

WEIGHTED LEG CUFFS versus WEIGHTED VESTS as Tools of Loaded Resistance Exercise for Canines.

Dr. Ravi R. Iyer, MD, Certified Canine Athlete Specialist
Chairman & CEO, ActivPower Inc.
Member, Blitzburg Hundesport Club, USCA
Member, South Metro Atlanta Schutzhund Club, GSDCA
Member, DVG

AUTHOR BACKGROUND & CONFLICT OF INTEREST DISCLOSURE

The author is a practicing physician, actively competes in competitive IGP dogsport, holds a multiple country patent on a version of canine weighted leg cuffs and also manufactures and sells weighted leg cuffs to competitive dog handlers world-wide.

The goal of creating a simple universal tool to achieve canine physical conditioning and fitness has been pursued for many years. Weighted leg cuffs have been used by veterinary rehab centers in Europe and Sweden for the structured recovery of power and mobility in dogs after TPLO and other orthopedic surgery with great success. In the US both weighted leg cuffs and weighted vests have grown in popularity in recent years.

Weighted leg cuffs have been used in high level competition dogs (the dogs in the US teams competing at the WUSV & FCI have used this; as well as several world class competitive dogs from other countries).

Weighted vests have been used to a larger degree by everyday pet owners and to a large part by non-competitive dog trainers. Both weighted cuffs and weighted vests have ardent supporters and detractors of their use.

By contrast critics of weighted resistance exercise have held to the position that ALL USE of weighted loads as a form of resistance exercise in canines should be avoided (except by highly trained professionals) and have instead focused on the promotion of gravity & body weight based resistance exercise as methods of canine conditioning. The arguments presented by these critics are based on the need for some degree of training and skill to safely exercise a high drive canine with wearable weights and the very low prevalence of skilled dog handling or training expertise in the general population even after training is given. Other arguments include observations of poor owner compliance with instructions and anthropomorphized notions of animal care and handling that lead to owner behaviors where dogs are treated not as canines but as “fur babies” and mini humans.

Reliable studies on weighted vests as well as weighted leg cuffs have also been lacking so far, therefore the arguments of both camps have not been coherently examined. This paper is a review of recent literature that brings up new data to clarify ambiguities in this area of public value and importance.

According to the manufacturer of one type of weighted leg cuff (ActoBands, ActivPower Inc.), the use of weighted leg cuffs by non-professionals is reserved for dogs and use scenarios that must meet the following criteria:

- 1) Dog should have no obesity
- 2) Dog should have no injury or joint dysplasia
- 3) Dog should have no Cardio-pulmonary disease
- 4) Exercise should be restricted to leashed walk only
- 5) Exercise should be restricted to duration of 10-15 minutes
- 6) Weights should not exceed 1-3 grams per kilogram body weight per leg
- 7) Veterinary approval of training program is recommended
- 8) Escalation of exercise intensity and loads is distributed in 2-3 week increments over 12-16 weeks

As mentioned earlier, there is a dearth of well-designed studies examining the use of weighted leg cuffs as a resistance training tool in dogs. Weighted leg cuffs however has been used by veterinary rehabilitation professionals in Sweden and Europe for the recovery and strength building of canines with muscle mass loss after prolonged immobilization after orthopedic surgery like TPLO for the repair of CCL rupture. The author reached out to the largest veterinary rehabilitation clinic in Sweden requesting them to provide any data on studies performed by them on the use of this tool. ReDog, Sweden was generous enough to share the manuscript of a paper written by one of their fellows on the use of weighted leg cuffs in healthy dogs. The entire manuscript of this clinical study was translated from the original Swedish language into English and both versions are separately posted as pdf files and may be downloaded using the following URL links.

1. Weighted Cuffs-Swedish Study (English Translation)
<https://www.facebook.com/groups/552981172105805/files/>
2. Weighted Cuffs-Swedish Study Original Swedish Manuscript
<https://www.facebook.com/groups/552981172105805/files/>

The following is a synopsis of the Swedish study.

REDOG SWEDISH STUDY ON WEIGHTED LEG CUFFS:

Essentially the Swedish study examined the use of weighted leg cuffs in healthy dogs of several breeds, all 1 year age or older.

13 dogs of the following breeds were studied:

Dalmatian (1); GSD (9); GSD/Rottweiler mix (1); Siberian Husky (1); Alaskan Malamute (1)

All dogs were large breed dogs. The control dog was Dog#1 (Dalmatian) who wore leg cuffs without any weights, while the remaining 12 dogs were exercised with weights of different amounts and durations. The youngest dog was 1 year old (Dalmatian) and the oldest dog was 8-year-old (GSD). The duration of the study was 30 days and measurements were taken on Day 1, Day 15 and Day 30 as follows:

- 1) The range of motion (flexion and extension) in the knee joint, the hip joint and the elbow joint checked with a goniometer.
- 2) Muscle mass was measured with an ordinary tape measure at:
 - a. - Thigh muscle (Trochanter major/lateral patella)
 - b. - Calf muscle (Distal crest tibia)
 - c. - Upper leg muscle (Proximal armpit)
 - d. - Lower leg muscle (Pisiform bone/dorsal olecranon)
- 3) A motion analysis was performed according to a fixed model on all dogs:
 - a. – Standing
 - b. – Sitting
 - c. – Lying
 - d. - From the front and rear (walking ordinarily and walking slowly)
 - e. - From the side (walking ordinarily and walking slowly)

All 13 dogs were trained with a specific weight and for a specific time. See Appendix 1 in the study. (A control dog (Dog 1) wore empty weight cuffs.). The dogs were be trained/loaded in a controlled manner by keeping the dog on a leash. The dogs were be warmed up for 10 minutes before the cuffs were applied. After the training, the dogs were cooled down for five minutes before stretching the forelegs and hind legs.

The exercise schedule was:

Week 1, dog's weight $1x X \text{ kg} = 1X \text{ grams in weight cuffs}$

Day 1: 5 minutes with weight cuffs, forelegs
 Day 2: 5 minutes with weight cuffs, hind legs
 Day 3: 10 minutes with weight cuffs, forelegs
 Day 4: 10 minutes with weight cuffs, hind legs
 Day 5: 15 minutes with weight cuffs, forelegs
 Day 6: 15 minutes with weight cuffs, hind legs
 Day 7: Rest

Week 2, dog's weight $2x X \text{ kg} = 2X \text{ grams in weight cuffs}$

Day 1: 5 minutes with weight cuffs, forelegs
 Day 2: 5 minutes with weight cuffs, hind legs
 Day 3: 10 minutes with weight cuffs, forelegs
 Day 4: 10 minutes with weight cuffs, hind legs
 Day 5: 15 minutes with weight cuffs, forelegs
 Day 6: 15 minutes with weight cuffs, hind legs
 Day 7: Rest

Week 3, dog's weight $3x X \text{ kg} = 3X \text{ grams in weight cuffs}$

Day 1: 5 minutes with weight cuffs, forelegs
 Day 2: 5 minutes with weight cuffs, hind legs
 Day 3: 10 minutes with weight cuffs, forelegs
 Day 4: 10 minutes with weight cuffs, hind legs
 Day 5: 15 minutes with weight cuffs, forelegs
 Day 6: 15 minutes with weight cuffs, hind legs
 Day 7: Rest

Week 4, dog's weight 4x X kg= 4X grams in weight cuffs

Day 1: 5 minutes with weight cuffs, forelegs

Day 2: 5 minutes with weight cuffs, hind legs

Day 3: 10 minutes with weight cuffs, forelegs

Day 4: 10 minutes with weight cuffs, hind legs

Day 5: 15 minutes with weight cuffs, forelegs

Day 6: 15 minutes with weight cuffs, hind legs

Day 7: Rest

SWEDISH STUDY CONCLUSIONS:

The Swedish study on weighted leg cuffs in healthy dogs showed a clear improvement in the movement pattern with increased range of motion and increased muscle mass in the dogs.

- 1) The motion analysis showed the dogs to have developed a more deliberate lowering of their paws and have thus improved their movement pattern.
- 2) The dogs that were amblers have walked normally through the use of weight cuffs.
- 3) The study also showed that the dogs that were uneven in musculature evened out their muscle mass.
- 4) There was no great difference in the amount of improvement between the various breeds in the study (all breeds improved uniformly)
- 5) The dogs that according to their owners were the least active, improved the most in range of motion and muscle mass. The dogs that were more active in winter improved in range of motion but less so in muscle mass.
- 6) Two dogs (Dogs 7 and 8) did not improve at all in muscle mass but did improve in range of motion. This may be because these dogs were trained the entire winter in (weight) pulling.
- 7) The control dog (Dog 1) that wore empty weight cuffs improved only in range of motion. This confirms the theory that if the goal is to build muscles in the dog, then the dog should be loaded with weights in the cuffs. If the goal is to improve the movement pattern, then using empty cuffs works.
- 8) The (training) setup with alternating the training with weight cuffs on front and hind legs (in order) to allow the muscles to recover between the training sessions, produced a very good result. Through the adaptation of the muscles to the training time and to the increased load, (as well as the rest time) the muscles developed in succession.

ADDITIONAL PUBLISHED MENTION OF WEIGHTED CUFFS:

“Leg Weights and Resistance Bands:

The therapist can increase resistance to a particular limb or muscle group using a leg weight or elastic resistance band (Fig. 14). Many leg weights designed for people do not fit properly. Human leg weights are often far too heavy, too large, and difficult to maintain in the desired position. Placement of the weight on the limb should also be considered. The stress on the limb is less when the weight is placed closer to the affected limb segment. A general rule of thumb is to use a weight that ranges between 1% and 3% of body weight, depending on limb strength and the stage of recovery. Leg weights are most effective in strengthening flexor muscles, which can be difficult

to target with most active exercises.” Principles and Applications of Therapeutic Exercises for Small Animals. Marti G. Drum, DVM, PhD, Denis J. Marcellin-Little, DEDV, Michael S. Davis, DVM, PhD

DATA REGARDING VEST:

Background:

Weighted vests have been marketed as a convenient exercise tool for all dogs regardless of breed or size or fitness level. These weighted vests have been promoted as an effective solution to canine obesity. Per manufacturers website, owners were not required to undergo any learning other than that they had to snap on these vests and go for a hike, which presented the advantage of easy conflict free acceptance of the tool by the owners. No user manual or exercise program is available for the use of the vests on the manufacturers website (as of April 1, 2020) Based on social media posts by owners of weighted vests, these vests have been used for extended hikes spanning 1 or more hours over all forms of terrain in dogs of all ages ranging from skeletally immature dogs of 6 months age to senior dogs of 9 years age.

Veterinary Expert Opinion:

Veterinary experts board certified in veterinary rehab and/or veterinary orthopedics have however maintained that loading weighted vests onto the back of a canine is damaging for the following reasons:

- 1) Alteration of the load bearing characteristics of the canine spine.
- 2) Alteration of and interference with the natural flex and extend of the canine spine that allows the transmission of the thrust forces generated by the rear limbs towards the forward propulsion
- 3) Increased impact stresses of the weights on the large joints of the shoulders, elbows, hips and knees of the dog....

EVIDENCE OF ALTERATION OF GAIT AND TRUNCAL MOVEMENT BY NON-WEIGHTED VESTS

PAPER 1: Dr.'s Timothy L. Foutz PhD & Steven C. Budsberg DVM, MS (School of Environmental, Civil, Agricultural and Mechanical Engineering, College of Engineering (Foutz), and the Department of Small Animal Medicine and Surgery, College of Veterinary Medicine (Budsberg), University of Georgia, Athens, GA 30602. Address correspondence to Dr. Budsberg : Budsberg@uga.edu) in a study titled “Impact of wearing a service vest on three-dimensional truncal motion in dogs” published a well-designed and executed study that addressed Item 1 & 2 of the 3 limitations that have been cited by Board Certified Rehab Vets and Veterinary Orthopedicians as negatives of the use of vests.

The full paper may be downloaded from the link below: https://drive.google.com/file/d/1ikH8OK-X5ITS9SuzWo8TU-YcwAz9dLr6/view?fbclid=IwAR3o7Ke6SgZMJ8-QLM4fZ8BvnUPvytctZiXS9sMF_UzQbXZaJwMZNA_LILE

Essentially Foutz and Budsberg demonstrated significant alteration and restriction in gait, limb movement and truncal movement with either a service dog vest OR the military style tactical vest even when there were no additional weights added to these vests.

DATA REGARDING THE EFFECT OF HIGHER IMPACT LOADS ON CANINE LARGE BONE JOINTS: DAMAGING EFFECT OF EXCESS WEIGHT ON CANINE JOINTS

PAPER 2: Several research studies have documented that excess weight in dogs due to obesity results in accelerated arthritis and degenerative damage to large joints of shoulder, elbows, hips and knees.... there are many studies in this area, but I will cite an authoritative review that establishes both the direct link between excess weight and arthritis but also how the reduction of excess weight results in improvement in arthritic symptoms even in established cases of canine arthritis....
<https://www.thieme-connect.com/products/ejournals/abstract/10.3415/VCOT-08-08-0069>

PAPER 3: Advances in the Canine Cranial Cruciate Ligament edited by Peter Muir.... A book in the Advances in Veterinary Surgery series which presents a state-of-the-art summary of current knowledge on cruciate rupture, and written by leading specialists, edited by a highly respected veterinary orthopedic surgeon and researcher, has a chapter on the medical management of canine arthritis involving the stifle (knee) wherein Dr's Jaeger & Budsberg write: "The importance of weight management in the prevention and treatment of OA (osteoarthritis) cannot be overestimated."

https://books.google.com/books?hl=en&lr=&id=7KORE3PX-XYC&oi=fnd&pg=PA241&dq=obesity+and+canine+arthritis&ots=_DmW_hYDW-&sig=TgkyY5cHmhqi4BDW628XO_Zi7Vs#v=onepage&q=obesity%20and%20canine%20arthritis&f=false

PAPER 4: OWNERS REGULARLY BELIEVE THEIR DOGS ARE NOT OVERWEIGHT

EVEN WHEN SPECIFICALLY TOLD SO BY VETS: Ordinary pet owners have been shown to have unrealistic and erroneous notions about the level of fitness possessed by their dogs and evidence has repeatedly shown cognitive resistance to recognizing the limitations of their dogs physical capacity.

Canine obesity: is there a difference between veterinarian and owner perception?

<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1748-5827.2011.01138.x>

PAPER 5: EXCESS NUTRITION RATHER THAN INSUFFICIENT EXERCISE IS THE

DOMINANT CAUSE OF OBESITY AND OVERWEIGHT: Proponents of canine weighted vests have claimed that the use of weighted vests is valuable in the fight against canine obesity by promoting exercise. However, examination of evidence shows that excess nutrition and quality of nutrition are the major drivers in canine obesity rather than primary lack of exercise. While

veterinary experts agree that limited exercise does play a role in both obesity and exercise, the evidence clearly points to the major contribution of nutrition as the driver for both obesity and arthritis and that it is not possible to effect elimination of obesity by exercise alone without addressing excess nutrition.

<https://www.sciencedirect.com/science/article/pii/S0167587709002402>

PAPER 6: INCREASED WEIGHT PRODUCES GREATER IMPACT FORCES IN OBESE

DOGS AND THE STRIDE LENGTH OF OBESE DOGS IS SHORTER:

Evaluation of gait-related variables in lean and obese dogs at a trot. Robert B. Brady, MS; Alexis N. Sidiropoulos, MS; Hunter J. Bennett, BS; Patrick M. Rider, MS; Denis J. Marcellin-Little, DEDV; Paul DeVita, PhD from Biomechanics Laboratory, Department of Kinesiology, College of Health & Human Performance, East Carolina University, Greenville, NC 27858. (Brady, Sidiropoulos, Bennett, Rider, DeVita); Department of Clinical Sciences, College of Veterinary Medicine, North Carolina State University, Raleigh, NC 27607. (Marcellin-Little). Presented in part at East Carolina University Research and Creative Achievement Week, Greenville, NC, March 2012, and at the Annual Meeting of the American Society of Biomechanics, Gainesville, Fla, August 2012. Address correspondence to Dr. Marcellin-Little (denis_marcellin@ncsu.edu).

Here the authors demonstrate that...

- 1) Mean stride lengths for forelimbs and hind limbs at both velocities were shorter in obese than in lean dogs.
- 2) Obese dogs exerted greater peak vertical and horizontal ground reaction forces than did lean dogs.

The authors conclude that Greater ROM detected during the stance phase and greater ground reaction forces in the gait of obese dogs, compared with lean dogs, may cause greater compressive forces within joints and could influence the development of osteoarthritis.

<https://avmajournals.avma.org/doi/abs/10.2460/ajvr.74.5.757>

The findings of PAPER 6 is significant when taken from another perspective. As already shown by Foutz & Budsford in Paper 1, non-weighted military style tactical and off the shelf service vests produce significant restrictions in limb and truncal movement and gait alterations. In Paper 6, Brady et al show that obesity itself produces shortening of the gait excursion. The data of Paper 1 and Paper 6 taken together suggests that putting a weighted vest on a non-obese canine may create the same conditions of limited gait excursion and higher peak vertical and horizontal ground reaction forces, and may cause greater compressive forces within joints..... in effect creating the same conditions that exist from a kinesiological principle as obesity.

TOTAL WEIGHT LOADS USED IN WEIGHTED CUFFS AND WEIGHTED VESTS:

The Swedish study demonstrated favorable results at 1 gram to 3 grams per kilogram of body weight per leg. This formula would mean that a 40-kilogram German Shepherd (88 lbs.) would be loaded with anywhere between 40 grams to 120 grams of weights in each leg cuff. This load translates into 0.1% to 0.3% of total body mass in each leg and a total combined 4-leg load of 0.4% to 1.2% of total body mass on the dog.

By contrast the manufacturer of weighted vests in the FAQ on their website reviewed on April 1, 2020 states that the vests are designed to add 7-10% of the total body mass onto the dog's spine and shoulders. This loading formula would mean that a 40-kilogram German Shepherd (88 lbs.) would carry a load of anywhere between 2.8 kilograms (6.16 lbs.) to 4 kilograms (8.8 lbs.) on their backs. The manufacturer also notes that some users have loaded the vests with weights up to 5 times the above loads (35-50% of total body mass) using BB shots instead of sand bags. A search of the manufacturer's website did not indicate whether any guidance was available regarding whether these loads were approved or not neither were we able to find any further guidance on any regimen or protocol of how these loads are to be used or whether any activities are to be restricted. No manufacturer issued user manual could be found on the website.

A review of multiple documented posts of users of weighted vests in social media on a Facebook group devoted to users of the weighted vest was performed. The review revealed that multiple users were exercising their dogs while wearing loaded vests for durations of hikes spanning 1-2 hours over varied terrain as well as running and jumping over obstacles of varied heights (Social media accounts, pictures and videos). Pictures of dogs jumping and running wearing these vests are also prominently featured on the manufacturer's website.

All of this is not to state that weighted vests are absolutely damaging in all cases. Conversations with canine fitness experts indicate that there is a role for the carefully selected and carefully supervised use of weighted vests at much lower loads (not exceeding 2-3% of total body mass) in dogs that have already been trained to high levels of physical fitness, and even in those cases the use is highly restricted by top canine competitors to short periods (1-5 minutes) of tightly controlled activity. However, there is a huge difference in the loads of 0.1-0.3% of body mass per leg (0.4-1.2% total body mass) used in weighted leg cuffs for controlled leash walks of 10-15 minutes duration as reported in the Swedish study, compared to the loads of 7% to 50% total body mass reported by the users of weighted vests at uncontrolled pace of activity for extended durations of time. By all measures of data collection, it appears that the current use of weighted vest in the public is unrestricted, unselected, poorly supervised, and that actual use case scenarios contravene established evidence showing the damaging effects of these kind of loads on the canine musculoskeletal architecture.

In conclusion, there is an abundance of evidence that though weighted vests may possibly be beneficial in a very limited carefully selected population of very fit canines, the present manner by which weighted vests are being used runs counter to establish evidence for the safe performance of canine resistance activity. By contrast the available evidence for weighted cuffs demonstrate significant measurable gains in gait, movement and muscle mass with the use of fractional loads of

only (0.4-1.2% total body mass) for controlled short durations of time (less than 15 minutes) at paces that are low impact and similarly controlled (leashed walks and controlled trots) without compromise of animal health or safety.