

BMJ Open Functional decline and associated factors in patients with multimorbidity at 8 months of follow-up in primary care: the functionality in pluripathological patients (FUNCIPLUR) longitudinal descriptive study

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To cite: Martín Lesende I, Mendibil Crespo LI, Castaño Manzanares S, *et al.* Functional decline and associated factors in patients with multimorbidity at 8 months of follow-up in primary care: the functionality in pluripathological patients (FUNCIPLUR) longitudinal descriptive study. *BMJ Open* 2018;**8**:e022377. doi:10.1136/bmjopen-2018-022377

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2018-022377>).

Received 14 February 2018
Revised 18 May 2018
Accepted 11 June 2018



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ABSTRACT

Objective To analyse short-term functional decline and associated factors in over 65-year-olds with multimorbidity.

Design and setting Prospective multicentre study conducted in three primary care centres, over an 8-month period. During this period, we also analysed admissions to two referral hospitals.

Participants Of the 241 patients ≥65 years included randomly in the study, 155 were already part of a multimorbidity programme (stratified by 'Adjusted Clinical Groups') and 86 were newly included (patients who met Ollero's criteria and with ≥1 hospital admission the previous year). Patients who were institutionalised, unable to complete follow-up or receiving dialysis were excluded.

Outcomes and variables The primary outcome was the decrease in functional status category (Barthel Index or Lawton Scale). Other variables considered were sociodemographic characteristics, comorbidity, medications, number of admissions and functional status on discharge.

Results Patients had a median age of 82 years (P_{75} 86) and of five selected chronic conditions (IQR 4–6), and took 11 (IQR 9–14) regular medications; 46.9% were women; 38.2% had impaired function at baseline. Overall, 200 persons completed the follow-up; 10.4% ($n=25$) of the initial sample died within the 8 months. In 20.5% (95% CI 15.5% to 26.6%) of them we recorded a decrease in functionality, associated with older age (OR 1.1, 95% CI 1.0 to 1.2) and with having ≥1 admission during the follow-up (OR 3.6, 95% CI 1.6 to 7.7). There were 133 hospital admissions in total during the follow-up considering all the patients included, and a functional decline was observed in 35.5% (95% CI 25.7% to 46.7%) of the 76 discharges in which functional status was assessed.

Conclusions A fifth of patients showed functional decline or loss of independence in just 8 months. These findings are important as functional decline and the increasing care needs are potentially predictable and modifiable. Age and hospitalisation were closely associated with this decline

Strengths and limitations of this study

- It is one of the few primary care studies which has been carried out in patients included in a clinical care multimorbidity programme, and focuses on functional decline as the main outcome variable.
- Two validated and widely used scales, in both basic (Barthel Index) and instrumental (Lawton Scale) activities of daily living (ADL), are used to assess functional status as the primary outcome variable.
- The 8 months of follow-up period is a relatively short time frame, however it is important in that it allows us to identify recent functional decline and facilitate early interventions.
- The fact that the assessment of the ADL was evaluated using a questionnaire and not directly assessed (ie, performance testing), coupled with the fact that data regarding ADL status on discharge were lacking in many patients after hospitalisation, could give a less precise picture of patients' true functional status after discharge and in general.

INTRODUCTION

Considering the most common characteristics of patients with multimorbidity in specific management and care programmes and criteria for their inclusion, there are four that best define this subgroup of patients^{1 2}: (A) advanced age; (B) the combination of two or more chronic health problems that can be considered 'major' (considering their impact at the personal level and quality of life, their clinical course and the associated need for care, or their effect on functional status), such as cardiovascular, lung, musculoskeletal and neurological diseases, diabetes, and so on³; (C) a high use of social and healthcare

resources, especially in relation to hospitalisation and contact with healthcare professionals; and (D) a high rate of some degree of established functional decline.^{4 5}

Although these patients do not represent a high percentage of the population, they have a significant impact on health and social care resource use. In this context, one of the priorities of many healthcare organisations is to manage patients with multimorbidity in a structured manner to achieve a more effective and efficient delivery of care, within the overall care provided to chronic patients. From an operational perspective, several methods have been used for including patients in specific programmes.⁶ It is common to carry out population stratification using strategies such as the Adjusted Clinical Groups (ACG), which categorises future healthcare needs based on the level of complexity and comorbidity of the people (<http://mchp-appserv.cpe.umanitoba.ca/viewConcept.php?printer=Y&conceptID=1304>); while elsewhere in Spain specific clinical criteria are also used such as that described by Ollero (Ollero's criteria),⁷ based on the coexistence of specific chronic diseases (cardiovascular, lung, neurological, musculoskeletal, kidney, digestive, autoimmune, diabetes, chronic anaemia and untreatable neoplasia).

Given the close association between multimorbidity and functional decline,^{4 5 8} it seems necessary to identify and explore factors that may be related to or may modify this deterioration and its progression. Hence, as the best overall indicator of health status in elderly patients in general and those with multimorbidity in particular, functional status should be a priority in the goals and strategies of interventions focused on managing patients with multimorbidity, as such an approach might have a greater impact on outcomes^{1 9} rather than focusing on the treatment of the comorbid conditions.⁹ The International Classification of Functioning, Disability and Health (ICF) by the WHO, <http://www.who.int/classifications/icf/en/>, is the reference framework employed when measuring health and disability at an individual and population level, structured around several components: body functions and structure, activities of daily living (ADL) in terms of basic tasks and interactions with the immediate environment (basic activities of daily living, BADL), and more complex tasks and interactions within the community (instrumental activities of daily living, IADL), participation and environmental factors; it is difficult to consider the ICF as a practical instrument in daily clinical practice for measuring functional status, although most evaluation scales have similar components. Some of these instruments are BADL (eg, Barthel) and IADL (eg, Lawton) scales, short physical performance tests (generally assessing mobility, gait and balance), others self-completed or completed by caregivers or those based on the direct performance of activities, and so on.

Functional decline is associated with a higher probability of experiencing health-related adverse events with poorer outcomes, as well as increasing progression towards developing greater disability and loss of

independence. Related factors associated with functional decline in patients with multimorbidity include: the number of concomitant chronic conditions,⁸ the level of pre-existing disability^{8 10 11} and the history of hospitalisation.^{12 13}

Addressing functional decline and associated factors is very transcendent in a progressively older population, especially in more vulnerable groups such as patients with multimorbidity. However, there are few studies that focus on patients with multimorbidity already included in clinical programmes who are receiving specific interventions and management, in the community setting, in primary care.

The *objectives* of this study were (A) to assess functional decline over an 8-month follow-up period in patients aged 65 years or more included in a clinical care programme for patients with multimorbidity; and (B) to investigate factors which may have an impact on this decline.

MATERIALS AND METHODS

Type of study and setting

A multicentre descriptive longitudinal prospective study, with analysis after 8 months of individual follow-up (within a global period from May 2016 to April 2017), was conducted in primary care, and included admissions to two referral hospitals (secondary care). This is part of a larger study investigating other variables related to multimorbidity and with longer follow-up periods.

We included patients from three urban primary care health centres in the Bilbao-Basurto Integrated Healthcare Organisation (IHO); one of them, San Ignacio Health Centre, has a solid research line in the elderly and the other two centres wanted to join in this specific research after asking for collaboration. As well as 23 primary care health centres, this IHO includes a main referral hospital (Basurto University Hospital), which has a unit for patients with multimorbidity within the Internal Medicine Department, and patients may also be referred to a subacute hospital (Santa Marina Hospital), which mainly cares for patients with multimorbidity or at the end of life. The study health centres had similar percentages of users ≥65 years of age to the mean in the IHO (23.5%), with 15, 17 and 14 general practitioner lists in each centre, and a similar number of nurses.

Figure 1 summarises the design and phases of the study.

Patients and sample

The study population was composed of patients ≥65 years old included in the local clinical care programme for patients with multimorbidity. The selection of patients (sample population) was carried out in two ways:

- Taking the initial list of *patients already included in the programme*, via the patient stratification system used by the Basque Health Service (2013 data), based on ACGs and selecting approximately the top 5% of the 'Kaiser Permanente pyramid' (www.kaiserpermanente.org) (excluding palliative care patients or patients

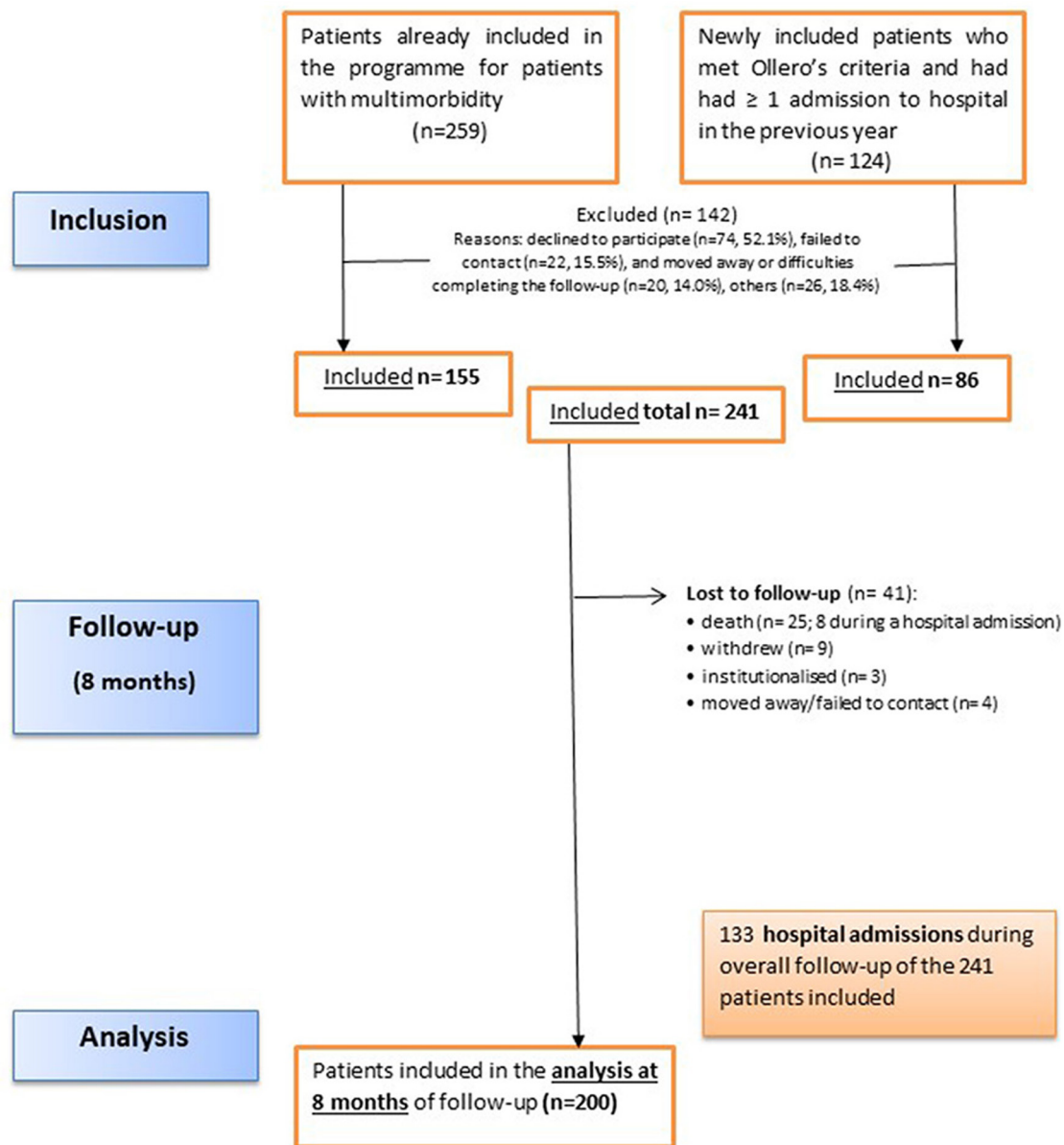


Figure 1 Design and phases of the study.

with limited life expectancy), and therefore including patients with certain diseases (chronic obstructive pulmonary disease, heart failure or diabetes mellitus) and at least one hospital admission.

- b. During an initial period of 2 months, before the beginning of the selection of the sample and baseline assessments, we included in the study and programme *new patients* from the participating centres who met Ollero's criteria and who had had at least one hospital admission in the previous year. These patients were included by the general practitioners or internal medicine specialists. Patients from a preliminary list based on the 2016 stratification were also included. The definition described by Ollero requires patients to have at least two different categories of certain relevant chronic conditions (cardiovascular, lung, neurological,

musculoskeletal, kidney, digestive, autoimmune, diabetes, chronic anaemia and untreatable neoplasia).⁷

We *excluded* patients who were institutionalised, had limited life expectancy, or on dialysis, as well as those who we could not contact or were not able to complete the 8-month follow-up (eg, due to moving away or between the homes of different family members), had received a transplant, had active cancer, declined to participate or were considered unsuitable by their primary care doctor (for various reasons).

Sample size

To estimate the percentage of patients with multimorbidity whose functional status would change, we first calculated the number we needed to study based on the patients with multimorbidity registered in the Bilbao-Basurto IHO

($n=1977$). For a margin of error of $\pm 6\%$ with a 95% confidence level and an expected percentage of up to 30%, 201 individuals would have been needed, and allowing for losses to follow-up of 20% (based on preliminary studies), this increased to 241 patients.

From an initial set of 420 persons, we selected patients by *simple random sampling*, using the statistical software, obtaining a new list ordered according to this randomisation. After this, patients were progressively contacted and included or excluded until we reached a sample size of 241; 155 were already in the programme for patients with multimorbidity and 86 patients were newly added. The reasons for the 142 exclusions from the study are shown in figure 1; the 'other' criterion included errors in the listing (12, 8.5%), considered unsuitable by their primary care doctor (9, 6.3%), death (3, 2.1%) and institutionalisation (2, 1.5%).

On recruitment, all patients received a patient information sheet and signed the informed consent form. To ensure the confidentiality of patient data in the data collection sheet and database, individual identification codes were used.

Study variables

The *primary outcome variable* was the change in the patient's functional status from baseline, 8 months after the initial assessment. To measure this we used the *Barthel Index* (assessing BADL) and the *Lawton Instrumental Activities of Daily Living Scale* (Lawton IADL Scale). We defined baseline functional status as the function of the patient when they were without exacerbations of their chronic health problems or had not had any hospital admissions in the previous 2 months.

These two scales are widely used and have been validated in our setting. The Barthel Index¹⁴ assesses 10 basic activities and the score, ranging from 0 to 100, can be interpreted using the following categories: independent (100), mildly dependent (60–95), moderately dependent (40–55), severely dependent (20–35) and totally dependent (<20). The Lawton Scale¹⁵ assesses more complex tasks (using the phone, shopping, using transportation, taking responsibility for one's own medication, handling finances, preparing food, housekeeping and doing the laundry); we have used the version that assesses only five activities in men, to avoid the effect gender bias, with different result categories for men (scores of 5, 4, 2–3, 1 and 0 corresponding to independent, mildly dependent, moderately dependent, severely dependent and totally dependent, respectively) and women (scores of 8, 6–7, 4–5, 2–3 and 0–1 corresponding to independent, mildly dependent, moderately dependent, severely dependent and totally dependent, respectively). The completion of both scales was done by asking the patient or his/her relatives.

Other variables considered in the initial assessment were:

- *Sociodemographic characteristics*: age and sex.
- *Comorbidities*, based on a list that considers diseases and other health problems commonly linked to an

impact on functional status, used and analysed by the authors in other previous studies¹⁶: hypertension, diabetes, coronary heart disease, heart failure, heart arrhythmia, chronic obstructive pulmonary disease or chronic asthma, stroke, Parkinson's disease or essential tremor requiring treatment, chronic anaemia, musculoskeletal disease, substantial visual or hearing impairment, mental illness (psychosis, depression, severe anxiety), dementia, abuse of alcohol or other drugs, chronic kidney disease and others (specified). Although we also calculated the Charlson Index, <http://www.charlsoncomorbidity.com/>, we preferred the analysis based on the above-mentioned list, as the Charlson Index is related to the prediction of mortality and does not include some important conditions associated to functionality (eg, mental disorders or sensory impairment)

- *Number of regular medications*, distinguishing between medications for use 'as needed' and for ongoing chronic use.
- *Baseline functional status*, the Barthel Index and Lawton Scale at the start of the study.
- *Number of hospital admissions* in the year before the baseline assessment and during the follow-up period, and reasons for the admissions.
- *Functional status on hospital discharge* (or in the first 5 days after discharge), assessed using the Barthel Index and Lawton Scale, and considering all the 241 patients included.

We also analysed the losses to follow-up and the reasons: death, institutionalisation, withdrawal from the study, moved away or failure to contact.

Execution of the study

In most cases, the general practitioners themselves initially contacted patients by phone to explain the study and invited the patients and their relatives to participate. In the initial assessment, at the health centre or in the patient's home if required, the study was explained to patients in more detail, a patient information sheet was given to the patient and written informed consent was requested. For those included in the study, we took baseline measurements, and in addition to setting an alert in the electronic health record regarding the participation in the study, we gave them the names of hospital liaison nurse they or their relatives should contact in the event that they were admitted to hospital, and a mobile phone number to contact the research team in the case of such an event and difficulties to contact with the liaison nurse. If a patient was excluded, we recorded the reason behind this.

If patients were hospitalised, their functional status was assessed using the Barthel Index and the Lawton Scale at discharge by a hospital liaison nurse or in the 5 days following discharge by the primary care specialised nurse case manager or a research team member.

At the end of the follow-up period, the evaluation scales (Barthel and Lawton) were used again in the same

conditions as those required for measuring baseline status (described above). Both baseline and the 8-month follow-up assessments were carried out by the researchers, general practitioners or by two trained collaborator physicians, in the health centre or in the patient's home if required.

Patients and public involvement

Patients did not participate in the design and conception of this study; however, they had an active participation in certain aspects of their own clinical follow-up, that is, when they had an admission, contacting the hospital-specific nurses indicated on the patient information sheet or calling the telephone number provided by the researchers in case there was difficulty to contact and it was they who facilitate it. It was not planned to specifically disclose the results of the study to patients, beyond the institutional diffusion that this type of health programmes has in the media; although in the successive evaluations they were informed in a non-standardised way of the development of the project.

Analysis

Univariate analysis of baseline characteristics was performed using measures of central tendency and dispersion for quantitative variables and percentages for qualitative variables. Population values were estimated, through inferential statistical techniques, for the most relevant values. Bivariate analysis was performed to assess the association of functional status with the other variables, using Student's t-test or the Mann-Whitney U test for quantitative variables (for data that were not normally distributed and for ordinal variables) and the X^2 test for qualitative variables (according to whether or not functional status was treated as a quantitative, discrete or qualitative variable).

Multivariate analysis (binary logistical regression) was performed, by the 'enter' method, regarding functional decline (yes/no at the end of the follow-up) as the dependent variable and the following as independent variables: age, sex, baseline functional status, number of comorbid conditions, Charlson index, number of medications taken and hospital admissions during the follow-up period.

In addition, the ability of the baseline characteristics considered and having at least one hospital admission to discriminate between patients who did and who did not have functional decline at 8 months of follow-up was assessed with the C statistic (equivalent to the area under the curve). For this, values of 0.5 to <0.7, 0.7–0.9 and >0.9 were considered indicative of poor, good and excellent discrimination.¹⁷

A descriptive analysis of the losses to follow-up and their causes was done too, and imputation of the missing values of the sample was not applied.

All analyses were performed using the statistical software IBM-SPSS V.23, and with a statistical significance level of 0.05.

RESULTS

Initially, we included and assessed 241 patients. Subsequently, 41 (17%) were lost to follow-up, 25 due to death, 9 due to withdrawal from study, 3 due to institutionalisation and 4 due to patients having moved away or failure to contact them. There were no missing values in the baseline or final variables, except in the functional assessment at hospital discharge.

The 46.9% (n=113) of the study population were women. The median age was 82 years old (P_{75} 86 years) which was significantly higher in women (median 83 and P_{75} 88 years) than in men (median 80 and P_{75} 84.7 years) ($p=0.001$).

Table 1 presents the distribution of the selected chronic conditions in the study population, overall and by sex. Included patients had a median of 5 of these conditions concurrently (IQR 4–6). The median in Charlson Index was 3 (IQR 2–4).

The median number of regular medications was 11 (IQR 9–14). By type, a median of 10 (IQR 8–12) were medications for ongoing chronic use, with a minimum of 4 and maximum of 24, and 1 (IQR 0–2) was for 'as needed' use. Women took more medications than men, in terms of both regular medications overall and those for chronic use: 12 (IQR 9–16) and 11 (IQR 8–13) vs 10 (IQR 9–13) and 9 (IQR 7–11), respectively, $p=0.001$ and 0.003.

Patients had a median of 1 (IQR 0–1) hospital admission in the year before the initial assessment, with 44.4% of the study population not being admitted in that period.

At baseline, 38.2% (95% CI 32.3 to 44.4) of patients (n=92) were classified as having impaired functional status, due to having scored <60 in the Barthel Index or moderate, severe or total functional impairment based on the Lawton Scale. Among this group, the level of functional impairment was the same for BADLs and IADLs in 32 patients, while the other 60 showed impaired IADL performance. As can be observed in table 2, women had poorer baseline functional status than men in terms of both BADL (Barthel Index) and IADL (Lawton Scale) performance.

In the logistic regression performed to analyse the association of impaired functional status at baseline with age, sex, the number of selected comorbid conditions, the total number of regular medications and the number of hospital admissions in the previous year, the model explaining between 21.4% and 29.1% of the variance in the dependent variable. The following variables reached significance: number of previous hospital admissions (OR=1.39, 95% CI 1.04 to 1.86, $p=0.027$), number of selected comorbid conditions (OR=1.36, 95% CI 1.08 to 1.71, $p=0.009$) and age (OR=1.13, 95% CI 1.07 to 1.19, $p<0.001$).

Comparing baseline variables between patients who had already been included or were newly included in the programme, the only significant differences detected were in the number of hospital admissions in the previous year ($p=0.027$), and among the chronic diseases considered in the prevalence of coronary

Table 1 Distribution of the selected chronic conditions in the study population overall and stratified by sex

Conditions considered	Total n=241	Women n=113	Men n=128	P values*
Hypertension, n (%)	201 (83.4)	98 (86.7)	103 (80.5)	0.193
Diabetes, n (%)	143 (59.3)	62 (54.9)	81 (63.3)	0.118
Coronary heart disease, n (%)	103 (42.7)	42 (37.2)	61 (47.7)	0.100
Heart failure, n (%)	110 (45.6)	61 (54)	49 (38.3)	0.015
Heart arrhythmia, n (%)	109 (45.2)	52 (46)	57 (44.5)	0.817
Stroke/cerebrovascular accident, n (%)	60 (24.9)	25 (22.1)	35 (27.3)	0.350
Symptomatic musculoskeletal diseases, n (%)	118 (49)	71 (62.8)	47 (36.7)	<0.001
Chronic obstructive pulmonary disease/asthma, n (%)	116 (48.1)	50 (44.2)	66 (51.6)	0.257
Substantial visual or hearing impairment, even with correction, n (%)	61 (25.3)	34 (30.1)	27 (21.1)	0.109
Chronic kidney disease, n (%)	60 (24.9)	25 (22.1)	35 (27.3)	0.350
Chronic anaemia, n (%)	50 (20.7)	22 (19.5)	28 (21.9)	0.646
Mental illness (psychosis, depression, severe anxiety), n (%)	30 (12.4)	21 (18.6)	9 (7)	0.007
Dementia, n (%)	26 (10.8)	10 (8.8)	16 (12.5)	0.362
Parkinson's disease/treated essential tremor, n (%)	9 (3.7)	5 (4.4)	4 (3.1)	0.738
Abuse of alcohol or other drugs, n (%)	3 (1.2)	0	3 (2.3)	0.250
Others, n (%)	78 (32.5)	41 (36.6)	37 (28.9)	0.204

* χ^2 .

Statistically significant results are marked in bold

heart disease (48.4% in patients already included vs 32.6% in those newly included, $p=0.017$). There were no significant differences regarding the other variables (sex, age, number of medications, Barthel, Lawton, overall basal functional impairment or remaining comorbidity).

A total of 200 patients completed the follow-up. Of these, 41 (20.5%, 95% CI 15.5% to 26.6%) experienced functional decline from baseline; that is, they were classed in a lower category by the Barthel Index or Lawton Scale at follow-up in comparison to their baseline score. In this group, approximately half did and half did not have

Table 2 Baseline classification by the Barthel Index and Lawton Scale overall and stratified by sex

Baseline functional status	Total n=241	Women n=113	Men n=128	P values*
Overall functional impairment (Barthel Index <60 or moderate, severe or total dependence based on the Lawton IADL Scale), n (%)	92 (38.2)	50 (44.2)	42 (32.8)	0.068
Barthel Index(BADL), n (%)				<0.001
Independent (score: 100)	86 (37.5)	24 (21.2)	62 (48.4)	
Mildly dependent (score: 60–95)	124 (51.5)	68 (60.2)	56 (43.8)	
Moderately dependent (score: 40–55)	15 (6.2)	10 (8.8)	5 (3.9)	
Severely dependent (score: 20–35)	12 (5)	9 (8)	3 (2.3)	
Totally dependent (score: <20)	4 (1.7)	2 (1.8)	2 (1.6)	
Lawton Scale(IADL), n (%)				0.011
Independent (women 8 points, men 5)	76 (31.5)	32 (28.3)	44 (34.4)	
Mildly dependent (women 6–7 points, men 4)	73 (30.3)	31 (27.4)	42 (32.8)	
Moderately dependent (women 4–5 points, men 2–3)	43 (17.8)	16 (14.2)	27 (21.1)	
Severely dependent (women 2–3 points, men 1)	27 (11.2)	18 (15.9)	9 (7)	
Totally dependent (women 0–1 point, men 0)	22 (9.1)	16 (14.2)	6 (4.7)	

* χ^2 .

BADL, basic activities of daily living; IADL, instrumental activities of daily living.

Table 3 Association between functional decline at 8 months with baseline characteristics and with having at least one hospital admission during follow-up

Baseline characteristics	Total (n=200)	Functional decline at 8 months (n=41)	No functional decline at 8 months (n=159)	P values*
Age at the start of the study, median (IQR)	81 (75–86)	85 (80–89)	81 (74–85)	0.001
Sex: women, n (%)	95 (47.5)	24 (58.5)	71 (44.7)	0.112
Number of conditions at baseline, median (IQR)	5 (4–6)	6 (4.5–7)	5 (4–6)	0.17
Charlson Index, median (IQR)	3 (2–4)	3 (3–4.5)	3 (2–4)	0.119
Number of regular medications, median (IQR)	11 (9–14)	11 (9–14)	11 (9–14)	0.243
At least one admission during follow-up, n (%)	61 (30.5)	21 (51.2)	40 (25.2)	0.001
Functional impairment at baseline (scored <60 on the Barthel Index or moderate, severe or total functional impairment based on the Lawton Scale), n (%)	66 (33.0)	21 (51.2)	45 (28.3)	0.005

* χ^2 tests for qualitative variables (%) and Mann-Whitney U tests for quantitative variables (age, number of conditions, number of medications). Statistically significant results are marked in bold.

functional impairment at baseline (21 patients, 51.2% vs 20 patients, 48.8%), 13 having impaired functional status in terms of IADL performance (Lawton Scale). Table 3 shows the association between functional decline at 8 months with the main baseline characteristics and with having at least one hospital admission during follow-up. Significant associations were found with older age, functional impairment at baseline and with having had at least one hospital admission during the follow-up period.

Table 4 summarises the results of the logistical regression, assessing the association between functional decline and the independent variables considered, the model explaining between 12.6% and 19.8% of the variance in the dependent variable. Functional decline was found to be significantly associated with age (OR 1.1, 95% CI 1 to 1.2) and with having had at least one hospital admission during the 8-month follow-up (OR 3.5, 95% CI 1.6 to 7.7). Regarding only deterioration in BADL performance (being classified in a lower category within the Barthel Index), functional decline was associated with age (OR=1.12, 95% CI 1.03 to 1.21, $p=0.005$) and with having had at least one admission during the follow-up (OR=3.41, 95% CI 1.37 to 8.48, $p=0.008$). Regarding deterioration in IADL performance (being classified in a lower category within the Lawton Scale), functional

decline was only associated with having had at least one admission during the follow-up period (OR=3.44, 95% CI 1.49 to 7.94, $p=0.004$).

Table 5 lists the C statistics indicating the ability of baseline characteristics regarded in the model and with having at least one hospital admission during follow-up, together and separately, to discriminate between patients who did and did not have functional decline at 8 months of follow-up. The set of variables together provides good discrimination (C statistics 0.76, 95% CI 0.69 to 0.84), age being the variable with the best discriminatory ability (0.67, 95% CI 0.58 to 0.77).

Regarding the entire follow-up for all the patients initially included (even if they did not complete the 8-month follow-up), there were a total of 133 hospital admissions in 83 patients (34.4%, 95% CI 0.29% to 0.41%); this represents a hospitalisation rate of 0.9 admissions per patient per year considering the cumulative follow-up for all patients. The main causes of the admissions were: respiratory (n=56, of which 51 were due to infection or exacerbation), cardiovascular (28, of which 22 were due to heart failure), neurological (14) and digestive (10); significant association was found between having had an admission related to the first three causes and functional decline at 8 months ($p=0.034$, 0.006 and

Table 4 Logistical regression results regarding the association of functional decline at 8 months with baseline characteristics and with having at least one hospital admission during follow-up

Variable	B	SE	df	P values	OR (Exp B)	95% CI
Age	0.09	0.03	1	0.012	1.09	1.02 to 1.16
Sex (men vs women)	−0.13	0.42	1	0.754	0.88	0.39 to 1.99
Number of comorbid conditions at baseline	0.04	0.17	1	0.809	1.04	0.74 to 1.47
Charlson Index	0.12	0.14	1	0.376	1.13	0.86 to 1.48
Number of regular medications at baseline	0.01	0.06	1	0.838	1.01	0.90 to 1.14
Functional impairment at baseline	0.57	0.41	1	0.164	1.77	0.79 to 3.99
At least one hospital admission during the follow-up period	1.26	0.40	1	0.002	3.51	1.60 to 7.69

Table 5 Ability of baseline characteristics and with having at least one hospital admission during follow-up, together and separately, to discriminate (C statistics) between patients who did and did not have functional decline at 8 months of follow-up

Variable	C statistics	95% CI
All seven variables combined	0.76	0.69 to 0.84
Age	0.67	0.58 to 0.77
Sex (men vs women)	0.57	0.47 to 0.69
Number of conditions at baseline	0.62	0.51 to 0.72
Charlson Index	0.58	0.47 to 0.68
Number of regular medications at baseline	0.56	0.46 to 0.66
Functional impairment at baseline	0.61	0.51 to 0.71
At least one hospital admission during the follow-up period	0.63	0.53 to 0.73

0.014, respectively), although not for the admission of digestive cause ($p=0.33$).

Around two-thirds (64.7%) of admissions were to the main referral hospital and slightly less than a third (29.3%) to the subacute hospital, with a few admissions (6%) to other hospitals. Regarding the 125 (out of the 133) hospital admissions in which the patient did not die, BADL performance was assessed on discharge or within 5 days in 76 cases (60.8%), IADL performance in 67 cases (53.6%) and one of the two in 76 cases (60.8%); that is, in all cases when IADL performance had been assessed on discharge, BADL performance had also been assessed. Regarding the 76 admissions for which BADL or both BADL and IADL performance had been assessed on discharge, there was functional decline in 27 cases (35.5%, 95% CI 25.7% to 46.7%) (the patient being classified in a lower category within at least one of the two evaluation scales), compared with baseline or with discharge from the previous admission if the functional status at that point had been poorer than at baseline (and did not improve with the subsequent admission).

Out of the 25 patients who died, 18 (72%) had impaired functional status at baseline, 10 (40%) with regard to BADL performance. There was a significant association between death and having an impaired functional status at baseline ($p<0.001$).

DISCUSSION

Key features of this study that make it important are that it considers patients included in a clinical care programme for patients with multimorbidity, and therefore, who have specific and distinct characteristics to patients just identified as having comorbid conditions, and also that it involves direct assessment of the patients (rather than using only clinical records). Another important feature is that it is one of the few studies carried out in this type of patient in a primary care setting, focusing on functional status as the main outcome variable.¹⁸

Investigating all patients with comorbidities is not the same as focusing on patients with comorbidities who, given their characteristics and higher risk or greater complexity, are candidates for inclusion in specific care programmes, called 'patients with multimorbidity' or sometimes 'complex patients', reflecting a higher level of progression and with clinical implications.^{19 20}

The characteristics of patients with multimorbidity, influenced by inclusion criteria, included: advanced age (median 80 years old, similar to other studies¹¹⁻¹³), with a high rate of the selected comorbid conditions (median of 5), similar to some studies¹⁸ although higher than in others^{5 10 21}; taking multiple medications (median of 11 regular medications), higher than in some studies¹⁸ although similar to that found in another study¹⁶; and frequently hospitalised (0.9 admissions per person per year of follow-up), as well as often having an impaired functional status (38.2%). In additional analysis conducted (though not described in detail in this paper) comparing patients by method of inclusion in the programme, we only found differences in the number of previous admissions; this seems logical given that the stratification method is based on data from several years prior to the study while newly included patients had to have at least one hospital admission in the year prior to follow-up.

A relatively high percentage of patients (38%) already had an impaired functional status at the start of the study, many (13%) being moderately or totally dependent in terms of performance of the BADL (Barthel Index); the percentage of disability was higher in 20% in people with ≥ 4 diseases with regard to another study.⁵ This low functional status at baseline was related to the number of selected comorbid conditions, as in previous studies,²² and to older age.²³

Notably, in only 8 months of follow-up, a fifth (20.5%) of patients experienced functional decline from baseline, a higher rate than reported in other studies with longer follow-up periods,⁸ and far from the 10% of another study¹⁸ at 2 years of follow-up although in general population. Of these, 80.5% ($n=33$) showed no functional impairment or only impairment in IADL performance (Lawton Scale) at baseline. This pattern links this group of patients to the concept of frailty in older people, underlining the need to detect persons with no perceived or incipient levels of functional impairment who are at risk of progressing to a more severe disability.²⁴ This is important in that the chain of events implies a worsening in the patients' health status and an upward spiral in their care needs but is potentially modifiable, predictable and manageable.²⁵

In the logistical regression analysis, functional decline at 8 months of follow-up was associated with age (which is a non-modifiable factor) but above all with having had at least one hospital admission during the follow-up period, hospitalisation being a factor contributing towards functional decline as noted by other authors.^{12 13 26}

In 35.5% of patients with functionality assessed at hospital discharge, functional decline was detected; despite this, in our sample, performance of the ADL was only assessed on discharge with at least one of the specific evaluation scales in 60.8% of the patients admitted to hospital. Our findings underline the importance of assessing functional status in patients with multimorbidity during and after hospitalisation (this being frequent, with a rate of 0.9 admissions per patient per year) and also that this type of assessment is an area for improvement in our setting. Regarding the correct management and intervention of hospital admissions, it is important to highlight that the majority of hospitalisations were caused by expected and limited causes, predominantly respiratory infections or exacerbations and heart failure.

Although several studies have reported an association between functional decline over time with the number and severity of concomitant diseases,^{8 21} or with underlying diseases such as heart failure,²⁷ other authors¹⁸ indicate poor discrimination between comorbidity or multiple medications and the outcome of functional decline. In this study, only the association of functional decline with the number of chronic diseases/conditions and Charlson Index has been analysed, however not with specific conditions as done in other studies,²⁴ due to a limited sample for each of them.

We should recognise some of the limitations of our study. The inclusion of only three health centres may limit the generalisation of the results, although analysis (not reported) comparing the characteristics of the populations of these centres with those of all the other health centres in the same health district did not find significant differences in terms of demographic or socioeconomic characteristics. Additionally, although we are currently working on data for a longer period of follow-up with this sample of patients, in this paper we report on a follow-up of just 8 months, which could be considered a relatively short period of time for analysing the main outcome variables; nevertheless, having found higher levels of variation than in other studies with longer follow-ups, we consider it interesting to analyse the changes observed, as the identification of a decline over a short period implies that the decline is being detected promptly, enabling early interventions that might be more effective than interventions used when decline is more established.

The fact that direct assessment of ADL like performance tests was not used, and that so much ADL data on discharge were lacking for patients is a limiting factor. On the other hand, it could have been interesting to have considered other aspects, apart from hospital admissions, that could have had an influence with regard to changes in the functional status of patients over time, for example, the incidence of new processes or diseases.

In line with other authors,²⁸ we consider it important to carry out more research between the association of the multimorbidity and the functional status and its deterioration, and to specify the subgroups of patients in whom this association is more intense; to discriminate between

which factors are more related to this functional decline and its intervention, and highlighting the importance on the primary care setting, with the goal of improving interventions for this population.

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Acknowledgements We thank the professionals from San Ignacio, Deusto and Gazteleku Primary Health Care Centres and those from the Basurto and Santa Marina Hospitals who have collaborated with us along the study, as well as the patients themselves, and their families for their generous contribution.

Contributors All authors have been involved from the beginning in all phases of the study with varying intensity according to the study's successive needs. IML, as the principal investigator (PI), participated in all aspects of the project, coordinating the different stages of the study too. IML and LIMC have had a transcendental role in the methodological and analytical aspects. SCM, ASDO, IGB, JPR and INP have made the clinical assessments of most patients and managed their clinical data. ISA and MJRF made the clinical assessments of most patients at hospital discharge. All authors have read and approved the final version of this manuscript.

Funding This work was supported by a Bilbao-Basurto IHO grant (OSIBB17/002).

Competing interests None declared.

Patient consent Obtained.

Ethics approval Clinical Research Ethics Committee of Euskadi (PI2016082, 24 June 2016).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Being the first article of the FUNCIPUR study, there are no additional data available directly by now. However, we are willing to complete or give more information or data to other authors who require it.

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