wellbeing and cattle welfare during transport.

Conflict of interest

None of the authors of this paper has a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of the paper.

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