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Prevalence of Complementary Studies in Patients with Spinal Conditions in a Public Hospital in Buenos Aires - A Descriptive Cross-Sectional Study

Santiago Soliño[1, 2*], Melina Calvo Delfino[1], Matías De la Rúa[1], Federico Mignone[1], Emiliano Navarro[1], Andrés Pierobon[1, 2], Sandra Salzberg[1], Juan Cruz Porollan[1], Camila Snaider[1], Juan Sebastián Vera Amor[1], Tomás Vuoto[1], Pablo Oscar Policastro[1, 2]

1. Hospital Durand, CABA, Argentina.
2. KINÉ - Kinesiología Deportiva y Funcional, CABA, Argentina.
*Corresponding author. Email address: ssolino@fmed.uba.ar

Abstract: Objective: To determine the prevalence of complementary studies (CS) in patients with spinal conditions attending the Physical Therapy Department of a public hospital in the Autonomous City of Buenos Aires. As secondary objectives, we aimed to calculate the direct costs of CS in patients with low back pain (LBP), neck pain (NP), and the prevalence of red flags in LBP. Materials and methods: A cross-sectional study was included. Patients with spinal cord disease, aged 18 years or older, and who provided informed consent were included. Results: The prevalence of CS in the general population was 83%. 87.5% of patients with LBP had at least one red flag. The total cost of CS was $210,133 (US$3,431), and the average cost per subject was $1,129 (US$18) in the general population. Conclusion: The prevalence of CS among patients with spinal cord disorders was 83%, resulting in an average cost of $1,129 (US$18) per subject. When assessing the presence of red flags, 87.5% of subjects with LBP had at least one.

Key words: Argentina; low back pain; neck pain; diagnostic imaging; public hospitals

1. Introduction

Spine conditions are a group of entities with a high epidemiological impact and are among the leading reasons for consultations with physical therapists at a public hospital in the Autonomous City of Buenos Aires. [1] Their lifetime prevalence varies, with reports ranging from 22% to 70% for cervical spine conditions and between 11% and 84% for lumbar spine conditions. [2, 3] Regarding prognosis, although low-back pain (LBP) and neck pain (NP) have a high recurrence rate, they usually have a good prognosis, and most cases progress favorably in the short or medium term. [4, 5]

Despite this, spinal conditions generate a significant economic and social burden. LBP and NP represent the first and sixth leading causes of years lived with disability, respectively, both in our country and worldwide. [6] In turn, LBP is the leading cause of work absenteeism and generates higher costs than cardiovascular diseases, autoimmune diseases, strokes, and diabetes. [7]

One of the factors that may influence the impact of these conditions is the indiscriminate use of complementary

studies (CS). [8] Despite their frequent use, these studies yield a high percentage of pathological findings in asymptomatic subjects, which can lead to unnecessary therapeutic interventions and incorrect interpretations by the subjects, generating catastrophizing, fear of movement, and hypervigilance. [8, 9] It has been observed that subjects who undergo imaging studies early are more likely to persist with symptoms at three months, as well as to present with worse general health. [10] In turn, CS has been shown to increase medical costs, the use of healthcare system resources, and work absenteeism. [11] Finally, we cannot ignore the adverse effect generated by irradiation. [8, 11]

For the reasons mentioned above, routine CS is not recommended. It is best performed when there is suspicion of serious pathology, there is no response to conservative treatment, there is unexplained progression of symptoms, or information can be obtained to modify the intervention. [12] Despite this recommendation, and given that 90% of episodes are nonspecific and the prevalence of serious pathology is only 0.9%, CS is currently performed in one in four subjects with LBP. [13, 14] This figure has remained stable worldwide since 1995 for radiographs (X-rays) and even increased by 50% for magnetic resonance imaging (MRI) and computed tomography (CT). [15]

The only Argentine registry on the prevalence of CS is the study by Soriano et al., which reports a value of 10% for MRI and CT in subjects with work-related LBP. [16] We consider it relevant to obtain more information on the prevalence of CS in the Argentine population. Therefore, our primary objective was to determine the prevalence of CS in subjects with spinal conditions who attend the Physical Therapy Department of a public hospital in the Autonomous City of Buenos Aires. The secondary objectives were to calculate the direct medical costs resulting from CS in subjects with LBP and NP and to determine the prevalence of red flags in subjects with LBP.

2. Materials and Methods

This study was designed following the guidelines of the STROBE Initiative Declaration (Strengthening the Reporting of Observational Studies in Epidemiology). [17] The work was approved by the Research Ethics Committee of the Carlos G. Durand Hospital under registration number DI-2019-472-GCABA-HGACD on Friday, August 23, 2019.

2.1 Study design

This study is an observational, prospective, and cross-sectional study conducted by physical therapists at a single center in the Autonomous City of Buenos Aires (Argentina).

2.2 Selection criteria

Subjects who attended the Physical Therapy Unit of the Carlos G. Durand Hospital were consecutively recruited. The inclusion period extended from the approval of the Ethics Committee until the sample size was reached.

All subjects with spinal cord disease, over 18 years of age, and who signed the informed consent form were included (Supplementary Material 1). Exclusion criteria were refusal to participate in the study and cognitive impairment. Subjects who withdrew their informed consent or experienced comprehension difficulties during data collection, which prevented them from obtaining the necessary information, were excluded.

2.3 Study procedures

In the initial interview with the subject, information was collected on an assessment form designed specifically for this study (Supplementary Material 2). The following demographic data were included: age, sex, nationality, address, educational level, and employment status. Regarding the current episode of spinal involvement, the affected region, mechanism of injury, onset and duration of symptoms, and the referring service were recorded. Information was obtained on the number of CS scans requested, differentiating between simple studies (X-rays) and complex studies (MRI and CT), the specialty of the requesting physician, and the presence of studies of more than one spinal segment. Due to the difficulty in distinguishing between CS scans indicated by the current episode and those indicated by previous episodes, only one

study from each category was considered per individual if more than one was present.

The history of spinal conditions and physical therapy visits prior to the current episode were also recorded. Finally, subjects with LBP were asked about the presence of red flags, defined as signs or symptoms related to a serious condition (spinal fracture, cauda equina syndrome, osteomyelitis, tumors, and ankylosing spondylitis), following the recommendations of the American College of Physicians. [18, 19]

The information was subsequently entered into a Microsoft Excel® spreadsheet for analysis.

2.4 Data analysis and statistical methods

Continuous data were expressed as mean and standard deviation (SD), or median and interquartile range (IQR), as appropriate. Normality analysis was performed using the Shapiro-Wilk test. Categorical data were expressed as absolute values and/or percentages. The Student t test or the Mann-Whitney U test was used to compare continuous variables, as appropriate, and the Chi-square test or Fisher's exact test was used to compare categorical variables. The 95% confidence interval (95% CI) was calculated for each proportion, either for a normal distribution or using an exact test based on the binomial distribution with Yates' continuity correction.

To calculate the sample size, a pilot study of 30 subjects was conducted. The prevalence of CS was 86%. To estimate the number of subjects needed to be included, an expected proportion of 86% was assumed, with a 95% CI of 81%-91% and an alpha error of 5%, and a sample size of 186 subjects was determined.

To calculate the costs generated by the CS, the amounts in Argentine pesos ($) corresponding to the study period were consulted, as described in the nomenclature of the Ministry of Health of the Government of the Autonomous City of Buenos Aires. These were added together to obtain the costs corresponding to X-rays, MRIs, and CTs. In turn, the total cost for the study period was calculated, as well as the average cost per subject overall and for subjects with NP and LBP. To facilitate comparison with the literature, the costs were converted to US dollars (US$) and the average of the daily values of the official dollar exchange rate from the Banco de la Nación Argentina during the study period was used.

Data analysis was carried out using R software (version 3.6.2). Graphs were created using the Plotly package.

3. Results

During the study period, from August 22, 2019, to January 15, 2020, 190 subjects were enrolled, none of whom were excluded, and four were eliminated due to comprehension issues during data collection. The total number of subjects for the final analysis was 186 (Figure 1). The clinical and demographic characteristics of the sample are presented in Table 1.

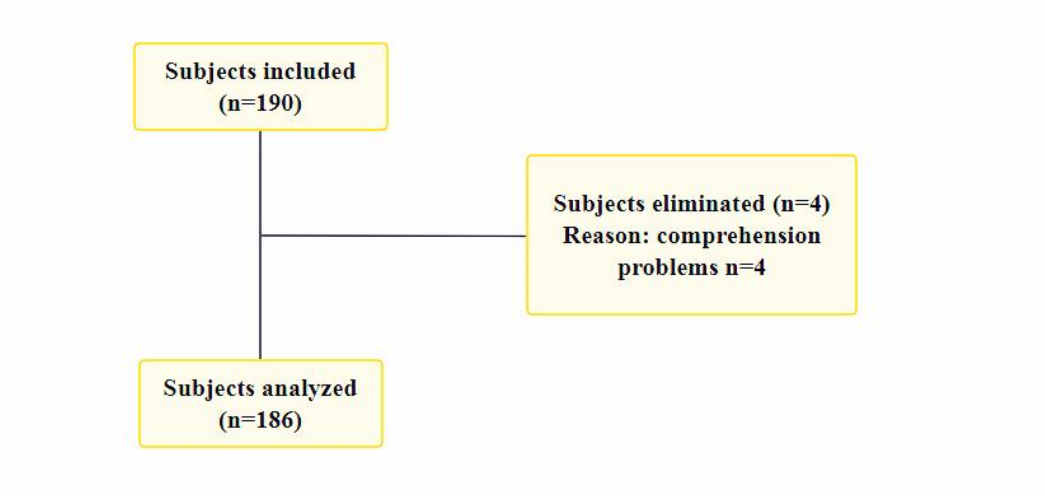


Figure 1. Flowchart.

Table 1. Clinical and demographic characteristics

Variable	n	
Age, median (IQR), years	186	50.5 (40.0 – 59.0)
Female gender, n (%)	186	136 (73.1)
Argentine nationality, n (%)	185	100 (54.1)
Educational level, n (%) Incomplete primary education Complete primary education Incomplete secondary education Complete secondary education Tertiary/university education	183	 27 (14.8) 33 (18.0) 29 (15.8) 61 (33.3) 33 (18.0)
Address, in (%) Autonomous City of Buenos Aires Province of Buenos Aires	183	 114 (62.3) 69 (37.7)
Employment status, n (%) Employed Unemployed Others	186	 109 (58.6) 65 (34.9) 12 (6.5)
Affected region (%) Lumbar spine Cervical spine Thoracic spine More than one region	186	 80 (43.0) 76 (40.9) 6 (3.2) 24 (12.9)
Evolution time, n (%) 0 – 1 month 1 to 3 months More than 3 months	178	 41 (23.0) 47 (26.4) 90 (50.6)
Mechanism of injury, n (%) Traumatic Atraumatic	186	 25 (13.4) 161 (86.6)
Form of onset, n (%) Acute Progressive	186	 56 (30.1) 130 (69.9)
First episode, n (%)	185	98 (53.0)
Previously underwent physical therapy, n (%)	186	55 (29.6)
Referring service, in (%) Orthopedics and traumatology Medical clinic Rheumatology Others	186	 126 (67.8) 30 (16.1) 22 (11.8) 8 (4.3)

IQR: interquartile range.

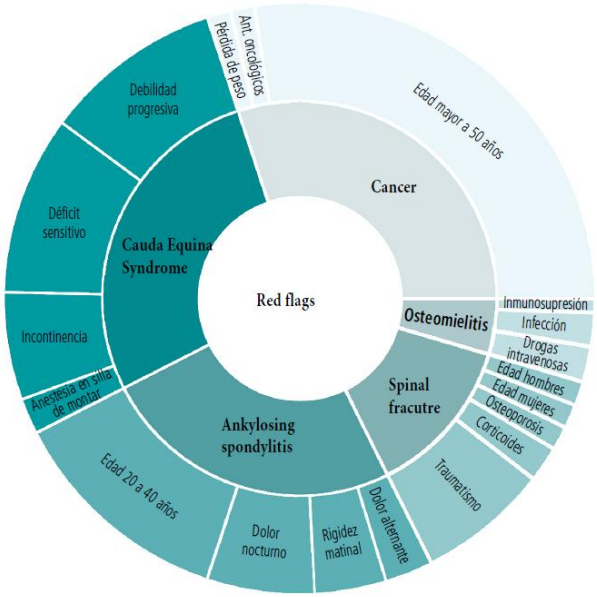
The prevalence of complementary studies in the general population was 83% (95% CI 78-89%). Table 2 presents the prevalence for simple, complex, and combined studies for the general population, subjects with LBP, and NP. 21.2% of subjects had complementary studies in more than one spinal segment, and 50.8% had prior imaging studies.

Table 2. Prevalence of complementary studies

Variable	Prevalence % (95% CI)
General population	83 (78 – 89)
Simple complementary studies	80 (74 – 86)
Complex complementary studies	15 (9 – 20)
Low back pain	87 (80 - 94)
Simple complementary studies	83 (75 – 91)
Complex complementary studies	25 (15 – 34)
Neck pain	80 (71 – 89)
Simple complementary studies	77 (68 – 87)
Complex complementary studies	6 (1 – 12)

95% CI: 95% confidence interval.

87.5% of subjects with LBP presented at least one red flag. Among the pathologies screened for by the presence of red flags, the only one present in our sample was vertebral fracture in two subjects. Figure 2 shows the frequency of occurrence of each red flag. Table 3 shows the number of studies performed on subjects with LBP with and without red flags.



Cauda Equina Syndrome	Ankylosing spondylitis	Spinal fracture	Osteomielitis	Cancer
Progressive weakness: 8 (10.0) Saddle anesthesia: 2 (2.5) Changes in urination or defecation: 5 (6.2) Sensory deficit in feet: 11 (13.8)	Age 20 to 40 years: 19 (23.8) Alternating gluteal pain: 4 (5.0) Morning stiffness: 6 (7.5) Night pain: 9 (11.2)	Trauma: 11 (13.8) Long-term use of corticosteroids: 3 (3.8) Age > 65 years in men: 2 (2.5) Age > 75 years in women: 2 (2.5) Osteoporosis: 2 (2.5)	Infection: 3 (3.8) Intravenous drug use: 3 (3.8) Immunosuppression: 1 (1.2)	Age > 50 years: 42 (52.5) Cancer history: 2 (2.5) Unexplained weight loss: 2 (2.5)

Figure 2. Red flags in the low back pain population.
Variables are expressed as number and percentage. Previous: Background.

Table 3. Prevalence of complementary studies in subjects with low back pain with and without the presence of red flags

Variable	CS presents	Does not present CS
Presence of red flags, n (%)	61 (76.2%)	9 (11.2%)
Absence of red flags, n (%)	9 (11.2%)	1 (1.2%)

EC: complementary studies.

The total cost of CS scans in our sample was $210,133 (US$3,431), of which $74,018 (US$1,209) corresponded to X-rays, $117,855 (US$1,924) to MRIs, and $18,260 (US$299) to CTs. This represents 35%, 56%, and 9%, respectively. Regarding the affected region, 58% of the total cost corresponded to subjects who consulted for LBP, 26% to those with NP, and the remaining percentage to subjects with dorsal involvement or more than one region. The average cost per subject was $1,129 (US$18) in the general population, $1,527 (US$24) in the population with LBP, and $738 (US$12) in those with NP.

4. Discussion

The main finding of this study was an 83% (95% CI 78-89%) prevalence of CS in subjects with musculoskeletal spine conditions. Direct medical expenses resulting from CS in this population totaled $210,133 over the study period, which lasted approximately 5 months, and an average of $1,129 per subject. On the other hand, the prevalence of red flags in subjects with LBP was 87.5%.

To our knowledge, the prevalence of CS in subjects with spine conditions, considering all vertebral segments together, has not been previously reported, so direct comparison of our findings is not possible. These values are available for subjects with LBP, in whom the prevalence of CS was 24% in primary care and 33.6% in emergency care, according to the latest systematic review on the subject. [15] Although these are considered high values, they are much lower than our findings, according to which 8 out of 10 subjects had a complementary study. Regarding the prevalence of simple studies, the reported values are 16.3% in primary care and 26.1% in emergencies, while in our case it was again much higher. [15] Regarding the indication for complex studies, we obtained a prevalence of 15% (95% CI 9-20) for the general population and 25% (95% CI 15-34) for LBP specifically. The values reported in the literature in subjects with LBP are 9.2% in primary care and 8.2% in emergencies, also lower than ours. [15] The only Argentine study that reports this data finds a prevalence of MRI or CT of 10% in subjects with LBP associated with work activity. [16] This difference in the number of subjects with complex studies is evident, despite the fact that our institution does not have a magnetic resonance imaging scanner, which makes access to this study difficult in our setting.

The prevalence of red flags in the LBP subjects in our sample was high (87.5%); however, within the serious pathologies investigated, we only found two subjects with fractures (1.07%). These findings are consistent with previous studies that reported red flags in more than 80% of LBP subjects and only 0.9% – 5.6% of serious pathologies. [14, 20] However, it is worth noting that a high percentage of subjects presented only age as a red flag, which increases the overall prevalence, as has already been reported in the literature. [14, 20] On the other hand, when analyzing the relationship between CS and red flags in LBP subjects, we found that 90% of the subjects without red flags presented CS. A 2018 meta-analysis that used the absence of red flags as a criterion for poorly indicated CS reported a 9% (95% CI 7.4–11) rate of cases, a notably lower number. [21] This suggests that healthcare professionals at our hospital overuse CS, regardless of the presence of warning signs. In any case, red flags individually generate slight changes in the likelihood of serious pathology, so the decision to perform CS solely based on this criterion is controversial. [14, 20] It should be noted that their use varies across studies and clinical practice guidelines (CPGs); therefore, there is no unified criterion for taking action based on these conditions. [22] Therefore, current recommendations regarding red flags are to use them while monitoring symptoms over time, to use low-cost care, and to consider them alongside health status, not only as a diagnostic test but also to provide a prognosis for the subject. [18]

Inappropriate prescription of CS not only fails to help plan a treatment strategy, but can also lead to a number of negative effects on the subject. First, the irradiation from a lumbar X-ray is 75 times greater than that of a chest X-ray, which is worrying since the higher the radiation dose, the greater the impact on the gonads and the risk of developing

neoplasia. [19, 23] Second, compared to those who do not undergo CS, a higher proportion of subjects who receive a lumbar X-ray indication persist with symptoms at three months and also perceive a worse general state of health. [10] Similarly, the early request for MRI is associated with a longer duration of disability. [24] With respect to the use of health system resources, performing CS comprises an average of 7% of the total cost generated by the LBP. [25] However, subjects who undergo CS make a greater number of medical consultations, consume more drugs and undergo surgery to a greater extent than those who do not. [10, 24] This large amount of medication and unnecessary interventions increases the economic burden generated by these subjects. [11]

Despite the high prevalence of CS in our population, the costs generated by them differ from those reported in previous studies conducted in other countries, although there is wide variability. A study from France published in 2010 found an average cost per subject of €68.9 (95% CI 61.8-76.0) over 6 months. [26] Similar data can be extracted from a report from the United States where annual costs were US$2780 per subject and the indication for CS corresponds to 12% of the total. [27] When evaluating average CS costs per subject in the United Kingdom, an estimated cost of £94.22 (SD 61.7) is reported for early studies and £40.26 (SD 75.1) for selective late studies (defined as CS indicated due to the development of symptoms or a decision on surgery). [28] Even higher values were found by Maniadakis and Gray, with an average of £138.2 for complex studies. [7] However, we must keep in mind the differences in publication date, methodology used for cost calculation, data source used, perspective from which these studies were conducted, internal costs of each country and the value of the local currency. [25, 29] Furthermore, the fact that only one study of each type was used per subject could underestimate the real expenditure generated by these.

The findings of this study suggest that the request for CS exceeds previous reports and does not appear to be based on the recommendations of current CPGs. [15, 30] With the available information, we do not know the causes of these results, but they could be related to the subject's demand for an accurate diagnosis, the belief that CS is necessary to reassure the subject that they do not suffer from any serious condition, the lack of time during the consultation to allocate to education, the inability to read the CPGs or the lack of knowledge of them. [10, 31, 32]

4.1 Limitations

Data collection was monocentric and limited to those referred to the Physical Therapy Service, which does not allow us to determine the prevalence of CS prescribed to subjects who consult a doctor for back pain and are not referred to physical therapy. For the cost study, we only considered one CS per subject, even though they could have had more than one. This way, we avoid errors related to subject recall, but the actual cost may be underestimated. Furthermore, the presence of previous CS was reported by the subject themselves, as there is no institutional record of such data, which means this variable is also affected by recall bias. Despite this, "good" to "excellent" agreement values have been reported using this method. [33] Finally, although costs were converted to US dollars, comparison with the literature should be made with caution because changes in domestic prices in Argentina, the devaluation of the local currency, differences in costs and salaries between different regions, among other factors, were not considered, as they are not part of the objective.

5. Conclusion

In a sample from a public hospital in the Autonomous City of Buenos Aires, the prevalence of CS among subjects with spinal conditions was 83%, resulting in an average cost of $1,129 per subject. When assessing the presence of red flags, 87.5% of subjects with LBP had at least one.

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Declaration

"Prevalencia de estudios complementarios en sujetos con afecciones de columna en un hospital público de la Ciudad Autónoma de Buenos Aires. Estudio transversal descriptivo" was originally published in *Argentinian Journal of Respiratory and Physical Therapy*. With the author's consent, the English version has been published in *AMEIR*.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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