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Original Article

Brazil's Family Health Strategy: factors associated with programme uptake and coverage expansion over 15 years (1998–2012)

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Abstract

Universal Health Coverage (UHC) is one of the United Nations Sustainable Development Goals (SDGs). Achieving UHC will require strong health systems to promote and deliver equitable and integrated healthcare services through primary healthcare (PHC). In Brazil, the Family Health Strategy (FHS) delivers PHC through the public health system. Created in 1994, the FHS covered almost 123 million individuals (63% of the Brazilian population) by 2015. The FHS has been associated with many health improvements, but gaps in coverage still remain. This article examines factors associated with the implementation and expansion of the FHS across 5419 Brazilian municipalities from 1998 to 2012. The proportion of the municipal population covered by the FHS over time was assessed using a longitudinal multilevel model for change that accounted for variables covering eight domains: economic development, healthcare supply, healthcare needs/access, availability of other sources of healthcare, political context, geographical isolation, regional characteristics and population size. Data were obtained from multiple publicly available sources. During the 15-year study period, national coverage of the FHS increased from 4.4% to 54%, with 58% of the municipalities having population coverage of 95% or more, and municipalities that had not adopted the programme decreased from 86.4% to 4.9%. The increase in FHS uptake and coverage was not homogenous across municipalities, and was positively associated with small population size, low population density, low coverage of private health insurance, low level of economic development, alignment of the political party of the Mayor and the state Governor, and availability of healthcare supply. Efforts to expand the FHS coverage will need to focus on increasing the availability of health personnel, devising financial incentives for municipalities to uptake/expand the FHS and devising new policies that encompass both private and public sectors.

Keywords: Primary healthcare, Universal Health Coverage, Brazil, Family Health Strategy

Key Messages

- The manuscript provides the first comprehensive assessment of possible factors associated with the implementation and expansion of the Family Health Strategy (FHS) in Brazil, across municipalities, from 1998 to 2012. The FHS, created in 1994, delivers primary healthcare (PHC) through the public health system, and in 2015, it covered almost 123 million individuals (63% of the Brazilian population). Considering that primary care is a first step toward Universal Health Coverage (UHC) (one of the new SDGs), results of this article are of interest not just to Brazil, but to a much broader audience that seeks examples of challenges and strategies to deploy and expand a PHC programme at a large scale.
- The manuscript investigates remaining gaps in FHS coverage, and utilizes the longest possible time-series of data, considering eight domains that could potentially affect implementation and coverage expansion, namely, economic development, healthcare supply, healthcare needs/access, availability of PHC, political context, geographical isolation, regional characteristics and population size.
- Results show that the uptake and expansion of the FHS were positively associated with small population size, low population density, low coverage of private health insurance, low level of economic development, political alignment between the Mayor and Governor and availability of healthcare staff. Most importantly, the Brazilian experience shows that the scaling up of primary care is feasible, albeit not homogeneous across municipalities. Findings point to the need of different policies conditioned on population size and economic development. For small and poor municipalities, funding mechanisms are likely to guarantee UHC. For larger and richer ones, competing sources of healthcare are often an obstacle, and thus policies should include mechanisms that encompass both public and private sectors.

Introduction

Universal Health Coverage (UHC) is one of the United Nations Sustainable Development Goals (SDGs) (WHO 2015). Achieving UHC will require health systems that promote and deliver equitable and integrated healthcare services thorough primary healthcare (PHC), which is the cornerstone of strong healthcare systems (Shi 2012; White 2015). Expansion of high quality PHC is a critical and necessary first step toward achieving UHC. Strong PHC has been associated with better population health outcomes, including lower infant and maternal mortality, reduction of mortality from heart and cerebrovascular diseases, reduced hospitalizations, and lower premature deaths from asthma, heart and cerebrovascular diseases, and pneumonia (Macinko *et al.* 2003; Starfield 2012; Macinko and Guanais 2015). Countries that have successfully expanded PHC have achieved UHC with improved health system outcomes (Tangcharoensathien *et al.* 2011; Atun *et al.* 2013, 2015). Yet, PHC is far from universal and from being adequately provided worldwide (Travis *et al.* 2004; Starfield 2010; Stigler *et al.* 2013).

The Unified Health System (*Sistema Único de Saúde*—SUS), launched in 1988, was designed as a public policy to freely deliver healthcare services to the Brazilian population, also aiming to overcome health inequities in Brazil (Grignolati *et al.* 2013). PHC is delivered by SUS through the Family Health Strategy (FHS) (Box 1). Created in 1994, by 2015 the FHS covered almost 123 million individuals (63% of the Brazilian population).

Ecological studies showed that the FHS was associated with significant declines in infant mortality, both at municipal and state levels (Macinko *et al.* 2006; Aquino *et al.* 2009; Rocha and Soares 2010), and with declines in avoidable hospitalizations (Macinko *et al.* 2010; Dourado *et al.* 2011; Ceccon *et al.* 2014). Individual-level analysis, based on a nationally representative survey, showed that individuals covered by the FHS had better healthcare access and utilization compared with individuals without health insurance and not enrolled in the programme (Lima-Costa *et al.* 2013). The FHS was also shown to be associated with reduction in social inequalities in healthcare access (Macinko and Lima-Costa 2012; de Santiago *et al.* 2014; Andrade *et al.* 2015).

Despite the evidence regarding positive effects of the FHS, two decades after its inception coverage gaps remain. In 2012, almost 50% of the Brazilian population did not receive PHC through the FHS. Proposed reasons for this gap include shortage of professionals, municipal budget constraints, lack of proper infrastructure and availability of other healthcare models such as private insurance (d'Avila Viana *et al.* 2008; Machado *et al.* 2008; Giovanella *et al.* 2009; Medeiros *et al.* 2010, de Mendonca *et al.* 2010). However, no comprehensive municipal-level analysis of factors associated with the uptake and the expansion of coverage of the FHS over time has been done.

To address this gap, we assembled a 15-year time-series of municipal-level data from varied sources, and used a multilevel model for change to identify factors associated with the FHS uptake and expansion across 5419 Brazilian municipalities from 1998 to 2012. We considered eight domains of factors that could potentially affect implementation and coverage expansion, namely, economic development, healthcare supply, healthcare needs/access, availability of other sources of healthcare, political context, geographical isolation, regional characteristics and population size.

Methods

Data

We merged data from several publicly available databases to create a longitudinal dataset by Brazilian municipality covering the years 1998 to 2012. In 1998, Brazil had 5507 municipalities, and 58 new ones were created between 1998 and 2012. To facilitate the analysis, we used the 1998 political division as reference, and aggregated data for the 58 new municipalities back into the administrative unit they originated from. We also excluded 88 municipalities that had only missing values on mortality records (Supplementary Table S1). Thus, our final analysis used data for 5419 municipalities over the 15-year study period covering a population of 191 950 364 inhabitants (99.8% of the total population).

Information on our main outcome variable, proportion of the population covered by the FHS, was obtained directly from the Brazilian Ministry of Health website. As data are available monthly, we extracted information using July (mid-year period) as the temporal reference. Although the Federal Government launched FHS in 1994, data are available only from 1998 onward. This is not a major

Box 1: Characteristics of the FHS in Brazil

The FHS uses a community-based approach. Healthcare services are provided by a team that comprises one physician, one nurse, one nurse assistant and up to six community health agents. Some teams may also include a dentist and two assistants. Each family health team is responsible for providing care for a maximum of 4000 people, all living in a defined geographic catchment area.

Usually, family health teams are based in health units, which should have adequate infrastructure to provide ambulatory care. These units are the primary care reference centre for the population living in the catchment area. In higher density areas more than one team can be located in the same health unit. Community health agents play a crucial role, acting as a bridge between health units and the population. Each household should be visited at least once per month by community health agents, who are responsible for household enrolment and data collection, for the identification of potential risk factors, for monitoring the availability and uptake of prescriptions, and for scheduling visits to the family health units (as needed).

The FHS follows a decentralized healthcare model, in which the responsibility for management and provision of health rests with the local levels of government (who are more aware of their own healthcare needs). Therefore, municipalities are responsible for the overall management of primary care, including contracting and paying healthcare providers, and managing and supplying adequate infrastructure. Ultimately, the implementation and progressive coverage expansion of the FHS rests on the Mayor.

The financing scheme of the FHS, created in 1998, uses a framework of incentives, as established by PAB, with two components (Brasil. Ministério da Saúde. Secretaria Executiva 2001). First, each municipality receives a fixed amount from the federal government, based on the number of inhabitants, to finance primary care expenses. Until 2012, this fixed amount was the same for all municipalities. Starting in 2013, this amount varied from US$10 to US$12 per year per capita, depending on the socio-economic conditions of municipalities (better off municipalities receive less) (Brasil 2013). Second, municipalities receive a variable amount conditioned on performance indicators, and on the development of some PHC programmes, such as the FHS. For instance, in 2012, the variable amount for each family health team was set monthly from approximately US$3500 to US$5400 depending on the type of the team (Mendes and Marques 2014). All money transfers from the federal government to municipalities are conditioned on the performance of municipalities in the management of PHC that is monitored through information systems and regulation mechanisms.

study limitation, as municipalities needed time to hire professionals to work in family health teams. By 1998, the FHS covered 4.4% of the Brazilian population.

Factors that could be associated with the uptake and expansion of the FHS were grouped into eight domains: economic development, level of healthcare supply, healthcare needs/access, availability of other sources of healthcare services, political context, geographical isolation, regional characteristics and population size.

The level of economic development was captured by two variables: municipal gross domestic product (GDP), and proportion of the population covered by *Bolsa Família* (BF). BF is a conditional cash transfer programme implemented in 2003, which unified four pre-existing cash transfer programmes, and targeted families below a defined poverty line, conditioned on compliance with requirements to attend health checks and maintain school-age children in school (Brasil 2004; Lindert *et al.* 2007). Nominal GDP for each municipality (current prices for the years 1999 to 2012) was obtained from the Brazilian Institute of Geography and Statistics (IBGE) (IBGE 2015g), and deflated using the implicit price deflator (IBGE 2015d). GDP for 1998 was estimated using the growth rate observed between years 1999 and 2000. We hypothesize that municipal GDP can be associated with the FHS coverage through at least two mechanisms. First, richer municipalities might have better means to implement and expand FHS, considering that they are likely to have more financial resources and better supply of healthcare providers (Scheffer 2013). Second, poorer municipalities, while more likely to be constrained on financial resources and infrastructure, may be more prone to implement social policies given the potential to improve local welfare with proper interventions.

The proportion of the population covered by conditional cash transfer was calculated using two sources. First, data on the number of families covered by BF were extracted from the Brazilian Social Development Ministry (Ministério do Desenvolvimento Social, 2015)—although BF was created in 2003, data are available only from 2004. Second, from IBGE we obtained data on (i) average number of people per household, as reported by 2000 and 2010 National Population Censuses (IBGE 2015a,b), and by the 2007 National Population Mid-Census Count (IBGE 2015c); and (ii) annual estimates of population by municipality. To obtain the proportion of the population covered by BF in each municipality, we multiplied the number of families covered by the average household size, and then divided the results by the estimated population. Since average household size is available only for 2000, 2007 and 2010, and considering that no substantial population structure changes were observed over the study period, the household size in year 2000 was used to calculate the variable for years 2004 to 2006; 2007 data was used for years 2007 to 2009; and 2010 data was used for years 2010 to 2012. Besides being a proxy for poverty, we hypothesize that the expansion of BF could have a learning effect for Mayors, since it is a municipal decision to implement a national registry that makes it possible for individuals to apply for the cash transfer benefit.

Healthcare supply was measured by two variables: number of doctors per 1000 inhabitants, and number of hospital beds per 1000 inhabitants (excluding psychiatric beds). Two sources were combined to generate these variables for the 15-year period. First, the Medical Sanitary Assistance Survey (IBGE 2015e), collected by IBGE in 1999, 2002 and 2005. Since no dramatic changes were observed in these variables in the three survey years, 1999 data was applied to years 1998 and 1999; 2002 data applied to years 2000 to 2002, and 2005 data applied to years 2003 to 2005. Second, the National Registry of Health Establishments (CNES) (Ministerio da

Saúde 2015a) provided annual data for years 2006 to 2012. CNES gathers detailed data on all health establishments and providers that supply healthcare services in the country, both public and private. Monthly update of CNES data is mandatory to all establishments, and necessary for disbursement of federal funds for payment. Here we hypothesize that shortage of healthcare professionals and infrastructure are negatively associated with the FHS uptake.

The geographical isolation of municipalities is related to the availability of healthcare professionals. Two variables were used to measure isolation: distance to the closest municipality with a hospital having >100 beds, and population density. A map of municipalities was obtained from IBGE, and the SIRGAS 2000-Mercator geographical projection was used to facilitate calculation of distances without distortions (IBGE 2008). Data on total population and hospitals with >100 beds were mapped, and population densities (per km^2) and distances (in km) were calculated using ArcGIS 10.2 (ESRI; Redlands, CA).

The proportion of deaths with ill-defined cause was used as a proxy variable in the healthcare needs/access domain. We assumed that the proportion of deaths with ill-defined cause captures not only the local ability to organize healthcare services, but also population health status (Santo 2008). Thus, communities that have a high proportion of deaths with ill-defined cause are expected to have lower access to healthcare services and consequently lower health status. The total number of deaths and the number of deaths with ill-defined causes were extracted from the Mortality Information System available through the Ministry of Health website (Brasil. Ministério da Saúde 2015).

The Brazilian Health System is a mixed system, with the private sector playing an important role in the financing and supply of healthcare services—in 2013, 28% of the Brazilian population had private health insurance (IBGE 2015f). Therefore, it is crucial to assess the extent to which competing sources of healthcare may impose barriers to the expansion of the FHS. We obtained data on the number of people covered by private insurance from the Brazilian Regulatory Agency (Agência Nacional de Saúde Suplementar 2015) for years 2004 to 2012. Unfortunately, no reliable data were available prior to 2004.

The political context considered the party affiliations of Mayors, state Governors and the President in each time period, available through the Superior Electoral Tribune website (Tribunal Superior Eleitoral 2015), and the Survey of Municipal Information (IBGE 2004–2012). Two dummy variables were considered: one indicating if the Mayor's party was the same as the state Governor's, and the other indicating if the Mayor's party was the same as the President's. Since the Mayor is responsible for the FHS implementation, we assume that political party alignment may act as an incentive to expand the FHS.

To account for regional characteristics, we included 27 dummy variables, one for each of the federal units (or states) in the country. Lastly, the population size domain was expressed by five dummy variables that categorized the size of each municipality in 1998, the initial period of analysis: <5000 inhabitants, 5000–9999 inhabitants, 10 000–19 999 inhabitants, 20 000–49 999 inhabitants and 50 000 or more inhabitants.

Statistical analysis

Density curves of the FHS coverage were represented by Epanechnikov kernel density estimators, and the bandwidth was optimized utilizing the function kdensity in STATA v.12 (Stata Corp., College Station, TX, USA).

In order to investigate factors associated with the FHS implementation and expansion in Brazil, we used a longitudinal multilevel model for change considering the municipality as the unit of analysis (Singer and Willet 2003). This model allows addressing the within-municipality changes in FHS coverage (first level), and the between-municipality differences in FHS coverage change (second level). The multilevel model is advantageous because FHS coverage depends not only on municipal characteristics but also on public policies developed at the state and federal level. Therefore, the multilevel model allows for the estimation of changes in FHS coverage taking into account the trajectory of each municipality but also the differences among them.

The two levels are collapsed into one composite model, assuming a linear functional form:

$$y_{it} = \left[\gamma_{00} + \gamma_{10}\text{time}_{it} + \boldsymbol{\alpha}^{\boldsymbol{k}}\boldsymbol{X}_{it} + \boldsymbol{\beta}^{\boldsymbol{k}}(\boldsymbol{Z}_{it}\text{time}_{it})\right] + [\zeta_{0i} + \zeta_{1i}\text{time}_{it} + \varepsilon_{it}]$$

where y_{it} is the proportion of the population covered by the FHS in the municipality i at time t; γ_{00} is the average initial status of the FHS coverage; γ_{10} is the conditional rate of change of FHS coverage; time represents the years of analysis, and is centred on 1998 (the first year of the time-series) so that model estimates represent initial status; $\boldsymbol{\alpha}^{\boldsymbol{k}}$ is a vector of coefficients for each of the k covariates included in the model affecting the initial status; $\boldsymbol{X}_{it}$ is the vector of k covariates affecting the initial status; $\boldsymbol{\beta}^{\boldsymbol{k}}$ is a vector of coefficients for each of the k covariates included in the model affecting the rate of change; $\boldsymbol{Z}_{it}$ is the vector of k covariates affecting the rate of change; ε_{it} represents the residuals of the first level, and indicates the fraction of the proportion of the population covered by the FHS in municipality i that is unpredicted on occasion t; lastly, ζ_{0i} and ζ_{1i} are residuals of the second level, and indicate the portion of initial status and rate of change of the proportion of the population covered by the FHS, respectively, not explained by the model. The coefficients in the first bracket are the fixed effects. They describe separately the effects of the predictor variables in the initial status (FHS uptake) and in the rate of change (FHS coverage expansion).

Three different sets of models were run. The first used data from years 1998 to 2012 and included variables from all eight domains detailed earlier, except for the proportion of people covered by the conditional cash transfer, and the proportion of people with private health insurance, since these two variables do not have data prior to 2004. The second included all variables from years 2004 to 2012. Lastly, we run models stratified by population size of the municipality in 1998 (five different sets of models, as categorized by the population size dummies previously described). Each of the three sets of models included an unconditional means model, an unconditional growth model and additional models in which each covariate was included at a time. The unconditional means model does not include any predictor and allows quantifying the relative magnitude of the within and between variance components. The unconditional growth model includes time as the only predictor variable and allows quantifying the variation in the individual growth parameters. Goodness of fit was analysed using pseudo-R^2 and deviance statistics. All calculations were performed in STATA v.12 (Stata Corp., College Station, TX, USA).

Results

Figure 1 shows the rapid geographic expansion of the FHS considering four selected time points: 1998, 2002, 2008 and 2012. The FHS coverage increased significantly over time; while in 1998, 50% of

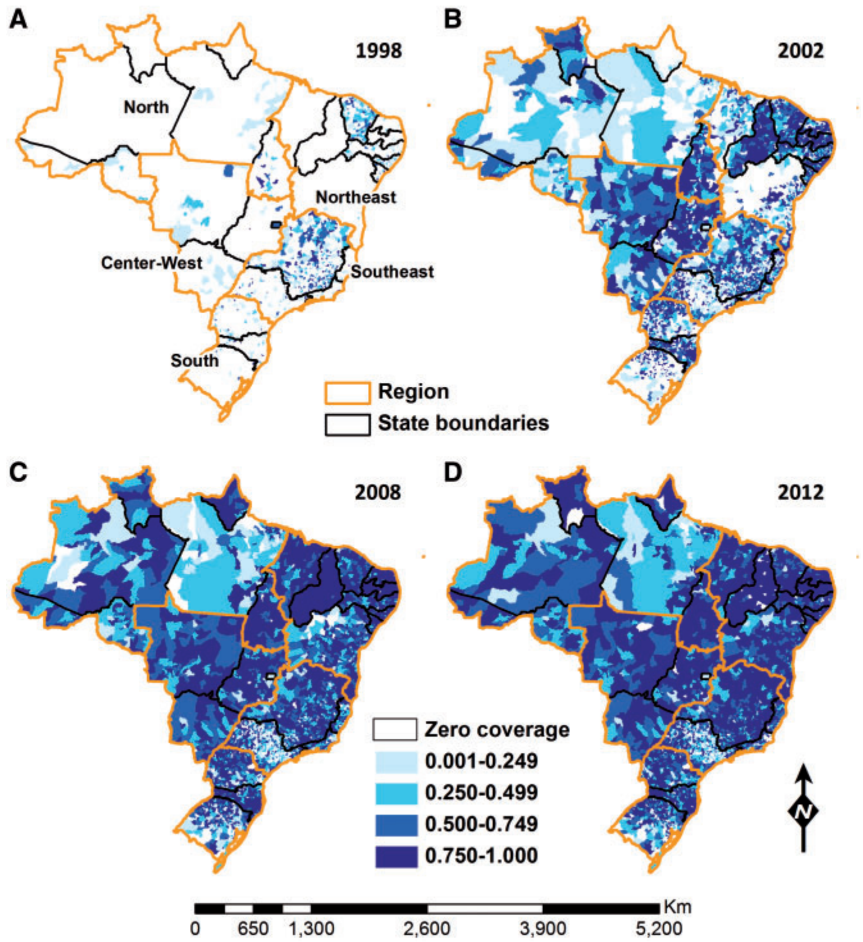

Figure 1. Proportion of the population covered by the FHS in each Brazilian municipality—1998, 2002, 2008 and 2012. Maps indicate the boundaries of states (federal units) and regions in Brazil

the Brazilian municipalities had not implemented the programme and in 2012, this figure was only 5%.

Table 1 presents descriptive statistics regarding characteristics of the Brazilian municipalities in the eight domains considered in the analysis, for the years 1998, 2004 and 2012. On an average, the proportion of people covered by the FHS in municipalities was 0.06 in 1998 and 0.81 in 2012. The GDP per capita also grew during the period revealing higher level of local development. The proportion of deaths diagnosed as non-defined registered an important decrease along the period, suggesting improvements in the local healthcare system. The coverage of the conditional cash transfer also expanded from around 22% in 2004 to 36% in 2012. Regarding population size, there is considerable heterogeneity across municipalities, and it persists over time. The supply of hospital beds per 1000 inhabitants decreased from 2.32 in 1998 to 1.82 in 2012. This decrease is a reflection of a reorganization in the health system that started in the end of the 1990s, resulting in a reduction in the number of small hospitals and of psychiatric beds (Boing *et al.* 2012; Mendes *et al.* 2012; Duarte and Garcia 2013). In contrast, the number of doctors per 1000 inhabitants increased from 1.15 in 1998 to 2.11 in 2012 (Grignolati *et al.* 2013).

Figure 2 shows the density curves of the FHS coverage across municipalities, stratified by five regions of Brazil (South, Southeast, North, Northeast and Centre-West) in four selected time points: 1998, 2002, 2008 and 2012. In 1998, the majority of municipalities had not launched the FHS and thus the distribution was highly concentrated near zero. Four years later, the distribution became bimodal (with the exception of the Centre-West region), indicating two distinct groups of municipalities: (i) 'early adopters', which had near full coverage, and (ii) 'laggards', in which the FHS was either not implemented or had coverage lower than 20%. The expansion of FHS coverage continued, and by 2012 the distribution was skewed toward high levels of coverage, albeit with a long left tail indicating remaining gaps. The Northeast region had the fastest FHS uptake, reaching near universal coverage in 2012. In contrast, the North, South and the Southeast regions still had major coverage gaps.

The FHS coverage expansion also showed distinct patterns considering the size of the municipality. Figure 3 shows coverage expansion according to population size and stratified by regions. Smaller municipalities tended to reach >80% coverage by 2012 regardless of region, whereas medium and larger municipalities had a slower pace in coverage expansion. The Northeast was the only region to present a different pattern for large municipalities, as it reached around 70% coverage in 2012. The period of fastest expansion occurred from 1998 to 2002, regardless of the size of the municipality. On an average, FHS coverage increased by 590.7% between 1998 and 2002, and by 77.8% between 2002 and 2012.

Density curves for the FHS coverage by population size also revealed important differences (Figure 4). The largest coverage gap remains among municipalities with population size equal to 50 000 or more inhabitants, reflecting both a slow pace in the initial uptake

Table 1. Selected characteristics of Brazilian municipalities ($N = 5419$)—1998, 2004 and 2012

Variables	1998			2004			2012		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Proportion of population covered by the FHS	0.06	0.19	0	0.64	0.38	0.76	0.81	0.29	1.00
Population size	29 392	177 686	10 316	32 565	193 873	10 787	35 422	207 281	11 382
Hospital beds per 1000 inhabitants	2.32	2.74	1.87	1.96	2.77	1.57	1.82	2.12	1.45
Population density (inhabitants per km^2)	91.60	498.88	23.47	102.31	547.92	24.18	110.88	581.53	24.73
Distance to closest municipality with a hospital having ≥100 beds (km)	40.20	43.59	29.88	44.97	43.98	34.80	43.13	43.55	32.50
Municipal GDP per capita (R$)	25 372	27 183	19 020	32 743	39 076	24 540	37 944	42 716	29 358
Proportion of deaths with ill-defined cause	0.28	0.24	0.20	0.20	0.19	0.14	0.09	0.09	0.06
Doctors per 1000 inhabitants	1.15	1.51	0.95	1.85	1.55	1.52	2.11	1.92	1.47
Proportion of population covered by 'Bolsa Familia'	—	—	—	0.22	0.15	0.18	0.36	0.22	0.31
Proportion of population with private health insurance coverage	—	—	—	0.05	0.09	0.02	0.08	0.12	0.04

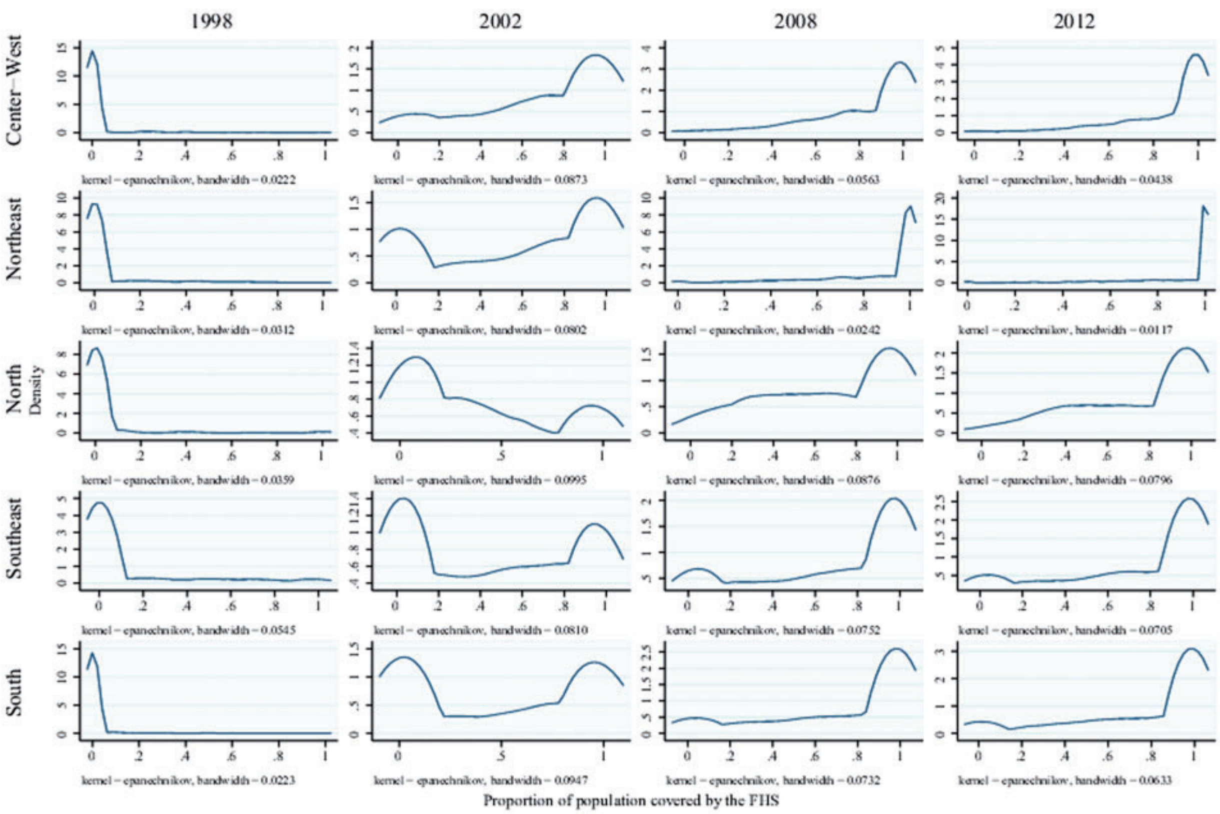

Figure 2. Density curves of the FHS coverage across Brazilian municipalities stratified by regions—1998, 2002, 2008 and 2012. Density curves are represented by Epanechnikov kernel density estimators. The bandwidth estimation is shown below each curve

of the programme, and a slow expansion of coverage. In 2012, 49.4% of the population in larger municipalities was covered by the FHS, while in the smallest municipalities the figure was 90.1%. The bimodal pattern revealed in the regional analysis was also observed for municipalities with <20 000 people.

Table 2 shows the results for the first set of longitudinal multilevel models for change including data from years 1998 to 2012 (Supplementary Table S2—Supplementary File S2 has the taxonomy of all models tested). The unconditional means model (Model A) indicated that 68% of the variation in FHS coverage was attributable to differences within municipalities (within variance = 0.1176 divided by total variance = 0.1728). The unconditional growth model estimated that 55% of the within-municipality variation in FHS coverage was associated with changes over time (within variance reduced from 0.1176 to 0.0527). Population size was inversely associated with both the initial uptake and the expansion of the programme—larger municipalities tended to start with a lower coverage level and to progress with a slower rate of change. Regarding the magnitude of the coefficients, population size presented a strong and monotonic effect for the programme uptake. A small municipality started the programme with a coverage level 25% higher than a municipality with >50 000 people. These findings corroborate the pattern shown in Figures 3 and 4.

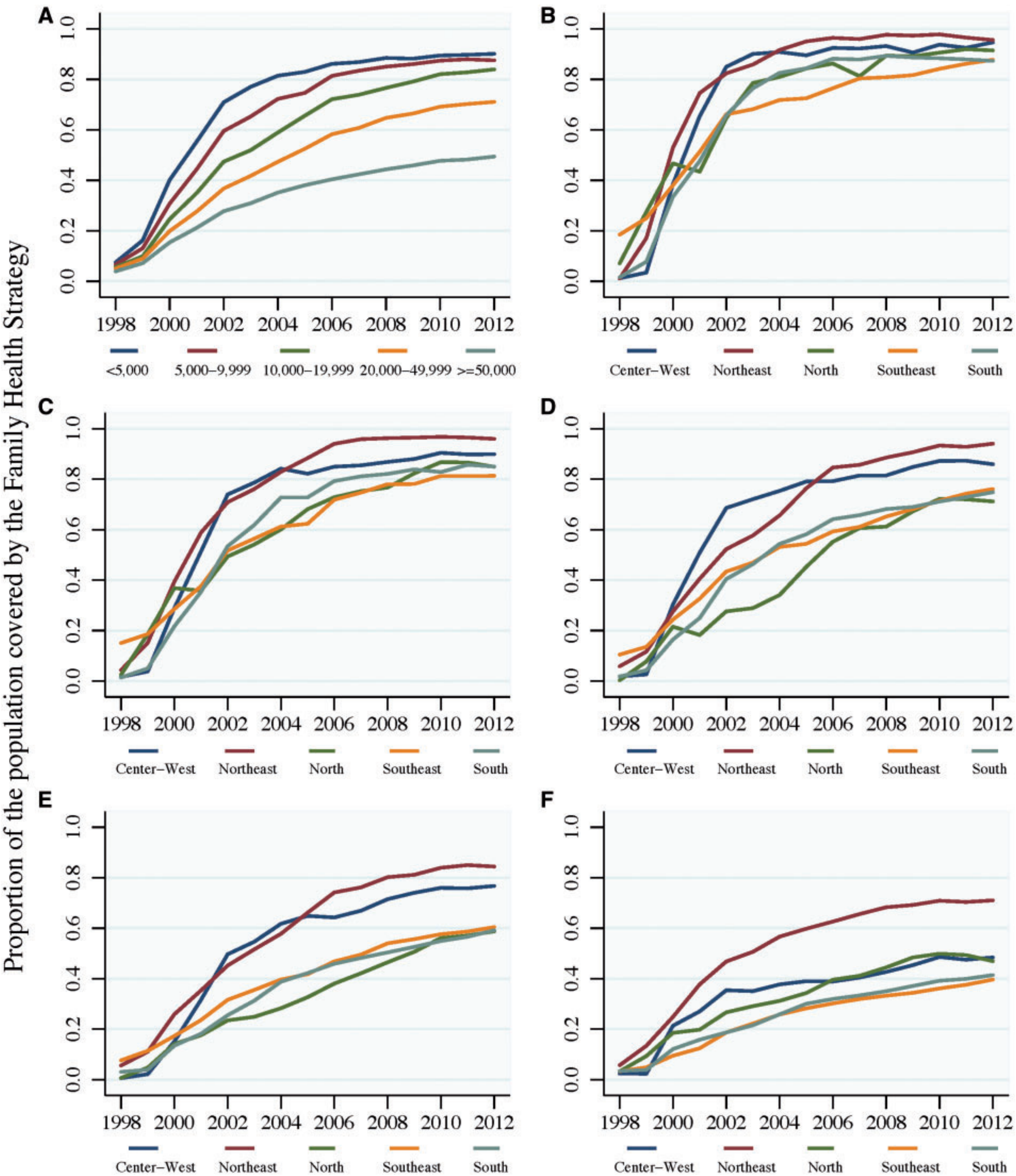

Figure 3. Annual distribution of the FHS coverage by population size of the municipality and Brazilian regions, 1998 to 2012. (a) FHS coverage by population size of the municipality in 1998. (b) FHS coverage by regions for municipalities with less than 5000 people; (c) FHS coverage by regions for municipalities with 5000 to 9999 people; (d) FHS coverage by regions for municipalities with 10 000 to 19 999 people; (e) FHS coverage by regions for municipalities with 20 000 to 49 999 and (f) FHS coverage by regions for municipalities with 50 000 people or more

Political party alignment of Mayors and Governors favoured both the adoption and the expansion of the programme, whereas Mayor-President alignment was only important for the rate of change. Municipalities with higher gaps in healthcare access (as measured by the proportion of ill-defined causes of death) showed a negative association with uptake of the FHS, indicating difficulties in starting the programme; in contrast, political alignment was associated with a faster coverage expansion. Also important both for adoption and expansion of the FHS coverage were regional characteristics (results not shown); state dummy variables were positive and significant for 13 states, 8 of them in the Northeast region, which experienced faster implementation of the FHS, and attained almost universal coverage (Figure 2).

The second set of models, including data from years 2004 to 2012, is shown in Supplementary Table S3 (Supplementary File S3 has the taxonomy of models tested). Although the FHS coverage in

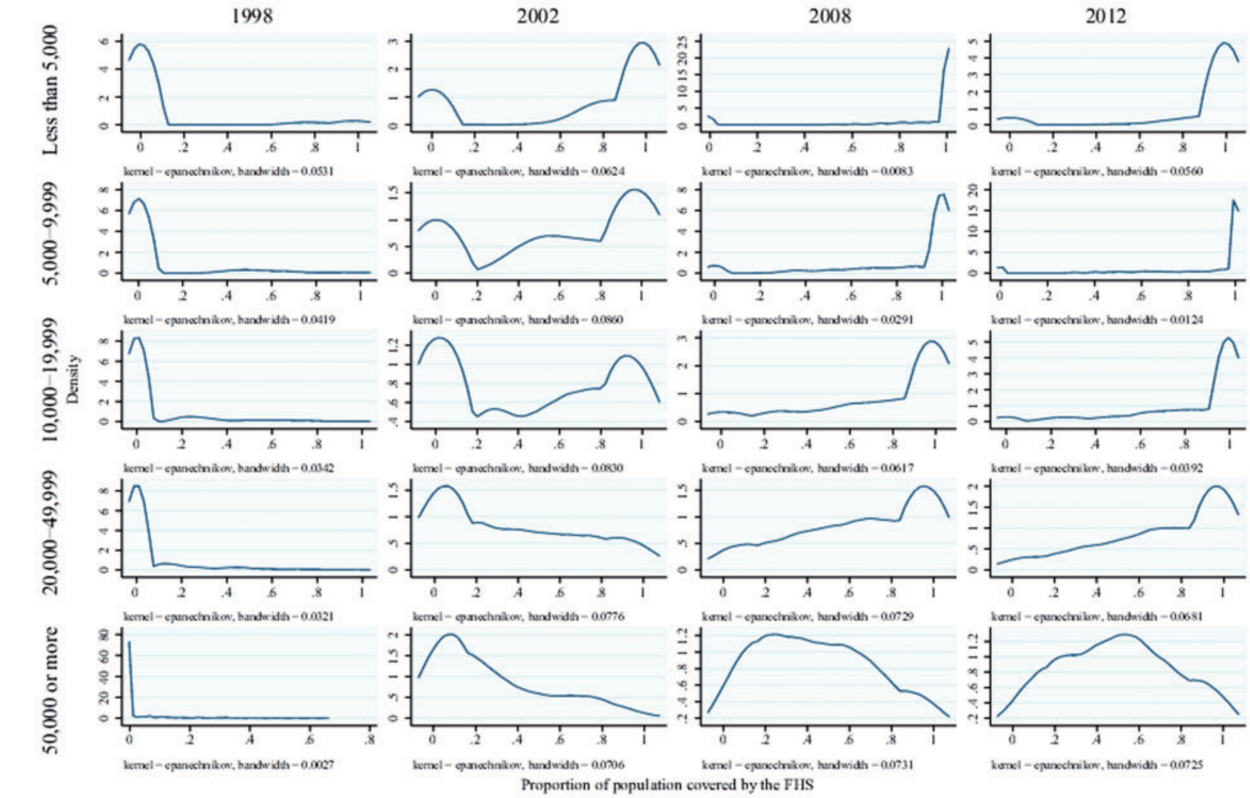

Figure 4. Density curves of the FHS coverage across Brazilian municipalities stratified by population size—1998, 2002, 2008 and 2012. Density curves are represented by Epanechnikov kernel density estimators. The bandwidth estimation is shown below each curve

Brazil was already 38.3% in 2004 (compared with only 4.4% in 1998), the goal of this set of models was to assess the possible association of poverty and private health insurance with the FHS coverage. Here, only 28% of the variation in FHS coverage was attributable to differences within municipalities, and 39% of the within-municipality variation in FHS coverage was associated with changes over time. The proportion of the population receiving the conditional cash transfer was positively associated with FHS coverage levels in 2004, but inversely associated with the rate of change. This contrast in the coefficients is not unexpected: since municipalities with a high proportion of the population receiving cash transfers are likely to be the poorest, their FHS coverage was already high in 2004 (since they experienced fast expansion—Table 2). With regards to private health insurance, a negative rate of change coefficient suggests that this factor is a disincentive for the FHS expansion.

The third set of models, including data from years 1998 to 2012 and stratified by population size, did not reveal significant differences from the models discussed above except for the political context (Supplementary Table S4—Supplementary File S4). The political party alignment between Mayors and Governors was only significant for municipalities with less than10 000 inhabitants. Dummy variables for Brazilian regions reinforced some findings shown in Figure 3. Most importantly, the Northeast region undertook a major effort to implement the programme in all municipalities, regardless of size.

With regards to model goodness of fit, the pseudo-R^2 showed that each set of models explained a significant portion of the variability in FHS coverage. In addition, the deviance statistic indicates that the final models shown in Tables 2 and 3 are the best fit among the taxonomy of models tested (Tables S2 and S3).

Discussion

From 1998 to 2012, the uptake and coverage expansion of the FHS in Brazilian municipalities was not homogeneous, with density curves of coverage indicating two distinct groups of municipalities: (i) early adopters, mostly smaller municipalities in less developed areas; and (ii) laggards, mostly larger municipalities.

By 2012, 54% of the national population was covered by the FHS, and 58% of the municipalities had coverage of 95% or more. The longitudinal change models showed that important factors associated with the uptake and expansion of the programme included population size, regional characteristics, availability of other sources of healthcare, political alignment between the Mayor and the state Governor, and healthcare needs.

An important aspect related to FHS uptake is financing (de Sousa and Hamann 2009; Mendonca 2009). The financial mechanisms that allowed municipalities to implement the FHS were introduced by the Federal Government in 1998, 4 years after the FHS was launched, creating incentives/opportunities for Mayors to adopt the programme. Indeed, while in 1998 the national FHS coverage was lower than 5%, it increased by 60% from 1998 to 1999, and by 128% from 1998 to 2000. However, while the *Piso da Atenção Básica* (PAB) financing mechanism may have acted as an incentive to facilitate FHS uptake, it raises concerns of sustainability over time as municipalities are responsible for an important part of PHC expenditure, which may cause instabilities and discontinuities in these policies (Mendes and Marques 2014).

The size of the municipal population had a larger effect on the initial FHS coverage and on FHS expansion over time. More populous municipalities, compared with smaller ones, tended to start FHS with a lower level of coverage, and to expand it slowly. Here, it

Table 2. Multilevel longitudinal models of change considering data for the period 1998–2012

Variables	Model A			Model B			**Full model**[a]		
	Coefficient	*P*-value	Conf. interval	Coefficient	*P*-value	Conf. interval	Coefficient	*P*-value	Conf. interval
Fixed effects									
Initial status									
Intercept	0.5802	<0.001	[0.5735; 0.5869]	0.2147	<0.001	[0.2073; 0.2220]	−0.2374	0.21	[−0.6103; 0.1355]
Municipal GPD per capita (R$10 000)							0.0162	<0.001	[0.0144; 0.0180]
Number of doctors per 1000 inhabitants							0.0247	<0.001	[0.0220; 0.0276]
Distance to closest munic. with 100 beds							0.0004	<0.001	[0.0003; 0.0006]
Population density (per 10 000 inhabitants)							−0.1396	0.04	[−0.2766; −0.0026]
Political alignment									
Mayor-Governor							0.0090	0.05	[−0.0002; 0.0182]
Mayor-President							−0.0084	0.13	[−0.0193; 0.0025]
Prop. of deaths with ill-defined cause							−0.5463	<0.001	[−0.5667; −0.5260]
Population size									
Less than 5000							0.2547	<0.001	[0.1384; 0.1946]
5000–9999							0.1665	<0.001	[0.0710; 0.1264]
10 000–19 999							0.0986	<0.001	[0.0209; 0.0786]
20 000–49 999							0.0497	<0.001	[0.0498; 0.0147]
Rate of change									
Intercept				0.0522	<0.001	[0.0515; 0.0529]	0.0356	<0.001	
Municipal GPD per capita (R$10 000)							−0.0014	<0.001	[−0.0016; −0.0012]
Number of doctors per 1000 inhabitants							−0.0025	<0.001	[−0.0028; −0.0021]
Distance to closest munic. with 100 beds							−0.0001	<0.001	[−0.0001; −0.0001]
Population density (per 10 000 inhabitants)							−0.0115	0.10	[−0.0253; 0.0023]
Political alignment									
Mayor-Governor							0.0011	0.07	[−0.0001; 0.0023]
Mayor-President							0.0027	<0.001	[0.0011; 0.0044]
Prop. of deaths with ill-defined cause							0.0859	<0.001	[0.0827; 0.0890]
Population size									
Less than 5000							0.0127	<0.001	[0.0097; 0.0159]
5 000–9999							0.0146	<0.001	[0.0115; 0.0177]
10 000–19 999							0.0133	<0.001	[0.0103; 0.0164]
20 000–49 999							0.0070	<0.001	[0.0039; 0.0102]
Variance components									
Level 1 Within σ		0.1176			0.0527			0.0489	
Level 2 Rate of change					0.0005			0.0005	
Initial status		0.0552			0.0635			0.0488	
Covariance					−0.0021			−0.0029	
Goodness of fit									
Pseudo-R^2								0.4668	
Deviance		67 970.1			13 951.7			5847.4	
Test deviance					54 018.4			114.7	
Observations		5419			5419			5419	

[a]Includes 27 dummy variables, one for each federal unity (results now shown).

Table 3. Multilevel longitudinal models of change considering data for the period 2004–2012

Variables	Model A			Model B			Full model[a]		
	Coefficient	P-value	Conf. interval	Coefficient	P-value	Conf. interval	Coefficient	P-value	Conf. interval
Fixed effects									
Initial status									
Intercept	0.7488	<0.001	[0.7412; 0.7565]	0.5363	<0.001	[0.5221; 0.5506]	−0.0965	0.63	[−0.5150; 0.3220]
Municipal GPD per capita (R$10 000)							0.0078	<0.001	[0.0048; 0.0107]
Number of doctors per 1000 inhabitants							−0.0157	<0.001	[−0.0219; −0.0096]
Distance to the closest munic. with 100 beds (kms)							−0.0004	<0.001	[−0.0006; −0.0001]
Population density (10 000 inhabitants/km^2)							−0.126	0.32	[−0.0375; 0.0124]
Political alignment									
Mayor-Governor							−0.0186	0.02	[−0.0347; −0.0025]
Mayor-President							−0.0229	0.14	[−0.0528; 0.0072]
Proportion of deaths with non-defined cause							−0.4658	<0.001	[−0.5170; −0.4149]
Population size									
Less than 5000							0.4572	<0.001	[0.4009; 0.5136]
5000–9999							0.3098	<0.001	[0.2536; 0.3660]
10 000–19 999							0.1398	<0.001	[0.0847; 0.1950]
20 000–49 999							0.0351	0.21	[−0.0216; 0.0919]
Prop. population covered by BF							0.4082	<0.001	[0.3584; 0.4582]
Prop. population with private health insurance							0.1153	0.13	[−0.0333; 0.2641]
Rate of change									
Intercept				0.0213	<0.001	[0.0202; 0.0223]	0.0177	<0.001	[0.0126; 0.0229]
Municipal GPD per capita (R$10 000)							−0.0005	<0.001	[−0.0007; −0.0002]
Number of doctors per 1000 inhabitants							0.0017	<0.001	[0.0011; 0.0023]
Distance to the closest munic. with 100 beds (km)							0.0001	0.03	[0.0000; 0.0001]
Population density (10 000 inhabitants)							−0.0044	0.60	[−0.0024; 0.0015]
Political alignment									
Mayor-Governor							0.0017	0.04	[0.0001; 0.0034]
Mayor-President							0.0025	0.09	[−0.0004; 0.0055]
Proportion of deaths with non-defined cause							0.0424	<0.001	[0.0368; 0.0480]
Population size									
Less than 5000							−0.0083	<0.001	[−0.0129; −0.0037]
5000–9999							−0.0002	0.93	[−0.0047; 0.0044]
10 000–19 999							0.0089	<0.001	[0.0044; 0.0134]
20 000–49 999							0.0088	<0.001	[0.0043; 0.0134]
Prop. population covered by BF							−0.0242	<0.001	[−0.0292; −0.0191]
Prop. population with private health insurance							−0.0279	<0.001	[−0.0403; −0.0156]
Variance components									
Level 1 Within σ		0.0317			0.0192			0.0188	
Level 2 Rate of change					0.0012			0.0011	
Initial status		0.0792			0.2529			0.1931	
Covariance					−0.0147			−0.0130	
Goodness of fit									
Pseudo-R^2								0.3585	
Deviance		−12 776.9			−26 314.0			−30 668.1	
Test deviance					13 537.2			4354.1	
Observations		5419			5419			5419	

[a]Includes 27 dummy variables, one for each federal unity (results now shown).

is important to reflect on the FHS design: each family health team is expected to cover up to 4000 people. In order to expand, and eventually achieve universal coverage, more populous municipalities have to contract a larger number of professionals to form family health teams, and must manage the family health units where those teams are based. This suggests the presence of important diseconomies of scale in programme management. In addition, larger municipalities often show heterogeneity in the supply of primary care (d'Avila Viana *et al.* 2008; Machado *et al.* 2008), and are likely to have a high percentage of the population covered by private health insurance. To address these difficulties, in December 2003 the government sought World Bank financing for the Family Health Extension Program (PROESF—*Programa de Expansão e Consolidação do Saúde da Família*) (World Bank 2007) to expand FHS coverage in municipalities with >100 000 inhabitants. By 2007, FHS coverage in 184 municipalities included in PROESF increased to 34.4% from 25.7% in 2003 (World Bank 2007; Coutolenc and Dmytraczenko 2013). However, analysis is needed to assess if the coverage expansion in these municipalities was significantly different from that observed in municipalities not included in PROESF.

High levels of private health insurance coverage are a major disincentive for Mayors to implement and expand the FHS, as FHS is not the main source of care for middle- and high-income classes (Macinko and Harris 2015), who use the private sector with a larger network of services and shorter waiting times. However, low-income groups may also have access to private insurance through employment benefits. We argue that the dual health system in Brazil is an important obstacle for public primary care and expansion of FHS as Mayors, mainly in larger cities, choose not to implement FHS due to low demand. Further, having multiple primary care providers interrupts continuity of care and undermines the role of the FHS as the gatekeeper of the public system.

High proportion of population receiving BF in municipalities was associated with higher FHS coverage in 2004 but inversely associated with the rate of change. This suggests that municipalities with high BF levels may not only demand more social programmes but may be more likely to implement them. With FHS, the marginal benefits are higher, as poor municipalities only have public primary care. The supply of primary care will not only improve population welfare, but also improve a Mayor's political support. The negative coefficient of the rate of change is most likely a consequence of the high level of coverage already observed for these municipalities in 2004; the higher the level of coverage, the harder it is to further increase it.

The role of political incentives is reinforced by the findings of a positive effect of the political alignment between the Mayor and the Governor on the FHS implementation. Yet, this effect was only observed for municipalities with <10 000 inhabitants. Note that, in Brazil, although municipalities are responsible for the provision of primary care, policies and regulation mechanisms are defined and managed by federal units (Ministério da Saúde 2002). Hence, political alignment between the Mayor and the Governor can make municipal management of primary care easier. For larger municipalities, this alignment is not so important because they are more able to develop their policies and therefore more policy-independent from federal units.

The presence of important regional differences in the country is corroborated by the fact that dummy variables for each of the 27 federal units explained a high percentage of the variance in the FHS coverage. In fact, FHS expansion presented a different pattern in the Northeast region, particularly for bigger municipalities, indicating that FHS is a policy priority in this region. The effort to expand PHC coverage in the Northeast is probably related to the likelihood of achieving higher marginal benefits, compared with other regions that have better socio-economic indicators (Medici 1994; Rocha 1998).

The supply of family doctors is undoubtedly one of the most important challenges for achieving higher levels of FHS coverage. In 2013, the Brazilian Government launched the More Doctors Program (*Programa Mais Médicos*) aimed at increasing the number of family doctors in underserved regions of the country (such as interior/remote areas, and suburbs of the main cities). Short-term measures included regulations for international medical exchange with the arrival in Brazil of foreign physicians, particularly Cuban professionals. Long-term measures include increasing the availability of medical training, and improving incentives for health professionals to work in underserved areas (Ministerio da Saúde 2015b). Over 2 years, >18 000 Brazilian and foreign physicians were deployed to over 4 000 municipalities.

To the best of our knowledge, this is the first study to examine the mechanisms associated with the FHS implementation and expansion across Brazilian municipalities, utilizing 15 years of data. The study has many strengths. First, it used the longest time-series and the most detailed spatial scale for which FHS data are publicly available. Second, it gathered and merged data from varied sources in order to capture a multitude of domains that could affect the uptake and the expansion of the FHS. Third, the unit of analysis, municipality, is also the decision-unit for the FHS, since the choice to adopt/expand the programme rests on the Mayor. Thus, the study results do offer evidence that can inform recommendations aimed at increasing programme coverage.

The main limitations of the study were related to data availability. The 15-year time-series was the longest period of analysis we could undertake, since no data on the FHS coverage are available prior to 1998, and since the majority of the covariates included in the longitudinal model were not available post 2012. Similarly, data on private health insurance were not available prior to 2004. No annual time-series by municipality was available for infant mortality rate and access to sanitation. However, since these two variables can be considered as proxy for poverty, their potential effects were partially assessed with the data on BF cash transfer coverage.

The uptake and expansion of the FHS increased substantially in Brazil from 1998 to 2012. Yet, gaps remain. Small municipalities need financial support to uptake FHS, and are likely to expand coverage faster. They could be helped by federal fund transfers to develop infrastructure and contract personnel for family health teams. In larger municipalities, which have a large network of private healthcare providers, FHS expansion is stymied and policies are needed to achieve a more optimal public-private mix.

Conclusion

Establishing a PHC programme with high coverage is the first step toward achieving UHC. This is the first article to analyze the uptake and expansion of primary care in Brazil through the FHS programme, using longitudinal data. Results show that implementing and scaling up the coverage of primary care in a context of large socioeconomic heterogeneity is feasible, albeit not homogeneous across municipalities, suggesting the need of different policies conditioned on population size and economic development. With regard to funding, small and poorer municipalities are likely to achieve universal care, while larger and wealthier ones often have competing sources of healthcare, which becomes an obstacle to expansion of coverage. In those contexts, policies should include mechanisms that encompass both public and private sectors. These lessons from the Brazilian experience should inform efforts currently being undertaken by other developing countries pursuing universal healthcare.

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Ethical approval

This study was approved by the institutional review board of the Harvard T.H. Chan School of Public Health, Protocol # IRB16-0157.

Supplementary data

Supplementary data are available at *HEAPOL* online.

References

Agência Nacional de Saúde Suplementar. 2015. Indicadores de Saúde Suplementar. Rio de Janeiro: Agência Nacional de Saúde Suplementar (ANS). http://www.ans.gov.br/perfil-do-setor/dados-e-indicadores-do-setor, accessed 30 October 2016.

Andrade MV, Noronha K, Barbosa AC *et al*. 2015. Equity in coverage by the Family Health Strategy in Minas Gerais State, Brazil. *Cadernos de Saúde Pública* **31**: 1175–87.

Aquino R, De Oliveira NF, Barreto ML. 2009. Impact of the family health program on infant mortality in Brazilian municipalities. *American Journal of Public Health* **99**: 87–93.

Atun R, Aydin S, Chakraborty S *et al*. 2013. Universal Health Coverage in Turkey: Enhancement of equity. *The Lancet* **382**: 65–99.

Atun R, De Andrade LOM, Almeida G *et al*. 2015. Health-system reform and Universal Health Coverage in Latin America. *The Lancet* **385**: 1230–47.

Boing AF, Vicenzi RB, Magajewski F *et al*. 2012. Reduction of ambulatory care sensitive conditions in Brazil between 1998 and 2009. *Revista de Saúde Pública* **46**: 359–66.

Brasil. 2004. Decreto n° 5.209, de 17 de setembro de 2004—Regulamenta a Lei 010.836-2004—Programa Bolsa Família. http://www.mds.gov.br/webarquivos/legislacao/bolsa_familia/decreto/decreto_no_5209_de_17.09.2004-1.pdf, accessed 11 April 2016.

Brasil. 2013. Ministério da Saúde. Portaria MS/GM, n1409, de 10 de julho de 2013. Define o valor minimo da parte fixa do Piso de Atenção Basica (PAB) para efeito do cálculo do montante de recursos a ser transferido do Fundo Nacional de Saúde aos Fundos do dos Municípios e do Distrito Federal

Brasil. Ministério da Saúde. 2015. Sistema de Informações sobre Mortalidade (SIM). Brasília, DF: Ministério da Saúde. http://www2.datasus.gov.br/DATASUS/index.php? area=0205&id=6937&VObj=http://tabnet.datasus.gov.br/cgi/deftohtm.exe? sim/cnv/obt10, accessed 30 October 2016.

Brasil. Ministério da Saúde. Secretaria Executiva. 2001. Programa de Atenção Básica (PAB): parte física. 32.

Ceccon RF, Meneghel SN, Viecili PR. 2014. Hospitalization due to conditions sensitive to primary care and expansion of the Family Health Program in Brazil: An ecological study. *Revista Brasileira de Epidemiologia* **17**: 968–77.

Coutolenc B, Dmytraczenko T. 2013. Brazil's primary care strategy. In: Bank W (ed). *Universal Health Coverage Studies—UNICO*. Washington DC: World Bank.

d'Avila Viana AL, Rocha JS, Elias PE, Ibanez N, Bousquat A. 2008. Primary health care and urban dynamics in large cities in Sao Paulo State, Brazil. *Cadernos de Saúde Pública* **24 Suppl 1**: S79–90.

de Mendonca MH, Martins MI, Giovanella L, Escorel S. 2010. Challenges for human resources management from successful experiences of Family Health Strategy expansion. *Ciência & Saúde Coletiva* **15**: 2355–65.

de Santiago AX, Barreto IC, Sucupira AC, Lima JW, de Andrade LO. 2014. Equitable access to health services for children aged 5 to 9 in a medium city of northeast of Brazil: A result of Family Health Strategy. *Revista Brasileira de Epidemiologia* **17**: 39–52.

de Sousa MF, Hamann EM. 2009. Family Health Program in Brazil: An incomplete agenda? *Ciência & Saúde Coletiva* **14 Suppl 1**: 1325–35.

Dourado I, Oliveira VB, Aquino R *et al*. 2011. Trends in primary health care-sensitive conditions in Brazil: The role of the Family Health Program (Project ICSAP-Brazil). *Medical Care* **49**: 577–84.

Duarte SL, Garcia MLT. 2013. Psychiatric reform: The path of psychiatric beds reduction in Brazil. *Emancipação* **13**: 39–54.

Giovanella L, de Mendonca MH, de Almeida PF *et al*. 2009. Family health: Limits and possibilities for an integral primary care approach to health care in Brazil. *Ciência & Saúde Coletiva* **14**: 783–94.

Grignolati M, Lindelow M, Coutolenc B. 2013. Twenty years of health system reform in Brazil. In: Bank W (ed). *An Assessment of the Sistema Único de Saúde*. Washington, DC: World Bank.

IBGE. 2004–2012. Perfil dos Municpios Brasileiros. Rio de Janeiro: Instituto Brasileiro de Geografia E Estatistica. http://www.ibge.gov.br/home/estatistica/economia/perfilmunic/default.shtm, accessed 30 October 2016.

IBGE. 2008. Recommendations for relative static GPS surveys. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística, Diretoria de Geociências, Coordenação de Geodésia.

IBGE. 2015a. Censo Demográfico 2000. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística. http://www.ibge.gov.br/home/estatistica/populacao/censo2000/, accessed 30 October 2016.

IBGE. 2015b. Censo Demográfico 2010. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística. http://www.ibge.gov.br/home/estatistica/populacao/censo2010/, accessed 30 October 2016.

IBGE. 2015c. Contagem da População 2007. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística. http://www.ibge.gov.br/home/estatistica/populacao/contagem2007/default.shtm, accessed 30 October 2016.

IBGE. 2015d. Deflator do Produto Interno Bruto Municipal. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística, Sistema de Contas Nacionais. http://seriesestatisticas.ibge.gov.br/series.aspx?no=12&op=0&vcodigo=SCN54&t=deflator-produto-interno-bruto, accessed 30 October 2016.

IBGE. 2015e. Pesquisa Assistência Médico Sanitária. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística. http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/ams/2009/microdados.shtm, accessed 30 October 2016.

IBGE. 2015f. Pesquisa Nacional de Saúde: 2013: acesso e utilização dos serviços de saúde, acidentes e violências: Brasil, Grandes Regiões e Unidades da Federação. Rio de Janeiro: Instituto Brasiliero de Geografia e Estatistica.

IBGE. 2015g. Produto Interno Bruto Municipal. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística, Sistema de Contas Nacionais. http://www.sidra.ibge.gov.br/bda/pesquisas/PIBMun/default.asp, accessed 30 October 2016.

Lima-Costa MF, Turci MA, Macinko J. 2013. A comparison of the Family Health Strategy to other sources of healthcare: utilization and quality of health services in Belo Horizonte, Minas Gerais State, Brazil. *Cadernos de Saúde Pública* **29**: 1370–80.

Lindert K, Linder A, Hobbs J, de la Brière B. 2007. The nuts and bolts of Brazil's Bolsa Família Program: Implementing conditional cash transfers in a decentralized context. *Social Protection Discussion Paper 709*. Washington, DC: World Bank.

Machado CV, Lima LD, Silva Viana L. 2008. Organization of traditional Primary Health Care and the Family Health Program in large cities in Rio de Janeiro State, Brazil. *Cadernos de Saúde Pública* **24 Suppl 1**: S42–57.

Macinko J, Dourado I, Aquino R *et al*. 2010. Major expansion of primary care in Brazil linked to decline in unnecessary hospitalization. *Health Affairs (Millwood)* **29**: 2149–60.

Macinko J, Guanais FC. 2015. Population experiences of primary care in 11 Organization for Economic Cooperation and Development countries. *International Journal for Quality in Health Care* **27**: 442–9.

Macinko J, Guanais FC, de Fatima M, de Souza M. 2006. Evaluation of the impact of the Family Health Program on infant mortality in Brazil, 1990–2002. *Journal of Epidemiology and Community Health* **60**: 13–9.

Macinko J, Harris MJ. 2015. Brazil's family health strategy—Delivering community-based primary care in a universal health system. *The New England Journal of Medicine* **372**: 2177–81.

Macinko J, Lima-Costa MF. 2012. Horizontal equity in health care utilization in Brazil, 1998–2008. *International Journal for Equity in Health* **11**: 33.

Macinko J, Starfield B, Shi L. 2003. The contribution of primary care systems to health outcomes within Organization for Economic Cooperation and Development (OECD) countries, 1970–1998. *Health Services Research* **38**: 831–65.

Medeiros CR, Junqueira AG, Schwingel G *et al*. 2010. Nurses and doctors turnover: An impasse in the implementation of the Family Health Strategy. *Ciência & Saúde Coletiva* **15 Suppl 1**: 1521–31.

Medici AC. 1994. Desigualdades sociais e desenvolvimento no Brasil: uma análise dos anos 80 ao nível regional. *Ensaios FEE* **15**: 30.

Mendes Á, Marques RM. 2014. O financiamento da Atenção Básica e da Estratégia Saúde da Familia no Sistema Único de Saúde. *Saúde em Debate* **38**: 900–16.

Mendes AC, Sa, DA, Miranda GM, Lyra TM, Tavares RA. 2012. The public healthcare system in the context of Brazil's demographic transition: Current and future demands. *Cadernos de Saúde Pública* **28**: 955–64.

Mendonca CS. 2009. Family Health, more than never! *Ciência & Saúde Coletiva* **14 Suppl 1**: 1493–7.

Ministério da Saúde. 2002. Norma Operacional da Assistência a Saúde/SUS—NOAS. *SUS 01/2002. Portaria 373 de 27 de fevereiro de 2002*. Brasília: Ministério da Saúde, Gabinete do Ministro.

Ministerio da Saúde. 2015a. Cadastro Nacional dos Estabelecimentos de Saúde. Rio de Janeiro: Ministerio da Saúde, DATASUS. http://cnes.datasus.gov.br/, accessed 30 October 2016.

Ministerio da Saúde. 2015b. Programa Mais Médicos—Dois anos: mais saúde para os Brasileiros. Brasília, DF: Ministério da Saúde—Secretaria de Gestão do Trabalho e da Educação na Saúde.

Ministério do Desenvolvimento Social. 2015. Dados e informações sobre o Programa Bolsa Família. Ministério do Desenvolvimento Social. http://mds.gov.br/assuntos/bolsa-familia/dados, accessed 30 October 2016.

Rocha R, Soares RR. 2010. Evaluating the impact of community-based health interventions: Evidence from Brazil's Family Health Program. *Health Economics* **19**: 126–58.

Rocha S. 1998. Desigualdade Regional e Pobreza no Brasil: a evolucao 1981/95. In: IPEA (ed). *Textos para Discussão*. Rio de Janeiro: Instituto de Pesquisa Econômica Aplicada.

Santo AH. 2008. Causas mal definidas de morte e óbitos sem assistência. *Revista Da Associacao Medica Brasileira* **54**: 23–8.

Scheffer M. 2013. Demografia Médica no Brasil: Cenários e Indicadores de Distribuição. São Paulo: Conselho Regional de Medicina.

Shi L. 2012. The impact of primary care: A focused review. *Scientifica (Cairo)* **2012**: 432892.

Singer JD, Willet JB. 2003. *Applied Longitudinal Data Analysis: Modelling Change and Event Occurrence*. New York: Oxford University Press.

Starfield B. 2010. Reinventing primary care: Lessons from Canada for the United States. *Health Affairs (Millwood)* **29**: 1030–6.

Starfield B. 2012. Primary care: An increasingly important contributor to effectiveness, equity, and efficiency of health services. SESPAS report 2012. *Gaceta Sanitaria* **26**: 20–6.

Stigler FL, Starfield B, Sprenger M, Salzer HJ, Campbell SM. 2013. Assessing primary care in Austria: Room for improvement. *Family Practices* **30**: 185–9.

Tangcharoensathien V, Patcharanarumol W, Ir P *et al*. 2011. Health-financing reforms in Southeast Asia: Challenges in achieving universal coverage. *The Lancet* **377**: 863–73.

Travis P, Bennett S, Haines A *et al*. 2004. Overcoming health-systems constraints to achieve the Millennium Development Goals. *The Lancet* **364**: 900–6.

Tribunal Superior Eleitoral. 2015. Resultado das Eleições. Brasília: Tribunal Superior Eleitoral. http://www.tse.jus.br/eleicoes/eleicoes-anteriores/eleicoes-anteriores, accessed 30 October 2016.

White F. 2015. Primary health care and public health: Foundations of universal health systems. *Medical Principles and Practice* **24**: 103–16.

WHO. 2015. Health in 2015: From MDGs, Millennium Development Goals to SDGs, Sustainable Development Goals. Geneva: World Health Organization.

World Bank. 2007. Implementation completion and Results Report on a Loan in the amount of US$68 million to the Federative Republic of Brazil in support of the first phase of the Family Health Extension Adaptable Lending Program (IBRD-71050 JPN-55399). Washington, DC: World Bank.