

Prevalence of nuchal crest adiposity in horses in Kaduna State, Nigeria – association with obesity status and risk factors

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Summary: Nuchal crest adiposity is defined as an excess of fat around the top of the neckline, often referred to as cresty neck. It is critical to investigate nuchal crest adiposity because of its association with health issues, including insulin resistance and laminitis. The study sought to ascertain the prevalence of nuchal crest adiposity (dropping neck) in Kaduna State, Nigeria, as well as its association with obesity status and risk factors. A cross-sectional study was conducted. In total, 116 horses were assessed. The cresty neck score and body condition score (modified *Henneke* technique) were used to measure nuchal crest adiposity and obesity, respectively. Horses with cresty neck scores ≥ 3 were considered to have nuchal crest adiposity, whereas horses with scores ≥ 7 were considered obese. A structured questionnaire was used to collect information on feeding and management; age was determined through dentition; and information about breed and sex were recorded. Logistic regression analysis was used to examine the factors associated with nuchal crest adiposity while a chi square was used to test for the association between obesity and nuchal crest adiposity status. The overall prevalence of nuchal crest adiposity obtained was 15.5% (18/116). Obesity and nuchal crest adiposity were shown to be strongly associated. Housing and exercise were factors associated with increased odds of nuchal obesity. The study emphasises the need for efforts to raise awareness within the horse community that nuchal crest adiposity is common.

Keywords: nuchal crest adiposity, dropping neck, body condition score, cresty neck score, obesity, Insulin resistance, horse, Nigeria

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Introduction

Equine obesity is the excessive (pathological) accumulation of fat that poses a health risk to a horse. Obesity may be generalised or regional (focal), internal (accumulations of adipose tissue around and within muscle and organs) or external (palpable subcutaneous fat) (*Rendle et al.* 2018). General obesity and regional adiposity (nuchal crest adiposity) are measured subjectively by the body condition score (BCS) and the cresty neck score (CNS), respectively (*Henneke et al.* 1983, *Carter et al.* 2009). Nuchal crest adiposity is an overabundance of fat along the top of the neckline, otherwise known as cresty neck.

Carter et al. (2009) developed the CNS, specifically for the top of the neck region. The cresty neck score is on a scale of 0 to 5, where 0 indicates no visual appearance of a crest, and 5 indicates an overabundance of fat along the top of the horse's neck. Researchers have focused on nuchal adiposity throughout the years due to a link between the degree of fat deposition, neck thickness, and insulin resistance. A CNS is assigned to estimate the risk of certain metabolic conditions such as insulin resistance in the same way that body condition scoring is (*Frank et al.* 2006). According to a recent study, the

CNS is a stronger predictor of insulin dysregulation in ponies than the BCS (*Fitzgerald et al.* 2019).

Because nuchal crest adiposity and health problems in horses and ponies are related, it is important to measure the nuchal crest adiposity. Few studies have established the association between horses displaying nuchal crest adiposity (CNS) and obesity (BCS) (*Martin-Gimenez et al.* 2018). Also, there is no research on horses assessing the prevalence of nuchal crest adiposity and associated risk factors in Nigeria, to the best of the author's knowledge.

The study aimed to determine: (1) the prevalence of nuchal crest adiposity; (2) the association between obesity (body condition score) and nuchal crest adiposity status (cresty neck score); and (3) the possible risk factors associated with nuchal crest adiposity in horses in Kaduna State, Nigeria.

Materials and methods

Study area

The study was carried out in Zaria and Igabi Local Government Areas (LGAs) of Kaduna State, Nigeria.

Study design and sample size

A cross-sectional study was conducted. A total of 116 horses were examined. Fifty from Zaria LGA and 66 from Igabi LGA.

General obesity using body condition score

A body condition score (BCS) (1–9) was used to measure general obesity as described by Henneke et al. (1983) and modified by Kohnke (1992). A visual assessment and palpation of the neck, ribs, withers, behind the shoulder, loin, and tailhead were performed on the horses to assess accumulated fat. Based on the amount of fat accumulation in all of the indicated regions, a number value (1–9) was assigned. After each area was assessed and assigned a score, an average of all the scores was obtained to get the horse's final overall score, which was rounded up or down to the nearest half-score to determine each BCS (Kohnke, 1992). Three trained veterinarians performed the BCS. The horses were classified as non-obese (<7) or obese (≥7) using the BCS.

Nuchal crest adiposity using the cresty neck score

Nuchal crest adiposity was assessed using the cresty neck score (CNS) (0–5) as described by Carter et al. (2009). This assessment is independent of the BCS. Like the BCS, a combination of visual and palpation inspection of the nuchal ligament area was used to obtain the score. Horses with CNS ≥ 3 have nuchal crest adiposity (regional adiposity). Three trained veterinarians performed the CNS.

Risk factors

Breed, sex, and age were recorded. Age was determined by using dentition as described by Richardson et al. (1995). A structured questionnaire was used to collect information on housing, use, concentrate feeding, and exercise.

Data analysis

To determine prevalence, the obtained data were summarised and displayed in tables using descriptive statistics. The Chi-square test was done to see if there was an association be-

tween obesity status (BCS) and nuchal crest adiposity (CNS). The odds ratio was determined using logistic regression to estimate the strength of the risk factors. Confidence values of 95% were calculated, and values of $P \leq 0.05$ were considered significant. The Statistical Package for Social Sciences (SPSS®, version 26) was used for the investigation.

Result

Prevalence of nuchal crest adiposity

The result showed the prevalence of nuchal crest adiposity in Zaria LGA to be 32.1% (18/56) and in Igabi LGA to be 0% (0/60). The overall prevalence of nuchal crest adiposity in the two LGAs was 15.5% (18/116) (Table 1, Figure 1).

Association between obesity status (body condition score) and nuchal crest adiposity status (cresty neck score)

The result showed that 85.7% (12/14) of obese horses and 5.9% (6/102) of non-obese horses had nuchal crest adiposity, while 14.3% (2/14) of obese horses and 94.1% (96/102) of non-obese horses did not have nuchal crest adiposity. The association between obesity (BCS) and nuchal crest adiposity status (CNS) was statistically significant ($\chi^2 (1) = 59.847$, $P < 0.001$) (Table 2).

Associated risk factors

Regarding breed, the prevalence of nuchal crest adiposity was 25.7% (18/70) in West African Barb horses, and none of the Argentine polo ponies had nuchal crest adiposity. In terms of sex, 30.5% (18/59) of stallions had nuchal crest adiposity, while none of the mares did. Regarding age, horses within the age range of 5 to 15 years (17.9%) were 1.31 times more likely to have nuchal crest adiposity than horses younger than 5 years (14.3%). The relationship was not significant (OR 1.31, 95% CI [0.45; 3.80], $P = 0.621$). Based on the use of the horses, the prevalence of nuchal crest adiposity in leisure horses was 31%, while none of the polo horses had nuchal crest adiposity. Regarding housing, tethered horses (31.5%) were 28.03 times more likely to have nuchal crest adiposity than stabled horses (1.6%), and the relationship was significant (OR 28.03, 95% CI [3.58; 219.40], $P = 0.001$). Concerning exercise, horses that were not exercised (66.7%) were 13.7 times more likely to have nuchal crest adiposity than horses that were exercised (12.7%), and the relationship was significant (OR 13.71, 95%



Fig. 1 White arrows indicating nuchal crest adiposity (drooping neck) (cresty neck score of 5). | Weiße Pfeile, die einen Cresty-Neck anzeigen (Cresty-Neck-Score von 5).

Table 1 Prevalence of nuchal crest adiposity in Kaduna State, Nigeria. | Prävalenz von Cresty Neck im Bundesstaat Kaduna, Nigeria.

LGA	No of horses sampled	No of horses with nuchal crest adiposity	Prevalence of nuchal crest adiposity (%)
Zaria	56	18	32.1
Igabi	60	0	0
Overall	116	18	15.5

LGA= Local Government Area

CI [2.30; 81.90], $P=0.004$). In terms of concentrate feeding, the prevalence of horses fed concentrate *ad libitum* was 32.1%, while none of the horses fed twice or three times a day had nuchal crest adiposity (Table 3).

Discussion

The prevalence of nuchal crest adiposity in the present study was lower than several other studies (Giles et al. 2015,

Morales et al. 2017, Martin-Gimenez et al. 2018, Morales-Briceño et al. 2018) and higher than the report by Sánchez et al. (2017). This may be accounted for by differences in study populations, sampling methods, and cresty-neck scoring methods, as well as seasonal variations. All the horses sampled in Igabi LGA were polo horses, this could have been responsible for the absence of horses with nuchal crest adiposity in this LGA. Polo horses undergo more intense activity and be fitter than leisure horses, reducing their risk of nuchal crest adiposity even more.

Table 2 Association between obesity status (body condition score) and nuchal crest adiposity status (cresty neck score). | *Assoziation zwischen Adipositas-Status (Body Condition Score) und Cresty-Neck-Status (Cresty-Neck-Score).*

BCS	CNS		Total	χ^2 value	df	P-value
	Nuchal crest adipose + (CNS \geq 3)	Nuchal crest adipose - (CNS < 3)				
Obese (BCS \geq 7)	12 (85.7%)	2 (14.3%)	14 (100%)	59.847	1	< 0.001*
None-obese (BCS < 7)	6 (5.9%)	96 (94.1%)	102 (100%)			
Total	18 (15.5%)	98 (84.5%)	116 (100%)			

BCS = Body condition score, CNS = Cresty neck score, + = Positive, - = Negative, * = Significant

Table 3 The prevalence of nuchal obesity with respective categories of the risk factors in Kaduna State, Nigeria. | *Die Prävalenz von Cresty Neck mit den jeweiligen Kategorien der Risikofaktoren im Bundesstaat Kaduna, Nigeria.*

Risk factors	No of sampled horses	No of horses with nuchal adiposity	Prevalence (%)	OR (95% CI)	P value
Breed					
WAB	70	18	25.7	-	-
APP	46	0	0	-	-
Sex					
Stallion	59	18	30.5	-	-
Mare	57	0	0	-	-
Age					
< 5 years	42	6	14.3	Reference	
5 to 15 years	67	12	17.9	1.31 (0.45; 3.80)	0.621
> 15 years	7	0	0	-	-
Use					
Leisure	58	18	31.0	-	-
Polo	58	0	0	-	-
Housing					
Tethered	54	17	31.5	28.03 (3.58; 219.40)	0.001 *
Stabled	62	1	1.6	Reference	
Exercise					
No	6	4	66.7	13.71 (2.30; 81.90)	0.004 *
Yes	110	14	12.7	Reference	
Concentrate feeding					
Ad libitum	56	18	32.1	-	-
Twice a day	19	0	0	-	-
Thrice a day	41	0	0	-	-

WAB = West African Barb, APP = Argentine polo pony, * = Significant

The present study found that obesity status (BCS) and nuchal crest adiposity status (CNS) were highly associated. In our study, 85.7% of obese horses had nuchal crest adiposity. This is consistent with the findings of *Martin-Gimenez et al.* (2018), who discovered that 97.5% of obese horses had a cresty neck. In the current study, there was no significant association between age and the prevalence of nuchal crest adiposity, indicating that horses within the three age groups kept under similar conditions were equally predisposed to nuchal crest adiposity. Horses tethered to a stake in the ground had significantly greater odds of having nuchal crest adiposity than stabled horses. This is because tethered horses have more restricted movement (physical activity) than horses kept in a stable.

The high odds of having nuchal crest adiposity in horses that are not exercised are in agreement with the study by *Morales-Briceño et al.* (2018). An increase in physical exercise helps them lose weight and even enhance their insulin sensitivity (*Stewart-Hunt et al.* 2006).

In conclusion, our study shows that 15.5% of horses have nuchal crest adiposity, with exercise and housing being the associated risk factors. Nuchal adiposity (CNS) and obesity (BCS) are strongly associated. The study highlights the need for efforts to promote awareness among the horse community that nuchal crest adiposity is a matter of concern.

Conflict of interest statement

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

Animal welfare statement

Ethical approval for the research was obtained from the Ahmadu Bello University Committee on Animal Use and Care (ABUCAUC) with the approval number ABUCAUC/2022/042.

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