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Research Article

Effect of Transport on Physical and Haematological Status of Cattle in Bangladesh

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Abstract | A cross-sectional study was conducted during the period of July- December, 2014 to determine the effect of transportation associated physical stress of cattle used for beef purpose in Bangladesh. A total of 300 cattle were randomly selected, those were subjected to long distance transportation (648km, 14h). A pre-structured record sheet was used to record the injury related data, physical parameters and others relevant data both before and after transportation. The frequencies of injuries were increased significantly (P<0.01) after transportation (47%) than before (26%). The injuries were most common in Hariana cattle both before (5%) and after (8%) transport. Abrasion was dominated type of injury (11%) and were increased significantly (P<0.05) after transportation. The most frequent location of injuries was pin bone in both phase of the study. The frequencies of nasal discharge and degree of dehydrations were significantly (P<0.01) increased after transportation. Increased number of injuries and other physical status indicators during transportation indicates relatively higher degree of stress and suffering. Cattle trader should aware about the comfortless of animal during transportation for maximum productivity as well as to maintain animal welfare.

Keywords | Transportation stress, Hematology, Physical injury, Animal welfare, Dehydration

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INTRODUCTION

Livestock plays an important role in the national economy of Bangladesh with direct contribution of around 8% to the agricultural GDP and providing 32% of total employment in the economy of Bangladesh (Alam et al., 2014). It is also declared that cattle of Bangladesh are an indivisible and essential part of the agricultural farming and agribusiness (Ahmed et al., 2010).

The transportation of livestock is an essential element of extensive farm production systems (Harris, 2001). Particularly for pasture-based farming systems it is necessary to move animals to central points, whether for sale or slaughter. Almost all cattle are transported at some time during their lives (Palme et al., 2000). The first shipment of live cattle to Chicago by rail occurred on September 5, 1867. Livestock may be transported within properties, between properties, and between a property and sale yard, abattoir, feedlot, and pre-export assembly depot. Livestock can also be transported to growing and finishing properties or to make best for the best use of seasonal conditions. The nature of modern cattle farming dictates that transport of animals from one place to another is necessary (Swanson

and Morrow-Tesch, 2001).

Transport stress is a complex issue. Many factors are responsible for transportation stress that includes pre-transport management, noise, vibration, novelty, social regrouping, separation of the animals from familiar groups and eventually move to new areas, crowding, climatic factors (temperature, humidity, and gases), handling methods and facilities, restraint, loading and unloading, time of transit, mixing with unfamiliar animals and feed and water deprivation (Swanson and Morrow-Tesch, 2001; Aradom, 2013). The response of animals to the effects of transportation stress involves a complex interaction between neurons and hormones. The results of such interactions are manifested clinically (Minka and Ayo, 2013). The animals reflect changes in physical, biochemical and immunological parameters of the body (Sporer et al., 2007). The physical changes include increased body temperature, increased heart and respiration rates etc. (Swanson and Morrow-Tesch, 2001). The biochemical changes due to transportation stress include concentrations of glucose, NEFA (Non-esterifies free fatty acid), muscle enzymes, such as CK etc. (Ishiwata et al., 2008; Uetake et al., 2009; Uetake et al., 2011). Measurements reflective of dehydration have also been reported, including increased packed cell volume (Sporer et al., 2007) and serum protein (Ishiwata et al., 2008; Sporer et al., 2008). Due to activation of hypothalamic-pituitary-adrenal axis (HPA), researchers suggested marked changes in cortisol and catecholamine in different stages of transportation (Ishizaki et al., 2005; Sporer et al., 2007).

While considering the immune response, transport stress increases the number of total white blood cells (WBC) and specific types of WBC (neutrophils, eosinophils, and mononuclear cells) in circulation (Lomborg et al., 2007; Mitchell et al., 2008). Decreasing number of Lymphocytes and increasing number of neutrophils result in increased neutrophil and lymphocyte ratio (N:L ratio) during transportation. These changes increase the disease susceptibility due to transportation (Mitchell et al., 2008; Hulbert et al., 2011). These changes may be effective bio-markers for estimation of degree of transportation stress (Fazio et al., 2012).Transport stress has a negative effect on productive and reproductive performances (King et al., 2006), moreover, transportation causes body weight loss that varies from 3-12 percent in different duration and different conditions of journey (Santosa et al., 2014).

The transportation of livestock in Bangladesh is mainly by road vehicles. In Bangladesh the primary sources of cattle for trade are rural markets. From rural markets cattle are purchased by the traders and transport them to larger market located in different cities of Bangladesh (Hossain and Chanda, 2002). From recent trends it is found that a large number of cattle are imported from India to Bangladesh each year. These cattle are first transported in border cattle markets of Bangladesh like- Benapole of Jessore, Satkhira of Khulna district, Kustia etc. and are then transported to different central markets of larger cities like Dhaka, Chittagong etc. for sale (Gregory, 2008).

Globally a lots of research have been conducted on transportation stress including Europe (Averós et al., 2008; Averós et al., 2009), United States (Sporer et al., 2007; Burdick et al., 2011; Hulbert et al., 2011), Canada (Mitchell et al., 2008), Japan (Ishizaki et al., 2005), Australia (Phillips and Santurtun, 2013; Stockman et al., 2013), UK (Gregory, 2008), Turkey (Teke et al., 2014) Nigeria (Minka and Ayo, 2007; Minka and Ayo, 2013) etc. In transportation the degree of transport stress mostly depends on environmental condition (Aradom, 2013). So it is required to study the effect of transportation in Bangladesh environmental condition. In Bangladesh only a limited study on transportation stress were conducted. As far known all the study were includes a cross section of animals from the terminal market (Market where the cattle are transported), without considering the initial market (The market from where transportation started) before transportation, hence the changes in biomarkers due to transportation are not clearly identified. Furthermore, most of the previous study in Bangladesh were limited to identification of physical injuries (Alam et al., 2014; Kober et al., 2014) and some were includes some biochemical parameters (Alam et al., 2010b). So it is utmost important to conduct a comprehensive study covering the physical injury and haematological status both before and after transportation of cattle. So the current study was designed with the aim to identify the effect of transportation of cattle in Bangladesh environment condition and transportation practices with the objectives to determine the frequency of physical injury and physiological alterations during transportation of cattle in Bangladesh.

MATERIALS AND METHODS

A study was conducted in two selected cattle markets of Bangladesh namely Portkhali situated in border area and Sagorika located in Chittagong city. The geographical location of Banapole is 23°02'31" N (North) and 88°53'44" E (East) in DMS. The Sagorika cattle market situated at Chittagong metropolitan area under Chittagong district of Bangladesh and located at 22°22′0″N 91°48′0″E. The distance between the primary and secondary market is about 648 km that covers a minimum of 14 hours vehicle journey. Everyday large numbers of cattle are transported from the Benapole cattle market to Chittagong cattle market via vehicle especially on Truck. The current study was conducted during a period of July to December, 2014. The current research is a cross-sectional study designed to determine the

detrimental effect of long distance transportation on cattle of Bangladesh. Those cattle that are transported from the Portkhali cattle market of Jessore to Sagorika cattle market of Chittagong during the research period were considered as target population.

Data Collection and Environmental Condition

A pre structured questionnaire was designed in relation to the objectives of the study for data collection. Data of necessary conditions of cattle were collected from 300 randomly selected bullocks from the primary markets before their transportation and the cattle were marked by painting on body and collar marking. Again necessary data were collected from the same animals when they were reaching in the secondary market after transportation. The primary data were obtained directly from the personnel of different levels involved in cattle trading. Some supportive secondary data were also collected from the office of primary and secondary cattle markets. The average temperature and relative humidity of environment recorded as 360°C and 67%, respectively during transportation. Transportation time is usually at night but cattle were also exposed to sun light of 1st part (morning) of the day.

Table 1: Frequency of physical injuries of cattle before and after transportation

Phase of transportation	No. of cattle examined	Cattle bearing injuries		P-value
		No.	%age	
Before	300	78	26	***
After	300	141	47	

***: Significant (P<0.001)

Physical Examination

During data collection from the cattle markets the physical parameters were recorded in a pre-structured data sheet. During physical examination only the inspection technique was used to find out the abnormal conditions such as nasal discharge, diarrhea, presence or absence of injury, types of injuries like abrasion, laceration, desquamation, barbed wire injury, scarification, sunburn etc., location of injuries on the body and so on.

Estimation of Dehydration

To estimate the dehydration both inspection and palpation techniques were used. The assessment of level of dehydration was determined by inspection of the eye and skin fold test on eyelid as per mentioned by (Chakrabarti, 2005).

Sample Collection

Blood sample were collected from 100 randomly selected individuals thrice such as immediately before, after and after 24 hour of transportation time of same cattle. Blood sample were collected through jugular vanipuncture in sterile vacutainer containing EDTA (anticoagulant) for haematology. During blood collection the collection site was disinfected with 70% alcohol solution. The collected samples were transported in icebox and haematology was done immediately.

Haematology

The samples collected with anticoagulant were analyzed for routine examination of blood as per (Weiss and Wardrop, 2013). The samples were analysed within 24 hours of collection. Haemoglobin (Hb), packed cell volume (PCV), Total leukocyte count (TLC), Total Erythrocyte count (TEC) and Differential leukocyte count (DLC) were performed in Physiology laboratory of Chittagong Veterinary and Animal Sciences University (CVASU).

Data Analysis

All collected data and sample evaluated values were imported in Microsoft Excell-2007 and transferred to SPSS-16 software for analysis. The comparison of different qualitative parameters at before and after transportation was performed by using McNemer's test. Comparison

Table 2: Various types and number of injuries before and after transportation of cattle

Variable	Categories	Percentage		McNemar's chi square value	P-value of McNemar's test
		Before	After		
Types of injury	Abrasion	33	63	10.00	**
	Laceration	9	24	5.00	NS
	Swelling	6	6	1.00	NS
	Scarification	18	18	0	NS
	Barbed wire injury	27	54	9.00	***
	Horn fracture	6	6	0	NS
Number of injury (Among the injuries)	Single	63	108	15.00	***
	Double	12	24	4.00	NS
	Multiple (> 2)	3	6	1.00	NS

N: 300; **NS:** Non-Significant (P>0.05); **: Significant (P<0.01); ***: Significant (P<0.001)

Table 3: Distribution of physical injuries at before and after transportation among different breeds of cattle

Breed	Types of injuries											
	Abrasion (%)		Laceration (%)		Swelling (%)		Scarification (%)		Barbed wire injury (%)		Horn fracture (%)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Hariana	15	24	-	6	-	3	3	3	6	15	-	-
Hallikar	6	12	3	3	3	3	3	3	6	9	-	-
Gir	-	12	3	3	3	3	6	6	6	12	6	6
Ongole	-	3	-	3	-	-	-	-	-	3	-	-
Tharparkar	3	9	-	3	-	-	3	3	3	6	-	-
Indian ND	-	3	-	9	-	-	3	3	6	3	-	-

N: 300; **ND:** Non descriptive

Table 4: Distribution of physical injuries on parts of the body before and after transportation

Location of the body	Percentage		McNemar's chi square value	P-value of McNemar's test
	Before	After		
Pin bone	33	48	5.00	NS
Hip region	3	6	1.00	NS
Paralumbar fossa	3	12	3.00	NS
Tail	3	6	1.00	NS
Point of hip	3	3	0	NS
Thoracic region	6	12	2.00	NS
Back	15	21	2.00	NS
Thigh	9	9	0	NS
Ear	6	6	0	NS
Horn	6	6	0	NS

N: 300; **NS:** Non-Significant (P>0.05)

among the quantitative parameters at before and after transportation were performed by using Repeated measures ANOVA.

RESULTS

Physical Alterations

From Table 1 it was found that about 26% of the cattle had injuries on their bodies in the primary market (Portkhali market) and the frequencies were significantly increased (p<0.01) after transportation to central cattle market (47%) at Sagorika cattle market. Table 2 and Table 3 shows the status of different injuries like abrasion, laceration, swelling, scarification, barbed wire injury and horn fracture of cattle before and after transportation. A significant (P>0.01) increment of number of abrasions was observed after transportation (21%) than before transportation (11%). The abrasion was more frequently observed in Hariana cattle in comparison to other breeds of cattle in both before (5%) and after (8%) transportation. Laceration was found in Hallikar and Gir breeds of cattle both at before (1%) and after (1%) transportation, but in other breeds lacerations were found only after transportation (1, 1, and 3%, respectively in Ongole, Tharparkar and Indian ND). The total number of cattle bearing laceration was insignificantly (P>0.05) increased after transportation. The current study revealed that barbed wire injuries were found among all the breeds of cattle under the study both the cases (before and after transportation) except Ongole in which barbed wire injuries were only found after transportation. Significant variations (P<0.05) were found in terms of number of barbed wire injuries at after (18%) transportation than before (9%).

Among all types of injuries the frequencies of single, double and multiple injuries were found as 36, 8 and 2%, respectively (Table 2). The results revealed that all the injuries were increased after transportation at secondary market, although the increment was significant (P<0.01) only in case of single injuries. Distribution of different types of physical injuries on parts of the body of cattle is shown in Table 4. Considering the location of the body the injuries were most frequently found on pin bone of cattle both before (11%) and after (16%) transportation. On most of the body parts (hip region, paralumbar fossa, tail, thoracic region and back) the injuries were numerically increased after transportation (16, 2, 4, 2, 4 and 7%, respectively) in comparison to before transportation (11, 1, 1, 1, 2 and 5%, respectively) though the increment was not statistically significant (P>0.05).

Table 5: Level of dehydration among the cattle before and after transportation

Variable	Categories	Percentage		McNemar's chi square value	P-value
		Before	After		
Dehydration	Mild	147	45	34.00	***
	Moderate	129	195	22.00	***
	Severe	24	60	12.00	***

N: 300; ***: Significant (P<0.001)

Table 6: Comparison of mean values of haematological parameters among 3 time periods of sampling

Variable	Time periods of transportation	Mean	SE	F statistic (Repeated ANOVA)	P- value (Repeated ANOVA)
HB (mg/dl)	Before	11.10	0.37	4.37	**
	Immediately after	12.31	0.45		
	After 24 hours	10.61	0.42		
PCV (%)	Before	30.12	0.74	3.05	NS
	Immediately after	32.38	0.76		
	After 24 hours	30.26	0.73		
TEC (10^6/ ml)	Before	4.72	0.22	11.49	***
	Immediately after	5.67	0.17		
	After 24 hours	4.50	0.14		
TLC (10^3/ ml)	Before	6.24	0.21	32.61	***
	Immediately after	7.25	0.19		
	After 24 hours	5.25	0.05		
Lymphocyte (%)	Before	61.60	0.64	8.45	***
	Immediately after	58.14	0.54		
	After 24 hours	60.58	0.67		
Monocyte (%)	Before	4.84	0.25	1.83	NS
	Immediately after	4.28	0.35		
	After 24 hours	4.16	0.26		
Neutrophil (%)	Before	29.68	0.55	6.62	**
	Immediately after	32.74	0.63		
	After 24 hours	30.22	0.64		
Eosinophil (%)	Before	3.76	0.23	6.38	**
	Immediately after	4.72	0.36		
	After 24 hours	5.30	0.33		
Basophil (%)	Before	0.12	0.05	0.00	NS
	Immediately after	0.12	0.05		
	After 24 hours	0.12	0.05		

N: 100; **SE:** Standard Error; **NS:** Non-Significant (P>0.05); **: Significant (P<0.01); ***: Significant (P<0.001)

In terms of physical effects on the body due to transportation, other than physical injuries the current study also investigated the changes of two important physical conditions such as nasal discharge and diarrhea of the body. Both of these parameters increased significantly (P<0.01) after transportation (28% and 23%, respectively) than before (15%, respectively) (Figure 1).

Haematological Changes

From Table 6 it is revealed that the haemoglobin (Hb), PCV and TEC were increased after transportation in comparison to before and after 24h of post transportation. The increment of Hb (12.31±0.45 gm/dl) and TEC (5.67±0.17) was highly significant (P<0.01) whereas the increment of PCV (32.38±0.76 %) was insignificant (P>0.05). While considering the white blood cell the total leukocyte count (TLC) was lowest (5.25±0.05 × 103/ml) at the 24h of post transportation and highest (7.25±0.19× 103/ml) at after transportation. Before transportation of cattle the TLC was 6.24±0.21× 103/ml. The values of TLC

differ significantly (P<0.01) among before, after and the 24h of post transportation. Among the WBC the percentage of lymphocytes were decreased (58.14±0.54%) and the percentage of neutrophils were increased (32.74±0.63) after transportation in comparison to before and after 24h of post transportation (P=0.01). The percentage of eosinophils were comparatively higher (P=0.01) after and 24h of post transportation but no change (P>0.05) of basophiles count were observed (Table 6). The ratio between neutrophils and lymphocytes were significantly increased (P<0.01) after transportation (0.56±0.01) in comparison to before (0.48±0.01) and the 24h (0.50±0.01) of post transportation (Table 6) (Figure 2).

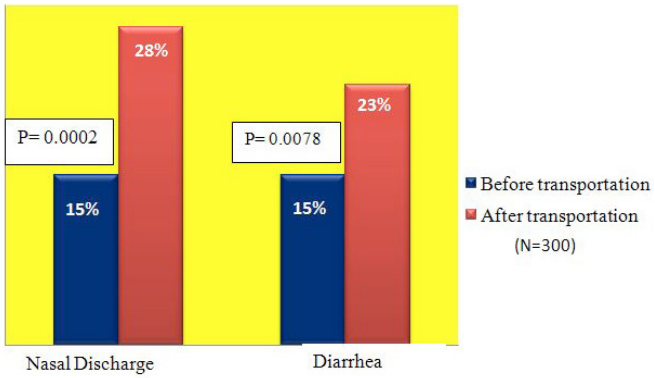

Figure 1: Comparative presentation of nasal discharge and diarrhea before and after transportation

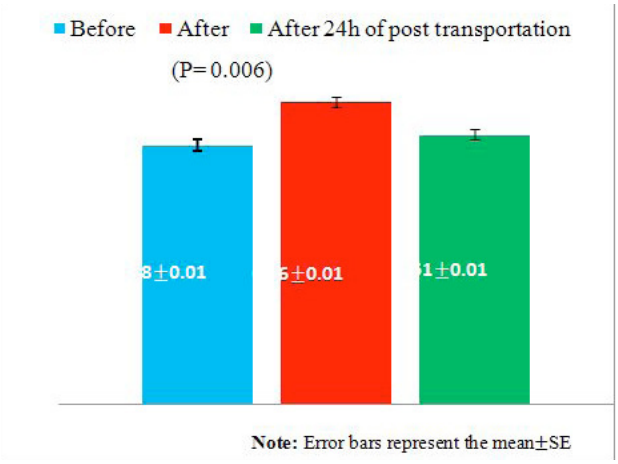

Figure 2: Neutrophil and lymphocyte (N:L) ratio at before, after and 24h of post transportation

DISCUSSION

The current study investigated the harmful effects of transportation on cattle in terms of frequencies of physical injuries, haematological changes, and immune response. About 14 hours of transportation in this study elicited a classical stress response in cattle. As far known, none of the researcher compares the stress response of cattle during before and after transportation in Bangladesh environment. So the current study was conducted with the hypothesis that the transportation stress may increase the frequency of physical injuries, changes in haematological and immune response of the body. In this study, the physical and physiological data were measured at the market before transport could not be used as a base line because the cattle are previously transported to the border market (primary market) from India before transported in central market (secondary market) (Gregory, 2008). From the current study it was revealed that a considerable population (26%) of the cattle bears injuries on their body in primary market (before transportation). This is because in present study the transportation of cattle only considers from the primary market, but as Gregory (2008) mentioned actually these cattle had already transported long distance into India to reach primary market as the source of cattle in primary market of Bangladesh is from India. The current study could not find out the duration and ways of transportation of cattle into India to reach the primary markets and the target cattle population already had some physical injuries on their bodies. The frequencies of physical injuries that are discovered in present study before transportation were significantly increased (p<0.05) after transportation among all the breeds of cattle. This finding has agreement with several researchers who have also found increased the frequency of injuries after transportation among cattle (Minka and Ayo, 2007; Gregory, 2008). In Bangladesh, the outcomes of some studies (Alam et al., 2010b; Kober et al., 2014) also indicate the higher frequencies of physical injuries due to transportation, although they only consider the data from the central market after transportation without considering the data of primary market (before transportation). The increment of injuries most probably due to contact with inner wall of vehicles during the transport (Bigras-Poulin et al., 2006; Alam et al., 2010a), from loading and unloading activities; due to higher stocking density (Friend, 2000) although some of the injuries also may come from the conflict among the cattle with their horn (Gregory, 2008).

According to current study, the injuries were more commonly observed in Hariana breeds of cattle both before and after transportation. These findings have similarity with the findings of (Kober et al., 2014), and they concluded that all injuries were higher in Hariana cattle compared to Rajasthani, Sahiwal and other exotic breeds which are found in Sagorika and Bibirhat cattle markets at Chittagong District (Sagorika market) in Bangladesh. Specific breeds are susceptible to injury is also supported by (Minka and Ayo, 2007), they showed that the injuries were more frequently found in Red Bororo cattle than White Fulani and Sokoto Gudali, respectively. (Alam et al., 2010a) showed species variations in prevalence of injuries and they concluded that the injuries were more commonly found in cattle in comparison to buffalo. In present study, it was revealed that the most common types of injuries among the cattle were abrasion both before and after transpor-

tation. This finding has close agreement with the findings of (Alam et al., 2010a) in a study on two cattle markets in Bangladesh although they consider the injuries only after transportation. Other types of injuries encountered in the present study are laceration, swelling, scarification, barbed wire injury and horn fracture. Among them most of the injuries were found insignificant changes after transportation. The current study showed the frequencies of single, double and multiple injuries were increased after transportation. These findings have partial similarity with (Alam et al., 2010a; Kober et al., 2014), they also showed more than one injuries in animal body after transportation. (Alam et al., 2010a; Kober et al., 2014) concluded that more frequent location of injury was buttock region though they did not classify the location pin bone and which is under buttock area hence this finding might consider similar with the current research. The current research finding has slightly dissimilarity with the findings of (Minka and Ayo, 2007), where they reported most frequent location of injury were neck and belly region in Red Bororo and White Falani cattle, respectively. The increment of nasal discharge in current study was in close agreement with the finding of (Ishizaki et al., 2005; Mitchell et al., 2008). The increase level of nasal discharge after transportation might results from invasion of bacteria and virus into the upper respiratory tract due to immune depression by transportation stress (Sporer et al., 2007). The current study showed insignificant increment of diarrhea after transportation. These findings were partially similar with research findings of (Bywater, 1980). The present study showed that the severity of dehydration increased after transportation. These findings concord with the findings of (Villarroel et al., 2001; Hogan et al., 2007). The dehydration were results from long time water deprivation, high evaporative water loss due to higher ambient temperature and water loss through diarrhea (Schwartzkopf-Genswein et al., 2012) of some animals.

The increment of Hb and TEC in current study after transportation indicates hemo-concentration due to effect of dehydration during transportation. These findings have similarity with the findings of some studies (Mitchell et al., 2008; Hulbert et al., 2011), suggested the increment of PCV, TEC and haemoglobin that leads to hemo-concentration after 9.75 hours of transportation. Various studies reported that the normal haematological parameters except white blood cell count (Ishiwata et al., 2008; Mitchell et al., 2008). The hemo-concentration in current study is mainly due to dehydration resulting from feed and water deprivation during transportation (Knowles et al., 1999).

One of the findings of present study was that insignificant variation of PCV before, after and after 24h of post transportation also supported by the findings of (Hulbert et al., 2011; Stockman et al., 2013). While considering the white blood cell count in current study the TLC was highest after transportation compared to before and 24h of post transportation. Similar results were also reported by other investigators (Hulbert et al., 2011; Stockman et al., 2013). Some researcher showed no significant change of TLC after transportation compared to before (Hulbert et al., 2011) in short duration (4 hours) of transportation. The proliferation of WBC in present study might be due to stimulating effects of glucocorticoids on white blood cells during long time transportation (Weber et al., 2007). The current study revealed that among the WBC the percentage of lymphocytes were decreased and the percentage of neutrophils was increased after transportation in comparison to before and 24h of post transportation. These findings are coincide with the findings of several researchers (Sporer et al., 2007; Mitchell et al., 2008; Hulbert et al., 2011; Stockman et al., 2013). The ratio between neutrophils and lymphocytes was significantly increased in present study after transportation in comparison to before and 24h of post transportation. This finding has similarities with the research outcomes of several investigators (Hulbert et al., 2011; Stockman et al., 2013).

CONCLUSION

The road transport conditions involve high stocking densities, poor ventilation, high humidity and temperatures, and crude forms of animal restraint, including the tying legs together, which may increase the risk of muscle injury, fatigue and stress. The most common type of injuries was abrasion and was increased after transportation. Among the different locations of the body the pin bone was mostly affected by injuries. The frequencies of nasal discharge and degree of dehydrations were significantly increased after transportation. Enormous variations of physical and haematological changes observed in the present study indicate relatively higher degree of stress and sufferings due to transportation that is opposition to animal welfare and productivity.

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CONFLICT OF INTERESTS

There is no conflict of interest.

AUTHORS' CONTRIBUTION

All authors contributed equally.

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