

THE SPANISH HIP FRACTURE REGISTER (RNFC) AND NATIONAL PATIENT REGISTER (CMBD) WERE VALUABLE FOR RESEARCH ON HIP FRACTURES: COMPARISON OF TWO REGISTERS^(*)

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ABSTRACT

Background: National hip fracture registries have been established in several countries and recent publications show that the care process has been audited inspecting the representativeness according to quality standards. The aim of this study was to analyse if the Spanish National Hip Fracture Registry (RNFC) represents the Spanish population aged 75 and older admitted for hip fractures, and to compare its results regarding the care process with the national average, according to the National Inpatient register (Minimum Basic Dataset, CMBD).

Methods: The 2017-2018 National Minimum Basic Dataset (Conjunto Mínimo Básico de Datos, CMBD) was used as reference. For analysis, we included 83,110 cases from the CMBD and 21,130 from the RNFC. Eight common variables of both registries were selected for comparison.

Results: No significant differences were observed in the patient-related common variables (age, sex, type of fracture and fracture side), but statistically significant differences were found in the variables describing the care process (proportion of patients operated, deceased, surgical procedures and postoperative length of stay).

Conclusions: The RNFC, designed as a convenience sample, is also representative of the population of patients aged 75 and older treated for hip fractures in Spain. However, there is a participation bias related to the professionals and the hospitals interested in voluntarily participating in a quality improvement program, which would explain the better results observed in the care process, compared to the national average as collected by the CMBD.

Key words: Hip fractures, Aging, Clinical audit, Mortality, Process assessment, Health care, Database, Medical record linkage, Quality of health care.

ABSTRACT

El Registro Nacional de Fracturas de Cadera (RNFC) y el Conjunto Mínimo Básico de Datos son útiles para investigar sobre fracturas de cadera: comparación de ambos registros.

Fundamentos: Los registros nacionales de fracturas de cadera se han establecido en varios países y publicaciones recientes muestran que el proceso de atención ha sido auditado para explorar su representatividad de acuerdo a estándares de calidad. El objetivo de este trabajo fue analizar si el Registro Nacional de Fracturas de Cadera (RNFC) es representativo de la población española de 75 o más años de edad ingresada por fractura de cadera, y comparar los resultados acerca del proceso asistencial con la media nacional según el Conjunto Mínimo Básico de Datos (CMBD).

Métodos: Se empleó el CMBD de los años 2017-2018 como referencia. Para el análisis se incluyeron 83.110 casos del CMBD y 21.130 del RNFC. Se seleccionaron ocho variables comunes a ambos registros para ser comparadas.

Resultados: No se observaron diferencias significativas en las variables comunes paciente-dependientes (edad, sexo, tipo y lado de fractura), pero se hallaron diferencias significativas en las variables que describían el proceso asistencial (proporción de pacientes intervenidos, fallecidos, tipos de procedimiento quirúrgico y estancia postoperatoria).

Conclusiones: El RNFC, diseñado como muestra de conveniencia, es también representativa de la población de pacientes de 75 y más años, atendida por fractura de cadera en España. Sin embargo, existe un sesgo de participación relacionado con los profesionales y los hospitales interesados en participar voluntariamente en un programa voluntario de mejora de calidad que podría explicar los mejores resultados observados en el proceso asistencial, comparado con la media nacional según se recoge por el CMBD.

Palabras clave: Fracturas de cadera, Envejecimiento, Auditoría clínica, Mortalidad, Evaluación de procesos, Atención de salud, Base de datos, Registro médico coordinado, Calidad asistencial.

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INTRODUCTION

Hip fractures are one of the major health problems associated with ageing and frailty. They have serious repercussions regarding morbidity and mortality, and a considerable number of patients become functionally dependent and institutionalised due to the fracture. Even if the overall trend of age-adjusted incidence of hip fracture is decreasing in Spain, the incidence is expected to continue to grow in the near future, especially among those aged 80 years and older⁽¹⁻⁵⁾. In Europe, hip fractures account for more years of life lost than most cancers⁽⁶⁾. Furthermore, hip fractures do not only have repercussions on the patient, but also on family and caregivers⁽⁷⁾.

National hip fracture registries have been established in several countries; among the most relevant would be the United Kingdom's National Hip Fracture Database (NHFD), the largest one worldwide, but also the Australian and New Zealand Hip Fracture Registry (ANZHFR), or the Swedish National Hip Fracture Registry (Rikshöft)⁽⁸⁻¹⁰⁾. The experiences of these registries have been summarised in recent publications that show that the care process has been audited in the countries in which registries have been established, inspecting whether the care provided adheres or deviates from established quality standards, and introducing corrective measures to improve the care process and overall efficiency^(9,11).

The Fragility Fracture Network (FFN) is an international organisation with the mission of promoting optimal multidisciplinary care of patients with fragility fractures worldwide, including secondary prevention; in 2013, it proposed a concise minimum common dataset (the FFN Minimum Common Dataset-FFN-MCD) that would cover the key elements of case-mix, care process and outcomes⁽¹²⁾. In 2018, the FFN

launched a global call for action to improve the care of people with fragility fractures⁽¹³⁾.

A large group of Spanish healthcare professionals directly involved in hip fracture patient care launched the Spanish National Hip Fracture Registry (RNFC, Spanish acronym for *Registro Nacional de Fracturas de Cadera*) in 2016, following the example of the FFN-MCD. The RNFC is a voluntary database, and not a probabilistic sample, involving approximately 25% of total Spanish hospitals treating hip fracture patients, heterogeneously distributed throughout the different regions of Spain. Its main objective is the continuous improvement of the quality of care of these patients based on early detection of deficits, the proposal of quality indicators and standards, and their periodic assessment⁽¹⁴⁻¹⁶⁾.

Spain, as other countries, has a mandatory national hospital patient discharge registry, the Specialized Care Register - National Minimum Basic Dataset (RAE-CMBD, Spanish acronym for *Registro de Actividad de Atención Especializada-Conjunto Mínimo Básico de Datos*, usually identified as CMBD), which is collected in hospitals and curated and published annually by the Ministry of Health and Consumer Affairs^(17,18).

Both registries, the RNFC (voluntary) and CMBD (mandatory) have different characteristics and variables, although they share socio-demographic and some clinical variables that allow comparison. These variables are described in the “variables” section.

In this context, the aim of this study is to analyse whether the RNFC is representative of the entire population of patients aged 75 years and older admitted to Spanish hospitals for hip fractures, and to compare the results regarding the care process observed in the RNFC with the national averages provided by the CMBD.

MATERIAL AND METHODS

In order to assess the representativeness of the RNFC, we used the CMBD database from the years 2017 and 2018 as reference⁽¹⁸⁾.

Primary data sources: Table 1 describes and compares the different variables in both registries, CMBD and RNFC. The CMBD is part of the Health Information System. It is a mandatory and anonymized record of all discharges occurring in all hospitals, both public and private, during one year^(17,18). The registry is carried out retrospectively, after issuing the discharge medical report, with each hospital's technical and administrative personnel starting the coding and transcription process to fill out the different items of the CMBD registry. Each new episode of discharge from hospital of the same patient implies a different record.

It includes, among others variables, dates of admission, surgery and discharge, primary and secondary diagnostics, surgical procedures, prefracture place of residence, cause of discharge and destination at discharge destination. There are two variables for admission date: time of initial contact and time of admission to the hospitalisation ward (in most cases both coincide, leading to confusion in the analysis of the length of stay in 2017 and 2018). Diagnoses and procedures are coded, from 2016 onward, according to the Spanish International Classification of Disease System, tenth revision (ICD-10-ES)^(19,20). The CMBD database is accessible for research purposes through a specific application form⁽²¹⁾.

The RNFC is a voluntary registry that collects data of patients aged 75 and older admitted for hip fracture in participating hospitals (dates of admission, surgery and discharge, prefracture place of residence and mobility, cause of discharge and destination at discharge, among others

variables), as well as on the care offered and 30-day follow-up (mobility, place of residence and vital status). It is a prospective registry filled in directly using a data collection template by the health personnel caring for the patient during hospitalization, choosing the correct category from those available for each item. If the patient is re-admitted in 30 days due to a process related to her first admission, the information is collected in the same initial template. The admission date is ever the time of arrival at the hospital's Emergency Department⁽¹⁴⁾.

The type of fracture is classified directly as: intracapsular, pertrochanteric or subtrochanteric. Surgical procedure is selected among four categories: non-operative, internal fixation, hemiarthroplasty or total hip arthroplasty. There are others variables as health status measured through the American Society of Anesthesiologists (ASA) Physical Status Classification System, walking ability and cognitive function through Pfeiffer test⁽¹⁴⁾.

Variables selected for comparison: Given the RNFC's peculiarities, we selected from the CMBD database the records of patients aged 75 and older that had as main diagnosis: Femoral head and neck fractures (code S72.0***), pertrochanteric fractures (S72.1***), and subtrochanteric fractures (S72.2***).

Hip fractures due to motor vehicle accidents were excluded, and records of patients readmitted in the first 30 days (identified according to an anonymised code) were merged with the initial admission record, given the low likelihood of suffering a new hip fracture in this period. Records corresponding to patients transferred to another hospital within 48 hours to continue treatment were also merged, using the date of admission from the first hospital and of discharge from the second. The number of CMBD records fulfilling these criteria was 87,432.

Table 1
Characteristics of the National Minimum Basic Dataset (*Conjunto Mínimo Básico de Datos, CMBD*) and the Spanish National Hip Fracture Registry (*Registro Nacional de Fracturas de Cadera, RNFC*). Similarities and differences (Years 2017 and 2018).

Variables	CMBD	RNFC
CONTEXT AND OBJECTIVE	The Registry of Specialized Health Care Activity, based on the Minimum Basic Dataset (<i>Registro de Actividad Atención Sanitaria Especializada, basado en el Conjunto Mínimo Básico de Datos, RAE-CMBD</i>), is part of the Health Information System of the National Health System. It is a mandatory record of all discharges occurring in all Spanish hospitals, both public and private. Its purpose is to guarantee the availability of information regarding specialized health care activity (information on the process during hospitalisation) ^(15,16) .	Voluntary registry promoted by professionals directly involved in the care of patients with hip fracture with the format of an audit and the objective of improving quality of care. 29% of Spanish hospitals participate, distributed heterogeneously by the different Autonomous Communities. The RNFC is a non-probabilistic convenience sample that collects data of patients aged 75 and older admitted for hip fracture in participating hospitals, as well as on the care offered and 30-day follow-up (mobility, place of residence and vital status) ⁽¹²⁾ .
COMPLETION	The registry is carried out retrospectively, after issuing the discharge medical report, with each hospital's technical and administrative personnel starting the coding and transcription process to fill out the different items of the CMBD registry. Each new episode of discharge from hospital of the same patient implies a different record.	It is a prospective registry filled in directly using a data collection template by the health personnel caring for the patient during hospitalization, choosing the correct category from those available for each item. If the patient is re-admitted in 30 days due to a process related to her first admission, the information is collected in the same initial template.
DATE/TIME OF INITIATION OF A RECORD	There are two time variables: Date and time of initial contact and date and time of admission to the hospitalisation ward (in most cases both coincide, leading to confusion in the analysis of the length of stay).	Date and time of arrival at the hospital's Emergency Department (moment from which the length of stay is calculated).
COMPARABILITY OF VARIABLES. Differences in the definition and coding of both registries.	1) Common variables: Age, sex, fracture side, non-operative management, post-operative length of stay and in-hospital mortality.	
	2) Variables coded differently that can easily be recoded or harmonized into one of the two classifications used: a) Fracture type. In RNFC: intracapsular, pertrochanteric, subtrochanteric. In CMBD: head and neck, pertrochanteric and subtrochanteric. b) Development of pressure ulcers: In RNFC: dichotomous variable (Yes / No) that appears in the RNFC data collection sheet. In CMBD it can be found among the secondary diagnoses. c) Surgical procedure. In CMBD: ICD-10 classification. In RNFC, four categories: non-operative, internal fixation, hemiarthroplasty or total hip arthroplasty.	
	3) Variables that require the date of admission to be constructed, which is different in both records. a) Total hospital stay. b) Pre-surgical stay (surgical delay).	
	4) Similar variables in both registries with information of interest that would require a more complex harmonization process due to different definitions, measurement scales or data collection methods, which would need new intermediate variables for comparison that can condition the assessment and interpretation of results when trying to compare them: a) Severity / Severity. In the CMBD: Severity Index: 4 categories for each GDR. In RNFC, ASA (American Society of Anaesthesiologists.) categories. b) Dementia / Cognitive impairment: In the CMBD it can be found among the secondary diagnoses related to Dementia or Cognitive Impairment, in the RNFC: Pfeiffer's test at admission of the patients. c) Prefracture place of residence and Destination at discharge: In the RNFC there is the category "Nursing care". In the CMBD this category and other hospital options (i.e. medium- / long-term hospitalisation and socio-sanitary care) are not contemplated and are difficult to homogenize between both registries. d) Re-admission after 30 days. In the CMBD it is a new record and sometimes in a different hospital, which needs to be rebuilt from the anonymised patient code. In the RNFC it is explicitly included in the dataset as follow-up of the initial hospitalisation.	

For this comparative study, we chose all records of patients discharged during the same time period (2017 and 2018) included in the RNFC (21,686 cases).

– Cases excluded due to low quality of collected data: For this analysis, we excluded the records of the CMBD and/or RNFC in which age and/or sex were not registered, those with the fracture type classified as “*other*” or “*no data*”, those with incongruous data regarding surgery and procedure performed (yes/no), and the records with a surgical date before the date of initial contact. These amounted to 4.5% of initial records (5% of CMBD and 2.6% of RNFC), so 104,240 cases were finally included (83,110 from the CMBD and 21,130 from the RNFC).

– Variables: The variables included in this study can be summarised in two groups:

i) Variables common to and equal in both registries. These are defined and collected the same in both registries. They are three patient-related variables (age, sex and fracture side), and three process-related variables (whether the patient underwent surgery or not, post-surgical length of stay and if the patient died during hospitalization).

ii) Variables coded slightly different that can easily be recoded into one of the two classifications used:

a) Hip fracture type: The RNFC classification was used. “*Femoral head and neck fractures*” in CMBD (code S72.0***) were considered intracapsular fractures. Because basicervical fractures were included as pertrochanteric fractures in RNFC classification (following the FFN-MCD recommendations⁽¹²⁾) but in CMBD were included within “*head and neck fracture*” (code

S72.04**) category, we transfer the basicervical fractures to pertrochanteric category in CMBD to allow the comparison between both registries.

b) Surgical procedure: the ICD-10 classification groups from the CMBD were recoded into the four categories collected by the RNFC (non-operative, internal fixation, hemiarthroplasty or total arthroplasty).

The rest of similar but not identical variables in both registries due to different definitions, measurement scales or data collection methods, were not used.

Statistical analysis: We merged the two registers in the same database, considering RNFC one independent sample. In order to evaluate the representativeness and the process results, we compared the frequencies of categorical variables (Chi-squared test and estimation of the 95% confidence intervals [95% CI] for each category), and the mean and their standard deviation for age (Student’s t test) and median and interquartile range for post-surgical length of stay (Mann-Whitney test).

Ethical considerations: The Spanish National Hip Fracture Registry project was approved by the Ethical Review Board of the Hospital Universitario La Paz, Madrid (IdiPAZ project, number 2,574) and was ratified by the review boards of all participating hospitals. Participation was authorised by the patient or next of kin by means of informed consent before the data collection.

RESULTS

The RNFC collected 25.4% of the CMBD records of patients aged 75 and above treated for hip fractures in Spanish hospitals during

Table 2
Distribution by age groups and sex of the cases provided by each of the hip fracture registries, percentage values (95% CI) of total records, for the years 2017 and 2018.

Variables		CMBD ^(a) (% [IC95%])			RNFC ^(b) (% [IC95%])		
		Total	Male	Female	Total	Male	Female
Number of cases		83,110	20,689	62,421	21,130	5,140	15,990
Percentage, by gender		100	24.9 (24.6-25.2)	75.1 (74.8-75.4)	100	24.3 (23.7-24.9)	75.7 (75.1-76.3)
Age (years)	75-84	35.4 (35.2-35.8)	9.5 (9.3-9.7)	26.0 (25.7-26.3)	35.0 (34.9-36.1)	9.2 (8.8-9.6)	25.8 (25.2-26.4)
	85-94	56.2 (55.9-56.5)	13.7 (13.5-13.9)	42.5 (42.2-42.8)	57.0 (56.4-77.7)	13.4 (12.9-13.9)	43.6 (42.9-44.3)
	≥95	8.4 (8.2-8.6)	1.8 (1.7-1.9)	6.6 (6.4-6.8)	8.0 (7.6-8.4)	1.7 (1.5-1.9)	6.3 (5.9-6.5)

(a) CMBD: Minimum Common Basic Dataset. Hip Fracture patients from Spanish National Inpatient Register; (b) RNFC: Spanish National Hip Fracture Registry.

Table 3
Distribution of categorical variables in each of the hip fracture registers, as a percentage of the total records for the years 2017 and 2018.

Variables		CMBD ^(a) (n=83,110)		RNFC ^(b) (n=21,130)		p
		n	%	n	%	
Sex	Female	83,110	75.1	21,130	75.7	0.088
Fracture side	Right	68,986	50.1	21,019	49.4	0.083
	Left		49.9		50.6	
Percentage of operated patients	Non-operative (%)	83,110	8.4	21,016	4.2	<0.001
In-hospital mortality	Deceased (%)	81,974	5.9	21,088	4.5	<0.001
Fracture type	Intracapsular ^(c)	83,110	41.9	21,130	40.1	<0.001
	Petrochanteric		50.4		52.2	
	Subtrochanteric		7.7		7.7	
Surgical procedure	Internal fixation	76,131	62.4	20,239	62.8	<0.001
	Hemiarthroplasty		27.9		34.5	
	Total hip arthroplasty		9.7		2.6	

(a) CMBD: Minimum Common Basic Dataset. Hip Fracture patients from Spanish National Inpatient Register; (b) RNFC: Spanish National Hip Fracture Registry; (c) Intracapsular fractures in CMBD include all “Neck and head femoral fractures” (code CIE10-ES: S72.0***) but basicervicales fractures (code: S72.04**) were included in Petrochanteric fractures category like in RNFC classification (2416 records, 6,9% of code S72.0***).

Table 4
Distribution of continuous variables for each of the hip fracture registries.
Data represents total records for 2017 and 2018.

Variables	CMBD ^(a) (n=83,110)			RNFC ^(b) (n=21,130)			P
	N	Mean (SD) ^(c)	Median (IQR) ^(d)	N	Mean (SD) ^(c)	Median (IQR) ^(d)	
Age	83,110	86.6 (5.7)	86.7 (82.6-90.6)	21,130	86.7 (5.6)	87.0 (83-91)	0.295
Post-operative length of stay (d)^(*)	76,281	-	6.1 (4.1-8.3)	20,213	-	6.2 (4.2-9.1)	<0.001

(a) CMBD: Minimum Common Basic Dataset. Hip Fracture patients from Spanish Inpatient Registry; (b) RNFC: Spanish National Hip Fracture Registry; (c) SD: Standard deviation; (d) (IQR): Interquartile range; (*): Data does not follow a normal distribution.

2017 and 2018 (21,130/83,110), and it included 29.1% of hospitals treating patients with hip fractures (80 of 275).

No significant differences were found regarding the age and sex distributions of the patients included in both registries (86.64 ± 5.67 years in the CMBD versus 86.69 ± 5.59 years in the RNFC; $p=0.295$). **Table 2** summarises the distribution in both registries by age group and sex, with 95% confidence intervals. Only the group of females aged 85-94 years old reached statistical significance (42.5% in the CMBD vs. 43.6% in the RNFC).

Table 3 shows the distribution of the different categorical variables used to compare both registries. **Table 4** shows the dispersion statistics of continuous variables.

Three common patient-related variables (age, sex and fracture side) showed no significant differences but hip fracture type shows statistically significant difference ($p<0.001$). Variables related with the care process (proportion of patients treated surgically, died in-hospital, surgical

procedures and post-operative length of stay) were significantly different ($p<0.001$).

DISCUSSION

Comparison between different records requires common variables, defined and measured in the same way. In this study, we used six common variables and two slightly different variables, that required a recoding process into one of the two classifications used. Regarding the variables common to the CMBD and RNFC, four are patient-related (age, sex, type of fracture and fracture side), and four process-related (proportion of patients treated surgically, deceased in-hospital, surgical procedures and post-operative length of stay), allowing to address the aim of this study.

In 2017 and 2018, the RNFC included 25% of all patients aged 75 and older treated for hip fractures in Spain, and the age and sex distribution showed no significant differences compared to the overall population of patients treated in all of Spain and registered in the CMBD, as occurred also with the fracture side.

In spite the RNFC being designed originally in a similar fashion to that proposed by the Fragility Fracture Network (FFN)⁽¹²⁾, as a non-probabilistic convenience sample in which 80 hospitals⁽²²⁾ distributed heterogeneously throughout Spain participated voluntarily, our data show it is a representative sample of the Spanish population in spite of the registry's low coverage rate. For comparison, several other registries such as the Swedish registry Rikshöft, the United Kingdom's NHFD or Ireland's IHFD included well over 90% of patients suffering a hip fracture in their respective countries^(10,23,24).

However, the common process-related variables associated with the care provided show significant differences between both registries. The percentage of patients managed non-operatively nationally as recorded by the CMBD was 86% higher than that found in the RNFC (8.2% versus 4.4%, respectively), and in-hospital mortality was also 31% higher in the CMBD group (5.9% versus 4.5%). Both variables are considered quality indicators of process of hip fracture care^(9,16,25), and their results support the existence of a selection bias in the RNFC sample that applies to the hospitals and the departments that treat the patients, rather than the patients themselves. In our opinion, this bias is attributable to the design and purpose of the RNFC itself, and the motivation and commitment demanded from the professionals for voluntarily participating in a program that improves the quality of care offered to hip fracture patients, involving data collection, periodic dissemination of the results obtained, the proposal of explicit quality criteria and standards, and the periodic evaluation of their application^(14-16,22).

Post-operative length of stay, the only variable related with hospitalisation lengths recorded the same in both registries, showed a difference (corresponding to 1% of the global time of stay or 2.4 hours of real time) that we do not

consider relevant at clinical level because it not means enough period of time for clinical evolution of the patients to be modified. Regarding management issues, that minimal difference neither seems to suggest disparity for the efficiency in the management of the cases.

The two other recoded variables, fracture type and surgical procedure, showed significant differences that we initially did not expect, which could be due to classification and/or coding biases. To facilitate the comparison among both registries we used de RNFC classification for these variables. "*Femoral head and neck fractures*" in CMBD were considered intracapsular fractures, but basicervical fractures were included as pertrochanteric fractures like in RNFC classification. After this adaptative process of recodification into one of the two classifications used we were continuing observing that pertrochanteric fractures were 3.57% more common in the RNFC than in the CMBD (52.2% vs 50.4%) and the opposite was observed for intracapsular fractures. This difference reach statistically difference but it seems not to be relevant from clinical point of view. The proportion of subtrochanteric fractures was similar, supporting the hypothesis of a classification bias, and that some of the fractures classified as pertrochanteric in the RNFC were coded as "*head and neck fractures*" in the CMBD in spite of the correction made with basicervical fractures.

The percentage of patients treated with an arthroplasty or internal fixation was similar in both registries, but the percentage of patients receiving total hip replacements versus hemiarthroplasties was 3.7 times higher in the CMBD than in the RNFC (9.7% and 2.6%, respectively), which is hard to justify. This variable was also recoded grouping the ICD-10 procedure categories into the three categories used in the RNFC. A possible explanation of these differences could be attributed to difficulties

adapting to the ICD-10 incorporated in 2016 after several decades ICD-9⁽²⁶⁾. Another possibility is a selection bias in the RNFC, already mentioned, in line with variability in the management of fractures among different departments and hospitals.

The CMBD, as part of the Health Information System of National Health System, is an essential registry which reach the aim of giving results for the management of hip fracture during hospitalization and it is a model to evaluate the representativeness of other registries at national level, as it is the RNFC case. However, the RNFC, being a prospective and exclusive tool of this process, gives more detailed and accurate information, specially related to the evolution of these patients one month after the fracture (mobility, place of residence, readmission, new surgical intervention and survival). Besides, the RNFC allows to identify and propose criteria and quality standards to offer to the participant hospitals a quality monitoring in a continuous way.

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AUTHORS' CONTRIBUTIONS

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Pilar Sáez-López: conceptualization, methodology, investigation, supervision, resources, writing-original draft, writing-review and editing, funding acquisition.

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Ramón Mazzucchelli: Conceptualization, methodology, writing-review and editing.

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