Knowledge and perception of animal welfare at the camel market in Egypt

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Abstract

Human-related factors, including experience in animal handling and management, and knowledge of animal welfare are crucial to safeguard animal well-being. This study aimed to gain information on camel caretakers' backgrounds, their perceptions of welfare, and possible associations with camel health and behavioural problems. Sixty-one workers were interviewed at the Birqash camel market in Cairo, Egypt. The interviewees were mainly young men (90.2% <50 years; P<0.001), from Egypt (96.7%; P<0.001), with more than 5 years of experience (93.4%, P<0.001), with a low educational level, who learned about camel handling and management from family and friends (78.7%; P<0.001). Eight were owners, 34 were caretakers and 19 were part-time workers who helped with management and sales operations (e.g., unloading) only on market days. Most of the interviewees judged their ability to identify a camel in distress/pain as "High" or "Very high" (62.3%; P=0.001), reporting monitoring camel eyes (52.6%) or feeding behaviour (42.1%). The interviewees' understanding of animal welfare was, however, low, missing the overall meaning. Moreover, 7 interviewees (11.5%) did not know at all the meaning of animal welfare. In general, animal welfare was defined mainly referring to only two out of the four welfare principles (45.9%; P<0.001). Good feeding and good health were often considered, while good housing and appropriate behaviour were reported rarely. As expected, interviewees' age, experience, and educational level were associated with the welfare status of the camels in their care, which often was under minimal standards. Education on camel behaviour and welfare is therefore recommended for all people who handle and manage camels.

Keywords: behaviour, caretakers, distress, dromedary camels, management, well-being

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Introduction

The Dromedary camel or Arabian camel (*Camelus dromedaries*) is the most common species of the genus Camelus (Wardeh, 2004; Nelson et al., 2015). They mainly live in southern hotter areas of the Old World and are found in different African and Asian countries (Faye, 2014). Camels are indeed unique livestock animals that can survive in difficult conditions; they are resilient and can withstand harsh conditions (Dorman, 1984), characterized by water scarcity and significant fluctuations in daily and seasonal temperatures (Babiker, 1984). They can withstand feed and water shortages and can

work and walk for a longer time in arid environments (Dorman, 1984). Dromedary camels serve, therefore, crucial socio-economic roles and sustain the livelihoods of millions of people in the semi-arid and arid regions of Asia and Africa (Gagaoua et al., 2022; Wardeh, 2004). People in these areas (particularly nomads) use camels as versatile animals for physical labour, transportation, and the production of milk, meat, wool, hair, and skin (Faye, 2014; Gagaoua et al., 2022). However, camels are also used for racing, beauty contests, and tourism (Faye, 2014; Smits et al., 2022).

The world camel population is increasing and is expected to reach 60 million in the coming twenty-five years (Faye, 2020). One of the reasons is that camels have become the preferred livestock species from a sustainability point of view, as their ammonia production is much less compared to cattle (Smits et al., 2022). Additionally, due to increased environmental temperature and desertification, the interest in dromedary camels is increasing as they have a high heat resistance ability (Gagaoua et al., 2022). To date, the majority of camel populations are managed under pastoralist nomadic environments (Dioli, 2022). However, there is a growing demand for live camels and camel products in various countries, including Southeast Asia, Europe, and the Middle East. In certain areas, this surge in demand has led to the development of an export industry, which, in turn, has brought about significant changes to the way camels are bred and to their production system. This transformation includes shifts toward more sedentary and intensified production methods. As a result, the intensification of camel farming, which started two decades ago, is expected to become much more widespread (Nagy et al., 2022). These changes emphasise the importance of implementing effective disease management strategies (El Harrak et al., 2011) and the need for better understanding and improvement of camel welfare.

Animal welfare has been defined as how well an animal is coping mentally and physically within its living conditions (Broom, 1991). There is a growing acknowledgement and consciousness that animals must also encounter positive emotions to achieve good welfare and a better quality of life (Webster and Margerison, 2022). To maintain the welfare of animals through good husbandry is mandatory, including disease control, prevention and treatment, the provision of suitable nutrition and shelter, handling and slaughter and, when necessary, euthanasia (Madzingira, 2018). Animal health and welfare are interlinked, and the absence of disease is a significant component of welfare. Similarly, effective management is a fundamental requirement for raising resilient and disease-resistant animals (Magnusson et al., 2022). Consequently, animals must be kept with high welfare standards from farm to fork, including during transport and short stays at markers, sale yards and control posts.

There has been a slight increase in the attention given to the welfare of Dromedary camels in recent times (Smits et al., 2022). However, camelids have specific needs that must be considered to ensure their welfare. These necessities include the ability to express species-typical behaviours, prevent diseases, live in a suitable social environment, and be appropriately handled (Previti et al., 2016). Unfortunately, despite the promising prospects of camel rearing, there is a significant lack of attention and knowledge concerning the welfare of these animals. These deficiencies pertain to both scientific understanding and legislative considerations (Padalino and Menchetti, 2021). Ensuring animal welfare is a human and collective responsibility that includes consideration for all aspects of animal welfare. Human-related factors, including experience in animal handling and management, and knowledge of animal welfare, are crucial to safeguard animal well-being (Madzingira, 2018). It has been suggested that to improve and maintain

the health and well-being of farm animals the owners, stockmanship, and caretakers' experience and awareness about good husbandry and welfare must be investigated and educational courses and workshops must be promoted (Madzingira, 2018; Menchetti et al., 2021b; Padalino et al., 2021).

Therefore, hypothesising that human factors would affect camel welfare, the current study aimed to gather information on camel caretakers' backgrounds and perceptions of welfare at a market in Egypt, and to investigate possible associations between human factors and camel health and behavioural problems.

Material and methods

Respondents

The research was conducted at the Birqash camel market in Egypt, from December 10, 2021, to September 1, 2022. The survey targeted all individuals involved in camel handling at the market, such as camel caretakers, drivers, and owners. The market comprises 29 pens, with many containing living facilities, including rooms, baths, and cooking spaces, where most caretakers reside. Throughout the study, nearly all pens were occupied by animals, except for two pens, and housed a varying number of camels ranging from fewer than 6 to more than 50. Three native Arabic speakers approached the camel workers, seeking their voluntary consent to participate in this research project and answer some simple questions. Before starting the survey, respondents were told that the research was a project for the University and their identity would not be disclosed and would be kept anonymous. Three workers were curious and easy to engage; all the others showed some reluctance to take part in the survey as they were worried about the information that they would be sharing, but in the end, all decided freely to participate. Most of the interviews were conducted on Saturdays when there was less market activity. On the other weekdays, the interviewers typically waited for workers to finish their tasks or used their breaks for the interviews. As a result, most interviews took place in the afternoon on Thursdays, Fridays, and Sundays, but on Saturdays they occurred at various times due to less activity and work. Each interview usually lasted from 15 to 20 minutes, but some lasted longer and there were interruptions. Caretakers often told personal stories, were pleased to show their animals or talk about their routine in the market, welcomed us into their houses for tea, and sometimes had to leave to continue with their tasks. Each day, approximately 3-4 interviews were conducted, and the workers were chosen at random. During the interviews, responses were recorded in Arabic, and they were later translated into English for analysis.

Survey

The study design addressed key aspects required to produce valid questionnaire results, as recently reviewed by Dean (2015) and Christley (2016). The questionnaires (Appendix A) contained 29 closed and 2 open-ended questions, with the aim of obtaining information from the respondents on the following points: i) their demographic characteristics (gender, age, country of origin, length of permanence in Egypt and the market, educational level); ii) information about their involvement in the camel industry and market (the specific type of activities in which they participated); iii) their experience of handling camel and/or other livestock, and training (experience in animal and camel handling, where they learned about camel management, understanding of animal welfare); iv) their knowledge to recognise a camel in distress; v) their pen and camel details (number of camels in their care, camel productive purpose, management practices and decision-making processes related to camel health). In addition to the information stated above, survey respondents were asked to answer questions about whether their camels had experienced

behavioural or health issues in the past year, and to describe the last case when one of their camels experienced an illness (Q31). The researchers designed the survey using an iterative review process, which was piloted with 5 camel breeders/caretakers. The answers were then classified according to the four welfare principles of Welfare Quality®, as reported by Menchetti et al. (2021b) (Table 1).

Table 1. Grouping of answers to the question "What is animal welfare to you?" into the four welfare principles from a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt.

Welfare principle	Welfare criteria (Padalino and Menchetti, 2021)	Open-ended answer	Original language answers
Good feeding	- Appropriate nutrition - absence of prolonged thirst	- Give camels food and drinks - Good food - More than one type of food	- اعطاء الجمال الطعام والشراب - طعام جيد - التنوع في الأكل
Good housing	- Comfort around resting - Thermal comfort - Ease of movement	- Warming, cover camels when it is cold - Good place to stay - Clean and warm place	- التدفئة، تغطية الجمال في البرد - مكان كويس (مناسب) للجمال - مكان نظيف ودافئ
Good health	- Absence of injuries - Absence of disease - Absence of pain and pain induced by management procedures	- Caring for camels when they are sick - Give medicines	- العناية بالجمال عند المرض - اعطاء الادوية
Appropriate behaviour	- Expression of social behaviour - Expression of other behaviour - Good human-animal relationship - Positive emotional state	- Don't use violence - Don't beat camels - Good dealing with camels	- عدم استخدام العنف - عدم ضرب الجمال - التواصل (التعامل) الجيد مع الجمال

Data analysis

Descriptive statistics were used to present data as numbers and percentages, medians (Md) and interquartile ranges (IQR). To perform inferential statistics, the caretakers' age, educational level, and ability to identify a camel in distress/pain were further categorized into categories (<20, 20-40, and >40 years old; No education and Education; Some-moderate and High-very high ability). A chi-square goodness of fit test was used to compare the observed distributions with the expected probability distributions (each assuming all categories equal). The associations between the demographic characteristics, productive purposes, and management choices of the caretakers were assessed using chi-square or Fisher's exact tests. The Mann-Whitney test was used to evaluate the associations between behavioural

problems (presence/absence) and the number of health problems. All analyses were performed using SPSS version 25.0 statistical analysis software (IBM Inc., Chicago, IL, USA) while Excel Microsoft Excel®, v16.0, Redmond, WA, USA was also used for data visualisation.

Results

Demographic data of participants

Table 2 shows the demographic characteristics of the participants. All the caretakers were males and almost all were from Egypt (96.7%, P<0.001). Two respondents were from Sudan, but they had been living in Egypt for more than 3 years. Most of them were young; over a quarter were under 20 years old (27.9%, P<0.01), and nearly all were under 50 years old (P<0.01). Most of the caretakers had worked at the market for more than 5 years (93.4%, P<0.001), and about half of them had not previously worked with animals (54.1%, P=0.609). Among those who had previously worked with animals, most had experience with cattle (78.6%) and small ruminants and only 10 had experience with camels.

At the time of the interview, a quarter of the respondents (24.6%) had between 6 and 10 years of experience working with camels (P=0.001), while most of them had more than 10 years of experience (60.6%). Over a third of the respondents (34.4%) had no education, but 27.9% had a high school diploma, and 4 (6.6%) had attended University (P=0.005). Most of the caretakers had learned to take care of the camels from family members (65.6%; P<0.001).

Table 2. Demographic characteristics of participants (n=61). Participants' backgrounds and professional expertise data were collected with a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt. Data are reported as frequency (n), percentage (%) and P value.

Variable	Category	Absolute frequency (N)	Relative frequency (%)	P value
Gender	Male	61	100.0%	.
Age	<20 years	17	27.9%	<0.001
	20-30 years	14	23.0%	
	31-40 years	9	14.8%	
	41-50 years	15	24.6%	
	51-60 years	5	8.2%	
	>60 years	1	1.6%	
Where are you from?	Egypt	59	96.7%	<0.001
	Other (Sudan)	2	3.3%	
When did you start working at the Birqash camel market?	More than 5 years ago	57	93.4%	<0.001
	More than one year ago	4	6.6%	
Did you work with animals before working at the market?	No	33	54.1%	0.609
	Yes	28	45.9%	
	Camels	10	35.7%	-

If yes, which animal have you worked with before (more answers are possible)?	Cattle	22	78.6%	
	Sheep	21	75.0%	
	Goat	19	67.9%	
	Buffaloes	10	35.7%	
	Horses	4	14.3%	
How many years of experience do you have with handling camels?	≤1 year	1	1.6%	0.001
	2-5 years	8	13.1%	
	6-10 years	15	24.6%	
	11-15 years	11	18.0%	
	16-20 years	7	11.5%	
	>20 years	19	31.1%	
What is your educational level?	No school	21	34.4%	0.005
	Elementary	9	14.8%	
	Medium	10	16.4%	
	High school	17	27.9%	
	University	4	6.6%	
Where have you learned to take care of camels?	During this job	13	21.3%	<0.001
	Father, relatives and family business	40	65.6%	
	Friends	8	13.1%	

Origin, use, and general management of camels

Table 3 shows the origin and use of camels and the organisation of the work of caretakers. The camels held by the interviewees had different origins. All respondents reported Sudan as the country of origin of their camels, and many of them also reported Somalia. Some also stated Egypt and other countries such as Kenya, Djibouti, Berbera, Libya, and Ethiopia. Most of the camels were sold at the market only for slaughter (90.2%, P<0.001), and almost all remained at the market for less than one week (33/34, 97.1%, P<0.001).

Only 6 respondents (9.8%, P<0.001) declared that they usually did not share their work with other colleagues, while most of them collaborated with 1-5 people (57.4%, P<0.001). Among the respondents, there were 34 caretakers and 8 owners. The others (n=19, 31.1%) were part-time workers who were hired to help with management and sales operations (e.g., loading and unloading of animals) only on market days. The subsequent questions, specifically related to the usual management of the animals, were addressed only to caretakers. Among them, most took care of just one pen (n=28, 82.4%, P<0.001), but the number of camels they looked after varied from 1 to more than 100 (P=0.275). Most of the respondents declared that the owner decided about the management of the camels (76.5%, P<0.001).

Table 3. Origin and use of camels, and organization of work of caretakers collected with a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt. Data are reported as frequency (n), percentage (%) and P value.

Variable	Category	Absolute frequency (N)	Relative frequency (%)	P value
Origin of camels (more answers are possible)	Sudan	61	100%	-
	Somalia	55	90.2%	
	Egypt	10	16.4%	
	Other	4	6.6%	
The majority of camels are sold at the market for:	Fattening and then selling for slaughter	5	8.2%	<0.001
	Selling for slaughter, selling for breeding	1	1.6%	
	Selling for slaughter	55	90.2%	
How long do the camels usually remain at the market?	One day maximum	3	8.8%	<0.001
	A couple of days / less than a week	30	88.2%	
	More than a week	1	2.9%	
How many people work with you?	No one works with me	6	9.8%	<0.001
	1-5 people	35	57.4%	
	6-15 people	14	23.0%	
	>15 people	6	9.8%	
What is your role within the 'office' (more answers are possible)?	Caretakers	34	55.7%	-
	Handler/seller	19	31.1%	
	Owner	8	13.1%	
How many pens are you taking care of?[a]	more than one	6	17.6%	<0.001
	only one	28	82.4%	
In a busy week, approximately how many camels do you take care daily?[a]	<10 camels	3	8.8%	0.275
	11-30 camels	11	32.4%	
	31-50 camels	6	17.6%	
	50-100 camels	6	17.6%	
	more than 100 camels	8	23.5%	
Who decides about the management of the camels?[a]	I decide what to do based on my experience	5	14.7%	<0.001
	the owner	26	76.5%	
	Both (owner and caretakers)	3	8.8%	

[a]questions addressed only to caretakers

The responses to the questions related to general management practices are shown in Table 4. About half of the respondents reported that camels were not fed ad libitum (20/34, 58.8%; P=0.391), and most of them (12/20) were provided food twice a day

(P=0.021) while water was always available in most cases (24/34, 70.6%, P=0.026). The camels' food management was unaffected by the age of the caretakers (P=0.376), while there was a greater proportion of caretakers under 20 years old (90.0%) choosing to administer water ad libitum than those over 40 years old; most of the over-40s (63.6%), indeed, did not provide water ad libitum (P=0.014). Associations with experience, educational level, and professional training of caretakers were not significant (for all P>0.05).

Most of the respondents (23/34, 67.6%, P=0.026) did not change their management during the summer or on very hot days, as they argued that camels cope very well with heat. One caretaker stated that only camels kept for breeding were offered shade, while the others (10/34, 29.4%) said that they only offered water and/or shelter more often during the summer. Finally, a caretaker declared that he would not change the management during the summer but would offer shelter on rainy days. The handling of the camels during the summer months was unaffected by the age of the caretakers, their experience, educational level, and their professional training (for all, P>0.1).

Most of the respondents (58.8%, P<0.001) stated that they assessed the health of the camels themselves by observing feeding and drinking behaviour. Most of them (n=9, 45.0%) were over 40 years old (P<0.05); moreover, most of them (n=15, 75.0%) had more than 5 years of experience (P<0.05). Thirteen respondents (38.2%) stated that routine checks of animals were not carried out. In particular, this answer was mainly given by respondents younger than 20 years (n=6, 46.2%; P<0.05) and by those with less than 5 years of experience (n=4, 30.8%; P<0.05). No other associations were found with the other demographic variables (for all, P>0.1). Only in one case, the health of the animals was evaluated by a veterinarian.

Over 80% of the respondents declared that vaccinations and deworming were not done (P<0.001) while half of them administered the ectoparasitic to their camels (15/34 themselves and 1/34 by a veterinarian, P=0.003). About half of the caretakers (52.9%; P=0.864) declared that they cared for their sick animals themselves, while the others warned the owner.

Table 4: Feeding, water, and health management camels' data collected with a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt. Data are reported as frequency (n), percentage (%) and P value.

Variable	Category	Absolute frequency (N)	Relative frequency (%)	P value
How often do you feed the camels?	Once a day	4	11.8%	0.021
	Twice a day	12	35.3%	
	Three or four times a day	4	11.8%	
	Always available	14	41.2%	
How often do you water the camels?	Once a day	6	17.6%	<0.001
	Twice a day	4	11.8%	
	Always available	24	70.6%	
Do you make any changes to your common management in summer or during very hot days?	No	23	67.6%	<0.001
	Yes	10	29.4%	
	Only for breeding animals	1	2.9%	
Who assesses the health of the camels?	A veterinarian	1	2.9%	<0.001
	Non-veterinary staff (myself)	20	58.8%	
	Routine checks are not conducted	13	38.2%	
Who administers vaccinations?	A veterinarian	3	8.8%	<0.001
	Non-veterinarian staff (myself)	2	5.9%	
	Not conducted	29	85.3%	
Who administers deworming?	A veterinarian	2	5.9%	<0.001
	Non-veterinary staff (myself)	4	11.8%	
	Not conducted	28	82.4%	
Who administers treatments for ectoparasites?	A veterinarian	2	5.9%	0.003
	Non-veterinary staff (myself)	15	44.1%	
	Not conducted	17	50.0%	
If an animal is sick, what do you do?	Call the owner and he decides	14	41.2%	0.002
	I treat the animals by myself	18	52.9%	
	Both (the owner and myself)	2	5.9%	

Behavioural and health problems of camels

Twenty-one out of 34 respondents (Figure 1) reported that the camels they cared for exhibited behavioural problems (61.8%, P=0.230), in particular biting (8/21 caretakers). Moreover, nine caretakers explained that, in their opinion, the behavioural problems were due to management, such as overcrowding, change of environment, or unnatural environment for the species. When asked whether the camels suffered from behavioural problems, the responses were: "Yes, it depends on the animals you are dealing with", "Yes, due to poor treatment", "Yes, camels are aggressive because people hit them and because they don't have available space as the market is crowded". Other responses explained that the aggressive behaviour was normal for the species (e.g. "Yes, this is the camel's normal behaviour", "Yes, this is normal because it's a wild animal").

Behavioural problems were associated with some demographic characteristics of the respondents. In particular, respondents younger than 20 years (80.0%) and those with more than 10 years of experience reported behavioural problems more often than the other groups (P<0.05). However, behavioural problems were not associated with their educational level and professional training, their ability to identify distress and pain, and camels' water and food management.

Most of the respondents (28/34, 82.4%; P<0.001) stated that camels showed some health problems (Figure 1). Diarrhoea was the most reported health problem (64.7%), followed by injuries (50.0%), respiratory problems (50.0%), colic (32.4%), and muscular problems (29.4%). Skin problems and overheating were reported by less than 10% of respondents.

Caretakers' age was not associated with the reported camels' health problems, while some associations were found with the educational level, the experience, and water management. In particular, overheating was reported more often by respondents with a certain educational level (31.3%; P<0.05). Respondents with more than 10 years of experience reported more respiratory problems (70.0%) but less colic (22.7%) and skin problems (9.1%; P<0.05) than the other groups. A greater proportion of those with less than 5 years of experience reported muscular problems (75.0%; P<0.05). Importantly, overheating problems were reported with a higher proportion (80.0%; P<0.05) by respondents who administered rationed water. Moreover, several associations were found between behavioural problems and health issues. Most of the respondents who claimed the camels had health problems also admitted that they showed behavioural problems (95.2%, P=0.021). In particular, associations with behavioural problems were found for injuries (82.4%, P=0.032), respiratory problems (82.4%, P=0.032), and muscular problems (90.0%, P=0.050). Behavioural problems were also positively associated with the number of pathologies (Md= 1, IQR=1-3 and Md=3, IQR=2-4 health problems for caretakers who did not report and reported behavior problems, respectively; P=0.013).

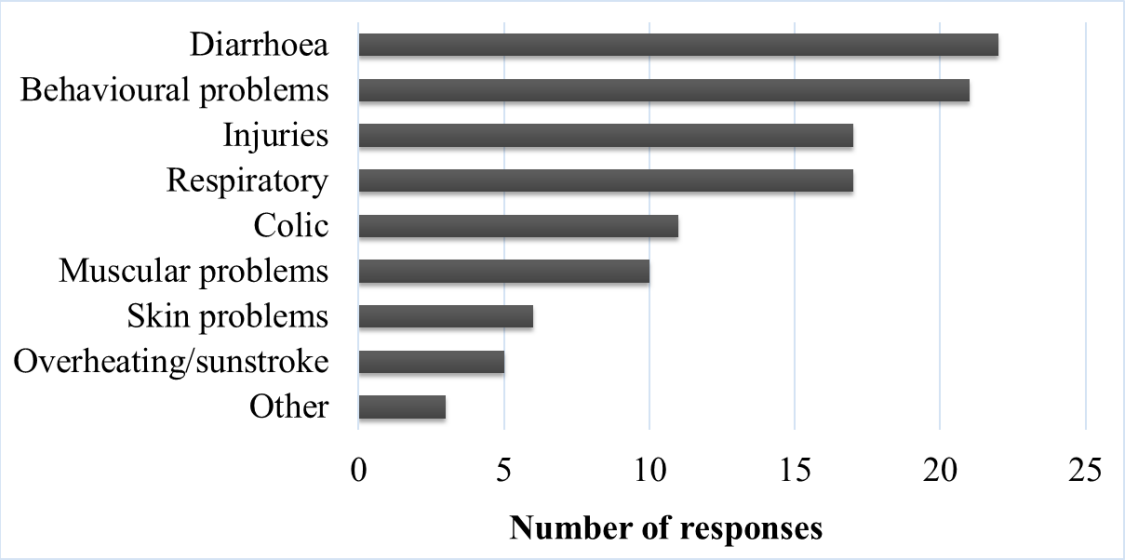

Figure 1: Number of caretaker answers from a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt, that included the different types of pathologies (each handler could give more than one answer; n=34). The number of respondents indicating behavioural problems is also reported.

Animal Welfare

All participants were asked what animal welfare meant to them. In most responses, there were references to good feeding (70.5%). Only a third reported aspects related to good health (32.8%), and even fewer reported aspects of appropriate behaviour (27.9%) and good housing (19.7%). Lastly, 7 interviewees (11.5%) declared that they did not know what animal welfare was (Figure 2).

About half of the respondents defined animal welfare according to two welfare principles (45.9%) and only 5 respondents (8.2%) indicated three principles ($P<0.001$; Figure 3). The welfare perception and the number of welfare principles were not associated with any demographic characteristics, such as caretakers' age and experience, water and feeding management of camels as well as health and behavioural problems of camels (for all: $P<0.1$).

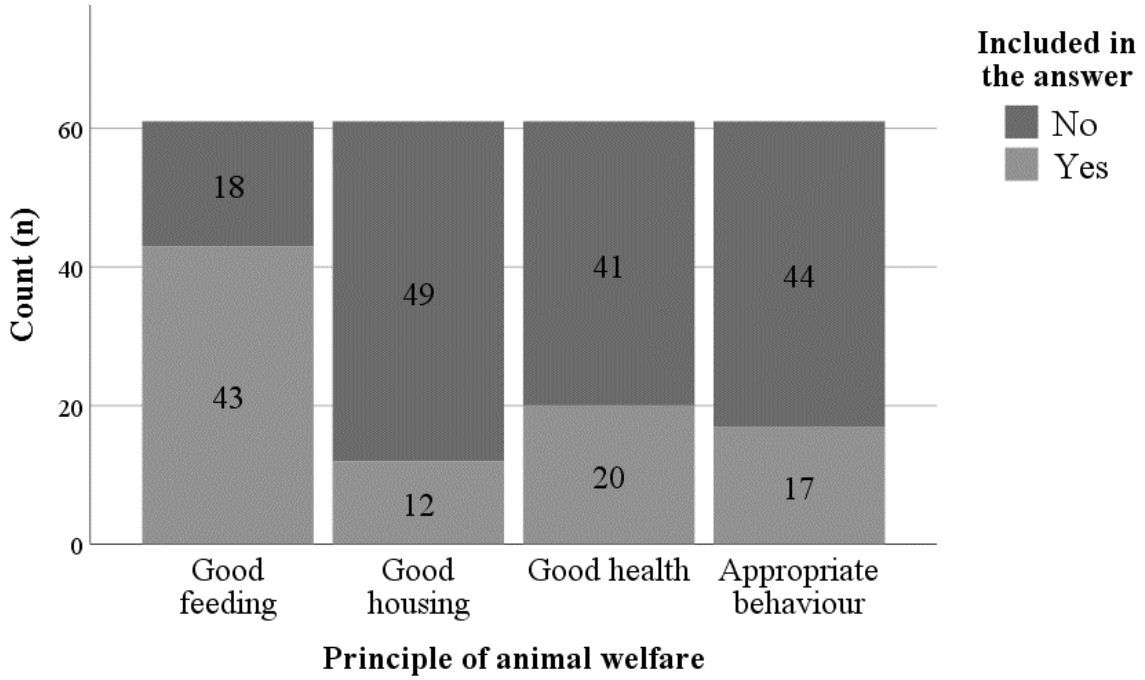

Figure 2: Number of handlers' answers to question 11 'What is welfare to you?' after recategorization of each answer based on the four welfare principles of Welfare Quality® (each answer could be included in more than one principle) from a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt.

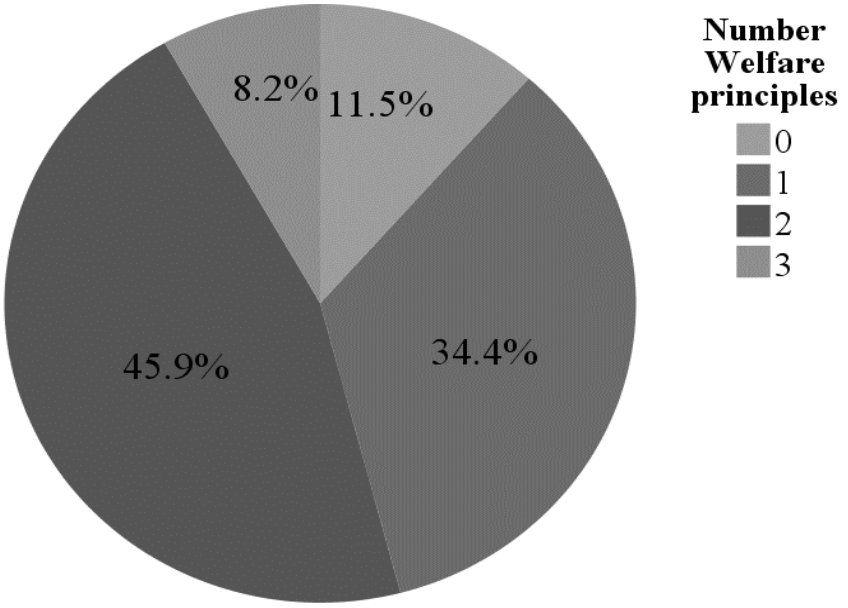

Figure 3: Number of welfare principles covered in the answer of each respondent, from a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt

Ability to identify a camel in distress

Caretakers were asked to indicate their ability to identify a camel in distress/pain (Figure 4). Most of the caretakers judged their ability as "High" (39.3%; P=0.001), followed by "Moderate" (32.8%) and "Very high" (23.0%). Three respondents (4.9%) admitted that their ability was poor. The majority of caretakers older than 40 years (81.0%) and those with more than 10 years of experience (75.7%) reported having a "High" or "Very high" ability to identify an animal in distress/pain (P<0.05). Conversely, the educational level and professional training did not influence this variable (P=0.795).

Respondents who rated their ability to identify a camel in distress/pain as "High" or "Very high" were then asked what criteria they used to identify a camel in distress (Figure 5). The most frequent answer was "from the eyes" (52.6%), followed by feeding behaviour (42.1%) and the inability to walk correctly (i.e., lameness; 34.2%). Other clinical signs, including injuries, shivering, and respiratory problems, were reported by
28.9% of respondents. Fewer than 10 respondents stated that they used signs of colic (28.9%), a long time spent in recumbency (23.7), and behavioural changes (13.2%) to identify a camel in distress or pain.

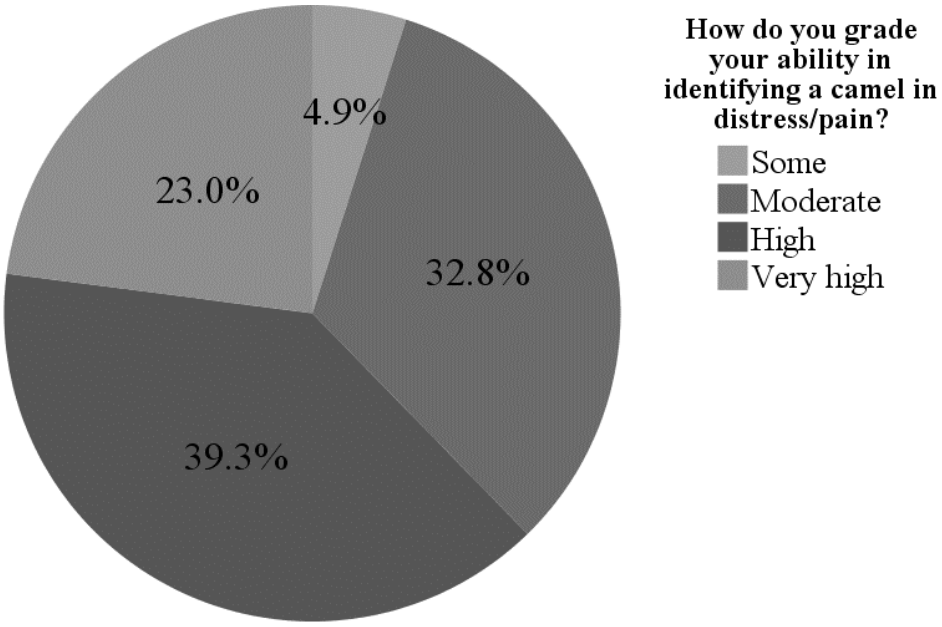

Figure 4: Degree of respondents' ability to identify a camel in distress/pain categorized into 4 categories from "Poor/some" to "Very high". Answers were collected from a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt.

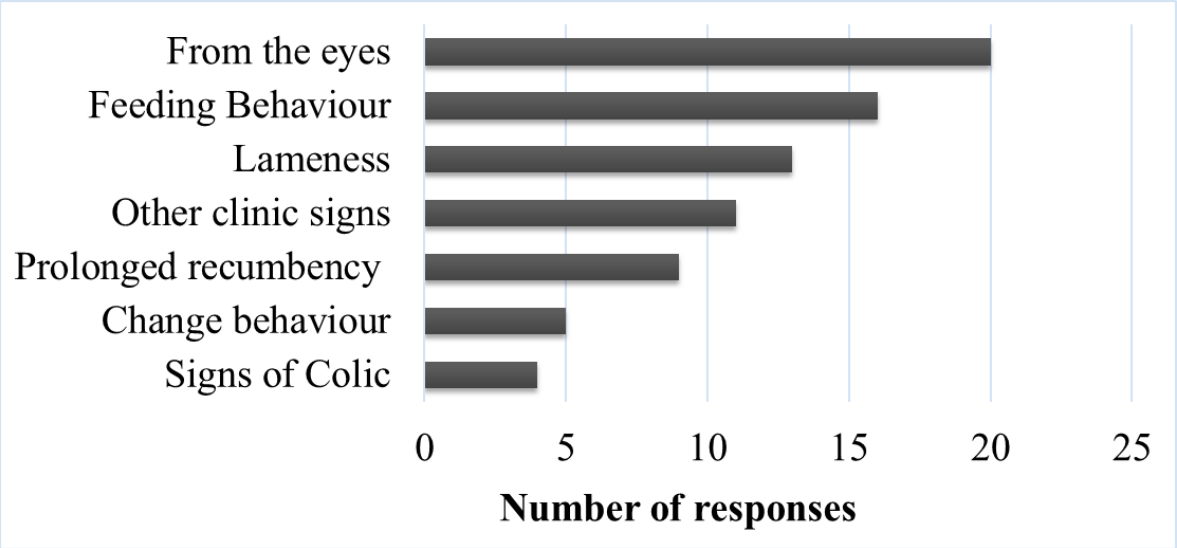

Figure 5: Frequency of criteria used to identify a camel in distress/pain from a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt (more answers were possible).

Question about a camel's latest health issue

Twenty-nine of the 34 caretakers described the latest health problem of their camels. Among these, 7/34 reported respiratory problems (20.6%), 10/34 reported diarrhoea (29.4%), 7/34 reported colic (20.6%), 2/34 reported muscular problems (5.9%), and 4/34 reported other health issues such as overheating, urine retention, eye problems, and blood parasites (Figure 6).

Diseased camels had a median age of 4 years (IQR=3-5 years); most were males (91.7%, P<0.001), and came from Somalia (96.0%, P<0.001). Nine caretakers (34.6%) were unable to explain the aetiology of these pathologies, while the others reported the change of environment and/or food (22.2%), travel (25.9%), the intake of sand (7.4%), and cold air as possible causes (7.4%). Interestingly, 11 caretakers (39.3%) included mishandling or transportation stress as possible causes (Figure 7). Examples of responses related to possible causes of health issues were: "beating", "loading and long travel to the market", "weather, rains, travelling", and "long travel, overloading, eating sand with food". Most of the respondents stated that they had treated the sick animals (93.1%, P<0.001) and only two admitted that the animals were slaughtered without treatment. In most cases (96.3%, P<0.001), the caretakers had chosen the treatment, mostly antibiotics, without consulting the veterinarian. Nearly all claimed that the camels were cured (89.7%, P<0.001).

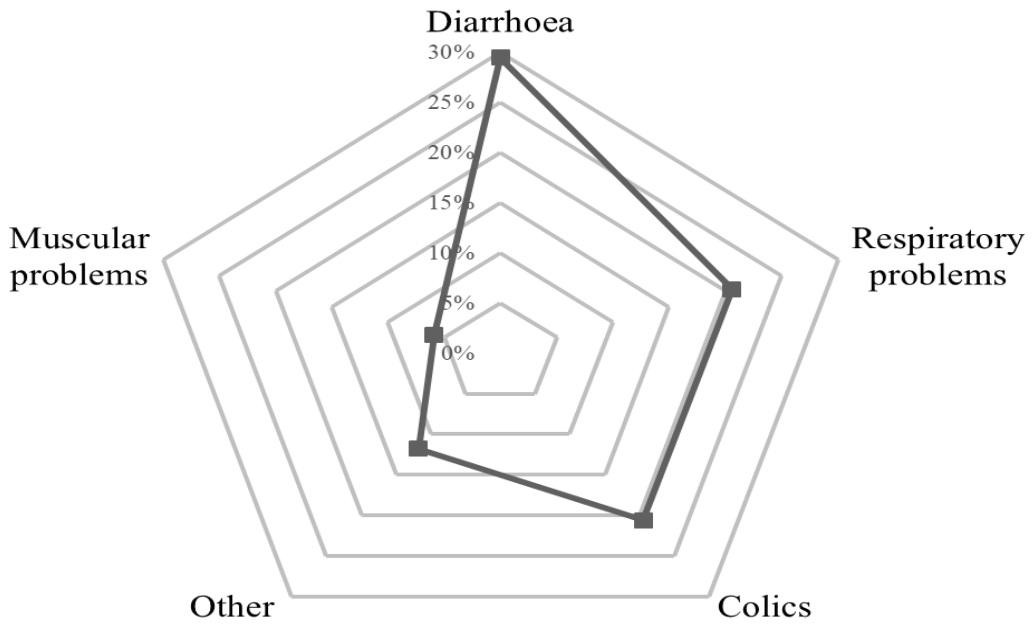

Figure 6: Radar chart showing the distribution of the last health issue observed in camels. The results show the answers given by caretakers to a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt.

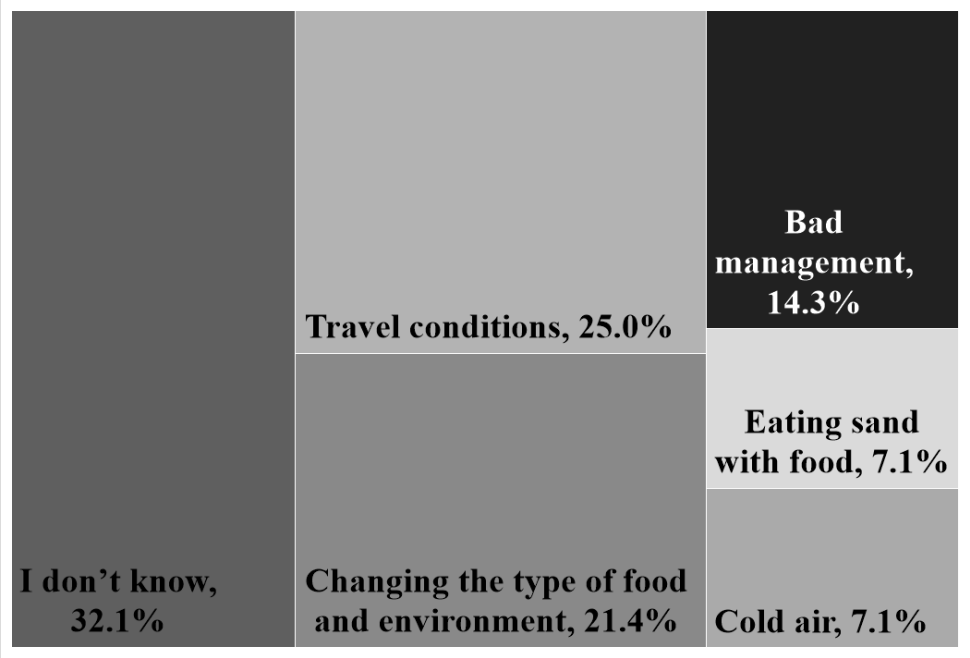

Figure 7: Treemap chart showing the distribution of the possible causes of the health problems in camels reported by their caretakers. The results show the answers given by caretakers to a survey on knowledge and perception of animal welfare conducted at Briqash market, Egypt

Discussion

The present study documented the background of camel caretakers, their perspectives on camel welfare, and potential associations between human-related factors and health and behavioural issues observed in camels within Egypt's largest camel market. Gathering information from camel breeders, owners, and caretakers is instrumental in gaining insights into welfare, husbandry management, and the health status of camels (Padalino and Menchetti, 2021). It is also worth noting that the attitudes, knowledge, practices and behaviour of livestock farmers, and owners are major factors in the prevention and control of animal diseases (Othieno et al., 2022). Global attention to animal welfare offers a chance to enhance animal lives on a massive scale, but it also causes us to consider how animal welfare can be safeguarded throughout the world (Fraser, 2008). The majority of industrialised and developed nations have enacted legislation to protect the welfare of farm animals during different phases of production, transportation, and slaughtering (Fraser, 2008). This is not the case in most developing nations in Africa and Asia, where there are extensive livestock production systems and there is no legislation or standards that govern and protect the welfare of animals. Therefore, our findings may be useful for providing evidence to the policymakers of these countries to encourage them to start regulating.

Demographic data of participants and general management of camels

All camel caretakers interviewed were males, and this outcome aligns with findings from studies conducted in Qatar (Menchetti et al., 2021b) showing that males are the main ones responsible for camel husbandry management. In numerous camel-rearing pastoralist communities, males typically bear the responsibility of managing camel herds (Hussein, 1988; Othieno et al., 2022). Even though most of the caretakers have considerable experience working at the market, half of them have no previous experience working with livestock, which is contrary to the finding of Menchetti et al. (2021b) who reported that almost all caretakers have previous experience with camel rearing activities. As expected, almost all interviewees originated from Egypt, and those who declared to have experience working with camels previously also indicated that they had learned camel handling and management from family members. Egypt is indeed a country where camel rearing has a long history and tradition (Bhakat, 2019; Mansour and Faye, 2016).

In terms of the origin of the camels, Sudan, Somalia, and Egypt were the countries of origin of most of the camels kept in the market, according to the interviewed respondents, and most of the camels in the market were sold for slaughter. Each year, hundreds of thousands of camels are imported into Egypt from countries such as Sudan, Somalia, and Ethiopia, primarily to meet the domestic demand for camel meat (Bauer, 2018; Khan et al., 2020; Napp et al., 2018). The majority of the caretakers mentioned that they manage a single pen with varying numbers of camels. In Qatar, Menchetti et al. (2021b) reported that caretakers used to manage more than one pen with fewer animals compared to this study.

Regarding the management of camels, most of the camels were fed twice a day, while water was always available in most cases. This is not in line with the behavioural needs of this species. Camels are browser animals, but they also graze on long succulent young grass. Dromedaries graze a diverse range of fodder plants, including prickly shrubs, halophytes, and scented species that other domestic herbivores avoid (Iqbal and Khan, 2001). Camels browse and graze on the natural range at any time of the day or night, mostly spending their time walking, searching and

browsing for feed (Iqbal and Khan, 2001); the feeding time of camels can reach up to 15 hours per day to fulfil their dry matter needs (Wilson, 1984). Menchetti et al. (2021b) stated that the provision of food at limited times of the day was a risk factor for both health and behavioural problems. This should be improved, even if the camels stay at the market only for a limited period of time (Al Jassim, 2024). Moreover, better feeding management may help them to recover from transport stress (El Khasmi, 2024).

The majority of the respondents stated that they assessed the health of the camels themselves by observing feeding and drinking behaviours. This is in line with the literature; decreased feed intake, longer resting periods, and lethargy were the behavioural changes that were also indicated by caretakers to identify sick camels in a study conducted in Qatar (Padalino et al., 2021). As expected, age and experience were associated with the assessment of the health of the camels under the responsibility of the caretakers. Lamuka et al. (2017) in their study also indicated that there was a correlation between age and pastoralists' knowledge and information on treating camels. This could be explained because the more years the camel caretakers have been working, the more likely they are to have a better understanding of the camels' behaviours and health status. It is recommended that livestock handlers, owners or stockmen should be trained, be experienced, and show compassion towards the animals under their care, so that they can easily identify health and other welfare problems and take necessary corrective actions. Livestock in any production system should be checked regularly by experienced staff to detect if there is any condition that hampers their well-being (Madzingira, 2018).

Behavioural and health problems of camels

Most of the caretakers reported that camels showed behavioural problems like biting. This is in line with another study conducted at a camel market (Menchetti et al., 2021b). It is worth noting that, in our study, some caretakers explained that, in their opinion, the behavioural problems were due to improper management conditions, such as overcrowding, change of environment, or unnatural environment for the species. This suggests that some of the caretakers in this study understand better the specific behavioural and management needs of camels. Camels are social, calm, and peaceful herd animals that have a strong bond within the group (Nagy et al., 2022). They are docile animals, but there are exceptions to the docile behaviours of camels, especially when their handling is not friendly, or the handler has no knowledge, is unsympathetic, or has a bad temperament (Dorman, 1984). Camels share many similarities with other ruminants, but they have separate species needs due to their differences in anatomy, physiology and behaviour (Faye, 2016). They need proper space to exercise, like walking, which is their innate behaviour (Previti et al., 2016). In domestic animals, space and social restrictions have an effect and result in excitement, aggression, and behavioural problems (Beerda et al., 1999; Menchetti et al., 2021a). Finally, it is also well-known that animals may show fear- and pain-induced aggression (Camps et al., 2019; Houpt, 2018). Therefore, our findings suggest that the aggressive behaviours reported could have been mainly due to pain, health problems and frustration, possibly caused by the lack of appropriate handling and management at the examined market.

Many health problems have been reported by the caretakers, and diarrhoea was one of the most frequently reported. There are many causes of diarrhoea in camels, such as fear and stress, but also bacteria such as *Escherichia coli* (ETEC) (Chauhan and Kaushik, 1991), *Proteus mirabilis, Pseudomonus aurogenosa, Proteus morgani, Pseudomonus fluorescence, Salmonella typhi, Actinobacillus, Sporothrix*

shenkii, and parasites such as Eimeria cameli, Trichostrongylus and Haemonchus spp (Sayed et al., 1998). Epidemiological studies in different countries reported that diarrhoea is one of the major causes of camel mortality (Agab, 2006; Al-Ani et al., 1998; Ali et al., 2005). Injuries and respiratory problems were also reported as a high percentage. The high occurrence of respiratory problems such as pneumonia could be explained by the presence of many well-known predisposing risk factors, including inappropriate handling, transportation, mixing and overcrowding (Bornstein et al., 2002). Considering that the majority of these camels were transported over long distances in bad conditions, it is therefore not surprising that many cases of respiratory disorders were reported.

Additionally, diseases such as bovine viral diarrhoea virus (BVDV) and Rift Valley fever virus (RVFV), which are known to cause reproductive and respiratory manifestations, have been reported in camels that were imported from Sudan to Egypt (El Bahgy et al., 2018). Overheating was more rarely reported, but it was associated with the lack of watering ad libitum, and it could also be caused by the lack of shelter (Zappaterra et al., 2021) or the transport induced dehydration (Padalino, 2015). It is indeed worth noting that camels stayed not more than a week in the market, and they were immediately sold for slaughtering, without any resting and recovery from the stress of the travel. It can be explained that most of the injuries and diseases that were reported by the caretakers were associated with transportation. Transportation of animals has severe consequences, resulting in stressful conditions and leading to a lowering of the well-being of animals (Saeb et al., 2010).

There is a high risk of the spread of infectious disease transmission, and animal health can be impaired by various pre-transport and transport handling and may cause physical injury, minimise the performance of animals, and result in the development of diseases in animals (Hartung, 2003). Transportation has a significant effect on the physiology and behaviours of camels and is a very stressful activity (Emeash et al., 2016; Padalino, 2015; Youssef et al., 2015). It is therefore recommended that the journey conditions of these animals should improve to safeguard their health and welfare during and after transportation, not only for them but also for the well-being of the people who may eat their meat (El Khasmi, 2024).

In the current study, several associations were found between behavioural problems and health issues. This was expected, as pain can cause many behavioural and physiological changes (Sneddon and Gentle, 2000). Health problems are the main cause of pain in farm animals (McLennan, 2018). Pain is an emotional and sensory experience in which the animal is aware of the damage that is inflicted on its tissues (McLennan, 2018; Molony and Kent, 1997). Therefore, pain results in a behavioural and physiological change in animals to avoid the painful situation, recover from pain, or minimise the recurrence of pain (Molony and Kent, 1997; Sneddon and Gentle, 2000). This could explain the reason why camels with health problems show abnormal behaviours in the market.

Animal welfare and ability to identify a camel in distress

Evaluating the perspectives of livestock keepers regarding animal welfare is an important process in determining farmers' efforts to improve farm animal welfare, knowledge of which is particularly important for understanding how the living conditions of production animals are determined (Hansson and Lagerkvist, 2014). Concerning the knowledge and attitude of caretakers regarding animal welfare, only limited respondents related good animal welfare with good health, appropriate behaviour, and good housing. These findings indicated that none of the respondents had a full understanding of

what animal welfare is. A similar study by Menchetti et al. (2021b) in Qatar reported that caretakers working in the market have difficulty understanding questions related to the concept of animal welfare, and the respondents related animal welfare with treating the animals gently and feeding them only. In different studies, farmers, pastoralists, and livestock keepers in the developing world commonly relate animal welfare with health, feeding, and appropriate shelter, and almost all lack the full understanding of what welfare is (Alemayehu et al., 2022; Lemma et al., 2022).

In the current study, caretakers have indicated their ability to identify a camel in distress/pain as "High". Specifically, caretakers with more experience have a very high capacity to identify animals in distress/pain. This is in line with the literature, as it was already reported that older people were more confident in their ability than younger ones in identifying camels in distress/pain (Menchetti et al., 2021b). The studied camels were exposed to many stressors, such as transportation and mishandling, including hitting, high voices, and shouting. In livestock production, one of the aims of livestock keepers is to maintain the good health of their herds and identify sick animals (Lawal-Adebowale, 2020). Therefore, caretakers must be able to identify pain and distress to prevent prolonged suffering. Interestingly, the eye was suggested as a way to recognise distress and pain. Unfortunately, there are no pain scales for dromedary camels (Dioli, 2022; Padalino and Menchetti, 2021), but facial expressions, including the eye region, are currently used in other species (Dalla Costa et al., 2014).

Question about a camel's latest health issue

The last cases of camel health problems included respiratory problems, diarrhoea and colic, and travel was mentioned as the most important cause of these health problems. Egypt is a country that imports live camel more than it produces locally (Ashour and Abdel-Rahman, 2022). Thousands of camels are imported from Somalia and Sudan every year, to fulfil the meat demands of the country. Most of the camels are transported by sea and road to different markets where they are sold to different slaughterhouses within short periods (Bauer, 2018). The travel is extremely long and exhausting, and some camels do not survive the hardship. Transportation is a stressful process that exposes animals to environmental stress, which could be warm, cold, humidity, noise, motion, and unfamiliar social regrouping. In addition, the handling, loading, unloading, and confinement conditions during transportation lead to distress, physical injury, and mortality, especially when the travel is not properly managed (Asmare, 2014).

Another finding discovered in the last section of the interview was that most of the respondents stated that they used antibiotics without consulting a veterinarian to treat sick camels. In a study conducted by Padalino et al. (2021) in Qatar, similarly, caretakers administered drugs by themselves to sick camels. It is a very common practice in developing regions of the world that livestock farmers and pastoralists treat their animals using different drugs by themselves, in most cases without the consultation of an animal health professional (Alhaji and Isola, 2018; Caudell et al., 2017; Gemeda et al., 2020; Padalino et al., 2021). A study conducted in Kenya (Lamuka et al., 2017) reported that most pastoralists administer drugs themselves to their camels and choose drugs based on their own experience or the advice of the attendant at a drug shop. The use of antimicrobials without proper knowledge, or protocol and advice from animal health professionals results in the misuse of antimicrobials which leads to antimicrobial resistance in animals and humans (Alhaji and Isola, 2018; Padalino et al., 2021). It is therefore recommended to minimise the health problems and their treatments by

improving transport and market management, where a constant presence of official veterinarians could be beneficial.

The findings of this study should be interpreted with caution since it was a survey-based interview. As stated by Dean (2015), limitations related to survey-based studies could be sampling bias, non-response bias, recall bias, and social acceptability bias. All these factors may confound the interpretation of interview and survey data, and all may apply to this study. Disease, health, and behavioural problems may not be properly described and identified by the respondents, and this may lead to the diagnosis and distribution of the problem as over or under-estimated. In addition, in face-to-face interviews, the respondents may not be freely speaking their minds and may have reservations about answering the questions, and this may have affected the accuracy of our data. Even though the data were collected from a single big camel market, the data could be too small to represent the situation of the camel market industry in the whole country. Notwithstanding the above-mentioned limitations, our study has enhanced our knowledge about camel handling, management, and welfare aspects in Egypt.

In conclusion, this study documented the workers' background, the camel management and related issues and their possible associations at one of the largest camel markets in the world. Most of the workers said they recognised camel pain/distress with very high ability, but none of them had a complete understanding of animal welfare. Most of the camels were reported to have behavioural and health problems, which often were positively associated with each other. Transport conditions and inappropriate handling were identified as the most common cause of those problems. The responsible stakeholders should implement the necessary strategies to improve the situation on the ground, including education on camels' behaviour and welfare for all people who handle and manage camels. Workshops/training on appropriate handling should be organized to increase the camel-human relationship. Regulation on the protection of the welfare of camels during transport and at markets should be implemented. Veterinarians and official veterinarians should be regularly at the market to treat the camels and protect their welfare.

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Conflict of interest

The authors declare no conflict of interest.

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Author Contributions

Conceptualization, B.P.; methodology, B.P., L.M. and A.Z.; formal analysis, L.M. and B.P.; data curation, B.P., A.Z., B.B., and L.M.; writing—original draft preparation, B.P. and N.T.M.; writing—review and editing, L.M., B.B.; project administration, B.P.; funding acquisition, B.P

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