

# The Effects of an Innovative Integrated Care Intervention in Brazil on Local Health Service use by Dependent Older People

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## Research Article

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# The effects of an innovative integrated care intervention in Brazil on local health service use by dependent older people

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## Abstract

### Background:

Since 2011, the Brazilian city of Belo Horizonte has been operating an innovative scheme to support care-dependent older people in disadvantaged communities: Programa Maior Cuidado (PMC – Older Person’s Care Programme). This paper examines two potential effects of inclusion in PMC on types of outpatient health service utilisation by dependent older people. The first is that being in PMC is associated with a higher frequency of outpatient visits for physical rehabilitation. The second is that being in PMC is associated with a higher frequency of planned versus unplanned outpatient visits.

### Methods:

We apply a quasi-experimental design to a unique set of government data. First, we preprocess our sample through different matching techniques such as ‘coarsened exact matching’ (CEM), ‘nearest neighbour’ based on logit scores (NN), ‘optimal pair’ (OP) and ‘optimal full’ (OF) methods. Second, we estimate marginal effects of being in PMC on our outcomes of interest. We use univariate log-binomial regressions with robust standard errors to calculate the incidence ratio of PMC on rehabilitation and planned visits.

### Results:

We find significant positive incidence rates for belonging to PMC for both outcomes of interest under all matching specifications. The CEM shows a higher incidence rate for the proportion of visits for rehabilitation by PMC patients compared to the non-PMC controls: 3.35 (95% CI 1.79 -

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6.27). For planned visits, there are significant positive associations for being in PMC in the CEM (1.25 (95% CI 1.17 - 1.33)) and the other models.

### **Conclusions:**

Our analysis reveals significant positive associations between older people included in PMC and a matched set of controls for making outpatient visits that were planned, rather than unplanned. We find similar associations for the proportion of visits made for rehabilitation, as opposed to another reason. These findings indicate that PMC influences some elements of outpatient health service utilization by dependent older people.

### **Keywords:**

older people; rehabilitation; planned visits; health policy in Brazil;

## Background: the context and purpose of the study

In many countries, there are growing concerns about the inefficiency and rising costs of existing forms of health service provision for older adults, and these have spurred the development of new interventions. This paper assesses the effects of one such intervention in the Brazilian city of Belo Horizonte on patterns of outpatient health service utilization by care-dependent older people.

In Brazil, as in most countries, outpatient service use in Brazil is strongly associated with older age [1]. Despite this, there is almost no published research on patterns of outpatient service use by older people in Brazil or in other countries [2]. This contrasts with a growing body of research on patterns of inpatient service use. In the case of Brazil, a high proportion of hospital admissions of older people are for conditions potentially amenable to treatment in primary care settings [3]. This indicates the importance of promoting appropriate outpatient provision for older people, both as a goal in its own right and to reduce pressures on inpatient services.

This study focusses on two elements of outpatient service utilization related to these concerns. Unplanned outpatient visits are associated with less efficient use of resources and greater risk of emergency hospital admission [4]. Likewise, outpatient rehabilitation has been shown to be a cost-effective intervention, which can significantly lower hospital readmission risk [5–8]. Consequently, reducing the share of visits made on an unplanned basis and increasing the share of visits made for the purpose of rehabilitation can be broadly as considered desirable policy outcomes.

In the context of Brazil's highly decentralised health system, innovative interventions mainly occur at the level of local government [9]. Since 2011, the city of Belo Horizonte has been operating a scheme to support care-dependent older people in disadvantaged communities: Programa Maior Cuidado (PMC – Older Person's Care Programme). The city government had been concerned about the limited capacity and sometimes very low quality of care provided by local long-term care facilities and by evidence of rapidly growing numbers of care-dependent older people living in poor neighbourhoods. Consequently, it was keen to develop a new model of community-based health and social care for these older people [10].

Families participating in PMC receive support from trained carers, who are recruited from similar communities and paid a basic wage. Each family receives between 10 and 40 hours of care support a week, depending on the level of need of the older person and the family's wider situation. PMC carers are not expected to replace family care responsibility for dependent relatives. Instead, the focus is on providing family carers some respite from what is often an exhausting 24/7 activity. PMC carers are also expected to work with families to build their care skills and competence, and to agree a care plan. As well as providing daily support, PMC carers monitor the situation of the older person and report back to monthly case reviews conducted by staff at health posts.

This paper examines two potential effects of inclusion in PMC on health service utilisation by older people. The first is that being in PMC is associated with a higher frequency of outpatient visits for rehabilitation. Along with their other responsibilities, PMC carers continue to support older people when they are in hospital, with a view to facilitate discharge back to families and to enhance person-centered linkages between in- and out-patient providers [11]. This includes supporting recovery and reducing risk of readmission by identifying rehabilitation needs and

reporting them to the PMC case reviews. The second hypothesis is being in PMC is associated with a higher frequency of planned versus unplanned outpatient visits. PMC carers are trained to recognize warning signs of potential acute health problems and report them immediately to health centers. There is some qualitative evidence that this can reduce unplanned, emergency visits to health care providers [12] and this study looks to validate this effect through quantitative analysis.

## Data and methods

### Data

In recent years, the government of Belo Horizonte has started to collect and process administrative data on outpatient health service use. These data include visits made by people aged 60 and over to the city's 76 government health posts since April 2018. These records include users' addresses, as well as their age and sex, and an individual patient number. The project team were granted ethical approval and access to anonymised patient data for the period April to June 2018. These data included individual patient numbers, which can be matched to those of older people enrolled in PMC.

Due to the targeted nature of PMC and its focus on poorer neighbourhoods, characteristics of relevance to our analysis were likely to differ between older people in PMC and the city's general population, even after controlling for age and sex. Consequently, simple comparisons between older people enrolled in PMC and other older people are not valid without including mediating effects. The local health department data set does not include personal data on socio-economic or health status. It was, however, possible to use patient addresses to construct a proxy indicator of socio-economic status based on a separate data set for 275 micro-districts with average populations of 8,546 (standard deviation 9,752) [13]. A limitation of this approach is it assumes there is no significant socio-economic heterogeneity within each micro-district. Nonetheless, key informants from the city validated this assumption and a similar level of spatial socio-economic sorting has been observed for other cities in Brazil [14].

### Methods

Our analytical model estimates the causal treatment effects of being in PMC on two outcomes: the likelihoods of planned outpatient visits and of outpatient visits for rehabilitation, compared to other types of outpatient visits. We apply a causal counterfactual framework [15], to estimate average treatment effect on the treated (ATT) of being in PMC for these outcomes of interest.

We apply a doubly robust procedure [16] to address the risk of weak identification of counterfactual observations and risks related to the causal inferential analysis. First, we preprocess our sample with different matching techniques [17] such as 'coarsened exact matching' (CEM), 'nearest neighbour' based on logit scores (NN), 'optimal pair' (OP) and 'optimal full' (OF) [18] techniques. CEM involves partitioning covariates into groups -called bins- when their values are similar [19]. CEM then performs an exact matching of observations (treatment and control) so only units with identical coarsened covariates values are matched and the remaining observations are discarded.

The other three techniques compute the distance between the treatments and controls. They select members of the control group to pair with member of the treatment one based on the distance between units, which are computed in several ways. This aims to reduce confounding variables and selection bias through the construction of a balanced sample of the treatment and control groups. The NN technique pairs each treated unit with a similar control observation. We use a maximum calliper of 0.01 standard deviation of propensity scores between groups computed as logit scores. We allow for the possibility that comparison units are matched to more than one treated unit and do not allow matching to more than one treated unit. In all cases, control observations outside the range of common support are discarded from the matching process. The OP technique also looks to match pairs, applying a collective criterion to find the best possible combinations. The OF assigns every treated and control observation to one subclass aiming to minimise subclass distances. Then, weights are computed based on subclass membership, which are used to estimate the treatment effect. For both NN and OP we use a ratio of 1:1 treatment to comparison group.

In case of NN, OP and OF, we are able to test possible bias from unobserved factors that may affect inferences about treatment effects by using Rosenbaum bounds sensitivity analysis. Under this context,  $\Gamma = 1$  mimics a randomized experiment where matched subjects have equal chances of belonging to the treatment group, while larger values of  $\Gamma = 1$  without changes to p-values suggest matched pairs are less susceptible to bias. In all cases, we make a visual inspection of covariate distributions after the matching process to assess similarities between groups. After finding an adequate match, we built 8 databases, one for each matching technique and outcome variable.

Our second step is estimating PMC's marginal effects on our outcomes of interest, to show the average effect of a treatment in a population. We calculate the average treatment on the treated (ATT) effect as an incidence ratio (IR) since our variables are dichotomous. The observational nature of our study means it is possible observe either  $Y_1$  or  $Y_0$ . As such, the estimate of unbiased ATT is conditional on the observed treatment group, noted as  $\overline{ATT} = E(Y_1 - Y_0 | Z = 1)$ . For that purpose, we conduct univariate log-binomial regressions in order to estimate the ATT effects of PMC on our variables of interest, such as in:

$$\log(\hat{y}) = \beta_0 + \beta_1 PMC + \epsilon$$

Where  $\beta_1$  represents the coefficient associated with belonging to PMC on the outcome variable  $\hat{y}$ . Alpha levels are set at .05. Exponenciating the coefficient  $\beta_1$  gives us the incidence rate associated to belonging to PMC in comparison to not belonging to the program, with relation to the variables of interest.

NN, OP and OF mimic a completely randomised experimental design, where treatment assignment depends only on the given probability of treatment. By contrast, CEM attempts to replicate a paired randomised design, where the observed covariates of treated and control groups are balanced and, therefore, unbalanced covariate bias is eliminated and bias due to unobserved variables eliminated. CEM has been shown to be more robust than other methods in reducing model dependence in the estimation of causal effects and covariate imbalance between groups [20]. This influences the parameter specifications used in our inferential analysis. In the case of CEM and OF, we include weights in the regression estimate. In case of CEM, we compute robust

standard errors, while in all the other techniques we use robust-clustered errors with the matching stratum membership as the clustering variable. We used ARCGIS PRO v.2.4.1 for computing spatial variables and R core team for the statistical analysis [21].

## Results

### Descriptive findings

From the start of April 2018 to the end of June 2018 the average total number of visits by people aged 60 or more to each of the 76 health posts was 1,150.7 (standard deviation (sd) = 920.61). Across all 76 posts, there were 87,455 visits by people aged 60 or more, involving 24,554 different individuals. As such, each of these older individuals made a personal average of 3.52 visits over the three-month period (sd = 3.25). Conversely, the data indicate that the large majority (92%) of people aged 60 or more living in the municipality (302,174, based on Census 2010)<sup>4</sup> made no visits to a government health post over this period. Of those older people who made at least one visit to a health post over this period, 366 were enrolled in PMC, representing 19% of its membership.

Before the matching process, PMC users had an average of 1.29 (sd = .53) rehabilitation sessions while non-PMC had 1.48 (sd = .78), and PMC users had an average of 2.58 (sd = 1.8) planned visits while non-PMC had 2.11 (sd = 1.67). In both the PMC and the control groups, we do not observe any patients making a large number of visits, which may bias estimates. Also, we observed no differences in the types of outpatient services offered by the same health posts to the PMC and the control groups.

Spatial analysis of access to health services reveals a high level of socioeconomic segregation. Figure 1 is a kernel density map of people aged 60 or more who visited a health post during the study period. The location of these health posts and utilisation were both heavily concentrated in low-income neighbourhoods, represented by the light green polygons in the map (less than US\$175 per capita monthly income). This suggests that socio-economic differentials between the PMC and control groups are likely to be smaller than they would be if utilisation were more evenly spread across different neighbourhoods.

FIGURE 1 ABOUT HERE

### *Matching and inferential analysis*

Tables 1 and 2 show summary statistics for unmatched data and CEM for rehabilitation and planned visits, respectively. We observe, in both unmatched datasets, that PMC users are on average 10 years older than non-PMC users and the proportion of women is 5 to 6 per cent higher.

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<sup>4</sup> <https://censo2010.ibge.gov.br/> (retrieved: 26/03/2021)

PMC users tend to live in more deprived areas in terms of lower per capita income, lower life expectancy and more household economic dependency on older members.<sup>5</sup>

TABLES 1 AND 2 ABOUT HERE.

The CEM technique retrieved 325 and 1,333 observations in the treatment and control groups for rehabilitation and 909 and 4,727 observations for planned visits. After matching, all standardized mean differences for the covariates were below .03. Also, all absolute within-pair differences of each covariate below .13 for both outcomes, suggesting an adequate balance between groups.

The NN, generated 465 and 1,243 observations in each group for rehabilitation and planned visits, respectively. The OP generated 510 and 1,317 observations. The OF generated 465 and 1,317 treatment observations, along with 26,138 and 59,812 control observations. Sensitivity tests ( $T$ ) for NN and OP became significant in a range of 1.4 and 1.7 for rehabilitation visits and 1.1 and 1.4 for planned visits. This suggests a higher sensitivity to hidden bias in the case of the matched rehabilitation visits. Tables 5 and 6 in the Appendix present results for the other matching strategies.

Table 3 presents the marginal effects between being in PMC and making a health post visit for rehabilitation, compared to other reasons for all matching specifications. In all cases we find a significant positive incidence rate, whereby the CEM shows a higher incidence rate ratio of 3.35 (95% CI 1.79 - 6.27) in comparison to the control group. This demonstrates that being in the PMC group was associated with a higher likelihood that outpatient visits were made for rehabilitation rather than for other reasons.

TABLE 3 ABOUT HERE

Table 4 shows that the marginal effects of being in PMC and making a planned visit in comparison to an unplanned one is significant in all three models. The CEM shows belonging to PMC increases the likelihood that outpatient visits were made on a planned rather than an unplanned basis (1.25, 95% CI 1.17 - 1.33).

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<sup>5</sup> [89.2% of those aged over 65 receive a social security or social assistance pension, while in a quarter (24,9%) of total households, older people contribute more than 50% of the household income [24].]

TABLE 4 ABOUT HERE

## Discussion and conclusion

This is one of the first analyses of different forms of outpatient service use by care-dependent older people for Brazil or any other country. It makes particular reference to the potential effects of being included in a specific community-based health and social care intervention for older people living in poor neighbourhoods. Our study design has several limitations. First, the scarcity of individual-level data does not permit us to identify potential predictors of service use. In order to compensate for this, we use a rich set of neighbourhood-level data. Second, although matching techniques enable a balancing of observations based on observed covariates, unmeasured confounding variables may still be present in our analysis. We address hidden bias through sensitivity tests and comparing post-match covariates between groups, and these indicate the estimates of treatment effects we report are robust.

The descriptive finding that 92 per cent of people aged 60 or more in Belo Horizonte made no visit to a government health post between April and June 2018 indicates that older people's engagement with the city's supposedly universal public primary health care system was in fact quite limited. This finding does not follow the results of studies for other locations in Brazil, which report higher rates of health post utilization by people at older ages [22]. For example, a national survey of Brazilians aged 50 and over reported that 63.5 per cent had made at least one visit to a government health post during the previous year [23]. One explanation for the lower rate of health post utilization reported in our study is that it refers to a three month rather than a twelve month period. Also, Belo Horizonte has a much hillier terrain than most Brazilian cities. Its poorer neighbourhoods are characterized by very steeply-sloping streets, creating specific difficulties for moving around the city for older people with limited mobility. This is a further reason for establishing an intervention like PMC in order to ensure that such older people have at least some engagement with the government health system. The low number of visits from more affluent Belo Horizonte neighbourhoods is likely to reflect a higher rate of private health service utilisation by older people in those areas, supporting evidence from other studies that rich older people mainly use private health care providers [1].

Our two-step analysis shows a statistically significant association between being included in the PMC programme and making visits to government health posts on a planned rather than unplanned basis, when compared to a matched set of older people who were not in PMC. There are no published studies for Brazil or other countries that specifically analyse this effect for older people in outpatient based settings. With reference to the UK, [2] it has been observed that: "there has been little attention to acuity of presentation to GPs during the working week, and in particular, multi-morbid community-dwelling older person's utilization of planned and unplanned GP care."

Applying the same analytical method, we find being included in PMC was significantly associated with a higher proportion of rehabilitation visits, as opposed to other motives for visits. Again, there are no comparable studies for Brazil or other countries. Brazil's national health system stipulates that primary health care providers have the lead responsibility for identifying and managing adult rehabilitation needs [24]. Leading causes of hospitalization of older people in

Brazil include hip fracture and stroke, and studies in other countries demonstrate the benefits of outpatient rehabilitation for these conditions [25, 26]. They also demonstrate the potential cost savings from outpatient rehabilitation. For example, analysis of average monthly post-stroke care costs in the USA found that services provided in outpatient settings cost less than a sixth of those provided as inpatient services [27].

More generally, the study demonstrates an important nexus between care provided to dependent older people in disadvantaged settings and their patterns of formal health service utilisation. Research from Brazil, the UK and other countries shows that inadequate social care for older people in the community contributes significantly to otherwise avoidable hospital and care home admissions [28-31]. This study was unable to explore wider sets of effects, including on patterns of hospital use, due to the limitations of the available data. Developing such studies will be an essential step towards assessing the potential of interventions like PMC to enhance the allocative efficiency of scarce health care resources.

Despite what might be considered its “niche status” within literatures on health services, this study provides useful insights to policy-making in Brazil and other countries. It adds to the limited evidence currently available about the effects of community-based primary health and social care interventions for older adults. A recent systematic international review of the effects of home-based multidisciplinary interventions for older adults on health service use found only very limited evidence, and none for Latin American settings [32]. As the global population continues to age and pressures on health services continue to mount, there is an urgent need for similar studies.

## Declarations

- **Ethics approval and consent to participate**

All methods were carried out in accordance with relevant guidelines and regulations in the ethical approval and consent to participate section of manuscript. All experimental protocols were approved by the Ethical Committee of the School of International Development, University of East Anglia. Informed consent was obtained from all subjects.

- **Consent for publication**

Not applicable.

- **Availability of data and materials**

The datasets generated and/or analysed during the current study are not publicly available due to confidentiality, but are available from the corresponding author on reasonable request.

- **Competing interests**

KG works for the Prefeitura of Belo Horizonte in the area of health care. There are no conflicts of interest for PLS or LS.

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- **Authors' contributions**

LS, PLS conceived the research question, contributed to the analysis and write up of the manuscript. KG provided contextual analysis and background and contributed to the writing process. The authors read and approved the final manuscript.

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Cassius Catão Gomes

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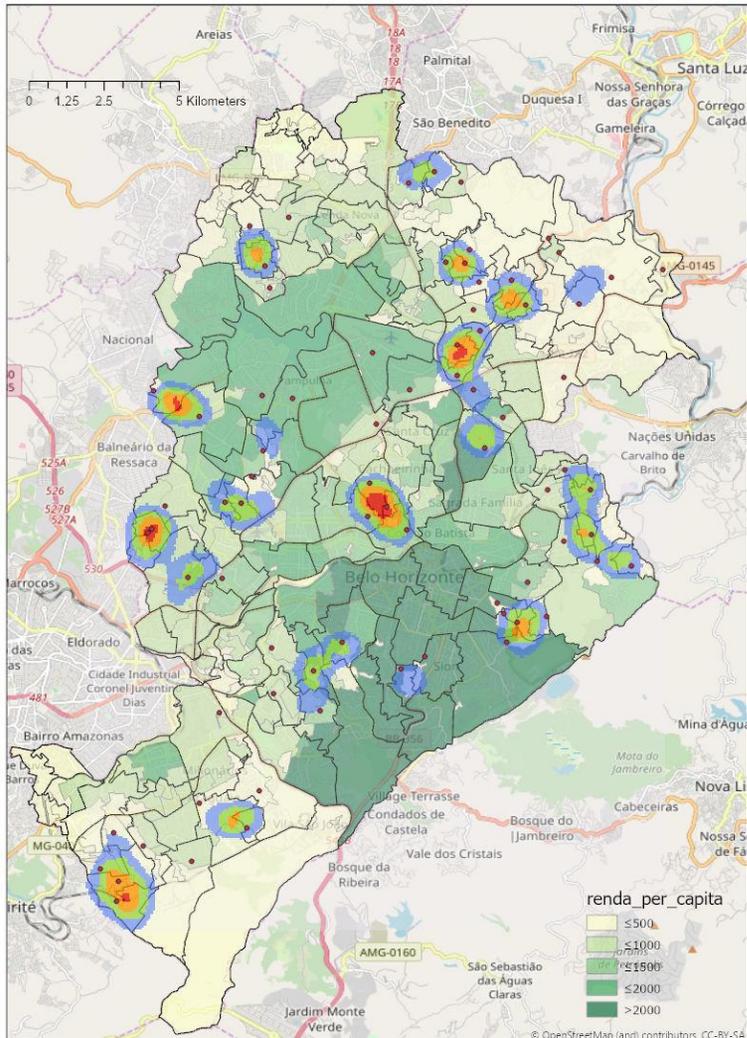


Figure 1: Use of government health posts by people over 60 in months April to June 2018 in Belo Horizonte.

Table 1: Descriptive statistics - Rehabilitation: Unmatched and CEM

Characteristic	Unmatched			CEM		
	Non PMC, N = 26,138 <sup>1</sup>	PMC, N = 510 <sup>1</sup>	P-value <sup>2</sup>	Non PMC, N = 1,333 <sup>1</sup>	PMC, N = 325 <sup>1</sup>	P-value <sup>2</sup>
Sex (F)	8,355 (32%)	133 (26%)	0.005	249 (19%)	70 (22%)	0.2
Age	68 (64, 75)	78 (70, 84)	<0.001	71 (66, 76)	73 (68, 80)	<0.001
Month of visit			>0.9			0.032
April	9,462 (36%)	186 (36%)		553 (41%)	117 (36%)	
June	7,384 (28%)	141 (28%)		272 (20%)	87 (27%)	
May	9,292 (36%)	183 (36%)		508 (38%)	121 (37%)	
XGEO	609,445 (604,527, 612,848)	609,803 (605,519, 612,902)	0.4	609,499 (602,543, 612,915)	610,428 (605,507, 613,844)	0.006
YGEO	7,798,942 (7,795,095, 7,802,850)	7,799,000 (7,794,381, 7,805,355)	0.7	7,798,390 (7,788,804, 7,801,427)	7,799,079 (7,794,637, 7,805,377)	<0.001
Social vulnerability Index	0.43 (0.39, 0.49)	0.44 (0.40, 0.49)	<0.001	0.44 (0.40, 0.49)	0.44 (0.40, 0.49)	0.2
Economic dependency	1.46 (0.88, 1.85)	1.62 (1.16, 1.93)	<0.001	1.46 (0.83, 1.84)	1.54 (0.86, 1.86)	0.003
Life expectancy	71.38 (69.20, 73.42)	70.79 (68.50, 72.76)	<0.001	71.08 (69.20, 73.28)	71.01 (68.50, 72.80)	0.020
Income per capita	419 (318, 556)	373 (292, 504)	<0.001	406 (318, 549)	402 (299, 510)	0.020
Distance health centre	419 (279, 578)	408 (275, 567)	0.3	421 (293, 599)	435 (287, 548)	0.076
Rehabilitation visit (Yes)	616 (2.4%)	71 (14%)	<0.001	23 (1.7%)	34 (10%)	<0.001

<sup>1</sup>n (%); Median (IQR)

<sup>2</sup>Pearson's Chi-squared test; Wilcoxon rank sum test

Table 2: Descriptive statistics - Planned: Unmatched and CEM

Characteristic	Unmatched			CEM		
	Non PMC, N = 59,812 <sup>1</sup>	PMC, N = 1,317 <sup>1</sup>	P-value <sup>2</sup>	Non PMC, N = 4,727 <sup>1</sup>	PMC, N = 909 <sup>1</sup>	P-value <sup>2</sup>
Sex (F)	19,487 (33%)	373 (28%)	0.001	874 (18%)	208 (23%)	0.002
Age	68 (64, 75)	79 (71, 85)	<0.001	70 (65, 77)	76 (70, 82)	<0.001
Month of visit			0.4			0.8
April	21,498 (36%)	489 (37%)		1,842 (39%)	347 (38%)	
June	17,134 (29%)	355 (27%)		1,183 (25%)	238 (26%)	
May	21,180 (35%)	473 (36%)		1,702 (36%)	324 (36%)	
XGEO	609,455 (604,703, 612,913)	609,813 (605,439, 612,932)	0.4	610,177 (603,614, 612,806)	610,174 (605,507, 613,770)	0.015
YGEO	7,799,066 (7,795,080, 7,803,396)	7,798,510 (7,794,117, 7,803,848)	0.001	7,798,081 (7,788,783, 7,805,845)	7,798,454 (7,794,381, 7,804,153)	0.047
Social vulnerability Index	0.44 (0.38, 0.49)	0.45 (0.42, 0.49)	<0.001	0.49 (0.43, 0.49)	0.45 (0.42, 0.52)	<0.001
Economic dependency	1.54 (0.89, 1.85)	1.62 (1.17, 1.86)	<0.001	1.62 (0.86, 1.92)	1.62 (1.16, 1.86)	0.3
Life expectancy	71.38 (69.20, 73.42)	70.79 (68.50, 72.76)	<0.001	69.20 (68.47, 71.42)	70.53 (68.47, 72.40)	<0.001
Income per capita	419 (318, 556)	373 (305, 504)	<0.001	318 (299, 423)	359 (299, 463)	<0.001
Distance health centre	420 (280, 578)	408 (267, 567)	0.056	409 (279, 575)	394 (257, 546)	0.002
Planned visit (Yes)	26,786 (45%)	695 (53%)	<0.001	2,270 (48%)	495 (54%)	<0.001

<sup>1</sup>n (%); Median (IQR)

<sup>2</sup>Pearson's Chi-squared test; Wilcoxon rank sum test

*Table 3: Incidence rate - Rehabilitation*

	Model	Incidence ratio	CI_low	CI_high	t	df_error	p
2	CEM	3.35	1.79	6.27	3.79	1656	0
21	NN	2.40	1.55	3.83	3.82	928	0
22	OP	1.97	1.36	2.92	3.48	1018	0
23	OT	2.65	2.10	3.27	8.60	26646	0

*Table 4: Incidence rate - Planned visits*

	Model	Incidence ratio	CI_low	CI_high	t	df_error	p
2	CEM	1.25	1.17	1.34	6.50	5634	0
21	NN	1.14	1.05	1.23	3.16	2484	0
22	OP	1.13	1.04	1.22	3.07	2632	0
23	OT	1.15	1.09	1.21	5.36	61127	0



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