Article

Musculoskeletal discomfort among Canadian bovine practitioners: Prevalence, impact on work, and perception of physically demanding tasks

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Abstract — Musculoskeletal discomfort (MSD) is prevalent in large animal veterinarians but little research has been conducted on prevalence of MSD and its impact among Canadian bovine veterinarians. This 2017 survey targeted practicing and retired members of the Western Canadian Association of Bovine Practitioners, and adapted the Nordic Musculoskeletal Questionnaire to quantify MSD prevalence. Open-ended questions were used to determine the impact of MSD on work and to determine what were perceived to be the most physically demanding tasks. The survey response rate was 51.4% (133/259). Prevalence of MSD was high, with 12-month and lifetime rates of 89.5% and 96.9%, respectively. Obstetrical procedures, rectal examinations, and bull semen collections were reported as the 3 most physically strenuous tasks. The high MSD prevalence rates observed in the shoulder, neck, and lower back call for research on direct ergonomic assessments and work practice interventions for bovine veterinarians.

Résumé — Inconfort musculo-squelettique parmi les praticiens bovins canadiens : prévalence, impact sur le travail et perception des tâches exigeantes sur le plan physique. L'inconfort musculo-squelettique (IMS) est prévalent chez les vétérinaires pour grands animaux mais peu de recherches ont été réalisées sur la prévalence de l'IMS et son impact parmi les vétérinaires bovins canadiens. Cette enquête de 2017 a ciblé les membres praticiens et retraités de la *Western Canadian Association of Bovine Practitioners* et a adapté le questionnaire nordique sur la santé musculo-squelettique pour quantifier la prévalence de l'IMS. Des questions à réponse libre ont été utilisées pour déterminer l'impact de l'IMS sur le travail et déterminer ce qui était perçu comme les tâches les plus exigeantes physiquement. Le taux de réponse a été de 51,4 % (133/259). La prévalence de l'IMS était élevée, avec des taux de 12 mois et d'une vie de 89,5 % et de 96,9 %, respectivement. Les interventions obstétriques, les examens rectaux et le prélèvement de sperme chez les taureaux étaient signalés comme les tâches les plus difficiles sur le plan physique. Des taux élevés de prévalence de l'IMS ont été observés dans les épaules, le cou et le bas du dos et nécessitent de la recherche sur les évaluations ergonomiques directes et des interventions pour les pratiques de travail des vétérinaires bovins.

(Traduit par Isabelle Vallières)

Can Vet J 2018;59:871–879

Introduction

Being a veterinarian is associated with an elevated risk of developing occupational illnesses. Veterinary practitioners may be exposed to an array of biological, chemical, psychosocial, and ergonomic hazards (1,2), contributing to elevated risks of adverse health conditions such as zoonotic diseases, mental illnesses, and musculoskeletal disorders (MSD) (1–5).

Having musculoskeletal symptoms is common in the veterinary workforce; studies have shown that 60% to 90% of veterinarians have experienced musculoskeletal pain or discomfort over the last 12-month period (6–8). By body region, prevalence rates of musculoskeletal discomfort were the highest in the lower back (63%), neck (57% to 66%), and shoulder (54% to 61%) (9,10). This ~60% prevalence rate for neck and shoulder symptoms among veterinarians was also much higher than the ~20% typically observed in mixed occupations (11).

Veterinarians who work with large animals, such as beef and dairy cattle, appeared to have different injury patterns compared to those who work with small or companion animals. Large animal veterinarians experienced more acute animal-related injuries (1). Heavy physical work has been identified as a causal factor for developing MSD (12), which was especially observed at the

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neck and upper limb locations among large animal practitioners (10). These practitioners had elevated physical exposures of lifting, awkward posture, and repetitive movement while performing tasks such as rectal palpations or large animal handling (13). For example, ~60% of Finnish equine veterinarians reported working in awkward postures such as bending over or twisting for more than 1 h during the workday; ~30% reported working with arms above shoulder height (2).

Musculoskeletal disorders are the second major contributor to years lived with disability in the general population (14), having a negative impact on work-related activities and overall quality of life. Prior research conducted among New Zealand large animal practitioners found 75% of those who experienced musculoskeletal symptoms had their work activities impeded, which led to work absence in 24% (7).

There are approximately 14 000 veterinarians and 3500 veterinary practices in Canada, and ~30% of practices work with large animals (15). Bovine practitioners, specializing in the treatment of beef and dairy cattle, play an important role in food animal production. After swine, cattle are the 2nd most common livestock on Canadian farms with over 12×10^6 head comprised of bulls, cows, heifers, calves, and steers (16). Procedures in bovine health and breeding practice require heavy physical work. Little research has been conducted on MSD prevalence and its impact on bovine veterinarians. The objectives of this study were to quantify the prevalence of musculoskeletal symptoms among Canadian bovine practitioners, to describe its impact on work, and to describe the most physically demanding tasks as perceived by bovine practitioners.

Materials and methods

The Western Canadian Association of Bovine Practitioners (WCABP) plays an important role in beef and dairy food production in western Canada, directly supporting bovine practitioners in the area of continuing education. The WCABP represents ~260 veterinarians specializing in dairy and beef practice in western Canada (17). Based on data obtained from WCABP, active and lifetime members are from Alberta (50%); Saskatchewan (29%); British Columbia (11%); Manitoba (8%); and Ontario (2%). This study targeted 259 practicing and retired members of the WCABP; student members were not included.

Prior to recruitment of participants, a keynote presentation on musculoskeletal issues in large animal practice was made at the WCABP's annual conference in January 2017. In March 2017, detailed study information and a paper survey were sent to WCABP members *via* the quarterly newsletter. Participation in the survey was voluntary and the results were confidential. Ethics approval was obtained from the University of Saskatchewan's Biomedical Ethics Board (Bio # 16-291).

The study questionnaire covered personal, health, and work characteristics. Basic demographic information included gender (male/female), dominant hand (right/left/ambidextrous), age (years), height (cm), and weight (kg). The questionnaire also included questions regarding general health and experience of musculoskeletal discomfort, in particular, its impact on work.

Musculoskeletal health questions were adapted from the Nordic Musculoskeletal Questionnaire (NMQ) (18). Body regions included in this adapted questionnaire were: the neck, one or both shoulders, one or both elbows, one or both hands, upper back, lower back, one or both hips/thighs, one or both knees, and one or both ankles. For each body region, participants were asked, *"have you at any time in the last 12 months had trouble (ache, pain, discomfort)?", "have you at any time in the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?",* and *"have you at any time in the last 12 months been prevented from doing bovine tasks because of the trouble?".* To understand the impact of musculoskeletal discomfort, the following 3 open-ended questions were included: *"how have musculoskeletal symptoms impacted your work?"; "have you ever considered leaving bovine practice due to musculoskeletal symptoms?";* and *"is there anything else you'd like to tell us about your musculoskeletal health or work tasks?".*

Table 1. Personal characteristics of participating western Canadian bovine practitioners.

Variables	Median (range)
Age (years old) (N = 131, 100%)	51.0 (28.0 to 84.0)
Male (*n* = 94, 71.8%)	53.0 (29.0 to 84.0)
Female (*n* = 37, 28.2%)	42.0 (28.0 to 64.0)
Height (cm) (N = 131)	178.0 (155.0 to 196.0)
Weight (kg) (N = 131)	83.0 (54.0 to 136.0)
Body mass index (N = 131, 100%)	25.9 (19.1 to 36.5)
Normal weight (*n* = 45, 34.3%)	23.5 (19.1 to 25.0)
Overweight (*n* = 58, 44.3%)	26.8 (25.1 to 29.8)
Obese (*n* = 28, 21.4%)	32.0 (30.3 to 36.5)

N — the total number of respondents; *n* — number of responses.

Veterinary professional information was collected on numbers of partners in the practice, the year of graduation from veterinary school, and the amount of time apportioned to each practice type (dairy, beef, equine, other large animals, or small animals). Veterinarians were also asked to estimate the total number of rectal examinations completed annually, to estimate the percentage of rectal examinations performed using ultrasound, and to report the 3 self-perceived most physically strenuous work tasks.

To ensure appropriate vocabulary and relevance to practice, a draft survey was piloted among 3 large animal veterinarians from the University of Saskatchewan's Western College of Veterinary Medicine. Revisions were made to the survey based on feedback.

The survey employed a mixed-mode design method as described by Dillman et al (19). The survey was both mailed (paper copy) and available for online completion. A postage-paid return envelope was included with each mailing. A total of 3 questionnaire mail-outs were sent to WCABP members in mid-March, end of April, and mid-June, 2017. The time between each mail-out was about 6 wk. An e-mail reminder was sent to the WCABP membership at the 2-week time point following each mail-out. Throughout the survey period, the survey was promoted on social media platforms (Facebook and Twitter). Responses were received from March to August 2017.

Descriptive analyses were conducted using SPSS (IBM, Armonk, New York, USA) using medians, quartiles, ranges, and percentages. Distributions of continuous variables were explored graphically and with the Kolmogorov-Smirnov test for normality. Body mass index was calculated using weight (kg) divided

Table 2. Veterinary work characteristics of participating western Canadian bovine practitioners.

Variables	N	Percentiles			Range
		25th	*50th*	*75th*	
Veterinarian partners (number)	130	2	3	5	0 to 20
Graduation from veterinary school (calendar year)	131	1982	1992	2005	1964 to 2015
Being a bovine practitioner (years)	133	11.0	24.0	33.0	2.0 to 50.0
Types of attributed practice (portion)					
Dairy (%)	131	0.0	3.0	45.0	0.0 to 100.0
Beef (%)	131	20.0	50.0	75.0	0.0 to 100.0
Equine (%)	130	0.0	3.0	10.0	0.0 to 65.0
Other large animal (%)	130	0.0	0.0	3.3	0.0 to 100.0
Small animal (%)	131	0.0	5.0	42.0	0.0 to 85.0
Hand use in rectal examination (percentage of time)					
Right	131	0.0	25.0	100.0	0.0 to 100.0
Left	130	0.0	70.0	100.0	0.0 to 100.0
Ultrasound use in rectal examination (percentage of time)	102	70.0	90.0	95.0	0.0 to 100.0
Rectal examinations (number per year)					
Dairy cows/heifers	128	0	100	5000	0 to 64 000
Beef cows/heifers	128	1000	4000	8000	0 to 25 000
Beef bulls	128	100	300	600	0 to 1800

N — total number of respondents.

by the square of height (m^2). Comparison of mean age was performed using the independent-samples *t*-test and comparisons on numbers of rectal examinations were conducted through the Wilcoxon signed-rank test. The reported first, second, and third most physically demanding tasks were analyzed by both total frequency of reporting, and frequency within each rank (most difficult, second most difficult, and third most difficult).

A conventional qualitative content analysis (QCA) approach (20) was used to analyze responses to the 3 open-ended text questions on the impact of musculoskeletal discomfort. Preliminary notes and coding schemes to identify themes and sub-themes were first developed based on initial interpretations. Codes were reviewed again to explore potential links or sub-categories, and finally, references for each code were checked for cohesion and alignment. When written examples spanned multiple sub-themes, they were categorized by main theme only.

Results

The response rate was 51.4% (133/259). Most responses (91.7%) were received by mail. Male participants accounted for 71.8% (94/131) of the respondents. Most participants (93.2%; 123/132) were right hand-dominant, 4.5% (6/132) were left-handed, and 2.3% (3/132) were ambidextrous. Female participants were on average younger than male, 42.0 *versus* 53.0 y old (P = 0.001). The median height and weight were 178.0 cm and 83.0 kg; body mass index had a median of 25.9 (range: 19.1 to 36.5). About 65.7% were classified as overweight or obese according to the World Health Organization obesity categories (Table 1) (21).

Table 3. Prevalence of musculoskeletal discomfort among western Canadian bovine practitioners.

Body region	12-month prevalence (N = 133)		
	Experienced discomfort[a]	Interrupted normal work[b]	Interrupted bovine tasks[c]
One or both shoulders	85 (63.9%)	10 (7.5%)	9 (6.8%)
Lower back	75 (56.4%)	17 (12.8%)	10 (7.5%)
Neck	68 (51.1%)	5 (3.8%)	4 (3.0%)
One or both elbows	58 (43.6%)	3 (2.3%)	2 (1.5%)
One or both hands	56 (42.1%)	6 (4.5%)	5 (3.8%)
One or both knees	49 (36.8%)	8 (6.0%)	7 (5.3%)
Upper back	38 (28.6%)	5 (3.8%)	5 (3.8%)
One or both hips/thighs	32 (24.1%)	3 (2.3%)	1 (0.8%)
One or both ankles	15 (11.3%)	1 (0.8%)	0 (0.0%)
Any body region	119 (89.5%)	35 (26.3%)	25 (18.8%)
1 to 3 regions	54 (40.6%)	33 (24.8%)	23 (17.3%)
4 or more regions	65 (48.9%)	2 (1.5%)	2 (1.5%)

N — total number of respondents.
[a] Experienced musculoskeletal discomfort at this particular body site in the previous 12 months.
[b] Musculoskeletal discomfort serious enough to prevent the veterinarian from performing normal work (at home or away from home) in the previous 12 months.
[c] Musculoskeletal discomfort serious enough to prevent the veterinarian from performing bovine tasks in the previous 12 months.

The work profile of the veterinarians in the present study is presented in Table 2. Participants had an average of 3 veterinarian partners (range: 0 to 20) in their practice; the median graduation year for participating veterinarians was 1992 (range: 1964 to 2015), and the median years practicing was 24.0 (range: 2.0 to 50.0 y). On average, respondents apportioned about 50.0% of their time to beef cattle practice, which was the greatest portion of all types; other types included dairy (3.0%),

Table 4. Impact of musculoskeletal symptoms on work among western Canadian bovine practitioners.

Theme	Definition	Written examples from survey
Mild or no work-related symptoms: Reported never experiencing significant work-related musculoskeletal symptoms (WRMS)		
Mild or no symptoms	Very mild or no WRMS	"Did not impact my work because the pain is not very bad."
Asserting symptoms not work-related	MS symptoms that were not related to veterinary work	"I have never had real chronic pain or severe acute pain that stopped me from work. However I am also lucky that I have always worked in a multiple vet practice to allow sharing the load of the physical tasks."
		"Most of my musculoskeletal problems are unrelated to my work."
Pain with no impairment: Reported experiencing significant WRMS pain that did not affect work tasks		
Desensitization	Ability to overcome or recover quickly from WRMS	"Usually keep on going and pain disappears."
Working through pain	WRMS during routine tasks	"The key is to be physically strong and flexible so you can handle tasks and/or recover quickly. If the body is weak and rigid problems will occur. Society is soft and weak."
		"It just makes it harder to do. I will still work with pain, but things take longer and it takes longer to heal."
Reduced productivity: Reported some form of reduced veterinary productivity due to WRMS pain		
Altered technique	Changed how a task was done to avoid/minimize WRMS	"If pain is felt then a change of technique or strengthening of the muscles needed for the task is required."
Worked more slowly	Worked slower to minimize WRMS	"Other areas of body begin having issues due to altered stance/compensation for discomfort — back especially."
Difficulty with routine tasks	Routine tasks became difficult or impossible due to WRMS	"I'm slower, I do more small animals. I have to rest more when I am working."
		"Surgeries/dentals, exams are all more difficult if you can't rotate your neck."
Reduced workload	Reduced workload to manage WRMS	"When I have tendonitis in my right wrist/elbow I am unable to perform both bovine-related work and small animal work."
Work absence	Time off work to manage or recover from WRMS	"Have to book lighter and space out appointments."
		"I have had to cut back to 50% small animals due to issues."
		"Occasional afternoon off, have taken some time off for chiropractic and massage help."
		"Have had to miss work approx. 1 month straight two years ago, and have missed several days off and on since. Have had to stop performing calvings, C-sections/prolapses because of lower back injury."
Temporary or permanent impairment: Reported sustaining a work-related bodily impairment		
Nerve injury	Sustained a nerve injury	"Brachial plexus syndrome — forced to reduce number of palpation, shoulders, elbows, and now I have had to reduce activity, now practice is about 20% of original volume."
Upper-limb impairment	Impairment related specifically to arm, hand	"Carpal tunnel surgery on both hands."
Animal-related traumatic injury	Sustained a traumatic injury caused by a large animal	"At one time I could not put my elbow on the car door armrest because of pain."
		"Arthritis in thumbs makes surgery difficult holding tissue forceps with left hand, writing medical records with right hand. Lack of hand strength due to pain in thumbs."
		"I have decreased my [large animal] practice after rotator cuff injury & concussion."
Quality of life: Reported quality of life being directly affected by WRMS pain		
Chronic pain	Experienced chronic or persistent WRMS	"Chronic headaches and severe facial pain make it difficult to have good client interactions and focus."
Emotional stress	Experienced stress, low mood, or anxiety	"Decreased any lifting with my right [arm]. Made me miserable and concerned for my longevity."
Pain while driving	Reported driving being a potential cause/aggravator	"Rural mixed/bovine practice is physically and emotionally demanding, I strongly believe that the emotional demands of practice contribute to physical outcomes."
Sleep impairment	Sleep interruptions	"Many large animal vets do a lot of driving, I think much of my back soreness comes from driving, not bovine practice. I drive about 70 000 km a year."
Participation affected	Reduced ability to engage in normal activities outside of work	"I continued to work but made tasks more difficult to complete and nights sometimes painful, so changed sleep patterns."
		"Does not affect my work as I still perform tasks. Simply affects my ability to sleep at night and enjoy a pain-free quality of life."
		"Makes it harder to do other things, hockey, play with kids, ride my horses, etc."
		"If I had not quit doing calvings, the lower back injury would have progressed and affected my life outside of work."

Table 4. Impact of musculoskeletal symptoms on work among western Canadian bovine practitioners *(continued)*.

Theme	Definition	Written examples from survey
Left practice: Reported career longevity being cut short (or anticipated) due to WRMS pain		
Considered leaving practice	Willingness to leave profession if WRMS symptoms worsen	"Will quit early to prevent."
Retired earlier than expected	WRMS symptoms a major factor in decision to retire	"The issue I have had is work-related injuries and repetitive strain injuries, which have not ever healed properly due to lack of sleep (chronic sleep interruptions from being on call) and lack of time to be able to seek treatment. This has led to chronic musculoskeletal pain and will likely be the cause of my retirement from vet med."
Changed careers	Left practice prior to retirement due to inability to manage WRMS symptoms	"Had no choice because of pain."
		"I have left regular bovine practice. I did 28 years of lots of pregnancy testing. Now I sell and train vets on ultrasound."
		"I was 25 and on painkillers for all of calving, surgery had not cured problem, no diagnosis available. I wonder if with exercise therapy or other new techniques I could have managed the pain."

small animals (5.0%), and equine (3.0%). The average number of rectal examinations performed annually was highest in beef cows/heifers category (4000), significantly higher than that conducted in beef bulls for breeding soundness examinations (300, $P < 0.001$) or dairy cows/heifers (100, $P = 0.009$). When performing rectal examinations, veterinarians reported typically using their left hand 70.0% of the time and using an ultrasound 90.0% of the time.

Almost all bovine practitioners (97%, 128/132) who completed the survey reported experiencing musculoskeletal ailments (ache, pain, or discomfort) in their lifetime. During the 12 mo prior to the survey, 89.5% had symptoms in at least 1 body region, and 48.9% had discomfort in ≥ 4 body regions. With respect to their overall health, about 51.5% reported "very good," 27.3% "excellent," 19.7% "good," 1.5% "fair," and none reported being in "poor" health.

The 12-month prevalence of musculoskeletal symptoms, as well as its interruption of routine and cattle-related tasks, is shown in Table 3. One or both shoulders were the most prevalent body region having symptoms reported by 63.9% of veterinarians. Over half of the practitioners had symptoms in their lower back (56.4%) and neck (51.1%). There was also a significant portion of participants experiencing symptoms related to other areas such as elbows (43.6%), hands (42.1%), knees (36.8%), hips/thighs (24.1%), upper back (28.6%), and ankles (11.3%).

Symptoms in the lower back were the most common of all types of musculoskeletal discomfort impeding normal work or bovine tasks in 12.8% and 7.5% of participants, respectively. Shoulder discomfort impeded work or bovine tasks for 7.5% and 6.8%, and knee discomfort 6.0% and 5.3%, respectively. Roughly a quarter (26.2%) of survey respondents had considered quitting bovine practice because of musculoskeletal symptoms.

Bovine practitioners sought varied treatments to alleviate musculoskeletal symptoms. Over-the-counter medication was commonly used (75.2%), followed by physiotherapy (43.6%), chiropractic therapy (41.4%), massage therapy (46.6%), exercise therapy (37.6%), prescription medication (25.6%), acupuncture (19.5%), and surgery (12.8%).

Table 4 presents a thematic analysis of the written responses describing musculoskeletal discomfort and their impact on work. Six overarching themes and 21 smaller sub-themes were identified with written examples from the surveys.

Difficult tasks, as reported by bovine practitioners, are presented in Table 5. The top 3 strenuous task categories were obstetrical procedures (42.0%) including dystocia (calving), cesarian-section, uterine prolapse, fetotomy, and embryotomy; rectal examinations (28.6%); and breeding soundness evaluation (10.9%). Other physically demanding tasks were conducting bovine surgeries (8.7%) including dehorning, castrating, hoof trimming, and left/right displaced abomasum surgeries; necropsies (3.6%); and dealing with down cows (2.2%), followed by cattle handling (1.1%), spraying heifers (0.8%), field examinations (0.6%), cattle exportation: age verification (0.3%), tasks that require bending at the waist or being on knees (0.3%), tasks requiring running, climbing, pushing, and standing (0.6%), and sitting at a computer (0.3%).

Discussion

This survey describes self-reported musculoskeletal symptoms and the impact on their work from 133 bovine veterinarians, 89.5% of whom reported musculoskeletal symptoms in the past 12 mo (Table 3). These results are consistent with findings among New Zealand veterinarians using the same survey tool (NMQ). Scuffham et al (7) reported that the annual prevalence rate of musculoskeletal discomfort was greatest in equine and large animal veterinarians (100%), compared with practices of mixed animals (96%) and small animals (94%).

In the current study, shoulder symptoms were the most frequently reported (63.9%) by bovine practitioners, and the second and third areas of discomfort were the lower back (56.4%) and neck (51.1%) (Table 3). Discomfort in the shoulder, lower back, and neck has also been commonly observed in prior studies among veterinarians in all practice types, presenting in a slightly different sequence. For example, Scuffham et al (7) reported that among New Zealand veterinarians, lower back symptoms were the most common (73%), then shoulders (59%), the neck (58%), and wrists/hands (52%). Kozak et al (10) only studied the upper limbs of German veterinarians,

Table 5. Identification of the physically demanding tasks during bovine practice reported by western Canadian bovine practitioners.

		Total responses in any order		1st rank		2nd rank		3rd rank	
Task name	Task description	*n*	%*	*n*	%*	*n*	%*	*n*	%*
Obstetrical procedures	Includes assisting with parturition: dystocia or calving, C-sections, prolapses uterus, fetotomy, and embryotomy	150	42.0%	73	20.4%	56	15.7%	21	5.9%
Rectal examination	May be used for pregnancy checks, herd health checks, or embryo transfer and part of clinical exams	102	28.6%	33	9.2%	39	10.9%	30	8.4%
Breeding soundness evaluation	Semen collection, scrotal palpation and measurement, rectal exam, and may include preputial scraping	39	10.9%	4	1.1%	13	3.6%	22	6.2%
Bovine surgeries	Includes dehorning, castration, hoof trimming, left/right displaced abomasum surgery, abdominal exploration, penile urethrostomy, and umbilical surgeries	31	8.7%	4	1.1%	9	2.5%	18	5.0%
Necropsy	Inspection of carcass to assess health indicators, may include sectioning and lifting sections	13	3.6%	7	2.0%	3	0.8%	3	0.8%
Dealing with down cows	Physical examination of animals who are unable to stand. May include sitting/kneel squatting on the ground and potentially lifting or pulling on animal	8	2.2%	3	0.8%	2	0.6%	3	0.8%
Cattle handling	Includes moving animals through chute system, working head gates, animal restraint both with and without handling facilities	4	1.1%	0	0.0%	0	0.0%	4	1.1%
Spaying heifers	Surgical procedure for sterilization	3	0.8%	3	0.8%	0	0.0%	0	0
Field examinations	Can include clinical examinations in the field, including blood collection from tail vein and rectal palpation	2	0.6%	0	0.0%	0	0.0%	2	0.6%
Cattle exportation: age verification	Can include clinical exam of animal for age indicators, including teeth, hoof, and reproductive tract status	1	0.3%	0	0.0%	0	0.0%	1	0.3%
Tasks require bending at the waist or on knee	Can occur during obstetrics, dealing with down cows, breeding soundness exams, and necropsy	1	0.3%	0	0.0%	0	0.0%	1	0.3%
Tasks require running, climbing, pushing, and standing	Can occur during animal handling tasks described above	2	0.6%	1	0.3%	0	0.0%	1	0.3%
Sitting at computer	Administrative and clerical tasks related to clinical practice	1	0.3%	0	0.0%	0	0.0%	1	0.3%
Total		357	100.0%	128	35.9%	122	34.2%	107	30.0%

Note: * 128 survey participants provided any response to the 'most demanding task' question, 122 responded to the 'second most demanding task" and 107 provided a response to the 'third hardest task' question. The total number of 'demanding task' responses was 122 + 128 + 107 = 357. Percentages in each column are based on these denominators.

reporting symptoms in the neck (67%) and shoulders (61%) as the most affected body regions, followed by hand (34.5%) and elbow (24.5%).

The differences in prevalence between the present study and the studies by Kozak et al (10) and Scuffham et al (7) may be explained by differences in the veterinarians who were sampled, varying from the type of practice to type of animals. The present survey focused only on bovine practitioners, and veterinarians predominantly practicing on beef cattle. According to the 2016 Census of Agriculture, 80% of Canada's beef production is in western Canada (British Columbia, Alberta, Saskatchewan, and Manitoba) (16). Whereas eastern Canada (provinces locates at the east of Manitoba, such as Ontario and Quebec) owned 77% of Canadian dairy cows as of January 2017 (22). Scuffham et al (7) surveyed New Zealand veterinarians practicing in equine (15.1%), large animal (10.5%), mixed animal (38.2%), small animal (28.8%), and other (7.4%) practices. Kozak et al (10) studied German veterinarians working with small animals (48.6%), mixed animals (20.1%), and large animals (31.3%).

Overall, musculoskeletal symptoms impeded normal work in 26.3% of participating bovine practitioners and impeded bovine tasks in 18.8% (Table 3). Low back pain showed the highest impact in terms of normal and bovine work interruptions, followed by symptoms involving shoulders and knees, which is

consistent with previous research. Among veterinarians of all practices, Scuffham et al (7) found that low back symptoms had the most significant effect on activities (42%) and absence from work (9%), while discomfort in the shoulders, wrists/hands, and neck demonstrated a secondary interruption for activity (25 to 28%) and work (3% to 4%).

While only 26.3% of survey respondents stated that musculoskeletal discomfort had interrupted normal work in the past 12 mo, 97% (129/133) of all respondents provided a written answer describing how their work had or had not been interrupted. Only a small number (23 out of the 129 written responses) described no or minimal impact on work, though several of these responses subsequently described specific work preparation techniques or coping mechanisms required to ensure pain did not impact work. It appears that most respondents do not consider difficulties such as working through pain or altering technique to avoid pain to be true interruptions when answering a yes/no question, but there is nonetheless impact on work. Perhaps the most troubling responses within the "quality of life" theme were those describing an inability to participate in regular "life" activities due to pain, such as picking up children or participating in sports. In a workforce in which the predominant culture and ethos may be to "tough it out" and minimize complaint (23), the data collection method (binary checkmark *versus* narrative of effects) may have an impact on a researcher's interpretation of the scope and nature of the issue. A mixed-methods approach to capturing both symptoms and impact on work would be advisable in future studies of workforces exhibiting high levels of stoicism.

The present study's findings of top physically demanding tasks as presented in Table 5 [obstetric procedures (42.0%), rectal examinations (28.6%), and breeding soundness evaluation (10.9%)] were similar to top causes perceived by 100 surveyed California veterinarians for cumulative trauma disorders: rectal palpation (64%), calving manipulations (30%), and general work-related lifting (25%) (24). A very small portion of large animal practitioners in the present study identified dehorning (1.4%) as a demanding task, as compared to 37% of New Zealand large animal veterinarians, who also reported ultrasound usage (32%), rectal palpation (26%), and obstetric procedures (24%) as the most likely contributors to musculoskeletal discomfort (13).

Other veterinary tasks previously named as difficult were also consistent in the present study, such as animal handling, foot trimming, performing surgery, sitting at a computer, tasks involving bending of the waist or knees, and driving (Table 5). Driving as an ergonomic hazard has been mentioned in previous studies as well; a Swedish study found that veterinarians are potentially exposed to a large number of ergonomic hazards related to working out of a vehicle "office" (25).

Multiple studies have indicated the potential association of rectal palpations with musculoskeletal injuries, especially in the upper limb and knee areas on the side of the body used for palpations (13,24,26). Rectal examinations account for a large portion of American bovine practitioners' professional time (26), and 75% of Australian veterinarians' cattle-related injuries have been anecdotally attributed to pregnancy testing, mostly in the shoulders, elbows, and knees (27). In the current study, the participants reported performing a median of 8200 rectal palpations per year, and only 2.0% of respondents reported never performing a rectal examination. Most examinations were performed on beef cows. Over a typical 30-year career, this amounts to a lifetime exposure of 246 000 examinations and presents a tremendous cumulative amount of exposure to the shoulder and upper limb. This average exposure may be an underestimate of peak annual volume, as several respondents noted that their palpation load was much higher earlier in their career. Comparatively, a study of registered German large animal veterinarians found 64.1% reported conducting 600 to 2400 rectal palpations per year, 19.6% reported less than 600, and 8.4% had never performed a rectal examination (10). In concordance with the findings of Cattell et al (26), the combination of the present results and previous studies demonstrate a compelling need for further research to evaluate and mitigate the ergonomic exposures related to rectal palpation.

The veterinarians participating in the present survey are a representative sample of WCABP members (Table 1). The study sample has a similar gender and age distribution to the general WCABP members, on the percentage of male (71.7% *versus* 74.0%), as well as the average age of male (53.0 y *versus* 54.0 y) and female veterinarians (42.0 y *versus* 46.0 y). In comparison to the general Canadian population (28), the WCABP membership is more male dominant (74.0% *versus* 50.0%), and on average older (male 54.0 y *versus* 40.2 y and female 46.0 y *versus* 42.2 y). Body mass index results of the present survey in 2017 were close to the Canadian Community Health Survey data collected in 2014 with respect to percentage of obese adults (21.4% *versus* 20.2%), but different on percentage of overweight adults (44.3% *versus* 67.5%); which may due to the different gender and education distribution, i.e., a more male dominant and higher educational attainment in the present sample.

The response rate for the present study (51.4%) is considered moderate. Previous surveys on self-reported musculoskeletal discomfort have varied in response rates and scope of targeted veterinarians: for example, 64.0% (1038 Australian veterinarians) (9); 41.0% (867 New Zealand veterinarians) (7); 38.4% (8265 German veterinarians) (10); 10.0% (8310 Minnesota veterinarians) (29); and 9.6% (926 Irish veterinarians) (6). Our response rate was also consistent with the typical rate of mailed surveys published in medical journals, which tends to be moderate, with a mean rate of 54.0% from physicians and 68.0% from non-physicians (30). The primary concern with a low response rate is response bias. The bovine practitioners in the present study were slightly older (median male age 53.0 y, female 42.0 y) compared with Jelinski et al's (31) study of Western Canadian veterinarians (male 49.4 y, female 40.7 y). More than 65.0% of the respondents in the present study were overweight, which is slightly higher than the 61.2% observed among all Canadian adults (32).

To our knowledge, this is the first study in a Canadian context to explore musculoskeletal issues and identify physically demanding tasks in bovine veterinary practice. The mixed method study design facilitates a better understanding of the scope of musculoskeletal issues among Canadian bovine

practitioners, targeting both the prevalence and the impact. The present survey employed a standardized musculoskeletal questionnaire for comparing across studies, along with providing both the returning envelopes and online options for participants.

A major limitation of this study is that the targeted sample is relatively small, focusing only on western Canadian bovine practitioners. Further, due to ethical reasons, the study was not able to obtain demographic information on the non-responsive portion (48.6%) of large animal veterinarians. The cumulative workload of bovine tasks was only questioned for rectal examinations, presuming it to be the most concerning task for practitioners (a survey design choice made based on the existing literature). Information on hours worked per day or per week may provide a better understanding of workload as a bovine practitioner; however, this was not collected in this survey. Additional questions on obstetrics or semen testing procedures, along with hours of work and driving, could be assessed in future studies to examine the total physical workload.

The focus on only physical risk factors contributing to musculoskeletal discomfort as reported by the bovine practitioners is another limitation. In addition to physical aspects, psychosocial risk factors are important for developing MSD. Smith et al (9) found significant correlations between MSD and a range of psychosocial factors, including work-related stress from career structure, clients, and insufficient holidays, lack of recognition from the public and colleagues, time pressures, and lack of understanding from partners and from family. Scuffham et al (7) also studied both physical and psychosocial factors in New Zealand veterinarians, whose findings supported the interaction between both contributing to MSD.

The survey design facilitated a greater understanding of musculoskeletal symptoms in Western Canadian bovine veterinarians. However, selection and information biases may exist in the present study (33). For example, the higher than average prevalence rate of musculoskeletal symptoms observed in the present study might be influenced by preferential participation by practitioners who had experienced symptoms and were therefore especially motivated to participate. On the other hand, the severity of musculoskeletal symptoms or the impact on work might be underestimated given that the surveyed bovine practitioners may be a physically healthier group, compared with those practitioners who may have left the profession due to MSD and are no longer members of WCABP. This is known as the "healthy worker effect" (34). This study adopted a standardized questionnaire to reduce information bias; however, the 12-month window for pain and impact on work might introduce recall bias. Further, there is evidence that workers with musculoskeletal complaints tend to overestimate their exposures (35,36). Since many of the veterinarians had pain, their self-reported exposure on numbers of rectal examinations performed per year may be overestimated.

A major strength of the conventional qualitative content analysis approach is that it is performed without adherence to preconceived frameworks, allowing themes to emerge from the data organically. Disadvantages of this approach involve the potential to misrepresent the data when attempting to develop a theory from the results or to miss key categories (20). There were several major limitations related to our thematic analysis. In contrast with an interview, the written responses did not allow for follow-up questions. The text-based questions were very broad, thus participants may have interpreted questions in different ways. The questions did not ask for specific injury descriptions or diagnoses, thus many respondents only described their musculoskeletal symptoms in general terms (e.g., "shoulder pain").

Shoulder, neck, and lower back symptoms were the most prevalent areas of musculoskeletal discomfort reported in the present study. While the impact of musculoskeletal symptoms on work tasks was perceived to have a "moderate" impact on checklist items, written responses were more likely to describe an impact on quality of life and work. The most commonly named physically demanding tasks were related to obstetrical and rectal procedures. Future research should focus on potential musculoskeletal risk factors and ergonomic exposure assessments of these strenuous tasks in real working environments, with a focus on the upper limbs and neck in large animal veterinarians. Consistent with the conclusion of previous studies, further research is also needed on prevention strategies, which may include such approaches as body conditioning, training of veterinarian trainees in biomechanically favorable techniques, or the development of ergonomic tools to reduce exposures.

Acknowledgment

We gratefully acknowledge the assistance of the Western Canadian Association of Bovine Practitioners, in particular, Phyllis Mierau and the veterinarians who participated in the study.

This research was undertaken, in part, thanks to funding from the Canada Research Chairs program [228136]. This research was funded by Department of Medicine at the University of Saskatchewan [Grant number identified by project title: Participatory Ergonomic Evaluation of Bovine Veterinary Practice]. CVJ

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