

Characterization of Shared Household Metabolic Syndrome Using the Companion Care Registry

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Background

Many disease definitions and proposed pathophysiologies are similar across species, highlighting their potential translational relevance. Because people and their companion animals coexist in the same household (dogs and cats sharing the indoor and/or outdoor environment, and horses sharing the outdoor environment with humans), animals may help uncover risk factors, disease pathways, and novel interventions for shared diseases.¹

One specific significant shared disease risk is obesity and the subsequent development of metabolic syndrome (MetS) in humans and metabolic-like syndrome (MetS-like) in pets. MetS is defined as abdominal obesity, hypertension, dyslipidemia, and insulin dysregulation.² MetS-like is defined based on species-specific criteria. Canine obesity-related metabolic dysfunction (ORMD) is defined as elevated body condition score (BCS) with any two of the following: dyslipidemia, hypertension, and hyperglycemia or previously diagnosed Type 2 Diabetes (T2D).³ Feline metabolic syndrome (FMS) is defined as elevated BCS with one or more of the following: dyslipidemia, hypertension, and hyperglycemia or previously diagnosed T2D.⁴ Equine metabolic syndrome (EMS) is defined as insulin dysregulation with or without generalized or regional adiposity and can be characterized by hyperinsulinemia, insulin resistance, and a high risk of laminitis.⁵

Household-level associations between the phenotypic features and complications of MetS and MetS-like are recognized by recent research. The body mass index (BMI) of adult dog owners and dog BCS were positively correlated in a study where nearly 58% of dog owners and 63% of dogs were overweight or obese, highlighting the cross-species prevalence and need for successful intervention strategies.⁶ Another study found that owners of a dog with diabetes were more likely to develop T2D during follow-up than owners of a dog without diabetes; the authors hypothesized that dogs with diabetes could serve as a sentinel for shared diabetogenic health behaviors and environmental exposures.⁷

To support One Health⁸ research at the household level, the **Companion Care Registry (CCR)** was established by linking human patients from the University of Colorado Health (UCHealth) system to their companion animals who received veterinary care at the geographically-adjacent Colorado State University Veterinary Health System (CSU-VHS).^{1,9} Electronic medical records data were linked using the Colorado University Record Linkage (CURL) approach¹⁰ and harmonized through the Observational Medical Outcomes Partnership (OMOP) common data model (CDM), allowing for co-analysis of multi-species, multi-modal health data (Table 1).

This project aims to characterize shared MetS in humans and MetS-like in companion animals at the household level by querying the CCR to gain insights into the human-companion animal co-occurrence of MetS and MetS-like. This work is exploratory and assesses the suitability of the CCR to provide insight into further One Health research questions.

Table 1: Initial demographic assessment of the linked CCR population.⁹ *43.07% unknown visit type

		CSU-VHS	UCHealth
Patient Species	Human		27,360

	Dog	23,086	
	Cat	5,422	
	Horse	4,756	
Patient Sex, % Female		47.68	74.78
Median Patient Age [years]	Human		46.76
	Dog	7.06	
	Cat	7.92	
	Horse	12	
Visit Type [%]	Inpatient	0.48	0.36
	Outpatient	99.52	56.67*
	Emergency	22.25	1.70

Methods

With IRB approval, a retrospective cohort design analyzed human and animal observational healthcare databases mapped to the OMOP CDM v5.4 in the CCR. Based on peer-reviewed definitions of MetS and MetS-like, four cohorts were constructed: human-companion animal pairs in which both are affected, in which neither are affected, and in which either the human or the companion animal is affected.

For each cohort, the following demographic and clinical data were collected: sex, species and breed (for companion animals), BMI or BCS, relevant objective results (e.g., laboratory results and procedures, such as blood pressure), date of diagnosis, frequency of care encounters, medications prescribed for dyslipidemia, hypertension, and insulin dysregulation, and comorbidities. Observational data spanned 2019 to present (the range of data contained in the CCR).

For each cohort, the following descriptive statistics were reported: (1) the total cohort size, (2) the distribution (counts and percentages) of sex and species and breed (for companion animals) categories, (3) the distribution of body condition classification (BMI scores for humans and BCS scores for companion animals), (4) the mean, median, and IQR of age, (5) the average number of care encounters per year within the patient observation period, (6) the most commonly prescribed medications for dyslipidemia, hypertension, and insulin dysregulation (counts and percentage of patients prescribed), and (7) the most commonly observed comorbidities (counts and percentage of patients diagnosed). For the cohort featuring both MetS and MetS-like diagnoses within a household, the percentage of households where each of MetS and MetS-like were diagnosed first and the average number of days and encounters between diagnoses were reported. The relative risk of developing MetS/MetS-like given that a companion animal/human in the household has MetS-like/MetS was calculated and reported.

All data analysis was performed within a HIPAA-compliant environment hosted by the University of Colorado Health Data Compass. Only aggregated data were shared publicly.

Results

Within the CCR, 3,904 (14.3%) human-companion animal pairs were identified as containing a human with MetS, while 374 (1.1%) pairs included a companion animal with a MetS-like diagnosis. A total of 53 humans and 54 companion animals were found to be part of pairs in which both individuals had a MetS or MetS-like diagnosis. Table 2 summarizes the most common comorbidities and prescribed medications for each group.

Table 2: Common comorbidities and prescribed drugs among human-companion animal pairs with both MetS and MetS-like diagnoses.

	Human	Companion Animal
Comorbidities	essential hypertension (54%)	decrease in appetite (21%)
	obesity (53%)	equine laminitis (20%)
	hyperlipidemia (44%)	heart murmur (20%)
	chronic pain (44%)	vomiting (16%)
	gastroesophageal reflux (41%)	chronic renal impairment (16%)
Prescriptions	atorvastatin (29%)	amlodipine (5%)
	lisinopril (28%)	pergolide (3%)
	metformin (25%)	levothyroxine (2%)
	losartan (20%)	benazepril (1%)
	rosuvastatin (19%)	telmisartan (<1%)

More care encounters were present in the CCR for humans with MetS (14.7 and 15.7 on average for humans with and without companion animals with MetS-like) than without (8.9 and 7.3 on average for humans with and without companion animals with MetS-like). A similar pattern was observed for companion animals: 3.6 encounters on average vs 2.1 and 2.2 on average for companion animals with and without owners with MetS. There was an average of 3.25 (SD: 2.45) years between diagnoses in human-companion animal pairs with both a MetS and a MetS-like diagnosis, and humans were diagnosed first in 57.4% of pairs.

Among CCR pairs, no relationship was found between human and companion animal MetS and MetS-like diagnoses. The relative risk of human MetS given companion animal MetS-like was 0.997 (95% CI: 0.78-1.28, $p=0.98$) and the relative risk of companion animal MetS-like given human MetS was 0.996 (95% CI: 0.75-1.33, $p=0.98$).

Conclusion

The results of this exploratory study provide novel information about the nature of MetS in humans and MetS-like in companion animals at the household level. Reported demographics of households with and without the presence of MetS or MetS-like diagnoses, clinical characterization of common treatments and comorbidities, and summaries of the temporality of shared household diagnoses allow for exploration of risk factors and treatments using a One Health approach. Additionally, these results serve as a proof-of-concept to assess the suitability of the CCR for further One Health research and inform further research questions and hypotheses. Future studies will consider a broader phenotype (namely obesity/overweight defined by elevated BMI in humans and elevated BCS in companion animals) and will focus on assessing the role of place-based indices including social determinants of health and environmental factors, gaining insights into the mechanistic link between diseases in humans and companion animals and prospective analysis of co-interventions for humans and companion animals suffering from similar conditions.

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