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A survey of control strategies for equine small strongyles in Lithuania

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Summary

Anthelmintic resistance (AR) in equine cyathostomins is being reported all over the world. In Lithuania, however, the last study on this subject was published more than fifteen years ago, thus little is known about the current situation. The aim of this study was to determine the factors that may associated with the development of AR on equine studs in Lithuania. A questionnaire containing seven open-ended and nine closed multiple-choice questions about worm control strategies, use of anthelmintic substances and stable management practices was posted to 71 randomly selected horse establishments in Lithuania. Replies were obtained from a total of 59 stables, representing 83 % of officially established stud farms in Lithuania.

The results showed that more than 80 % of these establishments performed pasture management practices such as excrement removal from stables and pasture, 56 % mowed their pasture, 31 % practised mixed or rotational grazing with other species, and 97 % of the horses were routinely dewormed. Macrocyclic lactones (ML) (58 %, n=33) were the most commonly used drugs, followed by benzimidazoles (BZ) (24 %, n=14) and tetrahydropyrimidines (THP) (19 %, n=10). The majority of farms (60 %) treated horses four times per year and 68 % estimated the weight of the horses by eye before treatment. About 36 % of respondents had heard of faecal egg counts (FEC), but only 17 % used the test and as few as 9 % had tested their herds for AR with faecal egg count reduction tests (FECRT).

The results demonstrate that there is scope for improving routines for worm control in many horse establishments in Lithuania. In order to increase knowledge and reduce the risk of the spread of AR, diagnostic methods should be adopted in a collaboration between stud farms and veterinary practitioners.

Keywords: questionnaire; parasite control; anthelmintic resistance

Introduction

The implementation of measures against parasites is an important aspect of equine husbandry since these infections can adversely impact horse health and welfare. Strongyle parasites are commonly found in the large intestine of horses and can cause disease that ranges from ill-thrift to sudden death. As a result, these parasites are the primary reason that horses at pasture should be maintained on a regular deworming program. Until approximately 20 years ago, the large strongyles (particularly *Strongylus vulgaris*) were considered the most important strongyles. However, subsequent to the introduction of ivermectin, large strongyles became

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relatively uncommon. In contrast, cyathostomes (small strongyles) are now considered the most important parasite of horses and produce almost all the strongyle eggs found in the feces of horses (Love *et al*., 1999; Nielsen *et al*., 2010b). Traditional control strategies have focused on nematode egg suppression regimens that involve frequent application of anthelmintics to all horses at intervals based on strongyle egg reappearance periods after treatment (Love *et al*., 1999; Nielsen *et al*., 2018; Matthee *et al*., 2002). Widespread use of such programmes has substantially reduced the clinical diseases associated with cyathostomin species, but the high frequency of treatment has led to considerable selection pressure for anthelmintic resistance (Matthews *et al*., 2014).

A large amount of evidence has been accumulated in recent decades documenting the declining efficacy of all three broad-spectrum anthelmintic classes for cyathostomin control for use in horses (Kaplan *et al*., 2004; Peregrine *et al.,* 2014; Smith *at al*., 2015). The identified resistance to macrocyclic lactones (ML) is an additional concern because no new medication classes or modes of action have been introduced since ivermectin in the 1980s (Cain *et al*., 2019).

Due to the increasing resistance of gastrointestinal nematodes (GIN) to anthelmintic substances and the lack of new anthelmintic classes for use in horses, recommendations have been made to control equine parasites with improved sustainable management, with the emphasis on monitoring and targeted dosing based on faecal egg count (FEC) for individual farms and horses (von Samson-Himmelstjerna, 2012; Matthews *et al*., 2014; Wilkes *et al*., 2019). However, current knowledge gathered from a few questionnaire studies of European horse owners underlines high treatment frequencies and systematic drenching schemes with a limited use of faecal egg count (FEC) analysis (O'Meara *et al.,* 2002; Relf *et al.,* 2013). The exceptions to this are Denmark and Sweden (Osterman *et al*., 2007; Nielsen *et al*., 2014). In Denmark since 1 August 1999, there has been restricted use of all veterinary anthelmintic formulas as prescription-only in an effort to secure more veterinary involvement in parasite control and reduce unnecessary usage (Nielsen *et al*., 2006a). In principle, this legislation bans prophylactic usage and requires a diagnosis to be made by a veterinarian before the anthelmintic can be prescribed (Nielsen *et al*., 2020). In Lithuania, only veterinarians can prescribe veterinary anthelmintics (drugs are subsequently delivered by veterinarians or by pharmacists upon prescription by a veterinarian), but no parasitic diagnosis is required before use. Based on Denmark's experience, improved control strategies may lead to a more sustainable use of anthelmintics in horses (Nielsen *et al*., 2020). There is limited knowledge about the level of implementation of these strategies in parasite control programmes in Lithuania. An understanding of current practices and potential risk factors for AR is required to facilitate the implementation of sustainable parasite control regimens.

Using survey data from a questionnaire, the aim of this study was to identify the parasite control practices used on equine studs in Lithuania and investigate factors that may be associated with the development of AR.

Material and Methods

Questionnaire

The survey comprised 16 questions: seven open-ended and nine closed questions. The multiple-choice questions with subjective answers to each question were divided into sections to obtain information on demography, grazing management and worm control strategies, including the use of anthelmintic substances.

Contact details for Lithuanian stables were obtained from the Lithuanian Equestrian Federation (LEF) and the national database jok.lt. From each of these lists, horse establishments were randomly selected using slips of paper or numbers randomly generated by the computer. The questionnaire was posted to 71 horse establishments in 2020. To maximise the number of respondents, 28 stables (central part of Lithuania) were visited and the farmers interviewed personally, while 31 others were interviewed by phone and the remaining respondents did not agree to provide data. Responses were obtained from the stable owner or stable manager (person responsible for the stable's internal activities). Each questionnaire was completed in full. The same investigator conducted all the surveys.

Data analysis

Descriptive statistics were calculated using Microsoft Excel® (2013). The answers to open-ended questions were checked and coded into categories where appropriate. The Wilson Chi-square test (showing how common the subject is in the population) or Fisher's Exact Test was used for categorised variables. All the tests were considered to be statistically significant at $P<0.05$.

Ethical Approval and/or Informed Consent

The research related to animals complied with all the relevant national regulations and institutional policies for the care and use of animals.

Results

Anthelmintic selection and administration

Overall, 97 % of respondents primarily used anthelmintics to control nematode infections in their horses. More than two thirds of the respondents (65 %, n=38) indicated that the owner was responsible for administering anthelmintics, while the remainder (25 %, n=15) reported that veterinarians or the stable manager (10 %, n=6) were responsible ($p<0.005$), (Table 1). Forty-eight percent (n=28) of the respondents referred to veterinary advice for helminth control, but only 27 % (n=16) of horse owners who treated their horses followed a veterinarian's recommendations ($p<0.05$). In addition, 85 % (n=49) stated that they dewormed all the horses

Table 1. Number, percentage and confidence interval (95% CI) of anthelmintic selection and administration practices assessed by questionnaires (n=59) on intestinal worm control practices in horses in Lithuania.

Worm-control factor	Number	%	95 % CI
Anthelmintic classes used on horse farms			
Macrocyclic lactones [a]	33	58 %	(45 – 70)*
Benzimidazoles [b]	10	19 %	(10 – 29)*
Tetrahydropyrimidine[c]	14	24 %	(15 – 37)*
Treatment frequency			
Once	2	4 %	(1 – 12)*
Twice	16	28 %	(18 – 41)*
Three times	4	7 %	(3 – 17)*
Four times	34	60 %	(47 – 71)*
Seven times	1	2 %	(0 – 9)*
Anthelmintic dosage calculate			
Weight tape, weight formula	3	5 %	(2 – 14)*
By eye	39	68 %	(56 – 79)*
One tube/packet per animal	15	25 %	(17 – 39)*
Responsible for administering anthelmintic			
Stud farm owner	38	65 %	(52 – 75)*
Veterinarian	15	25 %	(16 – 38)*
Farm manager	6	10 %	(5 – 21)*
Drug rotation			
Every treatment	15	26 %	(17 – 39)
Every year	23	41 %	(29 – 53)
Every 2-3 years	19	33 %	(23 – 46)
FEC/FECRT			
Aware of FEC test	21	36 %	(25 – 48)*
FEC used	10	18 %	(28 – 68)*
Monitoring and disease diagnosis	3	5 %	(11 – 60)*
Detection of AR	2	4 %	(6 – 51)*
Selection of horses for treatment	5	9 %	(24 – 76)*
Aware of FECRT	16	28 %	(17 – 40)*
FECRT used	5	9 %	(14 – 56)*

*P value (p<0.05); [a]active substance ivermectin (including injectable ivermectin for cattle) and moxidectin; [b]active substance fenbendazole; [c]active substance pyrantel embonate.

on their farm at the same time. Only three farms/studs/horse establishments (5 %) used a weighing tape for each horse prior to treatment; the majority of respondents (68 %, n=39) estimated the weight of the horses by eye and 26 % (n=15) administered one tube/packet of the drug per horse (p<0.05), (Table 1).

The number of anthelmintic treatments per year varied from one to seven, with an average of 4.5 times. The majority of respondents (60 %, n=34) reported that they treated their horses four times per year, while 28 % (n=16) treated them twice a year, and 2 % (n=1) seven times a year (p<0.05), (Table 1). Most of the respondents (93 %, n=53) stated that spring and autumn were critical times for treatment.

According to 81 % of the respondents, the main reason given for anthelminthic treatment was as a preventive measure, (Fig. 1), 12 % referred to clinical signs (diarrhoea 1 %, weight loss 1 %, colic 4 %, rough hair coat 4 %, tail rubbing 2 %), and only 7 % (n=4) gave the treatment following positive parasitological tests (Fig. 2). The most commonly used substances were ML (58 %) in different formulations (including injectable ivermectin for cattle), while THP (24 %) and BZ (19 %) were used more sporadically ($p<0.05$), (Table 1). Only 33 % claimed to alternate between these drug classes every two to three years, 41 % every year and 26 % every treatment (Table 1).

Twenty-one (36 %) respondents were aware of the FEC test, but only 18 % of respondents said that FECs were performed on their property ($p<0.05$). 5 % of respondents used FECs for monitoring and disease diagnosis, 4 % for detection of AR and 9 % for selection of horses for treatment ($p<0.05$). Sixteen respondents were aware of the FECRT test, but only five respondents indicated that FECRT had been performed on their property ($p<0.05$).

Preventive measures

Additional measures for equine gastrointestinal parasites were commonly undertaken in 80 % (n=47) of the stables ($p<0.005$). Twenty-six percent of the stud farms carried out more than one of the improvement procedures listed in Table 2. In all, 85 % (n=40) removed excrement from the stables and pasture (20 % of those stated that they did this at least once per week, 38 % at least once per month, 30 % once per quarter and 13 % once per year), 56 % mowed their pasture and 31 % practised mixed or rotational grazing with other species, i.e. cattle or sheep.

Discussion

Data on equine facilities

This study is the first report on equine parasite control practice at a national level in Lithuania. Given that the response rate was relatively high (83 %) and respondents were from different parts of Lithuania, it is reasonable to assume that the results reflected parasite control practices over a broad geographical area. The high response rate may have been influenced by several factors including the short, structured questionnaire, telephone calls or direct contact to gather information, free FEC testing offered to stud farms, horse stables/farms, and advice and direct, constructive communication during visits.

Anthelmintic selection and administration

According to the results of the present study, a positive FEC (diagnostic test) was ranked among the participants as the rarest reason for deworming horses (Fig. 1). Similarly, as in previous studies (Osterman *et al*., 2007; Earle *et al*., 2002; Stratford *et al*., 2014; Ras-Noryska *et al*., 2017; Elghryani *et al*., 2017), diagnosis of parasite-associated diseases often relies on nonspecific clinical signs and/or detection of parasite eggs or worms in faeces, and infrequently on veterinary examination. The basis for current recommendations for equine internal parasite control is the use of FEC to monitor parasite egg shedding levels and anthelmintic treatment efficacy through FECRT (Nielsen *et al*., 2020; Nielsen *et al*., 2018). In Lithuania, this therapy should also be applied, but this survey, however, illustrates a general lack of compliance with these recommendations since only about 17 % of the equine operations surveyed in Lithuania used FEC and only 9 % used FECRT (Table 1). These results are similar to a Polish survey conducted in 2017, where 4 % of equine operations made routine use of FEC and a further 22 % did so occasionally (Ras-Noryska *et al*., 2017). Similarly, a recent survey conducted among thoroughbred farm managers in the state of Kentucky in the United States revealed that about 20 % of respondents used FEC in their parasite control programme (Papini *et al*., 2015). However, these findings are in sharp contrast with Denmark, where 90 % of respondents routine-

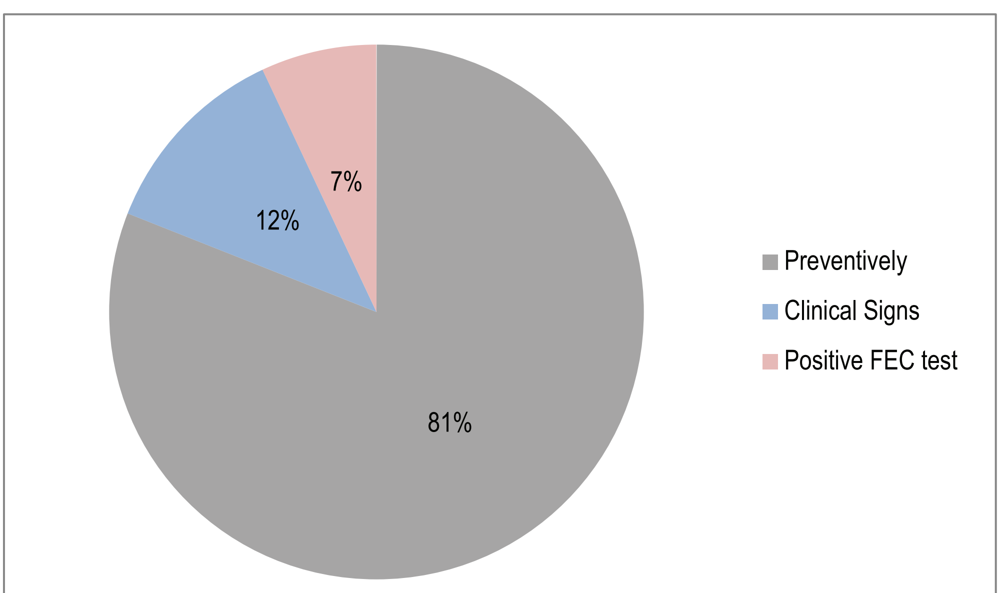

Fig. 1. Percentages of reasons for anthelmintic use, assessed by questionnaires (n=59) on intestinal worm control practices in horses in Lithuania.

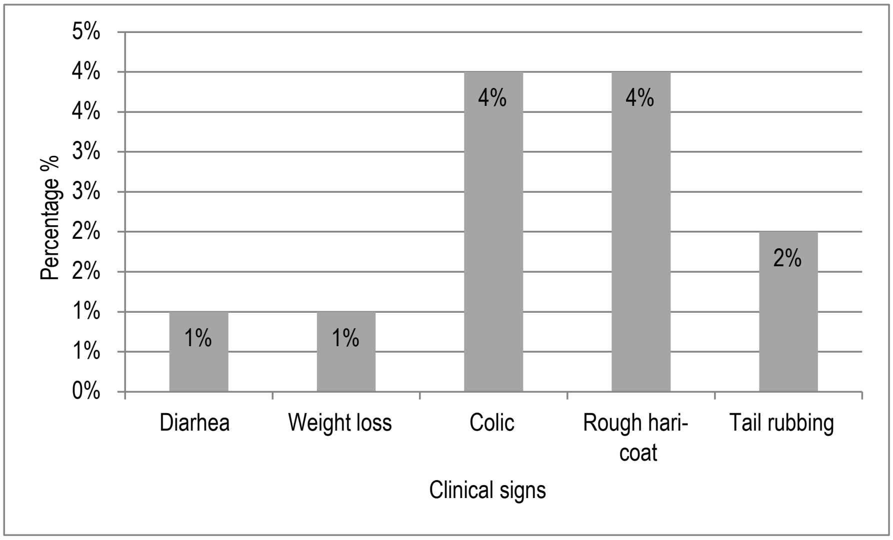

Fig. 2. Percentage distribution of clinical signs.

ly use FEC (Nielsen *et al*., 2006b). The explanations for this discrepancy could be numerous, but the restrictions on anthelmintic products being available only by veterinary prescription undoubtedly plays a role in the adoption of FEC in parasite control programmes. After the introduction of the prescription-only legislation, another questionnaire survey performed among equine veterinary practitioners illustrated that veterinary involvement in equine parasite control appeared to have increased tremendously, and routine FEC monitoring had become widely implemented (Nielsen *et al*., 2006a). With reference to the present questionnaire survey, veterinarians were responsible for administering anthelmintic drug in about 25 % cases and stud farm owners/farm managers in around 75 % of cases. A low level of veterinary involvement in parasite control programmes has also been reported in Ireland (25 %) (Elghryani *et al*., 2019) and Poland (13 %) (Ras-Noryska *et al*., 2017). Due the most countries having unrestricted access to anthelmintic drugs, veterinary practitioners are rarely involved in developing appropriate strategies for the treatment and control of equine nematodes. Consequently, control programmes are often based on frequent treatments and the rapid rotation of drugs (Nielsen *et al*., 2006a).

The survey from Lithuania revealed that 97 % of all equine operations dewormed at least once a year, with 60 % deworming four times or more and 26 % using drug rotation every treatment. Such intensive treatment frequency should be a matter of concern, since a direct relationship has been shown between the frequency of treatment and the rate of AR development (Uhlinger *et al*., 1991; Herd, 1993; Herd *et al*., 1995; von Samson-Himmelstjerna *et al*., 2009). Compared with Ireland (Elghryani *et al*., 2019), Lithuanian horse owners deworm at a similarly frequency (Table 1). In Ireland, horses of various ages are treated between four and five times a year with an average of four different drugs (Elghryani *et al*., 2019).

Table 2. Number, percentage and confidence interval (95% CI) of combinations of pasture management practices assessed by questionnaires (n=59) on intestinal worm control practices in horses in Lithuania.

Pasture management practices	Number	%	95 % CI
No pasture management practices	12	20 %	(12 – 32)*
Pasture management practices	47	80 %	(68 – 88)*
Faecal removal:	40	85 %	(72 – 93)*
at least once per week	8	20 %	(11 – 35)
at least once per month	15	38 %	(24 – 53)
at least once per quarter	12	30 %	(18 – 45)
once per year	5	12 %	(6 – 26)
Mixed grazing	15	31 %	(20 – 46)*
Pasture mowing	28	56 %	(45 – 72)*

*P value (p<0.05)

Equine establishments in Italy treat horses at 4 – 8 week intervals with rapid drug rotation all year round (Papini *et al*., 2015), and a similar British study reports a median of six annual treatments with two or three different drugs (Lloyd *et al*., 2000).

One of the risk factors in the development of AR is an inaccurate dose of the anthelmintic drug (Graef *et al*., 2013). In Lithuania calculation of doses on the vast majority of the participating farms (69 %) was done based on a visual assessment of horse weight, as is the case in other countries: Ireland (74 %) (Elghryani *et al*., 2019) and Italy (58 %) (Papini *et al*., 2015). Anthelmintics in paste are commercialised in tubes with a maximum dose for horses weighing 500 – 700 kg, but Lithuanian draft horses and large and Samogitian breeds exceed this weight. Thus, even the administration of a whole paste tube per animal may lead to underdosing. Compared with 18 % of horse owners in Ireland (Elghryani *et al*., 2019) and 12 % in Italy (Papini *et al*., 2015), based on the present questionnaire survey results, more Lithuanian horse owners administered one tube/packet of the drug per animal (26 %). This high percentage may lead to a lack of knowledge among respondents about the selection of an appropriate anthelmintic dose for AR.

This study confirms that the overwhelming majority of respondents rely on ML for equine parasite control (Tabel 1), which is in agreement with several other recent surveys (Wilkes *et al*., 2019; Elghryani *et al*., 2019; Nielsen et al., 2018; Papini *et al*., 2015). This is in accordance with current anthelmintic resistance profiles reported in equine cyathostomins worldwide, where ML still appears to be maintaining good adulticide efficacy (Nielsen *et al*., 2018; Peregrine *et al*., 2014). As cyathostomins remain primary targets in equine parasite control programmes (Nielsen *et al*., 2020; Nielsen *et al*., 2018), this is the most widely used drug class. However, several recent studies have shown that the egg reappearance period (ERP) is shortening with ML in Italy (Traversa *et al*., 2009), the Netherlands (Kooyman *et al*., 2016), Finland (Nareaho *et al*., 2011) and the UK (Lyons *et al*., 2011). This is being interpreted as emerging AR resistance, which is of additional concern because no new class or modes of action have been introduced since ivermectin in the 1980s (Cain *et al*., 2019). Therefore attention needs to be paid to the safer and research-based use of anthelmintics (Lyons *et al*., 2009).

Preventive measures

As 74 % of the respondents stated that their horses had access to grazing areas, usually permanent pastures, it can be concluded that the conditions on Lithuania horse farms are favourable for the transmission of pasture-borne strongyles. In countries with moderate temperatures, such as Lithuania, strongyle eggs and larvae may survive over winter.

Among the respondents, 80 % paid attention to the prevention of parasitic infections during the pasture period. Pasture maintenance mainly involved faecal removal, but only 20 % stated that they did this at least once per week, while 38 % did so once per month (Table 1). This is considerably lower than has been reported in the UK, where 49 % of respondents of a survey stated that they collected faeces at least once per week (Lloyd *et al*., 2000). This contrast indicates a lower awareness of the risk associated with larval burden on pastures in Lithuania. Furthermore, 85 % of the establishments in the present study did not practise mixed or rotational grazing with other livestock, although the benefit of such grazing management is often highlighted in parasite control recommendations. Lithuanian horse owners appear to be less inclined, or have less opportunity, to mix or rotate grazing with sheep or cattle than horse owners in Italy (30 %) (Papini *et al*., 2015) or Ireland (71 %) (Elghryani *et al*., 2019). These study results indicate that Lithuanian horse owners lack the knowledge or motivation to protect horses from major parasitic invasions and avoid wasting economic resources.

The results of this study indicate that parasite control strategies on Lithuanian stud farms are currently still over-reliant on anthelmintic use. In an effort to preserve anthelmintic efficiency and reduce the risk of the development of AR, parasite control strategies are required. These should include a greater emphasis on monitoring through FEC testing, the integration and expansion of pasture hygiene practices, reduced anthelmintic use in order to preserve parasite refugia, and effective veterinary advice for the implementation of sustainable parasite control practices.

Conflict of Interest

Authors state no conflict of interest.

Acknowledgement

Not applicable.

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