Management factors affecting stereotypies and body condition score in nonracing horses in Prince Edward Island

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Abstract — In North America, there are few representative data about the effects of management practices on equine welfare. In a randomized survey of 312 nonracing horses in Prince Edward Island (response rate 68.4%), owners completed a pretested questionnaire and a veterinarian examined each horse. Regression analyses identified factors affecting 2 welfare markers: body condition score (BCS) and stereotypic behavior. Horses' BCSs were high (mean 5.7, on a 9-point scale) and were associated with sex (males had lower BCSs than females; $P < 0.001$) and examination date ($P = 0.052$). Prevalences of crib biting, wind sucking, and weaving were 3.8%, 3.8%, and 4.8%, respectively. Age (OR = 1.07, $P = 0.08$) and hours worked weekly (OR = 1.12, $P = 0.03$) were risk factors for weaving. Straw bedding (OR = 0.3, $P = 0.03$), daily hours at pasture (OR = 0.94, $P = 0.02$), and horse type (drafts and miniatures had a lower risk than light horses; $P = 0.12$) reduced the risk of horses showing oral stereotypies. Some of these results contradict those of other studies perhaps because of populations concerned.

Résumé — Facteurs de gestion influençant les stéréotypes et la cote de condition physique chez les chevaux non courseurs de l'Île-Du-Prince-Édouard. En Amérique du Nord, il y a peu de données typiques sur les effets des pratiques de gestion sur le bien-être des chevaux. Dans une enquête au hasard de 312 chevaux non courseurs de l'Ile-Du-Prince-Édouard (taux de réponse de 68,4 %), des propriétaires ont rempli un questionnaire validé et un vétérinaire a examiné chaque cheval. Des analyses de régression ont identifié les facteurs affectant 2 marqueurs de bien être : la cote de condition physique (CCP) et le comportement stéréotypé. Les cotes de condition physique des chevaux étaient élevées (moyenne 5,7 sur une échelle de 9) et étaient associées au sexe (les mâles ayant une CCP plus basse que les femelles; $P < 0{,}001$) et à la date d'examen ($P = 0{,}052$). Les prévalences du tic à l'appui, du tic aérophagique et du tic de l'ours étaient respectivement de 3,8 %, 3,8 % et 4,8 %. L'âge (OR = 1,07, $P = 0{,}08$) et les heures hebdomadaires de travail (OR = 1,12, $P = 0{,}03$) étaient de facteurs de risque pour le tic de l'ours. La présence de litière de paille (OR = 0,3, $P = 0{,}03$), les heures quotidiennes au pâturage (OR = 0,94, $P = 0{,}02$) et la catégorie (les chevaux de travail et miniatures avaient un risque plus faible que les chevaux légers; $P = 0{,}12$) constituaient des facteurs de risques pour les stéréotypes oraux. Les résultats fournissent un aperçu de la nature des stéréotypes et de la CCP.

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Introduction

The management and welfare of nonracing horses in Prince Edward Island (PEI) have been described (1). This paper examines factors affecting the welfare of these horses (miniature, light, draft, and other horses that are not used for racing purposes). Animal welfare is a 3-dimensional concept that encompasses physical health, mental health, and satisfaction of the animal's nature (genetically encoded traits reflected in breed and temperament [2]) (3). There is no single objective measurement that can be taken to indicate level of welfare. Multiple measurements are needed and have been applied in the assessment of the welfare of farm animals (4,5), but there is no established method of assessing equine welfare. Two appropriate indices that may be readily assessed and might form part of a broader equine welfare

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assessment scheme are body condition score (BCS; index of physical welfare) and performance of stereotypic behavior (index of mental welfare and satisfaction of the horse's nature).

Body condition scoring provides an estimate of body fat cover, and the score can reflect several aspects of welfare. For example, a low BCS may be due to a heavy parasite burden, inadequate nutrition, poor dental care, or systemic disease, some of which are welfare concerns in themselves. A low BCS would therefore suggest reduced physical welfare (6). A high BCS is more difficult to interpret, but it too may indicate reduced welfare, as overweight horses are at a higher risk of laminitis (7). Stereotypies are behavioral patterns that are repetitive, invariant, and apparently functionless (8). In horses, examples include crib biting, wind sucking, stall walking, and weaving (9). Stereotypies are generally thought to result from the frustration caused when environmental constraints prevent a horse from exhibiting highly motivated behavior, such as social interaction or foraging (10). Welfare is thought to be worse if stereotypic behavior dominates the life of the individual by being very time consuming or if it appears to substitute for behavioral responses in a way that impairs adaptation to the environment (10). For example, some equine locomotory stereotypies may result in weight loss (11), while crib biting causes tooth wear (12) and may result in the ingestion of splinters. Research has been conducted on factors affecting the occurrence of stereotypic behavior in Thoroughbred race horses; dressage, event, and endurance horses; and in other riding horses (13–17). The factors included aspects of management, such as time spent in the stable (13,15,16), exercise (13,15), bedding type (15), and weaning methods (17), and aspects of the horses themselves, such as breed (16) and behavior of the dam (17). However, none of the studies were representative of the nonracing horses that are typical of PEI: these previous studies only provided data from owners who were registered members of an equine organization or had registered stables, and they did not provide horse level data derived from sufficiently large random samples of all possible owners. The objective of the present study was to investigate management factors affecting 2 welfare-related endpoits (BCS and stereotypic behavior) in nonracing horses in PEI.

Materials and methods

A survey of nonracing horses in PEI was conducted from July to September 2002; the methods have been described in detail in a previous paper (1). One hundred and seventeen horse owners and 312 horses were recruited through a random phone book search of all households in the PEI telephone directory; 12.3% of listed households were phoned. Information about management factors and the occurrence of crib biting, wind sucking, and weaving were reported by the horse owner in a mailed questionnaire (a copy of the questionnaire is available on request). The questionnaire did not include notes explaining what crib biting, wind sucking, and weaving are, but it asked if the horse had shown any of the behaviors within the previous 4 wk and, during the period of ownership, for how long the horse had been showing the behavior. The frequency and duration of bouts of the behavior were not asked for. The questionnaire was collected during a site visit, when the study veterinarian performed a physical examination on each horse and assigned a BCS on a scale of 1 to 9, with 1 being emaciated and 9 being extremely fat (18). Scores were assigned based on visual examination and palpation of the neck, back, ribs, and pelvis; half values (6.5, 7.5, etc.) were assigned where appropriate. The inter-rater reliability of the BCS measure was calculated and has been reported in a previous paper (1). Questions about hours worked and type of work were included in the questionnaire. The information from the questionnaires and laboratory analyses of forage and grain (1) was used to estimate the percentage of daily recommended intake of energy for each horse, with the aid of an equine nutrition program (PC-Horse, Version 1.24; Knut Hove, Agricultural University of Norway, Aas, Norway). The estimation was based on age, breed, body weight, lactation, amount and type of exercise, weight and amount of hay and grain fed, the number of hours spent in a pasture with grass per day, a subjective observation of the quality of the pasture, and the nutritional properties of the feeds.

All statistical analyses were performed using statistical software (Stata 7; Stata Corporation, College Station, Texas, USA). Factors with the potential to affect BCS or stereotypic behavior were established a priori by using causal diagrams. Univariable analyses were performed to evaluate the significance of each factor by using a *t*-test or χ^2 test, as appropriate. The combined effects of significant factors on BCS were assessed by using linear regression. Variables with multiple categories (type) were entered as indicator (dummy) variables. Only variables showing an unconditional association with a significance of $P \leq 0.20$ were retained for model-building, with the exception of potential confounding variables (sex, type of horse [miniature, light, and draft], and age), which were forced into the model in the initial stages of model building. A combination of stepwise selection procedures and manual comparisons of possible models was used to determine a final model. Factors were retained if $P < 0.1$. Potential confounding variables were evaluated at the end of the model-building by removing them from the model and then reinserting them, in order to assess the magnitude of the change in the other coefficients and their significance levels. Interaction terms were created and checked for significance in the final model, and any significant terms were retained. The multiple correlation coefficient (R^2) was used to evaluate the model, and the model's assumptions (normality, linearity, and homoscedasticity) were checked (19). The data were assessed for outliers and influential values (19).

Models were also built for the individual outcomes of weaving and oral stereotypy (crib biting and wind sucking), using logistic regression. The models were built in the same manner as the linear model, and the Hosmer-Lemeshow χ^2 test was used to evaluate them (19). As with linear regression, the data were checked for outliers and influential values.

Clustering of observations (the "barn effect") was assessed in both models by using a generalized estimating equation from which estimates of the intracluster

correlation, *e*, were obtained (19). The average cluster size was 2.7 and there were low intracluster correlations (linear model, $e = 0.076$; logistic model, $e = 0.005$); therefore, clustering was not a concern (19).

Results

The response rate for the survey was 68.4%. The mean BCS for horses was 5.7, $s = 1.0$; the distribution of BCS is shown in Figure 1; a BCS could not be obtained for 5 horses, because they were fractious and could not be palpated. Unconditional analyses identified the following significant factors affecting BCS: the number of years that the owner had owned horses; whether or not the owner was a member of a horse-related organization; the number of hours that the horse spent in a stall daily in the summer; the date on which the horse was examined; and the sex of the horse (Table 1). Nonsignificant predictors of BCS were the number of hours that the horse was worked (ridden or driven) /wk; the type of work; the fecal egg count (strongyle eggs/g); the presence of a dental abnormality; the date of the last dental examination; the percentage of daily recommended intake of energy; whether or not the horse exhibited a stereotypy; the age of the horse; and the type of horse (Table 1).

Linear regression identified 4 variables that influenced BCS (Table 2). Once these variables were included in the model, no other predictor variable was statistically significant. The effect of years owning horses depended on whether or not the owner was a member of a horse-related organization, but the combined effect of these ownership and membership variables on BCS was marginal (Table 2). The mean BCS increased with the date of the examination: for every month (30 d) increase from July to September, the BCS increased by 0.12 units (0.004*30). Geldings and stallions had a lower BCS than mares. The variables described above provided an explanation for 10% of the variability of BCS ($R^2 = 0.10$; adjusted $R^2 = 0.08$). The model assumptions were met and there were no influential values or outliers. A path model summarizing the relationship between the variables and BCS is presented in Figure 2.

The prevalence of all stereotypic behaviors (crib biting, wind sucking, and weaving) was 12.3% (36/292; the questionnaire for 20 horses was not fully complete). Two of these 36 horses were reported to show more than 1 stereotypy; in both cases, only the 1st stereotypy reported by the owner was included in the stereotypy dataset, so each horse was only represented once. Many owners (19/36) did not answer the question about how long the behavior had been occurring during their period of ownership. This variable was not included in the analyses, because there were so many missing data. The prevalence of individual stereotypies is presented in Table 3. Only 1 miniature horse was reported to show a stereotypy. Significant predictors for weaving, identified by unconditional analyses, were the use of straw bedding (as opposed to shavings, sawdust, peat, or no bedding), the number of hours worked (ridden or driven)/wk, the use of a nonsnaffle bit (pelham, kimberwick, curb, or gag), the number of times/d that the horse was fed hay in the summer, the type of horse, and the age of the horse (Table 1). Nonsignificant predictors for weaving were

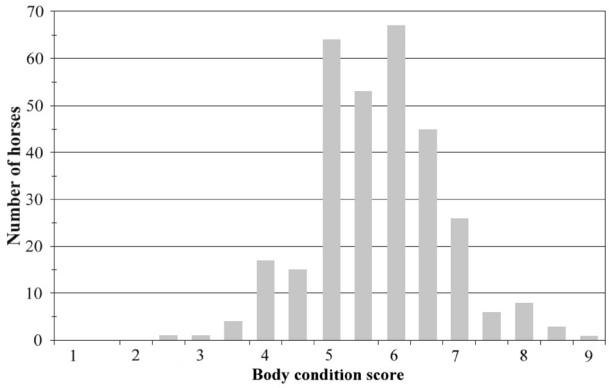

Figure 1. Distribution of body condition score, on a scale of 1 to 9 in 307 nonracing horses in Prince Edward Island.

the number of hours/d that the horse spent in a stall in the summer, the ability to touch or see other horses from the stall, the number of times/d that hay was fed in the winter, the number of h/d that the horse spent in a pasture with grass, type of work, and the sex of the horse (Table 1). The results of multivariable analysis for weaving are presented in Table 4. The odds of weaving increased with the number of h/wk worked: an increase of 6 h of work would double the odds of weaving (1.12^6). Similarly, a 10-year increase in age would double the odds of weaving (1.07^{10}). The goodness of fit of the model was acceptable (Hosmer-Lemeshow, $P = 0.86$) (19). A path model summarizing the relationship between the variables is presented in Figure 3. Horse type tended towards significance as a risk factor for weaving: compared with light horses, draft horses were less likely to weave, OR = 0.07, $P = 0.19$ (CI, 0.0013, 3.9). No miniature horses weaved (Table 3).

Significant predictors for oral stereotypies (crib biting and wind sucking), identified by unconditional analysis, were the ability to touch other horses from the stall, the use of straw bedding, the number of h/d spent in a pasture with grass, and the type of horse (Table 1). Nonsignificant predictors for oral stereotypies were the number of h/d spent in a stall in the summer, the ability to see other horses from the stall, the number of h/wk that the horse was worked, the use of a nonsnaffle bit, the number of times/d that the horse was fed hay in the summer and winter, type of work, and the sex and age of the horse (Table 1). The results of multivariable analysis for oral stereotypies are presented in Table 5. The odds of a horse having an oral stereotypy decreased 0.94 times for every additional h/d that the horse spent in a pasture with grass. An increase in 12 h/d at grass would therefore reduce the odds of having an oral stereotypy by half (0.94^{12}). Compared with light horses, miniature (OR = 0.18, $P = 0.12$, CI, 0.13, 1.54) and draft (OR = 0.27, $P = 0.12$, CI, 0.20, 2.1) horses were less likely to have an oral stereotypy. Horse type was a confounding factor for time spent at grass (light horses spent more time at grass than miniature or draft horses). The goodness of fit of the model was acceptable (Hosmer-Lemeshow $P = 0.44$) (19). There were no influential values or outliers. A path model summarizing the relationship between the variables is presented in Figure 4.

Table 1. Potential risk factors affecting body condition score, weaving, and oral stereotypies of 292 nonracing horses in Prince Edward Island, examined in unconditional analyses

Variable name	Description	Descriptive statistic	*P* (BCS)	*P* (weaving)	*P* (oral stereotypy)
Years owning	The mean number of years that the owner had been owning horses	17.1, *s* = 13.9 y	0.16	—	—
Member	Whether the owner was a member of a horse-related organization or not	35/110[a]	0.12	—	—
Stall hours (summer)	The mean number of h/d that the horse spent in a stall in the summer	5.1, *s* = 7.4	0.16	0.77	0.45
Touch	Whether the horse could touch other horses from the stall or not	123/232	—	0.63	0.11
See	Whether the horse could see other horses from the stall or not	199/231	—	0.51	0.87
Straw	Whether horses had straw for bedding (as opposed to shavings, sawdust, peat, or no bedding)	159/312	—	0.13	0.05
Date	The date on which the horse was examined by the study veterinarian	Range = 02/07/2002 to 26/10/2002	0.02	—	—
Hours work	The number of h/wk that the horse was ridden or driven	1.9 (4.7)	0.40	0.04	0.91
Nonsnaffle	The use of a nonsnaffle bit (pelham, kimberwick, curb, or gag)	29/312	—	0.19	0.61
FEC	Fecal egg count	420, *s* = 850 strongyle eggs per gram	0.72	—	—
Dental abnormality	Presence of: molar hook, sharp enamel points, or wave mouth	Molar hook: 40/296	0.89	—	—
		Enamel point: 27/297	0.82	—	—
		Wave mouth: 10/296	0.36	—	—
Dental exam date	The mean year that a veterinarian last examined the horse's teeth	2000, *s* = 4	0.46	—	—
Hay (summer)	Mean number of times/d that hay was fed in the summer	1.1, *s* = 1.3	—	0.01	0.23
Hay (winter)	Mean number of times/d that hay was fed in the winter[b]	2.7, *s* = 0.93	—	0.39	0.99
Hours grass	Mean number of h/d spent in a pasture with grass	17, *s* = 9.0	—	0.50	0.06
% dri (energy)	The mean percentage of the daily recommended intake of energy that the horse received	160, *s* = 55	0.67	—	—
Stereotypy	Whether the horse exhibited a stereotypy or not (crib biting, wind sucking, or weaving)	36/292 (see Table 3)	0.33	—	—
Work type	The average intensity of work done by the horse (none, mostly walk, or a combination of walking, trotting, cantering, jumping and pulling)	None: 158 (53.6%) Walk 79 (26.8%) Combination 58 (19.6%)	0.87	0.23	0.56
Age	Mean age of the horse, as identified by the owner	9.5, *s* = 7.3	0.80	0.17	0.86
Sex	Sex of the horse: mare, gelding, or stallion	Mare: 169/299 Gelding: 107/299 Stallion: 23/299	0.16	0.56	0.34
Type	Type of horse (miniature, light, or draft)	Miniature: 34/312 Light: 227/312 Draft: 51/312	0.77	0.13	0.08

s = standard deviation
[a]Number of positive/total responses for dichotomous variables
[b]This variable was included because frequent but irregular feedings could be associated with high levels of arousal and frustration, and might therefore be associated with stereotypies that persist into the summer

Discussion

Body condition score

In the present study, BCSs were generally high, which could have been due to over-feeding or lack of exercise. The finding that most horses were not ridden or driven was unexpected; horses with a high BCS were clinically healthy, but their future welfare may have been at risk due to an increased probability of developing laminitis (20). These horses may also have had a decreased ability to thermoregulate in hot weather (21) and may have required longer to recover from work (22). In a nonrandomized study of a variety of horses, including Thoroughbred racehorses, standardbreds, and ponies, the most prevalent BCS (assessed by visual examination and

Table 2. Final linear regression model of factors affecting body condition score in nonracing horses in Prince Edward Island

Factor	Coefficient	95% Confidence interval	*P*
Member of a horse-related organization	-0.15	-0.56–0.25	0.091
Years owning horses	-0.018	-0.042–0.006	0.087
Interaction term (years owning * membership)	0.017	0.0014–0.033	0.033
Date of examination	0.004	0.00–0.009	0.052
Sex: Gelding compared with a mare	-0.40	-0.64–-0.16	0.001
Stallion compared with a mare	-0.78	-1.2–-0.35	< 0.001

Table 3. Prevalence of stereotypies, as indicated by horse owners, in 292 nonracing horses in Prince Edward Island

	Horse type						Overall prevalence	
	Miniature		Light		Draft			
Behavior	*n* = 34	%	*n* = 211	%	*n* = 47	%	*n* = 292	%
Crib biting	1	2.9	10	4.7	0	0	11	3.8
Wind sucking	0	0	10	4.7	1	2.1	11	3.8
Weaving	0	0	13	6.2	1	2.1	14	4.8

Table 4. Final logistic regression model of factors affecting weaving in 292 nonracing horses in Prince Edward Island

Factor	Coefficient	Odds ratio[a]	95% Confidence interval (OR)	*P*
Hours worked per week	0.12	1.12	1.0–1.2	0.03
Age of horse	0.06	1.07	0.99–1.1	0.08

Hosmer-Lemeshow χ^2= 3.96 (*P* = 0.86)
[a]Odds ratios calculated based on logistic regression coefficients

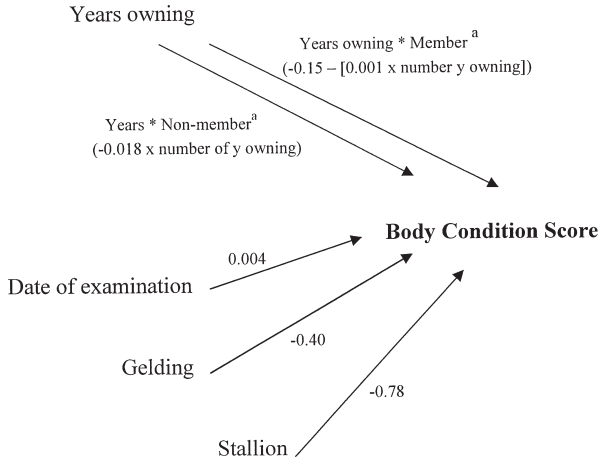

Figure 2. Path diagram showing relationship between factors affecting body condition score in nonracing horses in Prince Edward Island. Linear regression coefficients are indicated beside the arrows.

[a]Membership of horse-related organization — interaction with years owning horses.

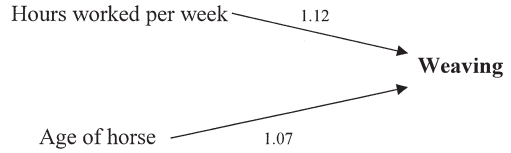

Figure 3. Path diagram showing relationship between factors affecting the occurrence of weaving in nonracing horses in Prince Edward Island. Odds ratios are indicated beside the arrows.

palpation of the neck, back, ribs, and pelvis, on a scale of 0 to 5) was 3.5; this was slightly above the midpoint, as in the present study (23). Body condition scores have also been reported in a group of feral ponies on Assateague Island, USA that were scored on a scale of 0 to 5 by visual examination only, the mean BCS was 2.47, approximately equal to the midpoint (24).

Two owner factors (experience owning horses and membership in a horse-related organization) were significant predictors for BCS, although their effects were not substantial. There was some correlation between these factors, indicating that people who had owned horses for a long time were more likely to be members of a horse-related organization. Experience and membership may provide a horse owner with more information about feeding practices and their effects on body condition. Also, membership in a horse-related organization may indicate an increased interest in equine management, nutrition, and health. However, the small effect of membership on BCS in the model suggests that owners in PEI would be unlikely to affect the BCS of their horse by joining a horse-related organization.

The date of the physical examination was associated with the magnitude of BCS, which increased over the summer. The increase may have been due to an increased availability of high quality grass or an improvement in feed quality, as the summer progressed. The lower BCS of stallions compared with mares contrasts with the BCS of feral pony stallions on Assateague Island, which was higher than that of mares (24). In the present study, data

Table 5. Final logistic regression model of factors affecting oral stereotypies (crib biting and wind sucking) in 292 nonracing horses in Prince Edward Island

Factor	Coefficient	Odds ratio[a]	95% Confidence interval (OR)	*P*
Daily hours spent in a pasture with grass (in the summer)	-0.058	0.94	0.90–0.99	0.02
Type of horse				
miniature compared with light	-1.69	0.18	0.13–1.54	0.12
draft compared with light	-1.29	0.27	0.20–2.1	0.12
Straw bedding	-1.19	0.30	0.10–0.89	0.03

Hosmer-Lemeshow $\chi^2 = 5.95$ ($P = 0.44$)
[a]Odds ratios calculated based on logistic regression coefficients

were not collected on all possible factors that might affect the BCS of stallions, but the lower scores may have reflected factors such as temperament and the high energy requirement of breeding (25). The result suggests that owners may need advice about the nutrition of stallions during the breeding season in order to prevent decreased BCS, and also about the nutrition of mares. All the above factors explained only 10% of the variability in BCS of nonracing horses in PEI and are of minor biological significance. Additional factors that influence BCS need to be investigated and might include grass quality, total nutrient intake, and genetics (26).

The final model must be interpreted in light of the high average BCS and rather narrow range of scores encountered in this study; despite the linearity of the relationship between BCS and the continuous predictor variables, it is not clear whether the model would apply to horses with low BCS. However, while an increase in score for fat horses would not be a welfare benefit, the same increase might be a benefit for thin horses. An additional consideration is that if the study were conducted in the winter, it might produce a different range of BCSs and a different model.

Stereotypic behavior

The present study examined 3 common stereotypic behaviors. The questionnaire did not include notes explaining what the 3 behaviors were, because pretesting and the authors' experience with a wide range of horse owners in PEI indicated that explanations were not necessary. However, this assumption may have been incorrect, and in some cases, the reported behaviors may not have been fully stereotypic, but developing stereotypies, or redirected behaviors with a learned component. Even if this were the case, horses with any of the 3 behaviors would still be of potential welfare concern, because developing stereotypies and redirected behaviors are responses to frustration or motivational conflict (27,28), both of which compromise mental welfare. Information about the duration and frequency of the behaviors would have further clarified their biological relevance, but this was not sought, because it was thought unlikely that valid information could be obtained. This assumption was supported by the failure of many owners to answer the question about how long the behavior had been occurring during the term of their ownership.

The prevalence of stereotypies fell within the range of reported values (13–16). The survey indicated a numeric difference in the prevalences of stereotypic behaviors between miniature, draft, and light horses. Horse type tended towards significance in the weaving model and it was a confounding factor in the oral stereotypy model: light horses tended to spend more time in a pasture with grass than did miniature or draft horses, indicating that there may be some differences in the management of the 3 types of horses. To the authors' knowledge, neither the behavior nor the management of the 3 types of horses has been compared previously and there has been no research on stereotypic behavior in miniature or draft horses. Previous research has suggested that breed type (warmblood, Thoroughbred, and other breeds) may predict the occurrence of a stereotypy (16,17). The significance of horse type as a risk factor for oral stereotypies and the tendency towards significance for weaving suggests that type may be relevant. A study with a larger sample size would clarify this.

Risk factors associated with the occurrence of stereotypic behavior have been investigated (13–17). Some of these risk factors have been described in the introduction. Additional factors are physical contact with other horses (13,15,16); amount of forced exercise (13); forage availability (15,16) and type (15); total number of horses in a yard (15); opportunities for contact with other horses (13,15,16); breed type (Thoroughbred, warmblood, and other breeds) (16); presence of grain in the diet (16); and temperament (16). In the present study, data were collected on the above factors and some were significant. The amount of forced exercise (13) is comparable with the number of h/wk worked. Time spent in the stable (15), forage availability (16,17), and opportunities for contact with other horses (16,17) may correspond in part to the number of h/d spent in a pasture with grass, in our study.

The risk of weaving increased with age, perhaps because, as a horse becomes older, the probability increases that it will have encountered a frustrating situation. This is generally consistent with previous findings in which the probability of performing stereotypies was higher in older horses (13,16). The number of hours worked per week was a risk factor for weaving in the present study. Previous studies have examined the effect of the amount of forced exercise on the occurrence of stereotypies (13,16), and results have been conflicting. One study showed that the risk of stereotypic behavior increased with exercise (13), while others found no significant relationship (14,16). Forced exercise may reflect reduced control by the horse over its environment, which may be distressing for some animals.

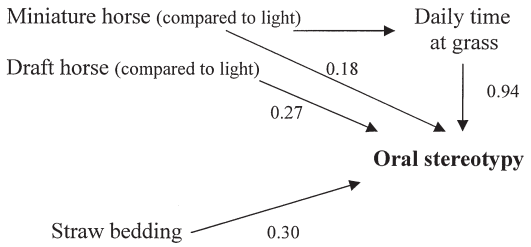

Figure 4. Path diagram showing relationship between factors affecting the occurrence of oral stereotypies (crib biting and wind sucking) in nonracing horses in Prince Edward Island. Odds ratios are indicated beside the arrows.

Use of a nonsnaffle bit was a potential risk factor for weaving in the univariable analysis, warranting further research. The use of a nonsnaffle bit per se is unlikely to cause stereotypic behavior; it is more likely that a nervous or excitable horse might be more difficult to ride, requiring a nonsnaffle (stronger) bit, and might also be more likely to weave. The type of bit may represent an extra increase in a horse's physical restriction when ridden or driven, reducing the horse's control over the environment, which may be distressing for some animals. For example, the head may be positioned so that the horse is unable to lift or lower it, and the speed and direction of movement is also out of the horse's control. Any research should take into account the material from which the bit is made, and the pressure exerted on it by the rider or driver. Bit-related pain has been associated with headshaking in horses (29).

The results suggested that a 12-hour increase in daily time spent on pasture with grass would halve the odds of having an oral stereotypy, and support those of other studies (13,16). Turn-out in a pasture with grass would provide the opportunity to move around and graze; turnout might also permit social interaction, but the number of hours spent in a pasture with another horse was not investigated. In order to optimize the mind and nature dimensions of welfare, horses should be allowed as many opportunities as possible to graze, move about, and interact with other horses, providing that they are not at risk of overeating or being injured (30). However, extended turnout would depend on the availability of pasture.

Straw bedding significantly reduced the odds of an oral stereotypy. This contrasts with previous studies (15,16), in which straw did not appear to affect the performance of oral stereotypies when compared with other bedding types. Straw might reduce the risk of an oral stereotypy because it provides an additional feed source, which approximates more closely to feeding conditions in the wild and may reduce any related frustration (31).

Reasons for differences between our results and those from other studies may include the relatively small number of horses with stereotypies in the present study; the lack of explanation in the questionnaire of what the stereotypic behaviors were; and differences in management, age, breed, and location between the equine populations in our study and those in other studies (13–16). Other reasons for differences may be that other studies either were not based on random samples (14,15) or were random, but the response rates were low (13,16). Another reason may be that the time of year when the research was conducted was different (16); because husbandry practices may change with the season, so the results of our study might have been different if the data had been collected in the winter.

The utility of stereotypies as an index of animal welfare may be questioned, because although a stereotypy may be beneficial if it allows the animal to cope with frustration, animals that are not showing stereotypic behavior may also be frustrated but unable to cope. Such animals would be of greater welfare concern than horses with a stereotypy (13,32). Conversely, the absence of a stereotypy may mean that there is no frustration present (32). The above aspects of stereotypies require further research, but, at present, the performance of a stereotypy may be considered an acceptable index of potentially reduced mental welfare because of the behavior's association with frustration (10). However, stereotypies should not be used as a sole index of welfare (32).

To the authors' knowledge, this study was the first of its kind in North America, because it used a random sample of all nonracing horse owners (with listed telephone numbers) in a region and had a high response rate, so it was representative of the equine population of interest; it provided horse level data on management, and the physical and mental aspects of welfare; and it included a veterinary examination of each horse. The results confirm some findings from studies that were not based on random samples, had low response rates, or used other populations of horses, and they indicate some managerial factors that may influence BCS and the occurrence of stereotypic behavior in nonracing horses in PEI during summer and early fall. The results also suggest a possible relationship between bit type and weaving, and between horse type and oral stereotypies, which warrant further research. CVJ

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