



# Slow-feeding dispensers for horses: Who, how and why?

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## ABSTRACT

Slow-feeders are feed dispensers designed to mechanically slow feed intake. As such, they are a promising tool for improving the welfare of horses by meeting their behavioural and physiological feeding needs while controlling the risk of obesity. However, there is limited knowledge regarding the current use of slow-feeders by horse owners and the profile of horses using such feeders. The objective of this questionnaire-based study was to evaluate the slow-feeding practices among horse owners and yard operators in some French-speaking European countries (Belgium, France and Switzerland). We received 1,283 replies, revealing that the population of horses fed with slow-feeders differs from the general population of ridden horses in several aspects, such as age, training, and housing. This information is valuable for ensuring representative sampling in future studies. Regarding the type of slow-feeder used, more than 85% of the respondents reported using hay nets, with hay nets covering the hay in the hayrack or surrounding a bale of hay being particularly popular. The main reasons for using slow-feeders were waste management, weight reduction, and increased feeding time for horses. Most respondents did not encounter any issues when using slow-feeders and less than 10% of respondents reported health problems and accidents resulting from the use of slow-feeder. Differences were also found between countries and between operators and owners, indicating that different user profiles have varying requirements for the feeder they use.

## Implications

This study provides new insights on the use of slow-feeders in horses (slow-feeding practices, users feedback and profiles of horses using slow-feeders) that can guide future research. Health problems and accident were infrequent and most users reported using slow-feeders as the only feed dispenser, highlighting the importance of safe feeders. Nets were the most common slow-feeder and the horses using slow-feeder tended to be outdoor, group-housed horses with low work frequencies. Therefore, further studies should investigate the challenges of nets (for groups) and the horses included in slow-feeder studies should be carefully selected to ensure the representativeness of the sample.

## Introduction

Horses (*Equus ferus caballus*) are herbivores whose digestive systems

have evolved to efficiently utilize low-energy, high-fibre forage. In their natural environment, they spend almost 16 h a day foraging, while consuming small, regular portions of feed (Duncan, 1980). This foraging behaviour is usually not interrupted for more than 4 h (Duncan, 1980). Indeed, as herbivores, their stomachs constantly secrete acid, which is neutralized by the alkaline saliva they produce and the food bolus that reaches the stomach during feeding (Hothersall and Nicol, 2013). However, as a result of domestication, feeding habits of stabled horses are limited by the timing of meals and feed provision (Lesimple et al., 2016). In most stables, hay is fed 1–3 times a day, in restricted quantities (Lesimple et al., 2016). This may pose some risks, in terms of higher susceptibility to gastric diseases (Vokes et al., 2023), and increase the likelihood of developing problematic (e.g., stereotypic, abnormal repetitive) behaviours (Nicol, 1999). Therefore, finding solutions to reconcile natural needs and domestication constraints is crucial to improve equine welfare.

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Several studies have identified a lower forage intake as a risk factor for equine gastric ulcer syndrome (Bell et al., 2007; Gehlen et al., 2019). More specifically, Banse et al. (2018) and Luthersson et al. (2022) found that horses fed less than 3 meals per day were 6–7 times more likely to develop equine squamous gastric disease compared to horses fed 3 or more meals per day. An epidemiological study also revealed that providing too few hay feeds per day was the primary factor in the development of abnormal repetitive behaviours (Lesimple et al., 2016). These findings were supported by a study comparing crib-biting and normal foals (gastroscopic examination), which highlighted an association between stomach condition and abnormal behaviour that could be modulated by diet (Harris, 2007). However, while providing *ad libitum* forage may seem to be the answer to a horse's various needs, it is not necessarily the best solution for all horses as it can compromise their body condition.

Providing horses with *ad libitum* forage helps maintain an optimal gastric pH-level and prevents them from becoming frustrated and/or bored. However, this almost constant supply of energy can be detrimental to some horses. Indeed, around 70% of horses in France and Switzerland are used for leisure purposes only (Ackermann and von Niederhäusern, 2019). Thus, these horses have low energy expenditure. Additionally, a large number of horses used for leisure purposes are from so-called 'easy-keeping' breeds, which tend to gain weight easily due to their metabolic predispositions (Johnson and Biddle, 2021). As a result, obesity is highly prevalent in the equine population: Wyse et al. (2008) found 45% of their Scottish cohort of riding horses to be obese, and Thatcher et al. (2012) reported 32% of a sub-population of 300 horses in Virginia to be 'overweight' and 19% to be 'obese'. For horses used for leisure only and with a metabolic predisposition to overweight, providing *ad libitum* hay can therefore be detrimental to their health. It may lead to important weight gain, which can cause laminitis, hyperlipemia and developmental orthopaedic disease (Johnson et al., 2004). Some studies also associate obesity and insulin resistance in horses with development of abnormal reproductive function and debilitating laminitis (Vick et al., 2007). Feeding horses in a way that meets their needs while optimising their body condition can therefore prove difficult.

In an attempt to solve this complex dilemma, over the last decade so-called "slow-feeding" systems have been introduced to the market (Benz et al., 2014; Ellis et al., 2015a; Rochais et al., 2018). These dispensers are designed to mechanically slow down the ingestion of feed by making it more difficult for the horse to access the feed (Morgan et al., 2016). By increasing the time spent feeding with the same amount given (Ellis et al., 2015a), slow-feeders (SFs) can improve the welfare of horses. Their implementation has been associated with a significant reduction in coprophagia and stereotypies/abnormal repetitive behaviors (Correa et al., 2020). SFs come in a variety of shapes and materials. Some are individual dispensers, while others are designed for group feeding. They include hay nets, metal racks with very narrow slats, plastic cylinders with holes to allow access to the feed, or boxes and troughs lined with netting, wire mesh or perforated plastic panels. These dispensers have become increasingly popular in recent years, with more and more models appearing on the market. A survey of 11,000 horse owners conducted by Agroscope's Swiss National Stud Farm (SNSF) in 2017 found that almost 30% of Swiss owners use SFs (Siegel et al., 2018).

SFs are promising to reconcile horses' natural needs and the limitations associated with their artificial housing environment. However, scientific studies that characterise the utilisation of SFs by horses' owners are currently missing. This absence makes it difficult to assess the requirements and challenges of SFs through appropriate research projects. Therefore, we carried out a questionnaire-based study in which we asked horses' owners from three French-speaking countries to describe their slow-feeding practices. Our aim was to gather detailed information on the population of horses being fed with these dispensers. This knowledge is essential for future research, as it will allow the selection of a representative sample of the population for studies on slow-feeding (e.g., to confirm the actual benefits of SFs over other feeding

strategies for horse welfare, or to assess their consequences on the horse's health). We also aimed to gather criticism from current and former users to promote the development of systems that better meet user expectations and horses' needs. Finally, we investigated whether differences between countries, in terms of equestrian culture, topography (particularly pasture accessibility) and legislation in force, could lead to different slow-feeding practices.

## Material and methods

### Questionnaire design

We designed a questionnaire in French to investigate the population of horses being fed with SFs, as well as the opinions of former users and non-users. This questionnaire was designed with GoogleForms and can be found in [Supplementary Material S2](#). First, participants were asked to indicate their status in relation to SFs ('current user', 'former user', 'non-user'), with the choice of answer leading to a predefined section of the questionnaire. Only data from current SF users have been analysed and are presented in this article. Additionally, former- and non-users were asked for their opinion on SFs. Data from former- and non-users can be found in [Supplementary Material S1](#).

The respondents were allocated to two main cohorts: Owners and operators. Owners were defined as people who own at least one horse (whether boarded or not), while operators are professionals who run an equestrian facility (e.g., livery yard or horse-riding centre). After indicating their country of residence and their cohort (owner, yard operator or both), yard operators would answer questions related to the management of their yard and their use of SFs. Like operators, horse owners would also respond to sections related to SF practices, such as the type of SFs used, advantages and issues encountered, as well as more detailed information about the horse(s) they own: general information, housing, feeding, training and health. Owners could answer the questions for up to five different horses.

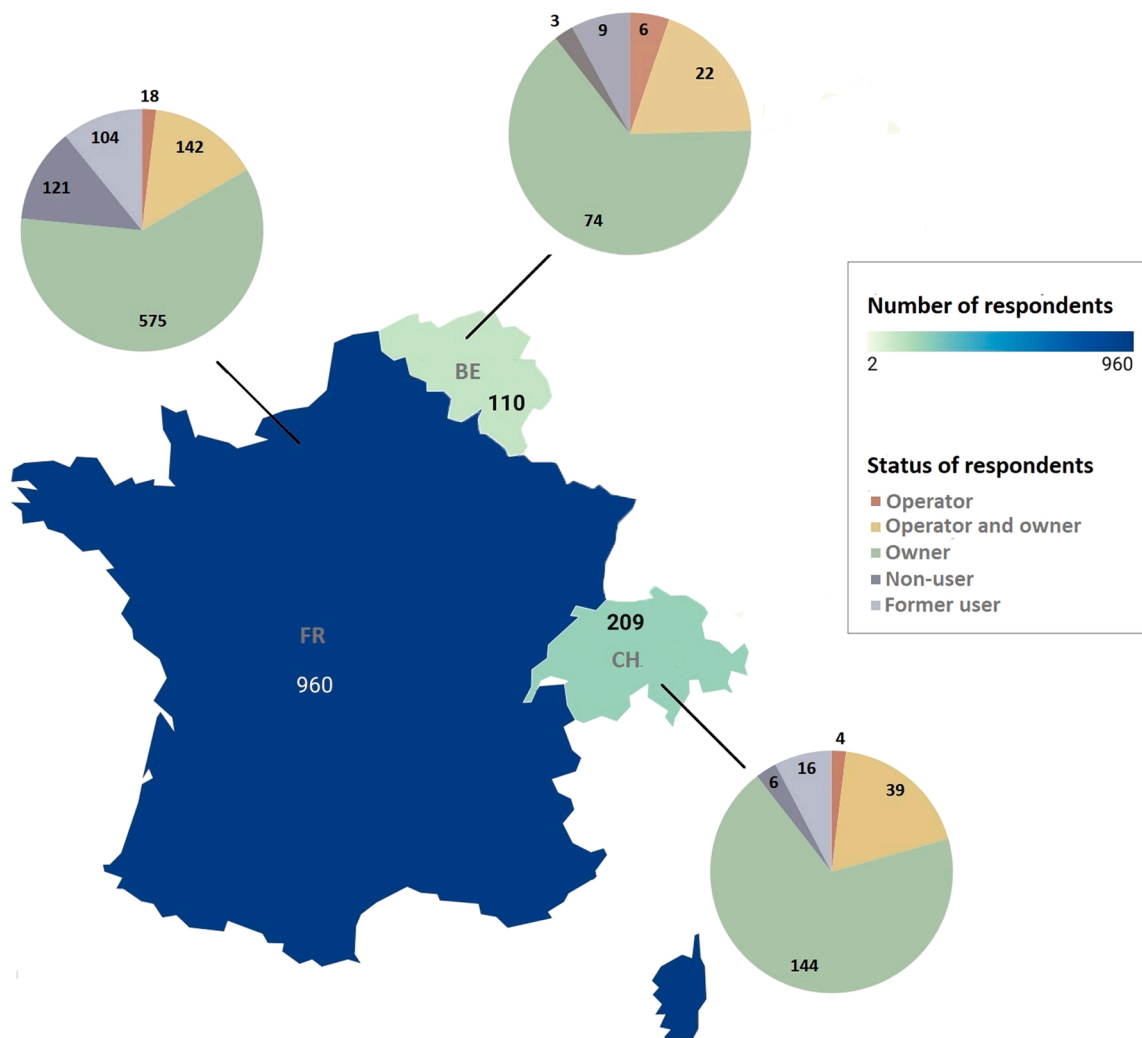
Most single-answers had an option "I don't know" and 4 multiple-answers questions had an "Other" option with a comment field (write-in responses). Questions about the area of residence and breed of horses were formulated as drop-down questions to facilitate data cleansing. During the questionnaire interpretation process, write-in responses and responses from open-ended questions were evaluated and grouped where appropriate. If a write-in response did not fit into a pre-existing category, a new category was created.

Prior to dissemination, the questionnaire was reviewed by nine peers within the research institute. The questionnaire was slightly revised based on their feedback.

### Questionnaire dissemination

In June 2020, the questionnaire was distributed via social media on the SNSF Facebook page (7.5 K followers), in a Facebook group dedicated to slow-feeding ("Filets à foin, trucs et astuces", 6.9 K members) and shared in SNSF's monthly electronic newsletters (sent to 982 people). The questionnaire was accessible from June 2020 to May 2022 to account for seasonal variations.

In total, we collected 1 283 answers, which is line with the number of respondents reported by Bushell and Murray (2016), Carroll et al. (2018) and DeBoer et al. (2022) (1,342, 1,451 and 1,450 respectively) who surveyed people on their management practices as well. The demographic distribution and status of respondents are shown in [Fig. 1](#). We created a database from the owners' responses about their horses. As some respondents were both operators and owners, and as owners could enter information for up to five horses, the total number of records in the databases exceeds the number of answers initially collected (1,283). Final database size used for this survey were: Operators = 229, Owners = 963, Former-users = 124, Non-users = 19 and Horses = 1,425.



**Fig. 1.** Demographics distribution of respondents to our questionnaire on slow-feeding practices for horse owners and yard operators. The proportions among groups (countries/status) are also displayed. (Abbreviations: BE = Belgium, CH = Switzerland, FR = France, GE = Germany).

### Statistical analysis of data

We extracted the results from GoogleForms into an Excel file, which was then loaded into R-statistics (v.4.2.1) for descriptive and statistical analysis.

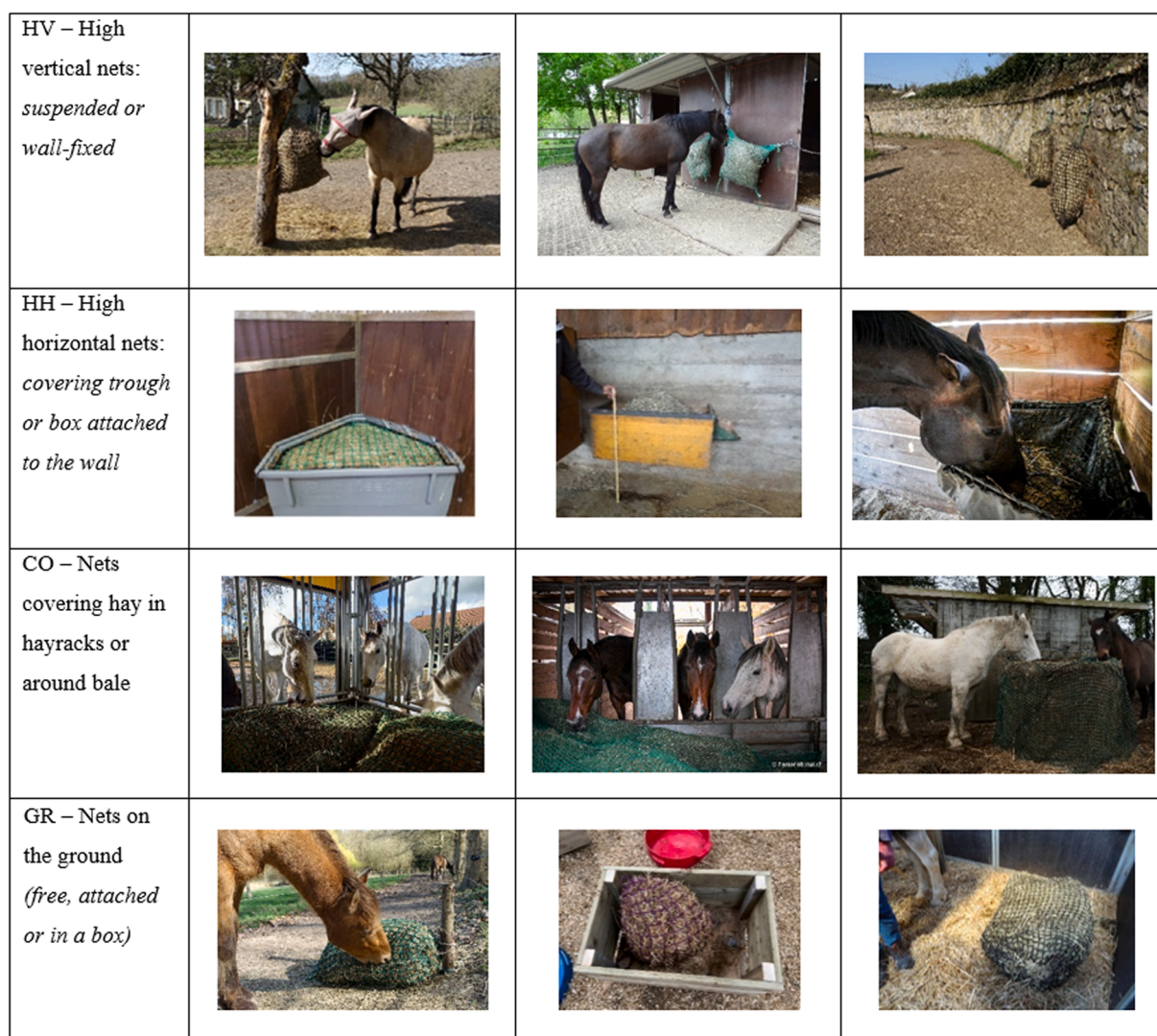
In order to facilitate the description of the results, the types of nets reported by the respondents were classified into 4 groups (High vertical net - HV, High horizontal net - HH, Covering nets - CO and Ground net - GR), as shown in Fig. 2. Breeds of horses were also classified into 4 categories to facilitate the analysis. Horses were either assigned to “Warmbloods”, “Draft horses” (heavy or light), “Ponies” or “Unknown” if declared as such.

Our primary aim was to evaluate the associations between the cohorts (operators / owners) or the country of residence (Belgium (BE) /France (FR)/Switzerland (CH)) and their SF practices. To do so, for continuous variables (such as the age of the horse), we presented the mean or median with standard deviation after visual assessment of distribution. Statistical differences between groups were assessed using a linear model. As no level could really be considered as a “reference”, the contrast linear model was used instead of the default linear model, so that the mean of all levels could be used as a reference point (intercept). Responses to single-answer multiple-choice questions were treated as categorical variables and frequencies of reporting among each group were calculated using the {svyr} R packages (Lumley, 2004).

Chi-square goodness of fit tests ( $\chi^2$  test) were performed to evaluate whether selected frequencies occurred equally between groups (Operators/Owners and BE/ CH/FR). Statistical difference was defined as  $p < 0.05$  and non-overlapping confidence intervals at the 95% level. Answers from multiple-choice questions could not be analysed using  $\chi^2$  test, as they were not mutually exclusive (e.g., because respondents could choose several options or type in their own responses, their answer could fit in more than one category). We therefore coded each option as binary variables (levels: ‘present’ or ‘absent’). For type-in responses, we extracted the most common keywords and coded them as binary variables. For these questions, only the frequency of occurrence of defined keywords out of the total number of responses was reported. The same response from the same participant could therefore contribute to several keywords. In other words, the sum of all keyword frequencies can be greater than 1.

In order to better understand some of the results, some additional analyses were carried out: as gain of time and loss of time were both reported by operators, we wanted to understand what factor(s) could tip the balance in favour of saving or, on the contrary, wasting operator time. To do this, the responses of the 128 operators (all countries included) who reported either a loss or a gain in time were linked to the general management of the yard. Due to the low frequency of certain values for many variables, only housing (individually housing / group housing), number of equids and use or non-use of CO nets were included





**Fig. 2.** Description of the hay net categories used by the horses using slow-feeders in the analysis. Categories were created based on the inclination of the net, its height and its use.

in the logistic regression as explanatory variables. After selecting the best model based on the AIC, we performed a model diagnosis and adapted the family link to “quasibinomial” due to overdispersion. Then, based on the p-value and confidence intervals, we extracted the odd-ratio associated with the explanatory variables.

As BE respondents were more likely to report problems and particularly likely to use HV nets compared to FR and CH, we hypothesized that HV nets could result in more problems and we also evaluated the association between use of HV nets and reporting at least one problem (regardless of the problem reported) using a  $\chi^2$  test as previously described. The same procedure was used to explore the association between the type of nets used and the absence of shoes.

## Results

### Owners and operators using slow-feeders

#### General description of owners and yards using slow-feeders

Of the 963 owners surveyed, 795 provided information on the number of horses they owned, including the number of horses fed with slow feeders. Irrespective of the country of residence, owners had an average of 2.5 horses (mean  $\pm$  SD: FR =  $2.6 \pm 1.82$ , CH =  $2.2 \pm 1.64$  and BE =  $2.5 \pm 1.72$ ) and reported using SFs for 72.0%, 71.2% and

69.7% of their horses respectively.

CH and BE operators had a similar distribution of number of horses, whereas FR operators reported significantly more yards with more than 20 horses (29.4%) compared to CH (11.6%) and BE (15.4%) ( $\chi^2(8, N = 229) = 27, p = 7e-04$ ). Regarding the yards using SFs for their equine livery, 75.5% of them had less than 20 horses in their yard, regardless of the country.

In terms of housing and feed management, yard operators reported mainly welfare-friendly practices. In fact, 75.6% of them, irrespective of the country, housed horses outdoor in loose group-housing. Concerning horses housed indoor, almost all yards, except for three French yards, reported daily turn-out. More than 90% of yards in BE, FR and CH reported daily social contact to their horses, either through housing or during turn-out. Finally, 73.1% of BE and FR operators declared providing an additional fodder to hay (straw and/or grass), and this proportion raised to 87.7% for CH operators. All information concerning the stables management is summarized in Table 1.

#### Slow-feeding practices

More than 65% of all respondents responded they had been using SFs for less than five years. The use of SFs for more than 10 years was reported by less than 5% of all groups of respondents (country, operators vs. owners). Some major differences were observed between operators

**Table 1**

Housing and feeding management of horses using slow-feeders reported by yard operators in Belgium, France and Switzerland. For turn-out, only yards with horses housed indoor answered the questions (Belgium=4, France= 31 and Switzerland=9).

	Belgium (N=26)		France (N=160)		Switzerland (N=43)	
	% of OPs	Upper and Lower 95% CI	% of OPs	Upper and Lower 95% CI	% of OPs	Upper and Lower 95% CI
Housing						
Outdoor – Group	80.8	[60.7; 91.9]	74.4	[66.9; 80.6]	76.7	[61.6; 87.1]
Outdoor – Individually	0	/	4.4	[2.1; 8.9]	2.3	[0.3; 15.2]
Indoor– Group	0	/	0.6	[0.1; 4.4]	2.3	[0.3; 15.2]
Indoor– individually	15.4	[5.7; 35.1]	18.8	[13.4; 25.6]	18.6	[9.5; 33.3]
Mixed	3.8	[0.5; 23.7]	1.9	[0.6; 5.7]	0	/
Turn-out (duration)						
No turn-out	0a	/	3.2b	[0.4; 21.1]	0a	/
1 – 3 h	0a	/	12.9b	[4.7; 30.8]	0a	/
3 – 5 h	25	[2.2; 83.1]	19.4	[8.6; 37.9]	0	/
5 – 10 h	25	[2.2; 83.1]	38.7	[22.9; 57.4]	55.6	[22.9; 83.9]
More than 10 h	50	[8.9; 91.1]	25.8	[13.0; 44.7]	44.4	[16.0; 77.1]
Turn-out (conspecifics)						
Individually	0a	/	40.5b	[25.6; 57.4]	22.2b	[4.9; 61.2]
Per pairs	25	[2.2; 82.9]	18.9	[9.0; 35.4]	11.1	[1.3; 54.2]
In groups	75	[17.1; 97.8]	35.1	[21.2; 52.2]	66.7	[30.7; 90.0]
Daily social contact (housing or turn-out)						
Yes	100	/	90.6	[85.0; 94.2]	95.3	[82.9; 98.9]
No	0	/	9.4b	[5.7; 15.0]	4.7b	[1.1; 17.1]
Fodder available						
Hay only	26.9ab	[13.2; 47.3]	26.9a	[20.5; 34.3]	2.3b	[0.3; 15.2]
Access to straw	3.8	[0.5; 23.7]	7.5	[4.3; 12.8]	9.3	[3.5; 22.6]
Access to grass	34.6	[18.8; 54.8]	48.1	[40.4; 55.9]	41.9	[28.0; 57.1]
Access to straw and grass	34.6	[18.8; 54.8]	16.9	[11.8; 23.6]	44.2	[30.0; 59.4]

Abbreviations: OP = Operator; CI = Confidence interval;

a,b Values within a row with different superscripts have their 95% confidence intervals (from  $\chi^2$  test) not overlapping, thus there is a significant difference between countries

and owners: operators were more likely to use SFs for more than 5 years (31.0%), compared to owners (13.8%). Additional information regarding the duration of use based on respondent status can be found in [Supplementary Figure S3](#).

Regarding the material of the SFs used (nets, metal, plastic, wood, or a combination of several dispensers made of different materials), no differences between countries were found for yard operators ( $\chi^2(4, N = 229) = 4, p = 0.4$ ). Most operators (86.9%) reported using nets only, and 11.4% reported using a combination of dispensers made from different materials. SFs made of wood were never reported and SFs made of plastic, or metal were reported by only two FR and two BE operators respectively. However, there were differences in terms of SF material used by owners between countries. Indeed, Swiss owners reported less use of nets only (75.3%) compared to FR (87.7%) and BE owners (89.2%) and more use of plastic dispensers (9.55%) than FR and BE owners, for whom plastic dispensers were rarely reported (0.87%, resp. 0.0%).

With regard to the type of net used by operators, the most frequently reported nets were CO nets, reported by 65.9% of operators using nets and GR nets were the least reported one (less than 25% of all operators). For hay nets used by owners, French and Swiss owners reported the

same ranking, with CO nets being also the most used nets for FR and CH owners whereas BE owners used more preferentially HV nets. More information about the prevalence of each type of SF can be found in [Table 2](#).

We found no differences between operators and owners with regard to the distribution of hay (“hay only in SF”, “hay always both in SF and loose”, “can vary depending on meals/days”). Most of participants (73.4%) reported that hay was only distributed in SFs, 13.5% of them reported that horses could always choose between loose hay or hay in SFs and 12.9% reported that the choice could vary depending on the day or the meal.

When asked about the reasons for using SFs, waste reduction was the most frequently selected item by all types of participants, except for Swiss owners, who selected “Weight Management” more frequently (44.4%) than any other reason. However, “Waste” was chosen more often by operators than by private owners. Weight management was the second most selected item for all types of participants, except for BE owners, for whom the time spent feeding by horses was the second most selected item (45.2% of respondents). “Time saving” was chosen by one third of all operators, whereas it was almost never chosen by owners. Finally, about 10% of owners in all countries reported that they used SFs

**Table 2**

Slow-feeders used by yard operators and horse owners from Belgium, France and Switzerland. As one respondent could use several dispensers, the sum of each column may exceed 100.

Type of slow-feeder	Belgium (BE)		France (FR)		Switzerland (CH)	
	% OPs (N=26)	% OWs (N=93)	% OPs (N=160)	% OWs (N=692)	% OPs (N=43)	% OWs (N=178)
Nets – Total (using only nets SF)	100 (88.5)	96.8 (89.2)	98.1 (88.8)	96.0 (87.7)	95.32 (79.1)	87.6 (75.3)
High vertical nets (HV)	50	58.1	40.6	37.4	30.2	33.1
High horizontal nets (HH)	50	52.7	43.8	37.3	21	29.8
Nets covering hay/haybale (CO)	65.4	32.3	65	49.4	67.4	36.5
Nets on the ground (GR)	19.2	20.4	23.8	21	18.6	12.4
Plastic – total (using only plastic SF)	3.8 (0.0)	6.4 (0.0)	5.0 (0.0)	5.8 (0.9)	16.3 (4.6)	20.8 (9.5)
Metal – total (using only metal SF)	7.7 (0.0)	4.3 (2.2)	3.8 (0.0)	5.2 (2.0)	7.0 (0.0)	5.1 (1.7)
Wood – total (using only wooden SF)	0	0	0.6 (0.0)	0.9 (0.1)	0	0

Abbreviations: OP = Operator; OW = Owner

because it was imposed by the livery yard where their horse(s) lived. Most operators and owners did not encounter any problems in their use of SFs. However, about a third of respondents reported an increased workload (32.7% of operators and 34.4% of owners). Health problems or SF-related risks were reported by less than 8% in each category (see Fig. 3).

Concerning the gain or loss of time associated with the use of SF, our results show that the number of horses boarded in the yard and the type of housing (individually or in group) did not have a significant effect on the likelihood of reporting either a gain or a loss of time, but the use or not of CO nets did ( $\chi^2(1, N = 129) = 23.8, p = 1.05e-06$ ). In fact, operators using CO nets were 2.9 more likely to report a gain of time, compared to operators not using them.

Interestingly, significantly more problems were reported by BE owners (72% of owners) than by CH owners (49.4%) ( $\chi^2(2, N = 963) = 15, p = 4e-04$ ). Belgian owners especially reported more often an

“Increased Workload” (39.8%) than Swiss owners did (26.4%). We also found that respondents using HV nets were significantly more likely (68.9%) to report at least one problem, compared to respondents using other types of Nets (49.9%) ( $\chi^2(1, N = 963) = 35, p = 4e-09$ ).

### Profile of horses using slow-feeders

#### Age, sex and breed

Horses using SFs were reported to be 12.9 (SD = 6.44) years old on average, with no significant differences across countries (lm with sum. contrast,  $p = 0.375$ ). The sex distribution was also similar between countries: 50.1% of mares, 46.7% of geldings and 2.8% of stallions in total ( $\chi^2(3, N = 1,419) = 4, p = 0.5$ ). Warmbloods were the most commonly reported type of horses in our cohort of horses using SFs (43.1% in total). Draft horses were the second most reported breed in CH (24.8%), whereas they were the less frequently reported breed by both

	Matter mentioned by respondents	%Operators BE (N=26)	%Owners BE (N=93)	%Operators FR (N=160)	%Owners FR (N=692)	%Operators CH (N=43)	%Owners CH (N=178)
Reasonings for use of SF	Waste reduction	84.6	61.3	88.1	62.3	76.7	36.0
	Weight management	57.7	39.8	56.2	48.7	67.4	44.4
	Time horses spend feeding	50.0	45.2	43.8	35.5	23.3	19.1
	Gain of time	38.5	0.0	24.4	0.3	32.6	0.0
	Digestive problems	19.2	24.7	38.1	23.7	30.2	24.7
	Stereotypic behaviour	15.4	7.5	18.1	3.9	9.3	6.2
	Dust, respiratory problems	11.5	7.5	30.0	15.9	20.9	6.7
	Group management	7.7	4.3	29.4	12.4	34.9	18.0
	Reduced stress	7.7	7.5	34.4	13.4	30.2	14.0
	Improved horse-human relationship	3.8	1.1	3.8	1.9	0.0	1.7
Issues encountered when using SF	No particular issue encountered	42.3	40.9	48.8	43.8	55.9	53.9
	Increased workload	26.9	39.8	35.6	35.7	25.6	26.4
	Requires new organization	19.2	11.8	26.2	17.2	16.3	10.7
	Financial cost	0.0	5.4	13.1	6.7	2.3	5.6
	SF-related risk of injuries, accidents	3.8	1.1	3.7	1.6	2.3	1.7
	Gums/teeth problems	7.6	5.4	3.1	3.2	7.0	3.4
	Musculoskeletal health problems	3.8	3.2	1.2	3.0	0.0	1.7
	Increased aggressiveness, frustration	15.4	5.4	4.3	3.2	7.0	5.1

**Fig. 3.** Reasons for the use of slow-feeders (SFs) and issues reported by horse owners and operators from Belgium (BE), France (FR) and Switzerland (CH). Proportions of operators choosing each matter are shown in blue and proportions for owners are shown in orange. As a respondent could choose more than one option, the sum of all percentages exceeds 100.

BE (9.7%) and FR (8.2%) owners. On the other hand, ponies/small horses represented only 15.3% of the Swiss reported horses, whereas they represented 29.2% and 24.2% of the Belgian and French reported horses respectively. Additional information regarding the age, sex, breed type and overweight status of the horses using SFs depending on the country can be found in [Supplementary Material S4](#) and additional information regarding the health of the horses using SFs can be found in [Supplementary Material S5](#).

### Housing and turn-out

Horses using SFs were mainly housed outdoor in groups, even though the exact proportions differed between countries (BE = 75.0%, FR = 84.3%, CH = 56.6%;  $\chi^2(6, N = 1,410) = 110, p < 2e-16$ ). Outdoor individual housing and indoor group housing were the 2 least reported housing systems, with no difference between countries (6.7% and 0.8%, respectively). However, the proportion of horses housed individually indoors (stables) differed between countries: 30.2% of Swiss owner reported horses, 17.4% of Belgian horses and only 8.2% of French horses.

Eighty-four percent of all the horses included in this study (housed either outdoor or indoor) were offered daily turn-out, regardless of their country of residence, with almost all horses housed indoor being offered daily turn-out. Owners reported that turn-out mainly took place in pasture with conspecifics (61.6% of reported turn-out) and the most common turn-out duration from the three countries was “More than 10 h” (53.3% of all turn-out), only 20.4% of horses had turn-out shorter than 3 h.

### Feeding management

Regardless of the country, more than half of the horses included in this study were offered hay *ad libitum*. Hay distribution differed significantly for Swiss horses, these horses were less likely to be offered hay *ad libitum* and more likely to receive 3 or 4 meals a day (14.5%) than BE (4.2%) or FR (4.0%) horses ( $\chi^2(6, N = 1,421) = 58, p = 1e-10$ ). Concerning access to grass, the proportion of horses with daily access to grass was the same within the three countries (36.6% of all reported horses). Finally, more BE horses (32.6%) were reported as overweight compared to FR (26.7%) and CH (24.0%) horses, although this conclusion was not supported statistically (confidence intervals overlapping). More details about the feeding management of horses using SFs can be found in [Table 3](#).

**Table 3**

Feeding management of horses using slow-feeders in Belgium, France and Switzerland. The daily amount of hay given was an optional question and was thus reported for only some of the horses (BE = 72, FR = 562, CH = 157). Confidence intervals given were extracted from  $\chi^2$  test. Rows in grey indicates 95% confidence intervals (from  $\chi^2$  test) not overlapping, thus, differences between at least 2 countries.

	Belgium (BE)		France (FR)		Switzerland (CH)	
	% of horses (N=144)	Upper and Lower 95% CI	% of horses (N=1039)	Upper and Lower 95% CI	% of horses (N=242)	Upper and Lower 95% CI
Number of meals/day						
1 meal/day	17.4	[12.0; 24.5]	11.5	[9.74; 13.6]	12.8	[9.15; 17.7]
2 meal/day	20.8	[14.9; 28.3]	18.8	[16.5; 21.3]	26.4	[21.3; 32.4]
3 or 4 meals/day	4.2 <sup>a</sup>	[1.88; 8.99]	4a	[3.00; 5.43]	14.5b	[10.6; 19.5]
<i>Ad libitum</i>	57.6ab	[49.4; 65.5]	65.3a	[62.3; 68.1]	46.3b	[40.1; 52.6]
Daily amount of hay (mean kg $\pm$ SD)	10 ( $\pm$ 4.47)	NA = 72	12 ( $\pm$ 4.49)	NA = 477	10 ( $\pm$ 3.62)	NA = 85
Access to grass						
Depends of periods	70.1a	[62.1; 77.1]	48.2b	[45.2; 51.3]	62a	[55.7; 67.9]
Both hay and grass, daily	26.4a	[19.8; 34.2]	38.5b	[35.6; 41.5]	34.7 <sup>ab</sup>	[29.0; 40.9]
Hay only	3.5a	[1.4; 8.1]	13.1b	[11.2; 15.3]	3.3a	[1.66; 6.48]
Access to straw						
No straw available	66a	[57.8; 73.3]	79.9b	[77.3; 82.2]	36.8c	[30.9; 43.1]
Straw always available	13.9a	[9.1; 20.6]	13.6a	[11.6; 15.8]	36.8b	[30.9; 43.1]
Straw partly available	16a	[10.8; 22.9]	6.5b	[5.19; 8.22]	26.4a	[21.3; 32.4]
Excess Weight	32.6		26.7		24.0	

Abbreviations: CI = Confidence interval

a,b Values within a row with different superscripts have their 95% confidence intervals (from  $\chi^2$  test) not overlapping, thus there is a significant difference between countries

### Training, use of bit and shoeing

Horses using SFs from Belgian and French owners were mainly ridden less than once a week (35.4% of Belgian horses and 42.1% of French horses), whereas Swiss owners reported significantly fewer horses ridden less than once a week (19.0%;  $\chi^2(8, N = 1,425) = 170, p = < 2e-16$ ). On the contrary, more than a third of CH horses were ridden or driven more than 4 times a week, whereas this frequency was significantly less frequent for BE (8.3%) and FR (9.1%) horses. The same tendencies were found for the reported number of ground sessions per week, with CH owners reporting significantly fewer (23.1%) horses worked on the ground less than once a week compared to FR owners (31.8%) ( $\chi^2(8, N = 1,425) = 18, p = 0.02$ ). In general, independently of country, 74.4% of the horses included in this study were being ridden for recreational purpose only.

Significantly more CH horses were ridden or driven with a bit (39% of horses), compared to BE (25%) and FR (24%) horses ( $\chi^2(4, N = 1,104) = 12, p = 0.02$ ). The same results were obtained for shoeing. CH horses were significantly more likely to be shod on all four feet (32.6%) than BE (6.3%) and FR horses (8.0%), and were less frequently reported as unshod (59.9%,  $\chi^2(4, N = 1,423) = 122, < 2e-16$ ), as shown in [Fig. 4](#).

We found a clear association between the use of nets and shoes. Indeed, significantly fewer shod horses were fed with nets (87.5%), compared to unshod horses (97.0%,  $\chi^2(1, N = 1,423) = 42, p < 8e-11$ ). In addition, the type of net used also differed between shod and unshod horses: shod horses were as likely as unshod horses to use HH nets (3% for both), but less likely to use GR nets (8.5% vs. 21.5%) and, to a lesser extent, HV nets (55.0 vs. 62.3%) and CO nets (29.9 vs. 47.9%).

### Discussion

#### Slow-feeding practices

Our results show that operators using SFs in their yard board fewer horses than the total operator population, whereas owners in this study were in line with the total owner population. Indeed, the vast majority of operators in this study boarded less than 20 horses, which is less than the median of 41 horses per yards, which was reported by the French Equine Network (Réseau Equin). Half of CH operators in this study also reported boarding less than five horses, which appears to be slightly lower than in the last Swiss Equine Industry Key Figures Report (SEIKF Report, [Ackermann and von Niederhäusern, 2019](#)), average of 7.5 horses



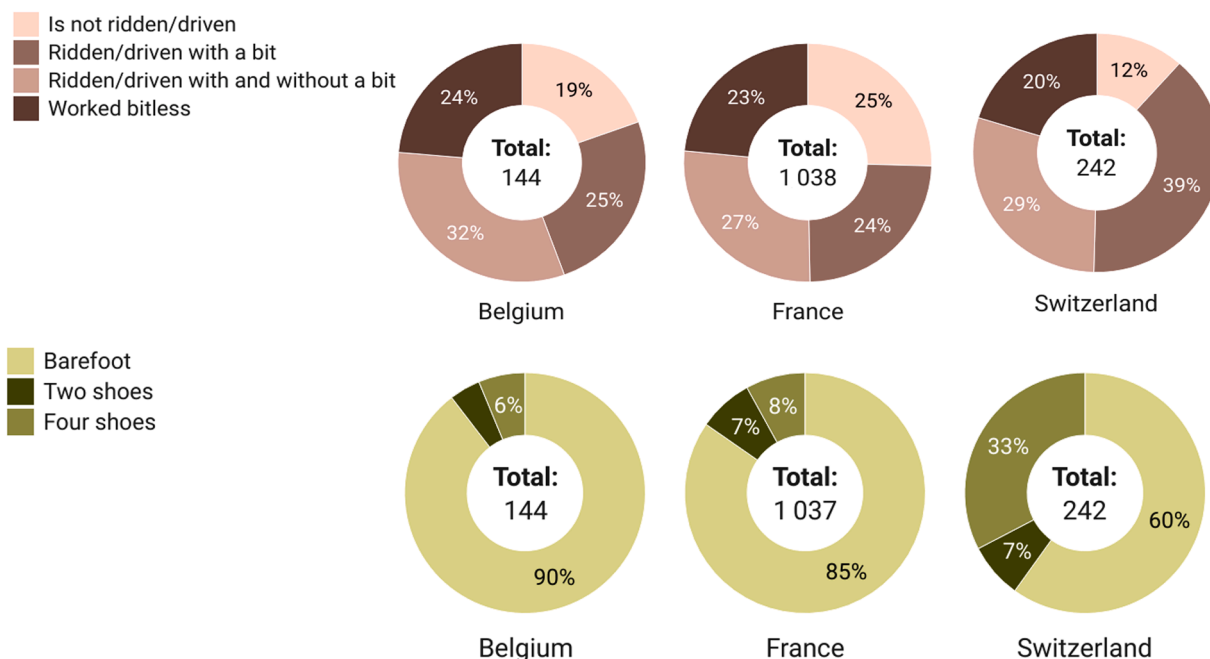


Fig. 4. Use of bit and shoeing among horses using slow-feeders.

boarded). The average number of horses reported by owners using SFs was 2.2 in the three countries and was in line with the finding of a recent study an average of 2.3 horses per CH owner (Ackermann and von Niederhäusern, 2019). Thus, owners using SFs did not differ from the total population in terms of the number of horses they own, but yard operators using slow-feeders boarded fewer horses than the average yard operator. This pattern could be linked to the popular belief of SFs use being associated with a loss of time, therefore being a disincentive for yards with many horses or to the cost of slow-feeders, which could pose a challenge for operators with large yards.

Overall, operators using SFs mostly provided housing conditions that appeared to fulfil the horses' needs (e.g., housed outdoor or with a daily turn-out, daily social contact, sufficient hay provision). This outcome may indicate a greater concern for the welfare of the horses compared to most yards.

More than half of the respondents (58.8%) reported using slow-feeders for less than 3 years, indicating that the practice is still relatively new and that most respondents certainly lack the benefit of hindsight. Operators in all countries reported that longer use of slow feeders than owners. This result may be due to the cost of these dispensers, particularly individual ones, which could discourage owners, with prices ranging from €30 to over €350 per slow feeder, depending on their characteristics (material, size...). However, more than a third of respondents said they had been using SFs for more than 3 years, suggesting that it would now be possible to study the long-term effects of such a dispenser on horse health and behaviour, provided that appropriate sampling is conducted.

Regarding the material and type of SF used, there were also some differences between owners and operators and between countries. While nets were the most commonly used slow-feeders by all caretakers in all countries, owners reported proportionally slightly greater use of plastic SFs compared to operators. This finding could be explained by plastic dispensers mostly being individual dispensers, whereas yard operators tend to use group dispensers for time efficiency. Indeed, among nets, covering (CO) nets were by far the most reported nets by operators. French owners also showed a clear preference for this type of net, as did Swiss owners, although to a lesser extent. This preference could be explained by the fact that these nets require much less handling than the other types of nets included in the study. Belgian owners differed as they

mostly used high-vertical (HV) nets and high-horizontal (HH) nets as hay nets. This is surprising as these types of nets are often criticised for the neck torsion they could cause (Raspa et al., 2021) and have been shown to modify the horse's posture (Bordin et al., 2023; Raspa et al., 2021). In addition, McAteer et al. (2023) found the use of hanging nets to be associated with increased muscular tensions in the neck region. Swiss owners reported using plastic SFs three times more often than BE and FR respondents and 10% of CH owners even reported using only plastic SFs, which was never reported by BE or FR owners. This result may be related to the fact that CH owners reported significantly more shod horses. Indeed, the use of nets can be dangerous for shod horses as there is a risk of the horses getting their shoes stuck in the net (Morgan et al., 2016). It is therefore possible that Swiss owners use more plastic dispensers to reduce the risk associated with the presence of shoes, as metal devices are sometimes viewed with suspicion, particularly in relation to their effect on teeth.

It should be noted that overall HV nets were mentioned by only 39.5% of the 1 192 users (all groups combined), which is a rather low number considering that this type of net represents the majority of research projects on slow-feeding (Bordin et al., 2023; Ellis et al., 2015a; Glunk et al., 2014; Hodgson et al., 2022; Raspa et al., 2021; Speaight et al., 2016). On the other hand, CO nets are the most commonly used hay nets and are only beginning to be studied (Seabra et al., 2023). This finding can be explained by the fact that a lot of research is carried out on horses in individual boxes (more convenient for observations, most common type of housing in several countries), and HV nets can be used in different situations, whereas CO nets require horses in group housing. However, this prevalence of hay nets should be taken into account when studying slow-feeding, as the results obtained for HV nets cannot always be extrapolated to horses using other nets, as they differ in many respects (height, inclination, group dynamics...) which may influence the results.

Waste reduction was the most frequently cited reason for the use of SFs by both owners and operators, although most SFs were not originally designed to meet this objective. However, several authors have reported that SFs are effective in reducing waste: Martinson et al. (2012) found a reduction in hay waste from 57% (no dispenser) to 6% when using nets and Grev et al. (2014) found that all feeders they tested paid for themselves within 11 months. Seabra et al. (2023) also reported a reduction



from 16.6 to 9.3 kg of wasted hay per day in groups of five horses. Waste reduction was more often mentioned by operators, for whom the financial outcome is of greater importance as they have to live from their equine operation.

Weight management was the second most commonly reported reason for using SFs, with over 55% and 45% of operators and owners reporting it. In the study of [Seabra et al. \(2023\)](#), horses fed *ad libitum* hay in SFs consumed significantly less hay than when offered loose hay. Interestingly, within each country, weight management was reported more frequently by operators than by owners. This finding may be related to the poor ability of owners to recognise when their horses are obese, as reported by [Wyse et al. \(2008\)](#). Both CH operators and owners seemed to have an increased interest in weight management than operators and owners from FR and BE. This interest can be linked to the significantly higher proportion of draft (heavy or light) horses reported by CH owners compared to BE and FR owners, with Franches-Montagnes being the most represented breed (20.2% of the Swiss reported horses of our study). Franches-Montagnes are easy-keepers and are frequently overweight which may explain Swiss horse owners' sensitivity to the issue. This hypothesis is supported by CH owners who reported significantly less hay *ad libitum*, and more hay meals (3–4 times), with access to straw which may indicate a willingness to manage access to forage while meeting the horses' need in terms of time spent feeding ([Dosi et al., 2020](#)).

Despite the increased workload that the utilisation of hay nets is known to entail ([Morgan et al., 2016](#)), approximately a third (27%) of all operators identified time efficiency as a key rationale for employing SFs. This opinion may be due to the fact that SFs allows for longer feeding time, thus allowing operators to distribute hay less frequently, which may explain the lower frequency of meals reported in this study compared to another feeding management survey conducted in Sweden ([Larsson and Müller, 2018](#)). However, "Time efficiency" was selected almost exclusively by operators (24.4–38.1% of operators) and rarely by owners (only reported by 2.2% of owners). For owners, it is easy to imagine that, given the type of SF used, the handling of slow-feeding dispenser is time consuming, especially when we know that owners are less likely than operators to use CO nets. For operators, the gain or loss of time was only associated with the type of nets used, but not with the housing they provide in their yards nor the number of horses boarded. This is an interesting finding as it suggests that slow-feeding may be suitable for operators even with large numbers of horses in their yards when using CO nets.

Looking at the disadvantages of SFs, almost half of the participants reported no problems in using SF, which is an encouraging finding. Although this result may be skewed by the fact that people experiencing 'serious' problems may have stopped using SFs and therefore not completed this particular questionnaire, it is still valuable to note that over 500 current users reported no disadvantages to using slow-feeders. The most commonly reported problem was an increased workload, which was a predictable result as it was already mentioned in the literature ([Morgan et al., 2016](#)). Frustration, as well damages to the teeth and gums, and to the equine musculoskeletal health, have been identified by researchers as potential adverse effect of slow-feeders ([Ellis et al., 2015a, 2015b, Hodgson et al., 2022; Raspa et al., 2021](#)). However, these issues were rarely mentioned by the respondents (less than 10% for each category). This result is consistent with the data from the former users, as only 12.9%, 10.5% and 8.1% of former users, indicated cessation of SFs use due to frustration, damage to teeth and/or gums and to the feeding posture and associated muscular issues. These findings may be attributed to the owner's inability to accurately identify pain or discomfort in their horses ([Lesimple and Hausberger, 2014](#)). However, they may also indicate that the concerns raised by data from individually stabled horses with high-hung hay nets and limited hay quantity (as used in [Ellis et al., 2015a, 2015b, Rochais et al., 2018 and Raspa et al., 2021](#)) may not be applicable to horses using horizontal slow-feeders and/or with greater opportunities for movement (outdoor housing) and larger

amounts of hay. Finally, we saw that HV nets were associated with a higher risk of reporting at least one problem (among the proposed list of problems presented in the [Table S2](#)), highlighting the importance of choosing the right dispenser - one that meets the expectations of the caretaker, is adapted to the horse's environment, while ensuring the safety of the horse using it.

Overall, 73.4% of current users reported distributing the hay only in a slow-feeding dispenser. Domesticated horses have been reported to spend up to 64% of their time feeding when given the opportunity ([Auer et al., 2021](#)), which underlines the absolute need for dispensers that are safe and do not compromise horses' welfare. Fortunately, only 1.1–3.8% of all current users who responded to the survey reported SF-related injuries and/or accidents. However, this number should be reduced as much as possible and the safety of horses using SFs should be the primary criterion for those responsible for the design and sale of these devices. Caretakers should also choose their dispenser so that it meets their expectations and is adapted to both the horse's environment and the horse itself (size of the horse, possible shoes, health problems ...). In addition, these dispensers should be a priority area for research to ensure that they do not compromise the health of the horses using them.

#### Profile of horses using slow-feeders

Overall, horses from our study seemed to differ from the global population in terms of age, housing and feeding management, training frequency and shoeing. This information is valuable, as a good knowledge of the target population is important to ensure a representative sample.

The mean age of horses reported by owners in this survey was 12.9 years. This age is slightly older than the population of Swiss leisure horses investigated by [Dittmann et al. \(2020\)](#) (mean age = 11.2) and UK leisure horses from [Hockenhull and Creighton \(2014\)](#), (mean age = 11.4 years). However, the survey conducted by the SNSF in 2017 found the average age of horses in Switzerland to be 12.5 years. Thus, our sample appears to be slightly older than the average age of ridden horses, with a distribution closer to the population as a whole. The sex ratio was fairly balanced in our cohort, with 50.1% of mares, 46.7% geldings and 2.8% stallions. Most horses reported by Belgian, French and Swiss owners were warmbloods (43.1% of the 1'425 horses included in this study). Franches-Montagnes accounted for 20.2% of the Swiss reported horses, which is in line with the findings from [Ackermann and von Niederhäusern \(2019\)](#), who reported 18.4% of all Swiss horses as Franches-Montagnes. As discussed earlier in this study, this pattern may explain the willingness of Swiss owners/operators to use SFs for weight management, as this breed is prone to obesity.

Owners from Belgium, France and Switzerland reported loose group-housing for 75%, 84.3% and 56.6% of their horses respectively. These are high prevalences compared to the results of [Dittmann et al. \(2020\)](#), who reported only 43% of their Swiss leisure horses and 15% of their Swiss competitive horses being housed in groups with free access to the outdoor. Although no comparable data could be found for Belgium and France, it appears that at least Swiss horses using SFs were housed differently than the overall horse population in this country, with more free access to the outdoor and a more frequent housing with conspecifics. This conclusion is supported by the results on the turn-out of CH horses using SFs, also more welfare-oriented (only 19.7% of horses turned-out individually, longer turn-out) than those reported by [Dittmann et al. \(2020\)](#) (29%) or by the survey conducted by the SNSF (23–28%).

*Ad libitum* access to hay was reported in our study for 57.6%, 65.3% and 46.3% of BE, FR and CH horses, respectively. These prevalence are higher than the prevalence of 25% reported by [Larsson and Müller \(2018\)](#) who investigated feeding practices among owners of Arabian horses in Sweden. This difference may be solely related to the use of SFs. "Increased time spent feeding by horses" was cited as a reason for using SFs by more than 40% of all users, highlighting an increased interest of

these horse caretakers in their horses' time budget. This outcome could further be related to slower hay intake when SFs are used (Benz et al., 2014; Correa et al., 2020; Ellis et al., 2015a, 2015b; Rochais et al., 2018), which could imply that hay can be distributed less frequently. This conclusion is supported by the reduced number of feeding frequencies in this study compared to Larsson's findings (Larsson and Müller, 2018).

Excess weight was reported for 24–32% of the horses included in our survey. Interestingly, the Swiss owners did not report a higher incidence of overweight horses, although weight management was one of their priorities. In comparison, Wyse et al. (2008) reported that 45% of the horses in their cohort (horses from riding schools in Scotland) were fat or very fat, which is more than we found in our study. However, owners are usually bad at estimating their horse's condition (Wyse et al., 2008), it is thus possible that owners from our study underestimated their horses' weight. This pattern is consistent with our findings in which almost half of respondents reported using SFs for weight management purposes. On the other hand, owners participating in our study were likely to be more sensitive to the issue of obesity than the average population. Thus, the lower proportion of overweight horses may indicate that the owner's feeding practices (including the use of SFs) were indeed effective. This weight management is important as reducing obesity rates is likely to reduce the prevalence of laminitis, osteoarthritis and hyperlipaemia in the equine population (Geor, 2009; King and Mansmann, 2004).

Three quarters (74.4%) of the horses in our cohort were reported to be ridden for leisure purpose. This percentage is higher than what Larsson and Müller (2018) found with their survey, but this may be biased as they surveyed owners of Arabians only. Wylie et al. (2013), reported 60% of horses used for leisure in their study and the SEIKF Report from 2019 identified 51% of Swiss horses to be leisure horses (Ackermann and von Niederhäusern, 2019). Thus, horses from our cohort tend to be more leisure horses than the average population of horses, at least for Switzerland. This pattern is supported by the finding of Dittmann et al. (2020), who reported that the average number of riding sessions per week for leisure riders was 4.7, whereas in our cohort only 30% of Swiss horses were reported to be ridden more than 4 times per week. Wylie et al. (2013) also reported that ridden horses in their cohort were ridden an average of 5 h/week, which far exceeds our findings. With the exception of the Swiss horses, more than a third of the horses in our cohort were ridden less than once a week and half of these horses were not ridden at all (unbroken, retired, health problems...).

With regard to shoeing, Dittmann et al. (2020) reported 27% and 11.5% unshod Swiss horses for leisure and competition respectively. In our cohort, this prevalence was much higher with 60% of the horses being unshod. One hypothesis could be that a certain proportion of the horses in our cohort were not ridden, or were ridden very occasionally, and could therefore remain unshod. An alternative hypothesis could be that the use of SFs (especially some nets) may pose a risk for shod horses, thus increasing the proportion of unshod horses reported in our study. This hypothesis is supported by the association we found between the use of HV nets and the proportion of shod horses as well as the increased use of plastic dispensers for Swiss horses, more frequently shod than BE and FR horses.

Although no research has confirmed any associations, the last decade has seen the emergence of new and alternative practices among horse owners: new housing systems (paddock-paradise, active stables ...) interest in the needs of horses (feed, social contact ...), few or unriden horses sharing other activities with their owners, less systematic use of shoes and bits, et cetera. Most of these alternative practices are in use simultaneously by owners whose approach to horses and riding is different from that of other riders. According to our data, the population of SFs users seems to fall into this category of keepers.

#### Limitations of our study

Despite achieving a similar number of responses to other

questionnaire-based studies (Bushell and Murray, 2016; Carroll et al., 2018; DeBoer et al., 2022), it should be noted that these data represent only a small proportion of the target population (horses using slow-feeders). There is also a risk of excluding potential respondents who do not or seldom use the internet, which could affect the results by making the respondents unrepresentative (e.g., excluding older owners/operators). As a result, the results may not be representative of the entire target population.

Although this study was designed to survey horse keepers (owners/operators) who were using SFs themselves, it is possible that some owners who were not involved in the feeding of their horse completed the questionnaire. In fact, approximately 10% of the total number of owners who completed the questionnaire stated that they used SFs because it was required by the yard. This result means that not all horses reported by their owners were kept at their owners' home premises but were instead boarded in a yard, thus introducing a potential bias into the question of the advantages/disadvantages of SF, or even the question on feeding practices if the owner were not in charge of feeding.

It is also important to note that Belgium and Switzerland are two multilingual countries. As the questionnaire was only available in French, only the French-speaking inhabitants of these two countries were able to complete it. It is possible that this restriction introduced a bias, as it is known that in Switzerland, for example, practices can differ between cantons (type of farms, use of horses ...), as described by Ackermann and von Niederhäusern (2019).

The use of a questionnaire based on a convenience sample and self-reported responses allowed us to obtain a large sample size and to include different profiles of respondent. However, such methodology is associated with several biases (Van, 2020). For multiple-choice questions, one common pitfall is in case participants don't fit in one of the predetermined options, thus forcing them to choose an answer that doesn't satisfy them. However, we tried to avoid this problem by always offering an "Other" option and / or a "Comment" section, so participants could express their opinion in their own words. However, despite the actions taken, data should be considered carefully, as there are still risks of socially desirable reporting and recall bias. Finally, it is important to consider that owners may have a subjective perspective or may be unable to accurately evaluate their own horses' behaviour and health, particularly in relation to the presence of stereotypies (Lesimple and Hausberger, 2014).

Finally, it should be noted that ours was an observational study without any manipulation of the horses' exposure to slow-feeders. Therefore, the associations presented in this paper should not be interpreted as a causal relationship.

#### Conclusion

This study highlights key characteristics of horses and operators using slow-feeders, such as older, less frequently trained horses living outdoors in groups and smaller yards with housing and feeding practices more suited to the needs of horses. These findings emphasise the importance of carefully considering sample representativeness in future slow-feeding research to enhance external validity, particularly for observational studies.

Regarding slow-feeding practices, nets—particularly those covering hay racks or surrounding hay bales—were the most widely used and seem to suit large yards due to their time efficiency. Conversely, hanging or suspended nets, despite their prevalence in recent studies, were less commonly used and associated with more reported issues. Future research should therefore prioritize evaluating the effects of nets covering hay racks or surrounding hay bales on horse health and behavior.

The low prevalence of health problems and accidents reported, coupled with widespread satisfaction among respondents, suggests slow-feeding is a promising management tool. Finally, observed differences between countries call for comparative studies, particularly in

English-speaking regions, to explore cultural influences on slow-feeding practices.

### CRedit authorship contribution statement

**Sabrina Briefer Freymond:** Writing – review & editing, Supervision; **Marie Roig-Pons:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization; **Iris Bachmann:** Writing – review & editing, Resources, Project administration, Funding acquisition.

### Ethics approval

The study was approved by the Institutional Review Board of Agroscope, who evaluated that ethical standards were met. In addition, per the definition of the new Federal Act on Data Protection of the Swiss federal legislation, no personal data were collected in this study and IP addresses were not recorded. Therefore, the data collected did not allow for respondents to be identified in any way. At the beginning of the questionnaire, respondents were informed about the purpose of the questionnaire and the identity of the investigator.

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### Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of the first draft of this work, the authors used DeepL to improve readability and language. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

### Conflict of Interest

None.

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### Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.jveb.2025.01.006](https://doi.org/10.1016/j.jveb.2025.01.006).

### Data Availability

The datasets generated and analysed in this paper, as well as the data set on former and non-users, are available at <http://zenodo.org/doi/10.5281/zenodo.10822206>.

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