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Original

One Welfare for all: Associations between sheep welfare indicators and producers' mental health

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ABSTRACT

Objective. The objective of this observational cross-sectional study was to investigate associations between sheep farmers' mental health scores for stress, anxiety, depression, and resilience, and sheep welfare indicators. **Materials and methods.** Twenty-two sheep farms in the Colombian departments of Boyacá, Cundinamarca, Tolima, and Meta, were visited on a single occasion. Clinical health, cleanliness, and calmness of randomly selected sheep per farm were scored to identify the number of animals with different welfare problems such as lameness, hoof overgrowth, and mastitis. A face-to-face interview with the farmer was performed to gather demographic information (farm size and year of establishment, gender, age, role at the farm, and education) and to complete validated psychometric scales to assess resilience, stress, anxiety, and depression. Linear regression models were used to evaluate associations between farmers' mental health scores, demographic aspects, and within-flock prevalence of sheep welfare indicators. **Results.** A total of 427 sheep were evaluated across different farms. The most prevalent welfare problems were hoof overgrowth (40.9%) and dirty fleece (32.9%); the least prevalent were clinical mastitis (1.3%) and respiratory issues (1.2%). Farmers' stress level was positively associated with the prevalence of clinically lame sheep and farm size. Anxiety was positively associated with the prevalence of sheep with dirty fleeces, clinical lameness, and with being a female farmer. Depression was positively associated with the prevalence of hoof overgrowth. **Conclusions.** Findings showed that higher levels of stress, anxiety, and depression among farmers were associated with the presence of animal welfare problems, larger farms, and gender.

Keywords: Animal health; human; mental status; One welfare; ovine; well-being (*Sources: CAB, MeSH*).

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RESUMEN

Objetivo. El objetivo de este estudio observacional-transversal fue investigar asociaciones entre puntajes de salud mental para estrés, ansiedad, depresión y resiliencia de ovinocultores, e indicadores de bienestar ovino. **Materiales y métodos.** Veintidós fincas ovinas en los departamentos colombianos de Boyacá, Cundinamarca, Tolima y Meta, fueron visitadas una sola vez. Se evaluó salud clínica, limpieza y tranquilidad de ovejas seleccionadas al azar por finca para identificar número de animales con diferentes problemas de bienestar, como cojera, sobrecrecimiento de pezuñas, y mastitis. Se realizó una entrevista cara-a-cara con el productor para recopilar información demográfica (tamaño y año de establecimiento del sistema, género, edad, rol en la finca y educación) y completar las escalas-psicométricas validadas para evaluar resiliencia, estrés, ansiedad y depresión. Se utilizaron modelos de regresión lineal para evaluar asociaciones entre las puntuaciones de salud mental de los productores, aspectos demográficos y prevalencia a nivel-de-rebaño de indicadores de bienestar ovino. **Resultados.** Se evaluó un total de 427 ovejas entre todas las fincas. Los problemas de bienestar más prevalentes fueron sobrecrecimiento de pezuñas (40.9%) y suciedad del vellón (32.9%); los menos prevalentes fueron mastitis clínica (1.3%) y problemas respiratorios (1.2%). El nivel de estrés de los productores se asoció positivamente con la prevalencia de ovejas clínicamente cojas y el tamaño del sistema. La ansiedad se asoció positivamente con la prevalencia de ovejas con vellón sucio, cojera clínica y con ser una productora mujer. La depresión se asoció positivamente con la prevalencia de sobrecrecimiento de pezuñas. **Conclusiones.** Los hallazgos mostraron que niveles altos de estrés, ansiedad y depresión en los productores se asociaron con la presencia de problemas de bienestar animal, fincas más grandes y género.

Palabras clave: Estado mental; humano; salud animal; Un bienestar; ovino (*Fuentes: CAB , MeSH*).

INTRODUCTION

Interactions between animals and stockpersons are immersed in the dynamics of animal production systems (1). The intensity and type of interaction vary according to the system and species involved, but also depend on human features such as familiarity with the animal, skills, and attitude (2). The nature of these interactions and the human-animal relationship (HAR) are important factors that impact animal welfare in terms of the positive or negative affect that the animal experiences and its consequences on health and production (3,4). In the case of sheep, they establish a strong bond with their shepherd from early life, and this bond helps them to cope better with stressful situations (e.g., isolation from the herd) as long as the shepherd is present (5). Moreover, a positive HAR (defined as "a positive perception by the animal of the human" (2)) has also remarked benefits on humane welfare (6), including work motivation and satisfaction (7).

The well-being of farmers (i.e., any person looking after livestock including the owner of a farm, a family member, or a stock person employed at the farm; FAWC, 2016) can affect their attitude and behavior towards animals and thus, the nature of the HAR. Farmer's poor mental health can cause a lower capacity of ensuring good animal welfare standards at the farm (6). Pioneering studies in Ireland and Denmark have shown anecdotal (8) and empirical evidence (9,10) of the link between farmers' mental health and animal welfare, where farmers with problems such as high stress, depression, or addictions, presented problems of high animal mortality rates and negligence in providing adequate feeding and pain prevention/control in their farms. In a recent study (11) researchers examined the connections between Canadian dairy farmers' mental health and gender and health indicators for dairy cows, and found a positive association between the level of stress and anxiety perceived by the farmer and the prevalence of lameness, as well as with being a female farmer. Regarding the link between sheep and farmers' welfare, there is little information available, but in an opinion report given by the Farm Animal Welfare Committee (United Kingdom) (6), it has been stated that when farmers' capacity to care for their sheep is reduced due to poor mental health, the main animal welfare issues that result would be inadequate feeding and control of parasites, increased lameness, poor fleece cleanliness, poor body condition score, and increased mortality.

The promotion of good mental health for farmers has been suggested as a strategy to enhance farm animal welfare (11). Worldwide, there is

a need for developing research that integrates the concept of One Welfare and investigates the connection between animal welfare and human well-being (12) as farmers' mental health is becoming a priority (13). In Colombia, one study has been done among sheep farmers in the department of Caldas that found that job satisfaction (which could be used as one indicator of emotional well-being) had a negative association with the flock flight distance, i.e., the more satisfied the farmer felt with his work, the less reactive and fearful the sheep at the farm were (14). However, there is scarce information about Colombian sheep farmers' mental health and the implications on their sheep welfare. Therefore, the objective of this study was to investigate associations between farmers' mental health scores for stress, anxiety, depression, and resilience, and sheep welfare outcomes.

MATERIALS AND METHODS

This observational cross-sectional study was assessed and given approval by the AGROSAVIA Ethics Committee and by the Ministry of Agriculture and Rural Development (Project No. 1002090).

This study was carried out in the departments of Boyacá and Cundinamarca (central part of the eastern mountain range of the Andes – High Tropics), and Tolima and Meta (central mountain range of the Andes and the eastern plains, respectively – Low Tropics), in Colombia. Twenty-two sheep farmers participated in this study (11 farms located in the High Tropics and 11 in the Low Tropics). Sheep production systems were selected for convenience based on the willingness of producers to participate. All farmers were fully informed about data collection methods regarding animal measurements and face-to-face interviews, and gave their consent to use the data (handled anonymously). However, farmers were unaware of the final purpose of the study (i.e., identify associations between their mental health and sheep welfare). Each production system was visited only once between September and November, 2021.

Animal measurements. The number of animals to assess per farm (n) was calculated assuming an overall prevalence of 15% for any welfare problem, a confidence level of 95%, and a desired precision of 10% (WIN EPISCOPE 2.0) (15). The assumed prevalence was determined based on research that has shown the prevalence of major welfare problems in sheep to be around that value (e.g., the prevalence of lameness, dirty fleece, injured animals and respiratory problems were 15%, 14%, 13% and 11%, respectively (16), and the prevalence of anemia was 14% (14)). The required sample size (n') per farm was adjusted using the finite population correction formula (17):

$$n' = 1/(1/n+1/N)$$

Where n = the original estimated sample size in an infinite population and N = farm size (total number of animals per farm) (17).

Proportional sampling by lots present at each farm was used to randomly select the animals to be inspected per production system. All measurements took place in a handling pen where sheep could be restrained (18). Once restrained, each animal was inspected to determine age (by assessing their teeth), then body condition score (BCS) was evaluated by palpating the spine by the loin region and classifying animals using a 5-point scoring system, where 1 was considered emaciated and 5 was considered obese. Fleece cleanliness was evaluated using a 3-point scale, where 1 was considered clean and dry, and 3 was considered very wet and filthy. Fecal soiling was evaluated using a 5-point scale, where 1 was considered no fecal soling present (wool around the breech area and under the tail is clean) and 5 was considered extensive soiling (soiling and dags extending down the legs reaching the hocks) (19).

Injuries were classified as absent (0 = no evidence of skin lesions to any part of the body including legs, head, eyes, and ears) or present (1 = evidence of lesions). Ocular secretion was classified as absent (0 = no evidence of eye discharge) or present (1 = evidence of eye discharge). Respiratory issues were evaluated, as present or absent, by observing the breathing of the animal (easy or with effort), the presence of breading sounds, cough, and nasal discharge. Mucosa color (at the conjunctiva) was evaluated to identify the presence of anemia using the FAMACHA© 5-point scoring system, where 1 was considered a not anemic animal (red conjunctiva) and 5 was considered a severely anemic sheep (white conjunctiva) (20). Hoof overgrowth was scored as either present on at least two legs (score of 1) or appropriate hoof condition (score of 0). Clinical mastitis was specifically assessed in lactating ewes by observing and palpating the udder in search of redness and changes in udder

appearance (lumps, hardness, and swollen and warm quarters), and it was classified as present or absent. Once the animal was released, lameness was evaluated by scoring locomotion while sheep walked away using a 3-point scoring chart, where 0 = no lame, 1 = mild lameness, and 2= severely lame. Additionally, sheep temperament was evaluated as animals were released and classified as calm, alert, uncomfortable, or depressed. All animal observations were carried out by trained veterinarians.

Farmers' mental health. A face-to-face interview with the farmer was performed (after collecting animal-based variables) to gather information about demographic factors (gender, age, level of education, role at the farm [owner, worker], year of establishment of the farm, and geographic location) and farmers' mental health. For the latter, the farmer completed a survey composed of validated psychometric scales to identify perceived levels of stress, anxiety, depression, and resilience, see King et al. (11) for details. Briefly, the Perceived Stress Scale (21) is a 10-item scale with questions regarding feelings and thoughts experienced during the last month (measuring "the degree in which situations in one's life are appraised as stressful") (22); each question was scored using a 5-point (0-4) scale and the total maximum score possible was 40 (indicating the highest level of perceived stress). The Perceived Anxiety and Depression Scale (23) is a 14-item scale divided into two subscales (one for anxiety and one for depression, each with 7 questions) that measure feelings and thoughts (e.g., "restlessness, anxiety, mood changes, loss of interest and diminished pleasure response") experienced during the last week; each question was scored using a 4-point (0-3) scale and the total maximum score possible was 21 for each subscale (indicating the highest level of perceived anxiety or depression, respectively). The Perceived Resilience Scale (24) had 10 questions regarding stress-coping ability, adaptation to change, and problem resolution; each question was scored using a 5-point (0-4) scale and the total maximum score possible was 40 (indicating the greatest level of resilience).

Data management and Statistical Analysis. Animal and farm-level analog data were digitized into Microsoft Excel (Microsoft Corp., Redmond, WA) for data organization and cleaning; then, digital data was uploaded into SAS® Studio (Cary, NC, USA) (25). Within-flock prevalence of animals with skin injuries, ocular discharge, respiratory issues, anemia (animals with FAMACHA score ≥ 4), clinical lameness (animals with mild or severe lameness), hoof overgrowth, and clinical mastitis, as well as the prevalence of under-conditioned sheep (animals with BCS < 2), over-conditioned sheep (animals with BCS > 4), sheep with dirty fleece (animals with fleece cleanliness score > 0), sheep with severe and extensive fecal soiling (score > 3), and calm sheep during handling were calculated. Within-flock prevalence data set was merged (by farm) with the farm-level data set (which contained information regarding demographics and mental health of farmers). Descriptive statistics included percentage, 95% CI, mean, standard deviation (SD), and range (min-max). Prevalence of respiratory issues and clinical mastitis were not included in the analysis due to lack of variation.

Mixed linear regression models were used to evaluate associations between farmers' mental health scores (four outcomes of interest: stress, anxiety, depression, and resilience score), demographic aspects (farm size, gender, age, role, education, and year of establishment) and within-flock prevalence of welfare indicators (independent variables). Adjusting for clustering was done by including the variable geographic location (Low vs. High Tropic) as a random effect. Only those independent variables that were significant (liberal $p<0.2$) in the univariable regression analysis were offered to the multivariable model. Collinearity between independent variables was tested using the Pearson correlation coefficient, one of the variables with a coefficient ≥ |0.7| was excluded from the analysis. Prevalence of clinical lameness and injured animals were correlated, as well as the prevalence of under and over-conditioned sheep, thus, the prevalence of clinical lameness and under-conditioned sheep were chosen for the multivariable analysis. The significance of the quadratic term was used to check the linearity of continuous variables. If the quadratic term was significant, dichotomization of the variable was performed based on the mean. The assumption of linearity was not met for the prevalence of clinical lameness and farm size; therefore, these variables were dichotomized, remaining as high prevalence of clinical lameness (>5%) vs. low (≤5%), and large (>65 animals total) vs. small (≤65 animals) farm. Backward elimination was used as the model reduction and variable selection strategy, remaining only statistically significant variables ($p\leq0.05$) or confounders. A confounder was a variable that "caused at least a 20% change to the coefficient of a statistically significant variable when removed from the

model" (26). The fit of the models was assessed by visually inspecting plots from conditional residuals (which incorporate the EBLUPs [empirical best linear unbiased predictions]).

RESULTS

Farmers' demographics and mental health, and farm features. The majority of the farmers interviewed were also the owners of the production system, were male (81.8%), and had at least an undergraduate university degree (72.7%). Table 1 describes the socio-demographic aspects of the producers in detail. The average number of animals per system (including empty, pregnant, and lactating ewes, lambs [< 12 months], and breeding males) was 65 sheep, thus, 36.3% of farms were classified as large farms (95% CI: 16.2–56.4%).

Table 1. Distribution of socio-demographic aspects of sheep farmers (n=22) in Colombia as well as the results of the psychometric scales of perceived levels of stress, anxiety, depression, and resilience.

Variable	Percentage	95% CI[a]	n
Gender			
Female	18.2	5.2–40.3	4
Male	81.8	59.7–94.8	18
Age (years)			
18 a 30	9.1	1.1–29.2	2
31 a 45	40.9	20.7–63.6	9
46 a 60	40.9	20.7–63.6	9
> 60	9.1	1.1–29.2	2
Farm role			
Owner	81.8	59.7–94.8	18
Worker	18.2	5.2–40.3	4
Level of education			
Primary	0		0
Secondary	22.7	7.8–45.4	5
Undergraduate	50	28.2–71.8	11
Postgraduate	27.3	10.7–50.2	6
Geographic location[b]			
High Tropics	50	29.1–70.9	11
Low Tropics	50	29.1–70.9	11
	Mean(± SD)	**Min - Max**	
Farm size (number of animals)	65 (±45)	14-182	22
Years of operation[c]	12.4(±9.4)	0-41	22
Total Perceived Stress Score	14.0(±4.2)	6-21	22
Total Anxiety Score	5.3(±3.1)	0-12	22
Total Depression Score	1.8(±2.1)	0-9	22
Total Resilience Score	33.2(±4.7)	19-40	22

[a]Confidence interval. [b]High Tropics: farms located in Boyaca and Cundinamarca, Low Tropics: farms located in Meta and Tolima. [c]Number of years that the farm has been operating.

In all farms, regardless of size, the work was done by one person (the person interviewed). All farms had a mixture of breeds, but the predominant breeds were Katahdin (36%; n=8) and Hampshire (23%; n=5), followed by Pelibuey (9%; n=2) and Santa Inés. (9%; n=2). The average year of establishment of the productive systems was 2008 (range: 1980 to 2021). The average perceived stress, anxiety, depression, and resilience score for farmers were 14, 5.3, 1.8, and 33.2, respectively.

Animals and prevalence of welfare problems. A total of 427 sheep were evaluated across the 22 farms (19 ± 4 animals on average per farm), 66% were female (n = 282) and 34% were male (n = 145); 28% of the total animals were less than one year old; among the rest, the average age was 2.8 ± 1.3 years (range: 1 to 7 years old).

Table 2 summarizes the mean flock-level prevalence and range across farms for each of the assessed animal-based variables. The most prevalent problems identified were hoof overgrowth and dirty fleece, while the least prevalent were clinical mastitis and respiratory issues.

Table 2. Farm-level prevalence of sheep health and behavioral indicators.

Prevalence (%)	Mean (± SD)	Min - Max
Clinical lameness	5.3 (± 8.2)	0 – 31.2
Hoof overgrowth	40.9 (21.2)	4.2 - 100
Clinical mastitis	1.3 (± 2.6)	0 – 7.7
Injured animals	15.2 (± 18.5)	0 – 56.2
Animals with severe faecal soiling	8.6 (± 19.4)	0 – 72.7
Animals with dirty fleece	32.9 (± 22.4)	0 – 86.7
Respiratory signs	1.2 (± 2.3)	0 – 6.7
Ocular discharge	12.3 (± 19.2)	0 – 73.3
Anemia	14.8 (± 11.8)	0 – 46.7
Under-conditioned sheep	28.4 (± 19.1)	0 - 73.9
Over-conditioned sheep	20.1 (20.1)	0 – 81.8
Calm sheep after handling	23.2 (± 33.5)	0 – 87.5

Associations between sheep welfare indicators and farmer mental health. The perceived level of stress by farmers was higher among farmers with a high prevalence (>5%) of clinically lame sheep and for those with a larger farm (Table 3). The perceived level of anxiety

was positively associated with the prevalence of sheep with dirty fleece, a high prevalence (>5%) of clinically lame sheep, and with being a female farmer (Table 4). A greater depression score was associated with a higher prevalence of sheep with hoof overgrowth (Table 5). No associations were found for the perceived level of resilience.

Table 3. Final multivariable linear regression model[1] of factors associated with the perceived level of stress[2] by sheep farmers in Colombia (n=22).

Variable	β[a]	95% CI[b]	SE[c]	P-value
Clinical lameness[d], *high vs. low prevalence*	3.92	0.06 – 7.79	1.84	0.04
Farm size[e], *large vs. small*	3.32	(-0.04) – 6.69	1.60	0.05
Intercept	11.94	(-1.32) – 25.21	1.04	---

[1]Adjusted by geographic location as a random effect (High Tropics: farms located in Boyaca and Cundinamarca, Low Tropics: farms located in Meta and Tolima). [2]Measured using a Perceived Stress Scale composed of 10 questions regarding feelings and thoughts experienced during the last month, each question was scored using a 5-point (0-4) scale and the total maximum scored possible was 40 (indicating the highest level of perceived stress). [a]Regression coefficient. [b]Confidence interval for the coefficient. [c]Standard error. [d]Prevalence of clinical lameness: high >5%, low ≤5%. [e]Farm size: large > 65 animals total, small ≤65 animals total.

Table 4. Final multivariable linear regression model[1] of factors associated with the perceived level of anxiety[2] by sheep farmers in Colombia (n=22).

Variable	β[a]	95% CI[b]	SE[c]	*P*-value
Prevalence of sheep with dirty fleece, %	0.04	0.004–0.08	0.02	0.03
Clinical lameness[d], *high vs. low prevalence*	5.23	2.97–7.59	1.09	0.0002
Gender of producer, female vs. male	4.80	2.23–7.37	1.22	0.001
Intercept	1.81	(-10.42)–14.04	0.96	---

[1]Adjusted by geographic location as a random effect (High Tropics: farms located in Boyaca and Cundinamarca, Low Tropics: farms located in Meta and Tolima). [2]Measured using a Perceived Anxiety Scale composed of 7 questions regarding feelings experienced during the last week, each question was scored using a 4-point (0-3) scale and the total maximum scored possible was 21 (indicating the highest level of perceived anxiety). [a]Regression coefficient. [b]Confidence interval for the coefficient. [c]Standard error. [d]Prevalence of clinical lameness: high > 5%, low ≤ 5%.

Table 5. Univariable linear regression model[1] of the association between the prevalence of sheep with hoof overgrowth and the perceived level of depression[2] by sheep farmers in Colombia (n=22).

Variable	β[a]	95% CI[b]	SE[c]	*P*-value
Prevalence of hoof overgrowth, %	0.03	0.002 – 0.06	0.01	0.03
Intercept	0.47	(-8.70) – 9.66	0.72	---

[1]Adjusted by geographic location as a random effect (High Tropics: farms located in Boyaca and Cundinamarca, Low Tropics: farms located in Meta and Tolima). [2]Measured using a Perceived Depression Scale composed of 7 questions regarding feelings experienced during the last week, each question was scored using a 4-point (0-3) scale and the total maximum scored possible was 21 (indicating the highest level of perceived depression). [a]Regression coefficient. [b]Confidence interval for the coefficient. [c]Standard error.

DISCUSSION

This research work is one of the first studies to provide details on associations between farmers' mental health and sheep welfare outcomes. Overall, a high prevalence of clinical lameness was associated with higher levels of stress or anxiety in farmers. The latter was also associated with a high prevalence of dirty fleece, while the prevalence of hoof overgrowth was associated with higher depression in farmers. Nevertheless, it is important to consider that the study design used in this work limits inferring a direct causal path, and the associations found should be interpreted either as correlations or as causal relationships that could run in both directions (11,17): Sheep welfare state can impact the mental health of farmers, or vice versa, where farmers who are feeling stress, anxiety, or depression could impact negatively the welfare of sheep.

Regarding sheep farmers' mental health, the average perceived stress, anxiety, depression, and resilience scores in this study were 14/40, 5.3/21, 1.8/21, and 33.2/40, respectively. These values evidenced low levels of negative mental states (stress, anxiety, depression) and high levels of positive mental states (resilience) among participants, as scores ≥ 27 (for stress) and ≥ 11 (for anxiety and depression) have been suggested as the cut-off point for identifying cases of high perceived stress (27) and probable cases of anxiety and depression (23). These results are in line with the most recent results from a Colombian National Mental Health Survey

(28), where more than 90% of adults perceived they had good or excellent mental health and they felt happy or very happy. There is no available data regarding the mental health of the general farmer population in Colombia though.

Compared to farmers' mental health in other countries (and studies using the same scales), Colombian sheep farmers seemed to have a better mental state than Canadian farmers (13) and specifically, Canadian dairy farmers (11). In these Canadian studies, the average scores (using the same scales) for stress were 18.9/40 (13) and 16.8/40 (11); and for anxiety, depression, and resilience the scores were 7.3/21, 5.4/21, and 28.4/40, respectively (11). Other studies, in Finland (29) and Australia (30), have found that the main causes of stress and well-being challenges for farmers can be external, for example, remoteness, social pressure, and government regulations; and intrinsic to the farm (e.g., amount of work, lack of prediction, and animal sickness).

In this study, larger farms and farms with a higher prevalence of sheep lameness were risk factors associated with the level of farmers' stress. Similar associations regarding cow lameness (11) and farm size (29) have been found for dairy farmers in Canada and Finland, respectively. Although, the latter showed higher stress levels with having more than 40 cows but also with having less than 20. Stress ('feeling troubled') can occur due to a wide range of circumstances, work and non-work related, but definitely, among people working with animals, the constant worry about their animals' welfare, and animal sickness or death can impact their emotions and even make them feel a sense of failure when animals are not thriving (31). Regarding farm size and farmer stress levels, we could indirectly argue that larger farms mean higher workloads and lack of time for non-work-related activities, which are known to be farmers' job stressors (32). The foregoing stands out more in the type of productive systems visited in this study, where regardless of farm size, the investment in technology and more personnel was minimal.

This study also found that farmers' levels of anxiety were associated, not only with a high prevalence of lameness but with more animals with dirty fleece and with being a female farmer. Anxiety is an emotional response, similar to stress, but it is a persistent excessive worry, fear, and nervousness, generally regarding something that has not happened yet, and women have been found to be more prone to suffer from anxiety. Jones-Bitton et al. (13) found that the percentage of Canadian female farmers experiencing a probable case of anxiety was almost double the percentage of male farmers with anxiety; a trend that has been identified among female dairy farmers as well (11). It has been identified that farmers' concerns vary depending on gender, with women tending to worry more about the financial situation of the household and the health of animals, and this has been associated with negative mental states (33).

Anxiety and depression among participant farmers were associated with having more dirty sheep and hoof overgrowth, respectively. Previous studies have identified farmers' negative mental state as a factor associated with being fined for negligence by animal care authorities (9, 10). Suffering from anxiety or depression, or any negative emotional state, can impair the performance of daily tasks and productivity of the affected person (34), which could have been the case in the present study, where farmers with anxiety or depression had lost interest in their job and thus, in keeping animals clean and performing timely hoof trimming. In Colombia, there is evidence that job satisfaction among sheep farmers (in Caldas) impacts the reactivity of their sheep, where a lower level of satisfaction correlates with fearful sheep (14), and the results of the current study support this association between poor human well-being and poor animal welfare. From another perspective, it could also be inferred that the lack of resources (common denominator in all the farms where preventive and curative management practices were minimal) caused the identified welfare problems in the sheep (more lameness, poor hoof and fleece condition); a situation that in turn may be generating the stress, anxiety and signs of depression in farmers. Seeing that they do not have the resources to properly care for their animals and seeing them in poor condition can negatively affect their mental health (31).

In conclusion, higher levels of stress, anxiety, and depression in farmers were associated with animal welfare problems and some socio-demographic factors. Female farmers, bigger farms, sheep lameness, hoof overgrowth, and dirty fleece were identified as possible factors associated with poor farmer mental health. Despite the limitations of this study, it opens a

door to understand, from the perspective of "One Welfare" for all, how the quality of life of humans and animals under their care is affected and how it can be improved. Future research should focus on investigating other possible factors impairing farmers' mental health such as physical health, lifestyle, socio-economic conditions, workload, working environment, and other aspects of quality of life, and evaluate connections among those factors, animal welfare outcomes, and farm productivity.

Conflict of interest

The authors of this study declare that there are no conflicts of interest with the publication of this manuscript.

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