Department of Economics- FEA/USP

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Working Paper Series Nº 2019-43

DEPARTMENT OF ECONOMICS, FEA-USP
WORKING PAPER Nº 2019-43

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Research Group: [GHE2 e γ-metrics]

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Keywords: Family Health Strategy (ESF), Self-assessment health, PNAD(IBGE) health supplement, PNS 2013, Impact Evaluation, Fixed Effects Instrumental Variables

JEL Codes: [I18, C23, C26]

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1. Introduction: ESF in metropolitan areas

The implementation of the Family Health Program (PSF), today called Family Health Strategy (ESF) in Brazil was preceded by the National Program of Community Health Agents (PACS) in 1991, which made use of the community health agents' (ACS) know-how to compose family health teams in the interior of Ceará (Brazilian northeastern area). The ACS's work had significant impacts on reducing infant mortality, increasing exclusive breastfeeding, increasing vaccination coverage in children and pregnant women, and decreasing infectious diseases in general.

In 1994 this success was translated into a new primary health program - the so-called *Family Health Program* (PSF) - which would refocus the care model based on the work of multi-professional teams in Basic Health Units (UBS). These teams are responsible for following-up an assigned population located within a delimited area through health promotion, prevention, recovery, rehabilitation of diseases and most frequent injuries. Four years later, the PSF became a structuring strategy of Brazilian Unified Health System (SUS), and the transfer of financial incentives from the federal government to the municipalities started. For the first time, the PSF has its own budget which is established in the "Multiannual Plan".[1] Thus, since November 1998 each Brazilian municipality can join the program and starting hiring health teams (eSF).[2]

Once the Family Health Program (PSF) has been expanded and consolidated as a priority strategy for the reorganization of Primary Care in Brazil, in 2006 the Federal government established it as the priority strategy of the Ministry of Health to organize Primary Care and renamed it as "*Family Health Strategy*" (ESF).[3] The program has expanded substantially and had reached 97.5% of Brazilian municipalities (5.430). However this rise has been heterogeneous over time and within the territory. Regarding geographical area it is noted that the ESF population coverage in metropolitan cities and cities of 500 thousand inhabitants has reached percentages lower than national coverage as one all. According to Bousquat et al. (2006) the ESF coverage in the country achieved 1.96% in 1998, growing to 33.32% five years later, while in the big cities, these values passed from 0.98% to 17.22% in the same period. The heterogeneity of the economic and social conditions large urban cities is also reflected

[1] The Multiannual Plan (PPA) is foreseen by Decree Law no. 2,829, of October 29, 1998. It is a medium-term plan that establishes the guidelines, objectives and goals to be followed by the Federal, State or Municipal Government over a four-year period.

[2] At first the family health-care teams were composed of one physician, one nurse, one auxiliary nurse, and four to six community health workers, but from 2004 on, the PSF started to include oral health teams

[3] Decree Law No. 648 of 28 March 2006

in the unequal access and utilization of health services. In large urban centers, despite the greater availability health services, particularly those of medium and high complexity, there is barriers to access and offering basic actions.[4].

Brazil is a country with enormous demographic diversity, as well as differentiated processes of organization of care models in the municipalities, which makes the implementation of any national program occur at unequal times. Large municipalities have a complex dynamics as well as poor housing and sanitation conditions in various regions (arising from disordered processes of urban agglomeration). At the same time, although the ESF's expansion in large cities be complex, it is crucial for two reasons: (i) it represents a major advance in population coverage; (ii) makes the program a key element in the effective transformation of the country's health model (Dain (2002)).

Since its implementation ESF has made considerable progress, and positive results have been achieved especially in small towns and sparsely populated areas, with scarcity of services and health professionals, especially regarding the improvement of the main indicators of health, such as decreased child mortality and increased immunization coverage (Nunes et al. (2014)). But the integrated analysis of metropolitan regions, where we find larger and more unequal cities, is less common.

1.1. Brazilian metropolitan areas

The 2010 Population Census shows that Brazil has a total of 36 metropolitan regions (MR), which together cover 44% of the country's total population. The table 1 shows us the great population disparity among the Brazilian metropolitan regions, as well as a wide temporal difference of their creations. The first nine metropolitan regions (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo,Curitiba and Porto Alegre) were institutionalized during the military period (1970s)[5], prior to the 1988 Constitution and the creation of the *Unified Health System* (SUS). At that time it was already showed a strong tendency to concentrate in these large urban centers, which continues today, as these first nine metropolitan regions currently account for approximately 30% of the country's total population, which is distributed among 172 municipalities.

[4]In order to consolidate the ESF in Brazilian large cities, the Ministry of Health, in partnership with the World Bank (BIRD), implemented the "Family Health Expansion and Consolidation Project" (PROESF) between 2002 and 2009 in municipalities with a population over 100 thousand inhabitants. This program had a total budged of US$ 550 million to improve the qualification of the work process and performance of services (see Saúde da (2003))

[5]Supplementary Law No. 14/1973.

The 1988 Constitution has created the SUS [6] in which the decentralization of health is one of its guidelines for reaching the three basic principles of the system: universality, completeness and equity. In this framework the municipality is responsible to provide health care services to the population, with Union and State technical and financial cooperation. In SUS, the responsibility for health must be decentralized to the municipality, and for this to exist each sphere of government is autonomous and sovereign in its decisions and activities.One of the challenges facing the principle of decentralization is that most Brazilian municipalities do not have significant own revenues and depend on intergovernmental transfers of resources, with limited ability to increase their degree of political and financial autonomy from the decentralization process (Lima (2012))[7]. Also challenging is the cooperation between the three federative entities on which the success of the SUS depends on the fulfillment of constitutional mandates related to health.

The effects of ESF on several dimensions have been evaluated by a growing number of studies. Among those that analyze the program in metropolitan regions, there is a concentration in case of São Paulo (MRSP) - (see Bousquat et al. (2008), Cesar et al. (2018), Cesar (2015)). This last study has showed that between 2002 and 2007, the ESF program in São Paulo MR grew below its potential, with slight improvements and worsening of the indices (which most remained stable). In case of Belo Horizonte (the third largest MR) the ecological study of Mendonça et al. (2011) shows that ESF have contributed to a major reduction in hospitalizations due to primary care sensitive conditions.

1.2. Health indicators

General self-assessement of health (SAH) were included in so many population-level studies because they are simultaneously economical measures of health status as well as conventional ways to open the topic of health status when it is to be covered in the interview in more detail. Following the trend observed in health and socioeconomic surveys conducted in other countries [8], in 1998 the self-assessment of health status has been incorporated into the Brazilian Supplement on Health of the National Household Sample Survey (PNAD). So since then the SAH has been used into epidemiological studies more frequently.

[6] The formulation and implementation of the Unified Health System (SUS) is the result of a significant movement of health reform, inserted in the broader movement of redemocratization of the country and which had in the VIII National Health Conference (1986)

[7] The objectives of regionalization include the rationalization of costs and the optimization of resources, leading to economies of scale in health-care services on the regional level (Ordinance/MS no. 399/2006)

[8] Such as the British Household Panel Survey (BHPS) or European Community Household Panel (ECHP) for example.

Metropolitan Region	State	Year of creation	Population Census 2010
São Paulo	SP	1973	19,672,582
Rio de Janeiro	RJ	1974	11,711,233
Belo Horizonte	MG	1973	5,413,627
Porto Alegre	RS	1973	3,960,068
Recife	PE	1973	3,688,428
Fortaleza	CE	1973	3,610,379
Salvador	BA	1973	3,574,804
Curitiba	PR	1973	3,168,980
Campinas	SP	2000	2,798,477
Manaus	AM	2007	2,210,825
Goiânia	GO	1999	2,173,006
Belém	PA	1973	2,040,843
Grande Vitória	ES	1995	1,685,384
Baixada Santista	SP	1996	1,663,082
Natal	RN	1997	1,340,115
Grande São Luis	MA	2003	1,327,881
João Pessoa	PB	2003	1,198,675
Maceió	AL	1998	1,156,278
Norte Catarinense	SC	1998	1,094,570
Florianópolis	SC	1998	1,012,831
Aracajú	SE	1995	835,654
Vale do Rio Cuiabá	MT	2009	834,060
Londrina	PR	1998	764,258
Vale do Itajaí	SC	1998	689,909
Campina Grande	PB	2009	687,135
Vale do Aço	MG	1998	615,004
Maringá	PR	1998	612,617
Agreste	AL	2009	601,251
Cariri	CE	2009	564,557
Carbonífera	SC	2002	550,243
Foz do Rio Itajaí	SC	2002	532,830
Macapá	AP	2003	499,116
Chapecó	SC	2007	403,458
Tubarão	SC	2002	356,790
Lages	SC	2010	350,607
Sudoeste Maranhense	MA	2005	345,878
Total metropolitan areas			**83,745,435**
Brazil			**190,732,694**

Table 1: Brazilian Population Metropolitan Regions

After Mossey, Shapiro (1982) had showed the capacity of SAH to predict mortality among seniors, the number of epidemiological studies which started to use the perception of health status as a global measure for the health level of a population had risen.[9]. Although widely used, its effectiveness and what it really represents has been examined by several studies. Some of them point out that its use is valid in measuring health inequality (e.g. Gerdtham et al. (1999), Van Doorslaer, Gerdtham (2003)), while others highlight that its subjective bias is prone to measurement error (e.g. Greene et al. (2015),Crossley, Kennedy (2002)). Here we will use four different question from Brazilian Health Survey to analyze how the expansion of ESF program impacts the "overall health" of individuals who lives in metropolitan areas. Are they:

a. *Overall, how would you rate your health?* : categorical variable ranging from very bad through to average to very good (this is commonly referred to as “the five-point scale"). Here we transformed this ranking into a dummy variable that aggregates the *bad* and *very bad* categories into one (*h_bad=1*), and sets it against the others (*h_bad=0*).

b. *In the last two weeks, have you failed to perform any of your usual activities (work, school, play, chores, etc.) for health reasons?* : dummy variable for limitation of routine activities (*routine_h*) - assume value 1 when person failed to carry out any usual activity for health reasons, and zero otherwise.

c. *In the past two weeks, how many days did you stop doing your usual activities for health reasons?* : number of days a person has failed to perform their usual activities for health reasons (*days_limit*). For those who have no limitations to perform any usual activities (that is: routine_h=0) this variable assumes zero value.

d. *In the last two weeks, how many days have you been bedridden?* :number of days person have bedridden (*days_bed*).

The paper's contribution is to measure the impacts of ESF coverage within metropolitan regions considering individual data and controlling for the individual's enrollment in the program.The focus here is the how the ESF impacts individual health status. We believe that, besides the challenge of expanding coverage in large Brazilian urban centers, it is equally important to analyze how this ESF's advance affects the well-being of individuals.

[9]In a recent systematic review of literature related to SAH in the elderly Brazilian population Pagotto et al. (2013) found few publications on this subject.

No work we have known so far has analyzed the effect of program coverage on the total population (treated and untreated), and its impact on the SAH of treated individuals.

2. Empirical Strategy: going from municipality to individual level

The ESF is a government-financed program focused on household visits by multidisciplinary health professional teams, designed to foster universal health coverage through primary health care. Since 1998, this program has been the main strategy for structuring municipal health systems. During the first decade (1999 to 2008) the program grew rapidly when the number of program teams increased from 4,114 to more than 29,500 across the Brazilian territory.

Once the presence of ESF in any city depends on the willingness of mayors to joint it, as well their efforts to speed up its coverage (Macinko et al. (2010)), we see that the ESF's assignment at municipality level is not random. But from the moment the municipality begins to hire health-care teams the decision about its distribution is made by the program's manager, who is responsible to coordinate the ESF's operation. Thus the choice to join or not the ESF is not taken at individual level [10]. The figure 1 shows the path from the municipality decision to implement the program until the household assignment to it, pointing these two moments of selection: the endogenous (A) and the choose on the observable characteristics (B). We also see that notwithstanding the fact that the direct impact of the program is immediate on individuals who are registered [11], it is thought that the expansion of the ESF can cause specific overflows (spillovers) even for individuals who are not registered in the program. These spillovers can be positive or negative and affect particular aspects of the functioning of the local health system.

Even individuals that are not registered in the ESF, but lives in municipalities with high program coverage vis-à-vis those residing in places where coverage is low, may be indirectly benefited or harmed in many ways.[12] That is, there are multiple ways in which ESF expansion can affect individual health indicators. Here we focus on self-rated health and, to capture the impact of the program, a temporal analysis of its expansion is needed.

The figure 2 shows that ESF's intervention is continuous, since the level of coverage varies

[10] The data shows that the coverage among the poorer families are higher. In the literature we can quote Bousquat et al. (2006) which shows that in São Paulo city the "target population" for the ESF implementation where families with less than five minimum wages.

[11] and therefore receive visits from health-teams (eSF) at certain intervals

[12] Among these we cite the ease or not to make medical appointments, and the level of quality of private health insurance arising from the greater competition (or not) by patients, etc.

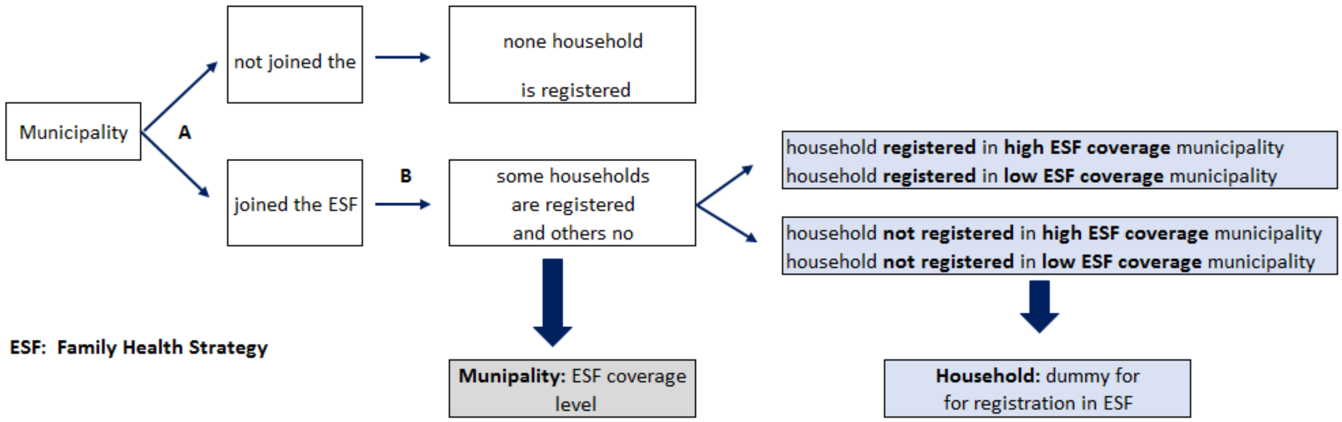

Figure 1: Ways of ESF's impact: from municipality to individual

across metropolitan regions and over time[13]. Therefore it is not enough to take into account the binary exposure to the program, but also its level. The analysis starts on the year when the program was still incipient (1998) and advances over time. The following presentation is based on Cameron, Trivedi (2005) and Cameron, Trivedi (2009).

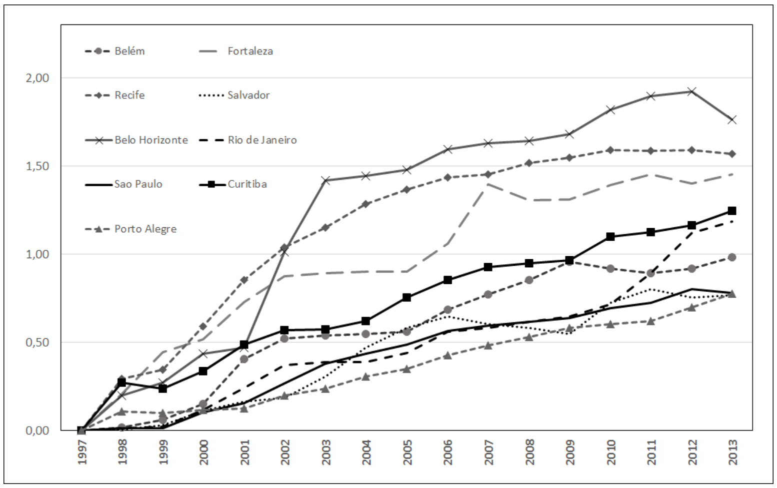

Figure 2: Evolution ESF coverage by Metropolitan Regions: 1997 - 2013

[13]The ESF coverage here is taken as number of health-teams (eSF) per 10,000 inhabitants in each metropolitan area

2.1. Models

We will estimate fixed effects models of metropolitan regions and years with instrumental variables to take into account the endogeneity of ESF coverage. The estimates uses pooled data from four different cross-section health surveys for the years 1998, 2003, 2008 and 2013.

2.1.1. Fixed effects (FE)

Also known as **within estimator**, the fixed effects estimator or **individual-specific effects model** is defined as:

$$y_{it} = \alpha_i + \mathbf{x'_{it}}\beta + \epsilon_{it} \tag{1}$$

where y_{it} is a scalar dependent variable, $\mathbf{x_{it}}$ is a $Kx1$ vector of independent variables, ϵ_{it} is a scalar disturbance term iid over i(indexes municipalities) and t (indexes time, years in our models). In this variant of the model 1, α_i is an unobserved random variable that is potentially correlated with the observed regressors $\mathbf{x_{it}}$.[14]

Then taking the average over time yields $\overline{y}_i = \alpha_i + \overline{\mathbf{x}}'_i\beta + \overline{\epsilon}_i$ and subtracting this from y_{it} of equation 1 yields the **within model**, according to Cameron, Trivedi (2005):

$$(y_{it} - \overline{y}_i) = (\mathbf{x_{it}} - \overline{\mathbf{x}}_\mathbf{i})'\beta + (\epsilon_{it} - \overline{\epsilon}_i), i = 1, \cdots, N, t = 1, \cdots, T. \tag{2}$$

as the α_i terms cancel. The **within estimator** is the OLS estimator in model 1 and it yields consistent estimate of β in the fixed effects model. Besides, if α_i are fixed effects and the error is *iid* this estimator is called fixed effects estimator and it is efficient estimator of β in equation 1[15].

Here we will have two fixed effects; one to the years of each survey (1998, 2003, 2008 and 2013) and other for the nine metropolitan area (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre). Thus the fixed effects model estimated will be:

$$y_{imt} = \alpha_i + \mathbf{x'_{imt}}\beta + ESF'_{mt}\gamma + M_m + T_t + \epsilon_{imt} \tag{3}$$

The fixed effects M_m control for time-invariant metropolitan region characteristics, while T_t accounts for time effects. In other words, metropolitan fixed effects control for a given

[14] Cameron, Trivedi (2005), p.700
[15] Cameron, Trivedi (2005), p.704.

pattern specific to an area, and time fixed effects control for possible shocks that could change, for example, program operating or funding rules (given by Federal government)[16] This FE model will be our baseline estimation.

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2.1.2. Fixed effects with instrumental variable (FEIV)

Figure 2 shows that the ESF coverage varies between different metropolitan regions and over time. Looking at the four specific years of the sample, we see that for the first two years (1998 and 2003) the lowest level of coverage of the program changes between Salvador and São Paulo, while the largest varies among two northeastern regions: Recife and Fortaleza. On the other hand for the last two years of the sample (2008 and 2013), the regions with the lowest and highest coverage are already consolidated, been Porto Alegre and Belo Horizonte respectively. However, intermediate levels of ESF coverage continue to change among other regions.

Given this picture we may ask: what drives the change in ESF coverage? We know that the decision to adopt the program belongs to the municipality and it is voluntary. Therefore the profile of the local public managers certainly affects the willingness to join PSF, whose general guidelines are given by the federal government. For this reason is necessary to consider that ESF coverage may be endogenous. The traditional strategy to identify causal effect on dependent variable is instrumental variable (IV), which we briefly present below.

Assuming the existence of Z_i instruments that satisfy $\mathbb{E}[\mathbf{Z}_{is}\epsilon_{it}] = \mathbf{0}$, but $\mathbb{E}[\mathbf{Z}_i'\alpha_i] \neq \mathbf{0}$, then the model estimated is the fixed effects model. According to Cameron, Trivedi (2005), **within IV estimator** is the IV or two stage least squares(2SLS) or panel GMM estimator of the **within model** or **mean-differenced model**:

$$(y_{it} - \overline{y}_i) = (\mathbf{x_{it}} - \overline{\mathbf{x}}_\mathbf{i})'\beta + (\epsilon_{it} - \overline{\epsilon}_i). \tag{4}$$

As described by Cameron, Trivedi (2005) (p. 758), $\mathbb{E}[\mathbf{z}_{is}\epsilon_{it}] = \mathbf{0}$ for $s \leqslant t$ no longer implies $\mathbb{E}[\mathbf{z}_{is}(\epsilon_{it} - \overline{\epsilon}_i)] = \mathbf{0}$ even for s less than t. The within transformation can only be used if the instruments are actually strongly exogeneous. (Cameron, Trivedi, 2005)

In order to address the endogeneity issue above described, we have created two dummies to political alignment to be used as instruments ($\mathbf{Z}_i$) that indicate: (1) percentage of municipalities in each metropolitan region where mayor and governor have the same party, (2)

[16]Phrased differently, year fixed effects capture trends that are not specific to a metropolitan area (or municipality).

percentage of municipalities in each metropolitan region where mayor and president have the same party. We explain it rationality below.

2.2. Instrumental Variable: Political Alignment

The instrumental variables that indicate the degree of political alignment between mayors-governors and mayors-presidents in each metropolitan region were constructed from the attribution of dummies to each executive position in each election. We started by assigning two dummies to represent political alignment: mayor's political party is the same governor's party, mayor's political party is the same president's party.

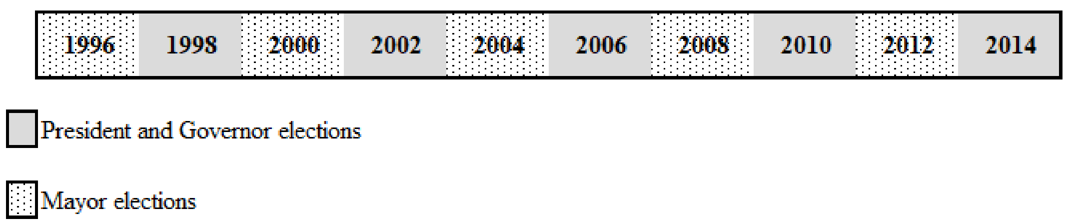

Figure 3: Brazilian electoral calendar 1996 to 2014: executive positions

Figure 3 shows the Brazilian electoral calendar, where is a temporal mismatched. The election for Federal and State executives occurs with a lag of two years related to the municipality query. This means that the two dummies can change every two year. Once we have these dummies for each year of our sample we calculated the average among the municipalities that sets up each metropolitan region.

The figures 4 and 5 show great variability of political alignment among metropolitan regions and sample years. It also points that the alignment of metropolitan's mayors occurs easily among governors than president. Besides, it turns out that the higher levels of party affinity at the beginning of the program occurs mainly among Northeast municipalities.

The conception of these variables as instrument comes from evidence in the literature regarding the importance of political process in the relationship among different levels of government. Brollo, Nannicini (2012) studies the relation between transfer of federal resources to municipalities managed by mayors belonging to the same political party or coalition that governs the Union. The study of **?** used political and health financing variable as instruments. In this case the IVs were: mayor's political party and the proportion of the municipal budget that was dedicated to health and social services. But we see an issue with the use of "proportion of spending with health and social services" once it could also be directly

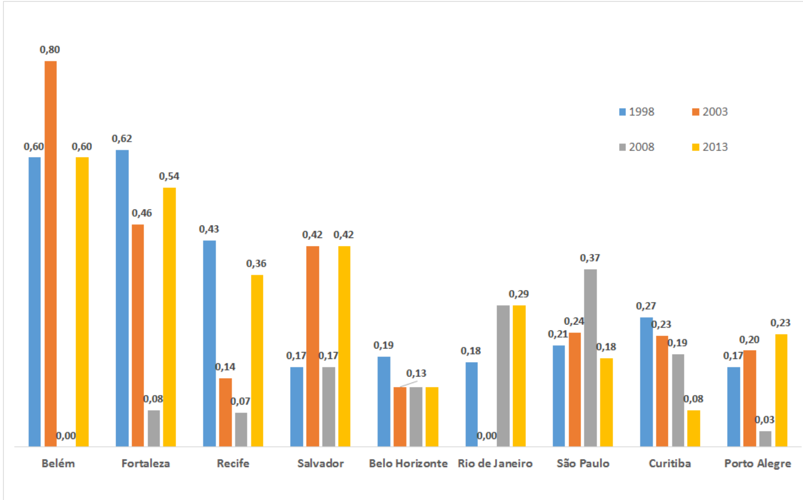

Figure 4: Incidence party mayor-governor by Metropolitan Region

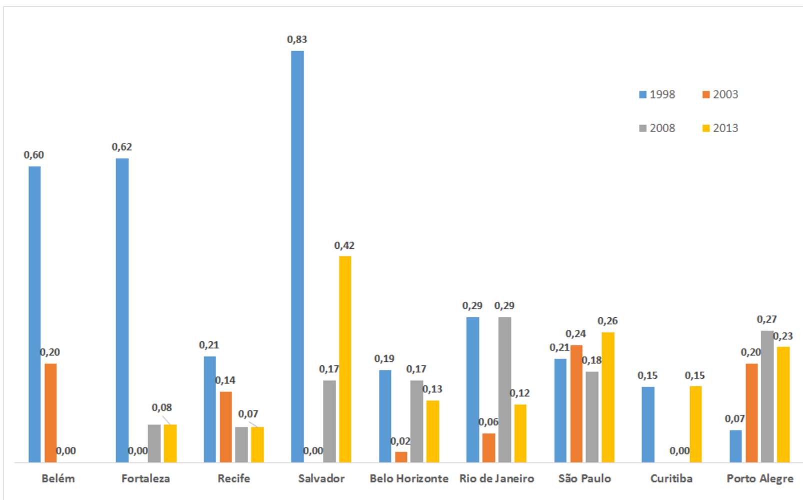

Figure 5: Incidence party mayor-president by Metropolitan Region

linked to general health indicators. For example, the amount of resources allocated to health management can affect both the availability of infrastructure as well as the quality of care, and ultimately interfere in individual health indicators.

We believe that political alignment seem to fit better for this purpose, since they would be correlated with dimension of program's coverage (and eventually with its launch in the municipality), but not directly with the outcomes. In next section we describe the set of variables that we use in the estimations. The results of the models estimated to check the condition of relevance of the instruments are presented in section 4.

3. Database

In Brazil the major source of historical data on living conditions and health are the Civil Registry Statistics, the Demographic Censuses, the National Household Sample Surveys (PNAD) and its special supplements covering health-related topics. The PNAD Special Health Supplement is published every 5 years since 1998, maintaining the same investigational aspects (what permits the parallel among different surveys years). The survey available matches the samples of 1998, 2003 and 2008. In 2013, the special PNAD supplement on Health became a special survey, known as the National Health Survey (PNS). Our estimates will use both surveys PNAD and PNS, thus the pooled data includes the years of 1998, 2003, 2008 and 2013. This set of samples permits the evaluation of how 15 years of ESF expansion in metropolitan area affects the health indicators of individuals.

Besides the entire country, this two surveys (PNAD and PNS) are representative at metropolitan regions (MRs), the 27 Brazilian states and the five major geographic regions. Regarding MRs the two surveys do not cover exactly the same set. While the PNADs covers 9 MRs, the PNS sample includes the total of 21 MRs [17]. The common MRs in both surveys are: Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre. To report the database used in the estimates we splited it in three groups based in data's level of aggregation: metropolitan area, household and individual. The set of variables in each of these groups is described following.

3.1. MR level: ESF's coverage and political alignment

To calculate the ESF coverage at MR level we use data from Department of Primary Care of the Ministry of Health (DAB) [18] which reports monthly the number of deployed (registered and accredited) ESF teams (eSF) [19]. We use this data in order to create the measure of coverage because it is possible to have monthly and complete updated data, and the

[17] One in each state, except six: Acre (AC), Rondônia (RO), Roraima (RR), Piauí (PI), Mato Grosso do Sul (MS) and Tocantins (TO).

[18] Source: `http://dab.saude.gov.br/portaldab/historico_cobertura_sf.php`. This link was discontinued in 2019 and replaced by `https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relHistoricoCoberturaAB.xhtml`, which contains information only from July 2007 onwards.

[19] Official definition of this variable is the "number of Health Strategy Teams(eSF) suitable for the municipality to receive financial incentives by the Ministry of Health, in the selected competence. The number of eSF teams for which the municipality will receive the federal financial incentive corresponds to the number of eSF registered in the system and that is in compliance with the accreditation by the Ministry of Health".

methodology employed is known.[20] In order to get the ESF coverage at metropolitan region level, we aggregate the DAB monthly data at annual standard for the deployed eSF and population (added among municipalities in each of the nine metropolitan regions analyzed). At the end we divided the number of eSF by population in each MR and multiplied by ten thousand [21].

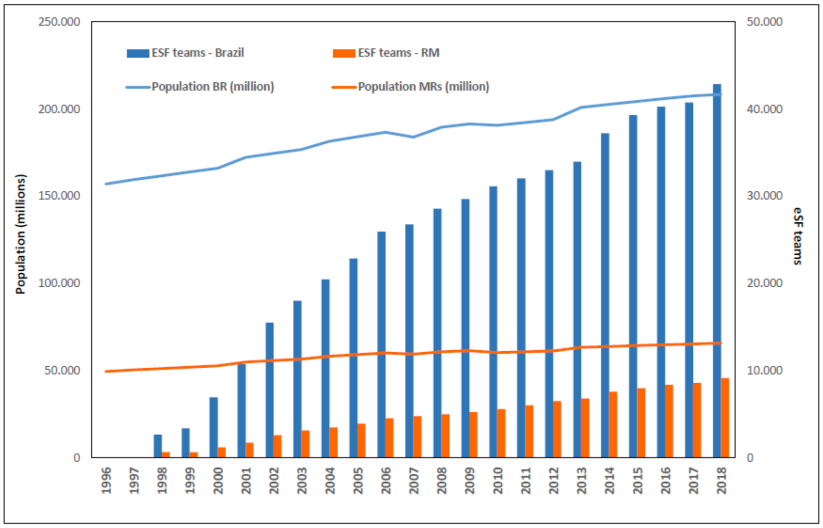

Figure 6: Evolution population and ESF teams: Brazil and MRs

Figure 6 shows the implementation process of ESF program among the whole country vis-à-vis the nine metropolitan regions analyzed here. It shows that the expansion in metropolitan regions occurred more slowly compared to the whole country. Even so, these MRs represents around 21% of all ESF's team implemented (see Appendix A), while concentrates 30% of Brazilian population.

The other characteristic of MR are the two political alignment variable that works as instruments in our FEIV model. In this case the data came from the elections counted by the Superior Electoral Court (TSE)[22] from 1998 to 2012, as pointed in figure3[23].

[20]Besides the data from DAB, there are two other potential sources: Primary Care Information System (SIAB) and a "*rule of thumb*" based on the optimal number of people to be covered by each health-team (3,450 individuals). We will not discuss here the problems from these other sources. For a more detailed discussion of their drawbacks, see Diaz et al. (2019)

[21]"*per* 10,000 inhabitant"

[22]http://www.tse.jus.br/eleicoes/estatisticas/repositorio-de-dados-eleitorais-1/repositorio-de-dados-eleitorais

[23]The information about how these data were transformed into the instrumental variables that will be used in the estimates is on section2.2.

Group	Variable	Mean	SD	Min	Max	N
Health Outcomes	Bad health	0.0375	0.1900	0	1	228831
	Routine limitation	0.0702	0.2555	0	1	228831
	Days limit	0.4122	1.9690	0	14	228831
	Days bed	0.1794	1.2155	0	14	228831
Individual Covariates	Age	41.1193	10.7789	25	64	228831
	male	0.4632	0.4986	0	1	228831
	Black	0.4816	0.4997	0	1	228831
	Health_plan	0.3324	0.4711	0	1	228831
	Work	0.6872	0.4637	0	1	228831
	Elementary School	0.4117	0.4921	0	1	228831
	High School	0.3434	0.4748	0	1	228831
	College or higher	0.1433	0.3504	0	1	228831
Household Covariates	Child up 5	0.4704	0.4991	0	1	228831
	Adult over 54	0.1431	0.3502	0	1	228831
	pca	-0.0367	1.5557	-13.9625	1	228593
	Urban	0.9598	0.1965	0	1	228831
	hh. treat	0.3308	0.4705	0	1	102540
Metropolitan Region Covariates	ESF level	0.6547	0.4989	0.0064	2	228831
	ESF (t-1)	0.5198	0.5236	0	2	228831
	ESF (t-2)	0.4485	0.4965	0	2	228831
	ESF (t-3)	0.4485	0.4707	0	2	228831
	ESF rate	-0.7010	1.5272	-5.0549	0.4982	228831
	Mayor-president	0.1674	0.1296	0	0.6154	228831
	Mayor-governor	0.2402	0.1736	0	0.8000	228831
Years Fixed Effects	1998	0.2626	0.3258	0	1	228831
	2003	0.2893	0.4534	0	1	228831
	2008	0.3057	0.4607	0	1	228831
	2013	0.1424	0.3494	0	1	228831
Metropolitan Region Fixed Effects	Belém MR	0.0719	0.2583	0	1	228831
	Fortaleza MR	0.0996	0.2995	0	1	228831
	Recife MR	0.1144	0.3183	0	1	228831
	Salvador MR	0.1050	0.3065	0	1	228831
	Belo Horizonte MR	0.1059	0.3076	0	1	228831
	Rio de Janeiro MR	0.1396	0.3466	0	1	228831
	São paulo MR	0.1630	0.3694	0	1	228831
	Curitiba MR	0.0701	0.2552	0	1	228831
	Porto Alegre MR	0.1305	0.3369	0	1	228831

Table 2: Descriptive Statistics

3.2. Household level: family characteristics, welfare and ESF treatment

The household controls used in the estimates are: dummy for children up to 5 years old, dummy for adults over 54 years old and welfare index, which was calculated using the Principal Component Analysis (pca)[24]. This information comes from the compatibility of the PNAD and PNS survey's household questionnaire regarding three types of questions: house features (wall and roof), assess of public services (piped water, sanitary sewer, trash and light) and consumption goods (phone, tv, fridge and washing machine).

In 2008 and 2013 household questionnaires, queries regarding registration in the ESF program were included. Given that the program's health team must attend the whole family, once household is registered, all its residents are considered as the population served by the program. Besides the information of just be or not registered, the survey brings a categorical question about how long ago the household is attended by the program[25]. We will use these two surveys years to create an individual dummy indicating if the person is registered in ESF for at least one year. This information enables us evaluate the programs impact from direct and/or indirect channels, as pointed in figure 1.

3.3. Individual level: personal characteristics

Concerning to individuals characteristics used as control in the estimates there are: age, sex, color, private health insurance, education and work. This analyzes focus on adult population, so our age variable goes from 25 to 64 years old.

For the other individual covariates we have dummies that assume value one when the person in the sample is: male. black, works and have health insurance. For education we created a categorical variable that indicates the highest course the person attended, and then segmented it into three dummies: elementary school (*study01)*, high school (*study02)*, college or higher (*study03)*. See table2 for descriptive statistics.

4. Results

As shown in the table 3, our analysis is divided into four parts, adding 16 specifications for each health indicator[26]. Besides the temporal and model differentiation, we tested distinct

[24] See Jackson (2005)

[25] The options are: less than 2 months, from 2 to less than 6 months, from 6 months to less than 12 months, or at least one year.

[26] Once we have four depended variables, in total we get 64 estimates.

formats for the ESF's coverage at MR level: level, at (t-1) and rate [27]. Is important to explain that we choose to test lagged coverage in just one period (t-1) because at the household level we considered enrolling in the program for those families that were registered in ESF for at least 12 months.

Spec.	Model	Period	PSF Coverage	hh treat.	Lagged control
(1)			level		No
(2)	Baseline	1998, 2003,	(t-1)	No	No
(3)	(OLS)	2008, 2013	level		(t-1), (t-2), (t-3)
(4)			rate		No
(5)			level		No
(6)	IV	1998, 2003,	(t-1)	No	No
(7)		2008, 2013	level		(t-1), (t-2), (t-3
(8)			rate		No
(9)			level		No
(10)	IV	2008,	(t-1)	No	No
(11)		2013	level		(t-1), (t-2), (t-3)
(12)			rate		No
(13)			level		No
(14)	IV	2008,	(t-1)	Yes	No
(15)		2013	level		(t-1), (t-2), (t-3)
(16)			rate		No

Table 3: Estimates Specification

The coverage here is given by the number of eSF by population (by 10,000), thus the greater the reason the greater the coverage. This way, if the coefficient is positive it implies that higher coverage increases: self-rated "bad" health, limitation of routine activities for health reasons, number of days the person failed to perform usual activities, and more days bedridden. If the coefficient is negative the impact goes in opposite way, what is a signal of ESF effectiveness in these specific health indicator [28].

For the baseline model, which does not account the endogeneity of ESF, the results (equations 1-4 in each appendix) show that without control for lagged level of coverage rarely

[27] And in one of them we insert lagged levels of ESF coverage.

[28] For sake of simplicity we present the coefficients of the variables of interest in the appendices according with the health outcome ("Bad Health" (B), "Routine Limitation" (C), "Days Limitation" (D) and "Bedridden" (E)). The 64 complete table results are available on request to the author.

the ESF affects these health indicators. The exception is the "Bedridden" variable, which presents positive and significant coefficient for level and (t-1), but negative for the program's growth rate. Although it seems contradictory, it cannot be considered a consistent result because it does not address the endogeneity issue .

What capture our attention is the behavior of the coefficients in the specification that incorporates lagged levels of coverage (t-1, t-2, t-3). In general, for estimates involving four-year samples, regardless of model (FE or FEIV)[29], we find significant coefficients for ESF coverage with a switch of signal among the different lags. We believe that this result is related to institutional factors, particularly the continuity or not in health management in the municipalities on these metropolitan regions.

Looking at the schedule of Brazilian elections (figure 3) note that the program itself has started at a President/ Governor election year (1998) and, the other years in our sample occur between elections (2003 and 2013)[30] or in the year of the mayoral elections (2008). Thus we intend to analyze in more detail the issue of the political cycle. Particularly the proportion of municipalities in each metropolitan region in which mayors were in their second term, indicating the continuity of health management.

4.1. Estimates fixed effects IV: endogeneity of ESF coverage

The FEIV models were estimated for two different samples, one with the four years (1998, 2003, 2008 and 2013), and other with just the two last years (2008 and 2013) but with information for household registration on ESF program. In both cases there were three different coverage variables: level, lagged (t-1) and rate. We start by presenting in table 4 the estimations only for instruments produced in the first stage to verify their relevance for all models. Unexpectedly, the sign of the coefficient was negative for both: the level of program's coverage in the current year and in the previous as well. On the other hand, when use the ESF's growth rate the coefficient becomes positive for both instruments, showing that the political alignment between the mayor and the governor, as well the president, speeds up program implementation.

[29]specifications from (1)-(8).

[30]2003 is one year before the mayor election, so the executive may be interested in reelection. On the other hand, 2013 is just one year after the municipal election, so it is usually a year of fiscal adjustment.

Instruments	Sample: 1998, 2003, 2008, 2013		
	ESF level	ESF (t-1)	ESF rate
mayor-pres	-0.5644***	-0.5961***	0.8743***
	0.0026	0.0025	0.0115
mayor-gov	-0.0835***	-0.2824***	1.4203***
	0.0021	0.0023	0.0079
N	228,589	228,589	228,589
R^2	0.0347	0.0346	0.0345

Table 4: First stage of Instrumental Variable Models

The results of FEIV[31] shows that the coverage at level in current year impacts negatively "routine limitations", that is: current expansion in ESF's coverage decreases the people's perception of failed to perform usual activities for health reasons. But it did not show any effect in the other three health indicators.

If we take the ESF's coverage in previous year, then the negative impact will get both: the perception of limitation ("routine limitation"), and the number of days which the person stopped doing usual activities for health reasons ("days limitations") as well. Yet, the ESF's coverage rate just did not show effect on being bedridden. However in the other three health indicators the significant coefficient assumes opposite sign than expected. Thus when ESF's coverage increases, the population: self-rated their own health as bad, increases the perception of limitation on daily activities for health reasons, and rise the number of days with health limitation.

The specification that includes current coverage as endogenous but adds three lags[32] reaffirms this dynamic for these same three indicators. For all health indicators, including being bedridden, there is: positive sign for ESF's coverage at current and (t-2) levels; and opposite sign for ESF's coverage at (t-1) and (t-3) levels. As mentioned before, we consider that this puzzle may be related to electoral process and/or the health management continuity in the municipalities of these metropolitan regions and deserves further investigation.

[31]see speficifications (5)-(8) on tables B.6, C.8, D.10 and E.12 appendices
[32]Estimation (7) for each health outcome.

4.2. ESF's treatment: Municipality coverage X Household registration

The sub-sample composed by PNAD-2008 and PNS-2013 is analyzed separately because for these two years the survey brings specific questions about ESF program. This allows a general view about the two treatment levels' program performance: municipal coverage and family registration. The table 5 presents the first stage results only for instruments in the specifications (13), (14) and (16) for all health indicators[33].

Instruments	S ample: 1998, 2003, 2008, 2013		
	ESF level	ESF (t-1)	ESF rate
mayor-pres	1.0347***	1.0254***	0.0452***
	0.0047	0.0035	0.0011
mayor-gov	-0.1483***	-0.2628***	0.1325***
	0.0014	0.0014	0.0007
N	102,429	102,429	102,429
R^2	0.0355	0.0352	0.0353

.

Table 5: First stage of Instrumental Variable Models

Here, regardless ESF's coverage measure is used, the more municipalities in metropolitan regions are politically aligned with the federal government, the greater will be the program coverage (or its growth rate). On the other hand, the political alignment with governor works in the opposite direction for current or lagged ESF's coverage, but increases the program's growth rate. Looking at the effect of ESF's coverage on the four health indicators, the results show that for these sub-sample, it's none regardless the inclusion of household treatment dummy. Again the exception is the ESF's growth rate, which has the same effect on the same three health indicators pointed before[34].

Taking into account person registration in the program does not vanish the positive impact of ESF growth in these health indicators. But the relevance of individual treatment

[33]See tables B.7, C.9, D.11 and E.13.

[34]Self-rated health as bad, routine limitation and number of days with health limitation.

works in the opposite direction (positive) for "self-rated as bad" and "routine limitation" variables [35].

5. Concluding remarks

This paper aimed at evaluating the impact of Family Health Strategy (ESF) on specific health indicators. We make use of two levels of treatment (municipality assignment to ESF, and its implementation, as well the individual registration in the program) to evaluate its possible pass-through and externalities among population in the first nine Brazilian Metropolitan Regions (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre). The empirical strategy employed estimation of fixed-effects instrumental variables. We adopted the ration number of teams by population in each Metropolitan regions as the coverage variable and the individual data is a pooled from two surveys: PNADs Health Supplement (1998, 2003 and 2008) and PNS-2013.

Statistically significant effects of the program were found using three different measures of ESF coverage (level, lagged (t-1) and rate) in three health indicators: self-rated their own health as bad, the perception of limitation ("routine limitation"), and the number of days which the person stopped doing usual activities for health reasons ("days limitations"). However the signs do not always go in the same direction, showing that additional attention should be given to the dynamics of the instruments used: political alignment among mayor and president, and between mayor and governor. We believe that a closer look for the existence of continuity, or its lack, in local health management is relevant to distangle some opposite directions results.

Looking at the results as a whole, it appears that the Family Health Strategy, on average, has a less clear impact on self-assessment health indicator. The results obtained in this work are according to Diaz et al. (2019), that have analyzed the direct impacts of Family Health Strategy on mortality related to diseases and conditions for which access to effective primary care can reduce the likelihood of more severe outcomes and quality of vital information (Chap 18 of ICD 10). In the study when all municipalities were analyzed, effects of reducing mortality from some causes were found (list of avoidable hospital admissions, hypertension and diabetes, coronary disease, cardiac insufficiency, diabetes complications and bacterial pneumonia). However, when these same causes were analyzed considering only municipalities located in some metropolitan regions, these effects disappeared.

[35] For the other two health indicators it's coefficient is not significant.

Acknowledgements

The authors acknowledge financial support from National Institute for Health Research grant for Global Health Econometrics and Economics Group (GHE2) and from Fipe - Fundacao Instituto de Pesquisas Economicas. Maria Dolores Montoya Diaz and Fernando Postali receive Research Productivity Grants from CNPq. Adriano Dutra Teixeira receive CNPq PhD Grant. The authors are also grateful for the excellent research assistance provided by Matheus Valentim de Barros and Guilherme Jardinetti Araujo.

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Appendix A. ESF's coverage trend: Brazil and Metropolitan Regions

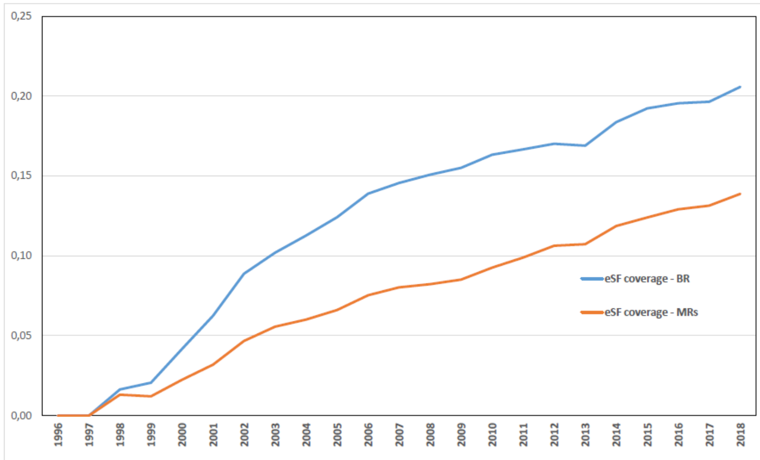

Figure A.7: Coverage Evolution: MRs and Brazil - eSF by population (10,000)

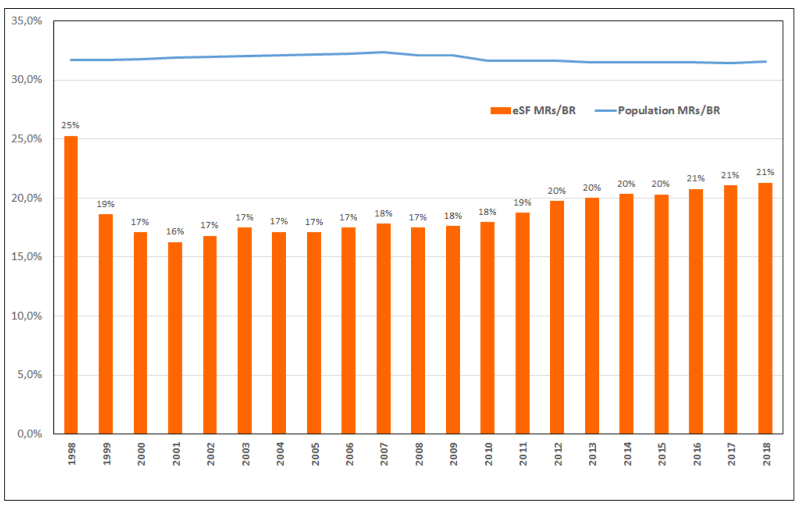

Figure A.8: Proportion of MRs in Brazil - eSF and population

Appendix B. Outcome: ***Bad Health***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	bad_h	bad_h	bad_h	bad_h	bad_h	bad_h	bad_h	bad_h
ESF level	0.0024		0.0266***		0.0015		0.0800***	
	(0.0033)		(0.0091)		(0.0071)		(0.0200)	
ESF (t-1)		-0.0006	-0.0388***			-0.0068	-0.1056***	
		(0.0026)	(0.0121)			(0.0052)	(0.0249)	
ESF (t-2)			0.0353**				0.0744***	
			(0.0140)				(0.0195)	
ESF (t-3)			-0.0168				-0.0275*	
			(0.0115)				(0.0123)	
ESF rate				0.0014**				0.0061***
				(0.0007)				(0.0018)
_cons	0.0016	0.0017	-0.0012	0.0064	0.0016	0.0013	-0.0062	0.0227**
	(0.0044)	(0.0044)	(0.0046)	(0.0049)	(0.0044)	(0.0045)	(0.0048)	(0.0076)
N	228,589	228,589	228,589	228,589	228,589	228,589	228,589	228,589
r2	0.0347	0.0347	0.0347	0.0347	0.0347	0.0346	0.0345	0.0345

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.6: Fixed Effects 1998-2013: Baseline (1-4), IV (5-8)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(168)
	bad_h	bad_h	bad_h	bad_h	bad_h	bad_h	bad_h	bad_h
ESF level	0.0093		0.0903		0.0086		0.0980	
	(0.0119)		(0.0685)		(0.0119)		(0.0682)	
ESF (t-1)		0.0011	-0.0931			0.0003	-0.0980	
		(0.0111)	(0.0504)			(0.0111)	(0.0502)	
ESF (t-2)			0.0193				0.0089	
			(0.0830)				(0.0828)	
ESF (t-3)			-0.0103				-0.0029	
			(0.0592)				(0.0590)	
ESF rate				0.1481**				0.1526***
				(0.0455)				(0.0454)
treat_hhc					0.0048*	0.0048*	0.0047*	0.0048*
					(0.0019)	(0.0019)	(0.0019)	(0.0019)
_cons	0.0044	0.0110	-0.0010	-0.0035	0.0037	0.0104	-0.0022	-0.0052
	(0.0116)	(0.0103)	(0.0147)	(0.0077)	(0.0116)	(0.0103)	(0.0147)	(0.0077)
N	102,429	102,429	102,429	102,429	102,429	102,429	102,429	102,429
r2	0.0354	0.0354	0.0352	0.0352	0.0355	0.0355	0.0352	0.0353

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.7: Fixed Effects 2008-2013: without hh treatment (9-12), with hh treatment (13-16)

Appendix C. Outcome: ***Routine limitation for health reasons***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	routine	routine	routine	routine	routine	routine	routine	routine
ESF level	0.0082*		0.0221*		-0.0304**		0.1323***	
	(0.0044)		(0.0120)		(0.0095)		(0.0273)	
ESF (t-1)		0.0041	-0.0204			-0.0315***	-0.1584***	
		(0.0034)	(0.0162)			(0.0070)	(0.0343)	
ESF (t-2)			0.0283				0.1091***	
			(0.0188)				(0.0264)	
ESF (t-3)			-0.0216				-0.0436**	
			(0.0150)				(0.0160)	
ESF rate				-0.0007				0.0133***
				(0.0009)				(0.0025)
_cons	0.0512***	0.0518***	0.0494***	0.0490***	0.0527***	0.0497***	0.0390***	0.0976***
	(0.0059)	(0.0059)	(0.0060)	(0.0064)	(0.0059)	(0.0060)	(0.0064)	(0.0104)
N	228,589	228,589	228,589	228,589	228,589	228,589	228,589	228,589
r2	0.0123	0.0123	0.0123	0.0123	0.0119	0.0118	0.0118	0.0113

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C.8: Fixed Effects 1998-2013: Baseline (1-4), IV (5-8)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	routine	routine	routine	routine	routine	routine	routine	routine
ESF level	0.0155		-0.0283		0.0145		-0.0164	
	(0.0154)		(0.0924)		(0.0155)		(0.0921)	
ESF (t-1)		0.0080	-0.0110			0.0068	-0.0188	
		(0.0144)	(0.0682)			(0.0144)	(0.0680)	
ESF (t-2)			0.1461				0.1298	
			(0.1083)				(0.1081)	
ESF (t-3)			-0.1552*				-0.1437	
			(0.0777)				(0.0776)	
ESF rate				0.1187				0.1256*
				(0.0614)				(0.0614)
hh treat.					0.0072**	0.0073**	0.0072**	0.0073**
					(0.0024)	(0.0024)	(0.0024)	(0.0024)
_cons	0.0438**	0.0506***	0.0827***	0.0440***	0.0428**	0.0496***	0.0809***	0.0414***
	(0.0150)	(0.0134)	(0.0193)	(0.0104)	(0.0150)	(0.0134)	(0.0193)	(0.0104)
N	102,429	102,429	102,429	102,429	102,429	102,429	102,429	102,429
r2	0.0117	0.0117	0.0117	0.0117	0.0119	0.0119	0.0119	0.0118

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.9: Fixed Effects 2008-2013: without hh treatment (9-12), with hh treatment (13-16)

Appendix D. Outcome: ***Days limitation***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	days_lim	days_lim	days_lim	days_lim	days_lim	days_lim	days_lim	days_lim
ESf level	0.0559		0.2115**		-0.1320		1.0265***	
	(0.0357)		(0.0956)		(0.0730)		(0.2147)	
ESF (t-1)		0.0161	-0.2198*			-0.1804***	-1.2398***	
		(0.0272)	(0.1245)			(0.0536)	(0.2664)	
ESF (t-2)			0.3482**				0.9455***	
			(0.1466)				(0.2103)	
ESF (t-3)			-0.2912**				-0.4541***	
			(0.1192)				(0.1293)	
ESF rate				-0.0023				0.0931***
				(0.0066)				(0.0192)
_cons	0.2252***	0.2283***	0.2034***	0.2194***	0.2323***	0.2169***	0.1264*	0.5505***
	(0.0457)	(0.0458)	(0.0472)	(0.0494)	(0.0457)	(0.0460)	(0.0509)	(0.0785)
N	228,564	228,564	228,564	228,564	228,564	228,564	228,564	228,564
r2	0.0117	0.0117	0.0118	0.0117	0.0115	0.0115	0.0113	0.0110

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D.10: Fixed Effects 1998-2013: Baseline (1-4), IV (5-8)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	days_lim	days_lim	days_lim	days_lim	days_lim	days_lim	days_lim	days_lim
ESF level	0.2053		0.1566		0.2005		0.2167	
	(0.1284)		(0.7058)		(0.1287)		(0.7031)	
ESF (t-1)		0.1265	-0.3735			0.1205	-0.4128	
		(0.1188)	(0.5139)			(0.1191)	(0.5122)	
ESF (t-2)			1.0988				1.0169	
			(0.8463)				(0.8447)	
ESF (t-3)			-0.9722				-0.9141	
			(0.6083)				(0.6069)	
ESF rate				1.1250*				1.1596*
				(0.4764)				(0.4754)
hh treat.					0.0362	0.0370	0.0361	0.0370
					(0.0194)	(0.0194)	(0.0194)	(0.0194)
_cons	0.1119	0.1861	0.2664	0.1599	0.1066	0.1812	0.2574	0.1470
	(0.1253)	(0.1111)	(0.1558)	(0.0844)	(0.1251)	(0.1109)	(0.1554)	(0.0841)
N	102,429	102,429	102,429	102,429	102,429	102,429	102,429	102,429
r2	0.0116	0.0115	0.0116	0.0115	0.0116	0.0116	0.0117	0.0116

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D.11: Fixed Effects 2008-2013: without hh treatment (9-12), with hh treatment (13-16)

Appendix E. Outcome: *Bedridden*

	(1) days_bed	(2) days_bed	(3) days_bed	(4) days_bed	(5) days_bed	(6) days_bed	(7) days_bed	(8) days_bed
ESF level	0.0587***		0.0609		-0.0258		0.2639*	
	(0.0219)		(0.0579)		(0.0456)		(0.1261)	
ESF (t-1)		0.0524***	-0.0502			-0.0354	-0.3043*	
		(0.0172)	(0.0735)			(0.0338)	(0.1552)	
ESF (t-2)			0.1793**				0.3281**	
			(0.0889)				(0.1242)	
ESF (t-3)			-0.1295*				-0.1701*	
			(0.0737)				(0.0791)	
ESF rate				-0.0092**				0.0183
				(0.0044)				(0.0118)
_cons	0.1559***	0.1612***	0.1524***	0.1263***	0.1591***	0.1561***	0.1332***	0.2216***
	(0.0270)	(0.0271)	(0.0280)	(0.0298)	(0.0270)	(0.0273)	(0.0304)	(0.0470)
N	228,582	228,582	228,582	228,582	228,582	228,582	228,582	228,582
r2	0.0082	0.0082	0.0082	0.0081	0.0081	0.0080	0.0081	0.0080

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table E.12: Fixed Effects 1998-2013: Baseline (1-4), IV (5-8)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	days_bed	days_bed	days_bed	days_bed	days_bed	days_bed	days_bed	days_bed
ESF level	0.0424		-0.0681		0.0400		-0.0396	
	(0.0762)		(0.3926)		(0.0765)		(0.3887)	
ESF (t-1)		0.0260	-0.1689			0.0231	-0.1875	
		(0.0706)	(0.2786)			(0.0708)	(0.2762)	
ESF (t-2)			0.9180				0.8790	
			(0.4983)				(0.4955)	
ESF (t-3)			-0.8898*				-0.8622*	
			(0.3603)				(0.3580)	
ESF rate				0.2348				0.2515
				(0.2665)				(0.2642)
hh treat.					0.0176	0.0173	0.0173	0.0178
					(0.0115)	(0.0116)	(0.0116)	(0.0115)
_cons	0.1313	0.1467*	0.2619**	0.1409**	0.1288	0.1443*	0.2576**	0.1347**
	(0.0728)	(0.0637)	(0.0893)	(0.0473)	(0.0726)	(0.0636)	(0.0888)	(0.0468)
N	102,429	102,429	102,429	102,429	102,429	102,429	102,429	102,429
r2	0.0071	0.0071	0.0072	0.0071	0.0071	0.0071	0.0072	0.0071

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table E.13: Fixed Effects 2008-2013: without hh treatment (9-12), with hh treatment (13-16)