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Factors associated with recording the exercise vital sign (EVS) in the electronic health records of patients in chiropractic teaching clinics

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Objective: *We set out to identify factors associated with recording of exercise minutes per week in electronic patient files at chiropractic teaching clinics to better understand whether this important health determinant – exercise vital sign (EVS) – is captured or not.*

Methods: *Patient files (4018) from 23 clinicians eligible for inclusion underwent multilevel logistic regression modeling to explore the association between a recorded EVS and the following: patients' age, sex, comorbidities and interns nested within clinicians.*

Results: *EVS discussion was documented in 81.2% of patient files, whereas 44.9% had exercise minutes recorded numerically. Clinicians and interns explained 1.7% and 25.5% of the variance in the EVS outcome.*

Facteurs associés à l'enregistrement du signe vital d'exercice (SVE) dans les dossiers médicaux électroniques des patients dans les cliniques d'enseignement chiropratique.

Objectif : *nous avons entrepris d'identifier les facteurs associés à l'enregistrement des minutes d'exercice par semaine dans les dossiers électroniques des patients dans les cliniques d'enseignement chiropratique afin de mieux comprendre si cet important déterminant de la santé, signe vital d'exercice (SVE), est capturé ou non.*

Méthodologie : *les dossiers des patients (4018) de 23 cliniciens admissibles à l'inclusion ont fait l'objet d'un modèle de régression logistique à plusieurs niveaux pour explorer l'association entre un SVE enregistré et les éléments suivants : l'âge des patients, le sexe, les comorbidités et les résidents travaillant avec les cliniciens.*

Résultats : *la discussion du SVE était documentée dans 81,2 % des dossiers des patients, tandis que les minutes d'exercice pour 44,9 % avaient été enregistrées numériquement. Les cliniciens et les résidents ont expliqué le 1,7 % et le 25,5 % de la variance du résultat du SVE.*

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Conclusion: *To enhance EVS recording, clinic directors and clinicians should better educate the interns on the importance of exercise is medicine and appropriate record keeping, as they explained the largest portion of variability in recording exercise in minutes per week.*

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KEY WORDS: chiropractic, education, exercise, physical activity, vital signs

Conclusion : *pour améliorer l'enregistrement du SVE, les directeurs de clinique et les cliniciens devraient mieux éduquer les résidents sur l'importance de l'exercice dans la médecine et la tenue de dossiers appropriés, car ils ont expliqué la plus grande partie de la variabilité dans l'enregistrement de l'exercice en minutes par semaine.*

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MOTS CLÉS : chiropratique, éducation, exercice, activité physique, signes vitaux

Introduction

Participation in physical activity has well-established relationships with a variety of health outcomes such as mortality, morbidity, and well-being.[1-3] For instance, from a 2008 systematic review with meta-analysis synthesizing findings from 33 studies, people with high levels of physical activity, compared to people who are least active, have risk reduction for cardiovascular mortality of 35% (95%CI 30-40%) and risk reduction for all cause mortality of 33% (95%CI 28-37%).[2] Women participating in strength training have reduced mortality from any cause with reported improvements in strength, mental health, and fitness.[4] In the elderly and youth, improvement in self-esteem and quality of life have also been linked to physical activity.[5-7]

Despite these benefits of enhanced strength, fitness, and well-being with associated reductions in all-cause mortality, one in two Canadian adults do not meet Canadian Physical Activity Guidelines (CPAG) recommendations of 150 minutes of moderate-to-vigorous physical activity per week.[8] Researchers and clinicians alike have acknowledged the importance of addressing exercise and physical activity in the clinical encounter.[9-11] Addressing 'exercise as medicine' has origins in ancient times within health care contexts and offers broad benefits in relation to preventive and reactionary medicine.[9-16] For instance, Kaiser Permanente has shown that incorporating 'exercise as medicine' principles with exercise as a vital sign (EVS) increases exercise adherence and shows significant health benefits within their patient population.[12-14]

Given discrepancies between physical activity recommendations and patient behaviours, there has been increasing promotion of exercise as a vital sign in primary care.[8-22] In this context, exercise is synonymous with physical activity. Vital signs are measurements used to assess the general physical health of a person, aimed at giving insight into potential disease states or showing progress towards recovery. The traditional vital signs used clinically are pulse rate, respiratory rate, body temperature and blood pressure. There is growing momentum to incorporate exercise as a fifth vital sign by recording minutes per week of physical activity in patient records.[12,18-22] For example, Ross *et al*.[23] highlighted that an individuals' fitness level is a better predictor of death than established risk factors, such as high blood pressure. This demonstrates that exercise minutes per week can offer a meaningful measure of someone's potential health status. Capturing EVS in clinical records has also shown a variety of benefits related to improved patient outcomes, such as greater weight loss for overweight patients and a decline in HbA1c for diabetic patients.[18-19] It also is a low-cost strategy with minimal time demands.[10-11] EVS documentation has also shown benefits related to more frequent exercise documentation, appropriately directed referrals and physician exercise counselling in line with exercise guidelines.[10-14,24-27] The growing evidence for the utility of EVS has led to a call to action for its implementation in primary care clinical settings and implementation into health system frameworks.[13,28,29]

Chiropractors often manage musculoskeletal conditions and adding EVS to the chiropractic encounter offers an opportunity to improve documentation of exercise, provide counselling on exercise, and target exercise recommendations based on patient need. Currently, the Canadian Memorial Chiropractic College (CMCC) uses an electronic medical record (EMR) within its clinic system which includes a dedicated field to record an exercise vital sign as minutes per week of physical activity. This offers the opportunity for clinicians and interns to record EVS, to regularly observe this measure and implement it into the standard care of patients. The use of the EVS field within the CMCC EMR has been the focus of ongoing investigation.[9] A pilot study investigated whether interns under the supervision of two CMCC clinicians were appropriately recording EVS in the patient charts and found that a discussion of exercise was documented in 86.4% of patient files with a numeric EVS recorded in 75.8% of those files.[9] A preliminary review of a new, more extensive dataset covering patient files of 23 CMCC clinicians found that exercise was discussed and documented in 81.2% of patient files, yet only 44.9% had a numerical value in the form of minutes per week.[30]

Given the importance of physical activity for a variety of health outcomes and the utility of EVS to promote physical activity, understanding the factors associated with the recording of EVS is paramount.[1,2,10-14,24] The purpose of the current study is to investigate factors associated with the recording of exercise minutes per week as an EVS in patient EMRs at clinics affiliated to a chiropractic college. The current study used the terms "physical activity" and "exercise" synonymously. Specifically, associated factors related to the patient (age, sex, comorbidities), the interns and the clinicians were explored to inform the enhanced recording of EVS.

Methods

Study design, population, inclusion and exclusion criteria

This study is a secondary analysis of data from a retrospective case series of consecutive new patient files with chart abstraction from electronic medical records.[30] Consecutive new patients were identified for inclusion between January 2016 and September 2017, under care of one of 23 clinicians across five teaching clinics of a chiropractic college. The targeted sample size was 200 new patient files per clinician, anticipating 80% of patients had given consent for their clinical data to be used for research purposes yielding approximately 160 patient files per clinician. The clinic management team provided file numbers to a research assistant who assigned a unique study identifier to each patient file for inclusion in the analytic dataset. These did not include patient files of students, staff, or faculty of the college to maintain privacy and confidentiality. Linkage between the patient file number and the study ID was maintained in a separate password-protected spreadsheet. The study protocol was reviewed and approved by the research ethics board at the college (REB# 2005X07).

Data extraction

For each patient file number provided by the clinic management team, the research assistant first checked to ensure the patient had provided consent for their clinical data to be used for research purposes. If this consent form was not located in the chart, then no further information was extracted for that patient file. If consent was provided, the following information was extracted from each file: patient age, sex, blood pressure recorded (Y/N), history of cancer documented (Y/N), history of cardiovascular disease documented (Y/N), history of diabetes documented (Y/N), documentation of discussion of exercise (Y/N), whether EVS minutes were recorded (Y/N) and finally the EVS minutes recorded. The co-morbidities captured are common non-communicable chronic diseases linked to physical inactivity.[2,8]

Within the EMR, EVS can be entered into the physical examination input screen by chiropractic interns. This examination page within the EMR includes vital signs, systems review and lifestyle review. The EVS field appears under the lifestyle review section in the clinical record on the physical examination page after the history, in close proximity to the blood pressure recording entry. Blood pressure was captured as a comparator given it is a traditional vital sign. Blood pressure, smoking, drinking habits and EVS entries are automatically populated into the EMR encounter homepage for each patient file which allows for easy reference for chiropractic interns and clinicians.

In addition, the extracted data was indexed by separate IDs for clinic, clinician, and intern. Clinician specialty designations were included in the data and classified as clinical sciences, orthopedics, rehabilitation, sports, or none. At this college, interns are fourth year chiropractic students seeing patients under the supervision of a clinician. Patient age was further grouped into three broad categories (5–17, 18–64, 65+ years of age), consistent with the CPAG guideline age groups.[1] The extracted data were stored on encrypted flash drives which were kept in a locked filing cabinet between sessions of data extraction. After data extraction was complete, the de-identified analytic dataset was moved to the chiropractic college internal server for analysis.

During data extraction, periodic random samples of patient files were drawn for double extraction and compared to assess reliability of data extraction. This was repeated three times. The first round involved 202 randomly sampled patient files from the first 1000 patient files extracted. The second round involved 203 randomly sampled patient files from the second 1000 patient files extracted. The final round involved 303 patient files from the next 1000 patient files extracted. Each data field double entered was compared and discrepancies represented as % disagreement at field / variable level. This allowed for an appropriate determination if raw data collection was extracted precisely.

Measures and analysis

The primary outcome analyzed was a dichotomous measure (yes or no) whether exercise minutes (EVS) was recorded in the patient file. The main explanatory variables were clinic location, clinician (nested within clinics) and clinician specialty, interns nested within clinicians and patient file characteristics (patient age, sex, recording of blood pressure as a vital sign, documented presence of comorbidities). The relationship between the outcome and the explanatory factors was investigated one at a time using cross-tabulations and chi-square tests. Rao-Scott chi-square tests stipulating clinician as the primary sampling unit were used to correct for clustering of patient files within clinicians.[31-32] Multilevel logistic regression models were used to model the primary outcome as a function of patient file and clinician characteristics.[33-35] The multilevel multiple logistic regression models included three levels: patient files (level 1), interns (level 2) and clinicians (level 3) with each level nested within the next. The models included random intercepts for interns nested within clinician and random intercepts for clinicians. The hypotheses of zero variance in outcome due to clinicians and due to interns nested within clinicians were tested and intraclass correlation coefficients (ICCs) were derived from covariance parameter estimates for the models to quantify variance in outcome explained by interns and by clinicians. Some interns appeared in the data nested under more than one clinician, due to rotations in supervision during the timeframe of the study files. For these cases, the models maintain the nesting of interns under clinicians (e.g., the same intern appears nested under two or more clinicians. The analysis for this study was generated using SAS software v9.4. (Copyright © 2012-2018, SAS Institute Inc., Cary, NC, USA. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.)

Adequacy of sample size

This study is a secondary analysis of the data collected from DeGraauw *et al*.[30] There were 4018 patient files usable for analysis with EVS recorded for 1802 (45%). General principles for single level (not multi-level) logistic regression suggest 10 to 20 limiting sample size per parameter to be estimated.[36] Limiting sample size is the smaller of the two outcome categories, in this case 1802, which under the general principles accommodates estimation of 90 parameters. In a fully specified model, including patient file characteristics (age, sex, BP recorded, three comorbidities) and specialty of clinician (five categories), there are 12 parameters to estimate, so limiting sample size based on 20 per parameter yields 240 sample sizes for each level of the outcome (yes and no), and the available sample size is sufficient. However, we also note that with clustering of patient files within interns and clustering of interns within clinicians, there is additional correlation within the data which may drive sample size requirements higher, but how much higher depends on how much variability in the outcome is driven by intern level and clinician level.

Results

Reliability analysis

Three stages of reliability analysis were performed based on review of random samples of 202, 204, and 303 patient files extracted a second time covering 4,242, 4,284 and 6,363 fields, respectively. Discrepancies between data values from the two extractions were for 1.4%, 1.5% and 0.3% of fields at each stage, respectively. These were all considered satisfactory error rates. By the final round of reliability analysis, the error rate of 0.3% was low enough that no further reliability assessments were performed.

From January 2016 to September 2017, 4998 files were identified (Figure 1) and provided to the research team by the clinic management team; 958 (19%) of these files were excluded due to missing research consent forms, one was excluded due to lack of a medical history, one was excluded due to lack of patient sex specification, and one was excluded due to the clinician having a single patient file at one clinic with all other patient files at a different clinic. Another 19 files were excluded due to missing intern numbers leaving 4018 files eligible for data analysis.

Patient files came from five clinic locations with 23 clinicians nested within these locations. Table 1 displays the nesting structure of patient files under interns, under clinicians, and under clinics. There were 597 unique interns in the data with 491 nested under a single clinician, 103 nested under two clinicians and 3 nested under three clinicians due to clinical rotations occurring during the time-period for data collection. The models included parameters for 706 interns (491 + 103x2 + 3x3) to maintain nesting of interns within clinicians. Patient files per clinic ranged from 119 to 2152. There were on average 5.7 patient files per intern (Table 2) with a minimum of 1 and maximum of 20, an average of 30.7 interns per clinician ranging from a minimum of 17 to a maximum of 37, and an average of 174.7 patient files per clinician with a minimum of 82 and maximum of 365.

Descriptive statistics for patient file level data are displayed in Table 3. The majority (80.7%) of patients

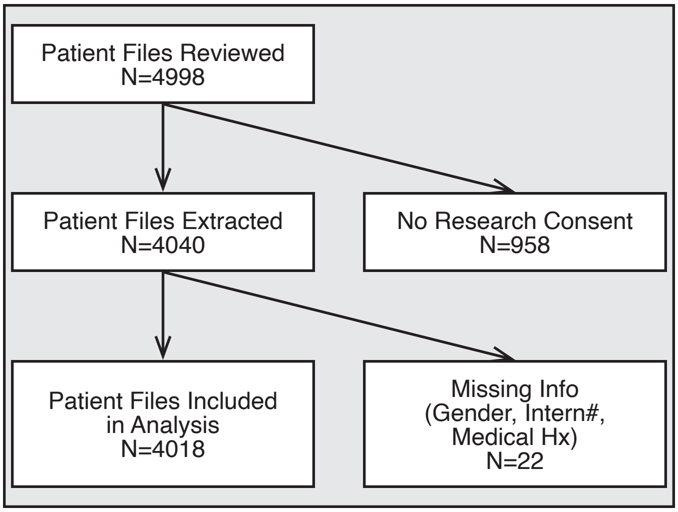

Figure 1.
Flow of patient files from identification through to inclusion in analytic dataset

Table 1.
Levels of data included in the study and nesting.

Level	Overall #	Clinic 1	Clinic 2	Clinic 3	Clinic 4	Clinic 5
Clinicians (#)	23	2	13	7	1	2
Interns (#)	706	61	420	197	19	58
Patient Files (#)	4018	623	2152	857	119	267

Table 2.
Structure of nested data in terms of patient files per intern, per clinician and interns per clinician.

	Mean	SD	Minimum	Maximum
# Patient Files per Intern	5.7	3.3	1	20
# Patient Files per Clinician	174.7	55.2	82	365
# Intern per Clinician	30.7	5.4	17	37

Table 3.
Description of patient file level variables for the N=4018 files included for analysis.

Patient Variables	Level	N	(%)
Age group	<18	102	2.5
	18-64	3244	80.7
	≥65	672	16.7
Sex	Male	2013	50.1
	Female	2005	49.9
Blood Pressure Recorded	Yes	2530	63.0
	No	1488	37.0
Cancer documented	Yes	126	3.1
	No	3892	96.9
Cardiovascular Disease documented	Yes	522	13.0
	No	3496	87.0
Diabetes documented	Yes	197	4.9
	No	3821	95.1
EVS Discussed	Yes	3261	81.2
	No	755	18.8
EVS Recorded	Yes	1802	44.9
	No	2216	55.2

fell between 18 and 64 years of age. Patients were evenly split between male and female (50.1% male). Blood pressure was recorded in 63% of the files. The patients' comorbidities (cancer, diabetes, cardiovascular) were undocumented in the majority of patient files. Although there was a documented discussion of EVS in 81.2% of patient files, only 44.9% had a formal recording of EVS in minutes.

Tables 4a and 4b display bivariate relationships between patient and clinician characteristics and the main study outcome of EVS recording. Chi-square tests were conducted to test whether EVS recordings were independent of these characteristics or not. The Rao-Scott chi-square test was used for all comparisons except for one as it accounts for the clustering of patient files within clinicians. The one exception was when the relationship

Table 4a.
Bivariate comparisons between whether EVS recorded and other study variables using Rao-Scott corrected chi-square test (corrected for clustering of patient files within clinicians).

		Exercise Recorded		**Rao-Scott Corrected Chi-Square Test**
		Yes N (%)	**No N (%)**	
Age group	< 18	40 (39.2)	62 (60.8)	$\chi^2 = 8.2$
	18 – 64	1495 (46.1)	1749 (53.9)	df=2, p=0.017
	≥ 65	267 (39.7)	405 (60.3)	
Sex	Male	921 (45.8)	1092 (54.3)	$\chi^2 = 1.8$
	Female	881 (43.9)	1124 (56.1)	df=1, p=0.2
Blood Pressure Recorded	Yes	1246 (49.3)	1284 (50.8)	$\chi^2 = 53.8$
	No	556 (37.4)	932 (62.6)	df=1, p<.0001
Cancer Documented	Yes	58 (46.0)	68 (54.0)	$\chi^2 = 0.07$
	No	2148 (55.2)	1744 (44.8)	df=1, p=0.8
Cardiovascular Disease Documented	Yes	227 (43.5)	295 (56.5)	$\chi^2 = 0.36$
	No	1575 (45.1)	1921 (55.0)	df=1, p=0.6
Diabetes Documented	Yes	1708 (44.7)	2113 (55.3)	$\chi^2 = 1.0$
	No	94 (47.7)	103 (52.3)	df=1, p=0.3
Clinic	1	245 (39.3)	378 (60.7)	$\chi^2 = 14.8$
	2	958 (44.5)	1194 (55.5)	df=4, p=0.005
	3	421 (49.1)	436 (50.9)	
	4	73 (61.3)	46 (38.7)	
	5	105 (39.3)	162 (60.7)	
Clinician Specialty	Clinical	236 (43.22)	310 (56.78)	$\chi^2 = 5.9$
	Orthopaedics	274 (50.18)	272 (49.82)	df=5, p=0.3
	Rehabilitation	64 (35.16)	118 (64.84)	
	Sports & Rehabilitation	153 (52.9)	136 (47.1)	
	Sports	670 (43.3)	879 (56.8)	
	None	405 (44.7)	501 (44.7)	

between EVS recording and clinician was examined, in which case the Rao-Scott chi-square test cannot be computed. Among patient characteristics displayed in Table 4a, there was a significant relationship between age group and EVS outcome, and between blood pressure recording and EVS outcome. EVS was more likely to be recorded in the 18-64-year-old age group than the other two age groups and when blood pressure was recorded. Among clinic characteristics, whether EVS was recorded or not varied significantly depending on clinic location (Table 4b). The recording of EVS at different clinics ranged from 38.7% to 60.7%. The variance in whether EVS was recorded is dependent on the clinician, which ranged from 35.2% to 66.8% and this result is statistically significant. The clinicians' specialty is not significantly related to whether EVS was recorded within patient files.

Table 4b.
Bivariate comparison of whether EVS recorded across clinician using chi-square test.

		Exercise Recorded		**Chi-Square Test**
		Yes N (%)	**No N (%)**	
Clinician	1	97 (37.6)	161 (62.4)	$\chi^2 = 119.9$
	2	72 (40.7)	105 (59.3)	df=22, p<.0001
	3	45 (37.2)	76 (62.8)	
	4	60 (41.1)	86 (58.9)	
	5	133 (66.8)	66 (33.2)	
	6	48 (35.3)	88 (64.7)	
	7	88 (54.3)	74 (45.7)	
	8	73 (61.3)	46 (38.7)	
	9	105 (60.0)	70 (40.0)	
	10	69 (40.6)	101 (59.4)	
	11	45 (44.1)	57 (55.9)	
	12	64 (35.2)	118 (64.8)	
	13	37 (45.1)	45 (54.9)	
	14	89 (45.9)	105 (54.1)	
	15	77 (42.1)	106 (57.9)	
	16	148 (40.6)	217 (59.5)	
	17	64 (37.4)	107 (62.6)	
	18	79 (43.7)	102 (56.4)	
	19	68 (35.2)	125 (64.8)	
	20	77 (44.3)	97 (55.8)	
	21	80 (47.1)	90 (52.9)	
	22	96 (54.2)	81 (45.8)	
	23	88 (48.6)	93 (51.4)	

Table 5.
Multilevel logistic regression level 1 (patient file) model coefficients, t-tests and odds ratios with 95%CI

		β	SE(β)	t-stat	p-value	OR	95%CI
Age Group	< 18	0.13	0.26	0.50	0.6175	1.14	(0.69, 1.89)
	18 – 64	0.29	0.11	2.71	0.0068	1.34	(1.08, 1.65)
	≥ 65	ref					
Sex	Male	ref					
	Female	-0.09	0.07	-1.23	0.2170	0.92	(0.79, 1.05)
Blood Pressure	Yes	0.48	0.08	5.71	<.0001	1.61	(1.37, 1.90)
	No	ref					
Cancer	Yes	ref					
	No	-0.29	0.21	-1.36	0.1729	0.75	(0.49, 1.14)
Cardiovascular Disease	Yes	ref					
	No	0.09	0.12	0.76	0.4453	1.09	(0.87, 1.38)
Diabetes	Yes	ref					
	No	-0.18	0.17	-1.01	0.3118	0.84	(0.60, 1.18)

Tables 5 and 6 display findings from the final multilevel model. Table 5 shows level 1 (patient file) factors while Table 6 shows level 2 and 3 (intern and clinician) factors. This model included patient file level factors; age group, sex, documentation of cancer, diabetes, and cardiovascular disease and whether blood pressure was recorded. It also included a random intercept for interns nested within clinician and a random intercept for clinician. Table 5 shows two significant patient file level factors for whether EVS was recorded or not, age group and whether blood pressure was recorded, aligning with results from the bivariate comparisons reported above. For the age group, the middle group (18-64-year-olds) was most likely to have EVS recorded with an odds ratio of 1.34 (95%CI 1.08-1.65) compared to the reference group of ≥65 years. When blood pressure was recorded, EVS was more likely to be recorded with odds ratio of 1.61 (95%CI 1.37-1.90). Table 6 shows that there is significant variance in the recording of EVS between both clinicians and interns (both tests of variance=0 significant with p-values of 0.0026 and <.0001 respectively). The ICC values indicate that 1.7% of the variance in patient EVS recording is explained by clinicians and 25.5% of the variance is explained by interns. When we considered other variables for the multi-level model, such as clinician specialty, there was no additional relationship explained. Variation across clinics was largely tied to clinician variability.

Table 6.
Multilevel logistic regression results, variance in outcome due to clinicians and interns nested within clinicians: test of variance = 0 and Intraclass Correlation Coefficient (ICC) expressing how much of the variance explained by that level of clustering

Hypothesis	DF	Chi-square	p-value	ICC
Clinician Variance = 0	1	7.81	0.0026	0.017
Intern Variance = 0	1	274.4	<0.0001	0.255

Discussion

This research assessed the factors related to whether EVS was recorded or not. This research highlights that chiropractic interns were the predominant source of variability for the recording of EVS and that those who record EVS also tended to record blood pressure, a standard vital sign, much more consistently. Blood pressure was chosen as the vital sign to compare EVS to, since it is commonly monitored and recorded. It was felt that respiratory rate and pulse may be more highly utilized and recorded in a critical care setting. This research builds on the work of Howitt *et al.*[9] and DeGraauw *et al.*[30] which investigated the minutes of weekly physical activity recorded for patients at CMCC clinics. The results of this current study indicate that physical activity was discussed during the initial visit at CMCC for the majority (81.2%) of patients. However, the numeric EVS minutes of weekly physical activity was only recorded in 44.9% of files. Interns are trained to routinely evaluate exercise behaviour as a tool to capture patient health information, but their habits in recording it as a vital sign within the patient file is limited. This behaviour does not appear to be driven by lack of understanding of exercise efficacy as CMCC interns show positive perceptions toward the intervention.[37] Results also showed that interns appear to be the largest predictor of EVS recording (25.5%) compared to clinicians (1.7%). Based on this information, interns' behaviours related to appropriate recording of EVS minutes in the patient file needs greater attention and emphasis.

The results of this study showed that blood pressure recording was significantly associated with the recording of EVS. Blood pressure is already considered a vital sign measurement that appears quite proximal in the EMR where EVS can be recorded. As a result, there may be some concordance in the recording of vital signs or items located in similar locations within the EMR system. This may also simply be that chiropractic interns with better patient record keeping skills tend to record both metrics more frequently. This further highlights the importance of educating interns on appropriate record keeping behaviours for patient management.

The patient variable of age group was also significantly associated with a recorded EVS. Patients within the 18 to 64-year-old group were found to have EVS recorded more than the other two age groups (below 18 years old and 65 years old and older). There are numerous possible explanations for this, such as intern priority, as children and elderly patients may be seeking care for alternative reasons or have increasingly complex cases in which interns did not feel it necessary to ask about EVS. Additionally, a clinical assumption may be made by the intern and/or clinician that this (18 to 64) age group may be more receptive to the question and respond positively or be more willing to increase their physical activity. Perhaps interns also feel most comfortable to enter into a conversation regarding physical activity in this generally healthy group. Exercise for pediatrics and geriatrics is often more nuanced and may have concomitant conditions to consider. It was found that 45% of adults 65 years and older at CMCC clinics were not meeting the Canadian Physical Activity Guidelines (CPAG) recommendation of 150 minutes of moderate to vigorous exercise per week.[9] Although this is similar to the general population, it still offers an opportunity to improve.[8] Physical activity and exercise have been shown to reduce fall risk, improve quality of life and self-esteem, decrease risk of dementia, and improve cardiorespiratory fitness in the elderly.[5,38-39] In individuals younger than 18 years of age, physical activity has the unique benefit of showing improved self-rated health and specifically, improved mental health in previously inactive girls.[6] Regardless of age, reporting an EVS can be helpful to further promote physical activity. In the present study, age group (18 to 64 years old) and blood pressure recording were found to be statistically significant predictors(of EVS recording), but the odds ratios were small in magnitude and considered not important.

With respect to clinicians and clinic location, several interesting results were noted. Statistically clinicians were found to influence the recording of EVS, but clinician specialty did not play a role. A large range was also found for EVS recording by clinicians (35.2% to 66.8%). There was a similar result for Howitt *et al.*[9] and the current study (86.4% and 81%) for a documented EVS discussion. Although, there was also a noticeable discrepancy in the data between the previous study by Howitt *et al.*[9] given that 75.8% of patient files had a formal recording compared to 45% in the current study. While the importance of exercise appears well understood given the high percentage of files in which it is discussed, the previous work of Howitt *et al.*[9] may be reflective of the emphasis the two chiropractic clinicians placed on this measure with their interns given their clinical and research interests in 'exercise as medicine.' The results of this study and the study by Howitt *et al.*[9] demonstrate the variability in the recording of EVS and offers an opportunity to standardize practice among clinicians and clinic locations.

Chiropractors are typically viewed as health care providers for musculoskeletal problems, specializing in conservative management for conditions such as low back pain. Given current musculoskeletal guidelines for low back pain promoting the use of exercise, chiropractors are afforded the opportunity to facilitate promotion of physical activity.[40] As the burden of physical inactivity is ranked the fourth largest contributor to overall morbidity and mortality, this has a multitude of benefits.[41-48] Physical activity has a variety of musculoskeletal and non-musculoskeletal benefits that are helpful for conditions such as osteoporosis, low back pain, type 2 diabetes, and coronary artery disease.[24,41,49] As we improve the consistency of obtaining EVS through regular patient interactions, there is an opportunity to utilize this exercise vital sign to realize the health impacts of physical activity.[50-51]

Clinical implications

Several avenues may be explored to improve the frequency of recording of EVS in the clinical record. To help bridge the gap between knowledge and implementation, clinical and educational directors could further educate interns and clinicians on the importance of recording EVS as a numerical entry in clinical encounters. Secondly, the EMR layout and interface may better position EVS within the vital signs' category to logically encourage interns to formally record the number. The clinical management staff may promote the clinical recording of the EVS measure through initiatives such as comprehensive file audits for specific vital signs. As clinicians dictate the final recording, it is pertinent to emphasize their role within appropriate recording of EVS. This would influence clinicians to better guide interns in EVS documentation. Finally, the authors also feel an important but significant change to the EMR should include changing exercise in minutes per week to, physical activity in minutes per week. This would better reflect the information we are currently striving to obtain from patients.

Research implications

Future research should seek to investigate ways to influence clinical behaviour for the recording of EVS in an academic chiropractic setting. The current significant variables driving EVS investigated in this study were found to be small in magnitude and do not explain a large degree of the variance. More comprehensive characteristics of interns who are more frequently recording EVS could be explored. Patient variables can be investigated in the context of various social determinants of health, such as income level, education, employment status and access to physical activity opportunities. A prospective study design may be beneficial to understand if implementation of an educational intervention changes behaviour for interns in a clinical setting for the recording of EVS. Additionally, as this research was performed in an academic chiropractic setting with a dedicated EHR field for EVS, further analysis of data and behaviours should be performed in community-based non-academic chiropractic settings and clinics without a dedicated EHR entry for EVS. Overall, given the importance of physical activity, future research should further investigate if including EVS in all patients' files influences increased physical activity levels over time.

Strengths and limitations

The study presented several strengths and limitations. The strengths of the study included a large sample size for data interpretation. Data from multiple clinicians and interns were also collected allowing for greater generalizability for results. Data was also collected from consecutive patient files. A quality control phase was done through a secondary data collection of a random sample of the files recorded, in which high rates of agreement were found. The electronic medical record system also had a dedicated area for the recording of exercise, allowing for more consistent data recording. Finally, the data collected offers a novel investigation of EVS in a chiropractic setting with pragmatic clinical utility to guide clinical and educational initiatives.

Regarding limitations, data collection excluded CMCC students, staff and faculty given anonymity concerns which may have skewed the results. The data analyzed was only from the patient intake information entered (exercise minutes per week) which disregards the potential discussion or recording of EVS at subsequent visits which may appear in a clinical SOAP note with more detail including exercise types, such as resistance training. Files between January 2016 and September 2017 were extracted, as such the data were collected prior to the new 24-hour physical activity guidelines. Due to this, the data may not represent current practice in 2022 and may underestimate PA levels which considered bouts of exercise of at least 10 minutes, previously. Two CMCC clinic locations were not included in the study due to their use of a different electronic medical record system. Therefore, generalizability for all chiropractic clinics at CMCC is not entirely possible. Additionally, the original data collection did not include all vital sign measures and did not explain a large degree of the variance in EVS collection. As such, a thorough interpretation of vital sign recording in relation to exercise was not possible. Finally, clinician specialty was recorded but other potential education and training variables were not explored which could help explain the minor variance attributed to clinicians. For example, clinicians could have differed in their undergraduate education, chiropractic college attended, gender or years in practice. Similarly, the intern variable was not further explored and could have included looking at gender, grades, undergraduate training, etc. However, this was beyond the scope of the current research.

Conclusion

This study elaborates on several factors related to the recording of EVS. The main patient variables related to EVS recording were age group (18 to 64 years old) and if blood pressure was also recorded. Although clinicians and clinic locations were found to influence the recording of EVS, clinician specialty was not found to affect the recording of EVS. Interns accounted for the majority of variance compared to clinicians for the recording of EVS. Considering the significant role physical activity can play in one's health and its recommendation in various guidelines for musculoskeletal rehabilitation, educational institutions should understand what factors affect its recording, in order to have all files include this important health determinant.

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