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Equity in children's utilization of dental services: effect of a children's dental care programme

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Objectives: To evaluate the long term impact on fairness of children's dental care programmes. ***Methods*****:** Data were taken from the Health Module of the Spanish Disability Interview Survey in 1999 (n=8,049).The probability of visit to a dentist and the number of visits are estimated with binary logistic models and count data models in order to compare the regions with consolidated dental care programmes, PADI regions, with the rest of Spanish regions. The effects of family income, residential status and living in small village settings on dental care access for both regions are investigated and compared. ***Results***: The scope of the dental care programme (PADI) makes a very significant difference. Regions with consolidated PADI are by far more equitable than the rest. Once the other explanatory factors have been controlled, the percentage of users is by far larger in PADI regions, odds ratio 3.47 (95% CI 2.38 to 5.07). In PADI regions family income doesn't have any significance in the probability of visits to the dentist, odds ratio 1.9 (95% confidence interval 0.92 to 1.81). In non PADI regions poorer families have less probability of visiting a dentist, odds ratio 1.68 (95% CI 1.50 to 1.88). In addition, in each region, inequalities discriminating against those children that live in small villages cannot be found in PADI regions.***Conclusions***: PADI regions have more equity in access to dental care. The PADI programme managed to drop any income base discrimination in access and succeeded in equalizing access in small villages and in urban areas. The use of dental services is very unequal among the population. Public dental care programmes for children equalize utilization and strongly contribute to improving children's oral health.

Key words: Count data models, equity, health plans, oral health

Introduction

Equity in access to health care is one of the basic objectives of the health systems in the developed world, particularly in countries with National Health Systems. In Spain, health economists have analyzed and evaluated inequalities and the trade off between efficiency and equity in health care in general, but dental care has been omitted. Only a few theoretical references or empiric works have been published about equity in the demand and use of dental services, Guillen (1991), Murillo and González (1993), Regidor et al. (1996), and Álvarez and Delgado (2002) being the principal contributions. For a survey of Spanish contributions see Pinilla (2004).

Dental care has been frequently considered as a standard health service, with the implication that the same analytical instruments applied to other health care services could also be applied to dental care. However, dental services have specific characteristics, both technological and organizational, that set them apart from the rest of medical services (Devlin et al., 2002). Most notably, dental care has much less of a tradition of third-party involvement in any kind in funding, whether by insurance or government, than other types of health care. Out-of-pocket payments for dental care are common even in systems where most other types of health care are free.

There are three different approaches to measuring equity or inequity: inequalities in access, inequalities in use and inequalities in the population's oral health. In this study, we evaluate inequalities in access and utilization by means of econometric models applied to individual data of a population's representative sample (Mooney et al., 1991). To evaluate the inequalities in health it is necessary to allow some time to elapse, because of the delayed nature of the programme's effects. The frequent changes in regulations and particularly in the extent of public dental programme's coverage impose extra difficulties (Watt and Sheiham, 1999; Parkin and Devlin, 2002).

The health system in Spain is a decentralized National Health Service. There are seventeen regions, with their respective governments and parliaments. The size of these regions ranges from 0.25 million inhabitants (La Rioja) to 7.6 (Andalucía).

Private provision is common in the dental care system in Spain. Public coverage is generally limited to diagnosis, pain relief and tooth extraction for adults. Public dental care coverage is generally more widespread for children and adolescents. At present most regions have preventive programmes for children as well as some benefits in conservative dentistry. Dental care coverage in Spain is remarkably lower than in other countries of the European Union, particularly for adults (García, 2000).

This study is the first contribution in Spain to the measurement of equity in the access of Spanish children to dental care services. In addition to interpersonal equity in relation to income and area of residence, this study pays attention to the specific characteristics of the different regional dental care programmes (coverage, en-

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dowment of human resources). Two regions (The Basque Country and Navarra) have had public programmes of dental care under way since the 90's. These programmes cover preventive visits to the dentist, as well as some dental treatment when necessary, for all the children and adolescents living in these regions. The Infant Oral Care Programme (PADI) is an expansion of the public dental provision units through the incorporation of private dental clinics. The patient can choose between visiting his local public health centre or the nearest private dental practitioner who has a financial agreement with the public health system. The objective of the PADI is to promote the utilization of dental services.

The Basque Country in 1990 and Navarra in 1991 were the first Spanish regions to implement public coverage of dental care for children. Recently Andalucía in 2002 and Murcia in 2003 have implemented similar programmes. Their name is PADI (*Plan de Atención Dental Infantil*). PADI provides free treatment of permanent teeth but it covers just palliative care for primary teeth. The benefits include a yearly check-up and the treatment of decay (oral health education, sealants, radiographs as required, fillings, extractions, root canal fillings, dental crowns etc.). Dental care is provided by public and private practitioners. Public centres are integrated in the primary care network. Private providers contract with the Regional Health Service on a per capita basis (Freire, 2003).

Materials and Methods

Data sources and description

We have used data of those aged 15 and younger from the Health Module of the Survey on Disabilities, deficiencies and handicaps (EDDM). This is a survey of 79,000 households, and approximately 220,000 people (70,000 of them in the health module). The EDDM is a cross-sectional household interview survey. It selects a sample of the general population, not only families with some disability, and encompasses the whole national territory. Personal interviews were carried out during the second quarter of 1999. The health module includes 8,049 individuals younger than 16 years. The questionnaire provides information on the use of health and dental care services, subjective valuation of personal health, lifestyle and habits, accidents, and chronic illnesses. The methodology of the EDDM fits the recommendations of the WHO (Spanish Statistics Institute, 2005).

Table 1 shows descriptive statistics of the main variables used in the study. The dependent variable is the number of visits to the dentist in the last year. The explanatory variables include personal characteristics (gender, age, per capita family income), a dummy for small village habitat (size of residence area < 10,000 inhabitants), and some specific variables of the dental care system in the region: the endowment of human resources (number of dentists per 1,000 resident aged 0-15 years), a dummy set at one if the individual is covered by a public programme of dental care (that depends on the subject's age and on the scope of the particular regional programme) and finally a dummy set at one if the individual lives in a region with consolidate PADI.

Model specification and estimation methods

Since the dependent variable is the number of visits to the dentist it is a count of events. Specific models of regression for count data are more suitable for our study than standard models of linear regression, because the standard models ignore the characteristics of the dependent variable, mainly, its discreet nature and the fact that it only has positive whole values (Jones, 2000).

Table 1. Descriptive statistics

Variable	*Mean*	*Standard deviation*	*Freq.*	*Percent*	*Missing values*
Number of visits to the dentist in the last year	0.841	2.41	-	-	-
Gender:	0.481	0.499			
female=1			3868	48.06	-
male=0			4181	51.94	-
Age	8.239	4.566	-	-	-
Family income per capita (in Euros)	306.44	193.32	-	-	895
Number of dentist per 1,000 resident aged 0-15 years	4.26	6.19	-	-	-
Coverage:	0.559	0.495			
=1 if child was covered by respective Dental Health Programme last year			4503	55.9	-
=0 if child wasn't covered			3546	44.1	-
Small village:	0.227	0.419			-
=1 If size of residence area <10,000 inhabitants)			1834	22.7	
=0 for the rest			6215	77.3	
PADI:	0.057	0.233			-
=1 if the Region have special Children's Dental Care Programme (PADI)			462	5.7	
=0 for the rest			7587	94.3	
Number of observations			8049		

The baseline model for count data is the Poisson regression model. However, it assumes rigid hypothesis on the distribution of the dependent variable, and for this reason it usually does not fit the data well. More general models are preferable in this case. There are two specific reasons why the hypothesized Poisson distribution does not fit the data: overdispersion and excess of zeros.

Either unobserved heterogeneity or a process that has separate mechanisms for generating zero and nonzero counts can produce both over-dispersion and excess of zeros. A simple Negative Binomial (NB) model, a Zero-Inflated Poisson model (ZIP), and a Zero-Inflated Negative Binomial model (ZINB) are all candidates for count data with these characteristics (Cameron and Trivedi, 1998).

We have also estimated logistic regression models to explain utilization (Yes or No) of dental services (including emergency services). Logistic models have been estimated for the total sample and for the sub samples of PADI regions and non PADI regions respectively. All the analysis was conducted using STATA 8.1 (Stata Corp, 2003)

Results

A strengthened PADI programme covers 462 children of 8,049 (5.74 per cent) of the sample of those living in the Basque Country and Navarra. Perception of "need" strongly depends on the PADI coverage: 44.4 per cent of the families covered by consolidated PADI declare that their child "needed" dental care in the last year, versus 25.2 percent outside consolidated PADI ($P<0.001$ to the test of difference between two independent proportions). See Table 2.

There are significant differences in the percentage of users between consolidated PADI regions and the rest. In the latter, maximum utilization is at 11 years of age (39.4 percent), in PADI regions it is at 12 (79.4 percent). In non PADI regions the percentage of users, both public and private, does not reach 40 per cent at any age, (Figure 1), 20 per cent for public dentist visits. The PADI programme makes a tangible difference in the proportion of children, aged 8-15 years old, who have visited a dentist within the previous year. In the PADI regions utilization of dental visits is significantly higher than in the non-PADI regions.

For a given treatment, public and private providers are close substitute services, one chooses between public or private dentists. Double utilization is very infrequent. Only 47 minors (0.58 per cent) visited both types of dentists. 18.14 per cent visited a private dentist, and 7.58 per cent visited a public dentist. The effect of PADI coverage on utilization of public dental care is very prominent. Utilization percentage was 22.3 per cent among the children covered by a PADI and 6.6 per cent among the non covered children ($p<0.0001$).

The basic count model and the zero-inflated models are not nested, so it is not easy to conduct specification tests. Greene (1994) adapted one of the tests of non-nested models developed by Vuong (1989) to the cases of ZIP versus Poisson and ZINB versus simple NB models. The result of the Vuong test of ZIP versus standard Poisson yields a value of $z=17.62$ (Prob> $z=0.0000$), see Table 3, rejecting the null hypotheses of the validity of the Poisson model. The same result was obtained in the Vuong test of the ZINB versus simple NB model. Hence we found that ZIP is preferable to

Table 2. Number of visits to the dentist in PADI and non PADI regions

Number of visits to the dentist in the last year	Regions with infant care programme (PADI)	Regions without infant care programme	Total
0	55.6%	74.8%	73.7%
1	29.0%	11.0%	12.1%
2	6.5%	5.7%	5.7%
3	2.4%	2.4%	2.4%
4 or more	1.1%	1.5%	1.4%

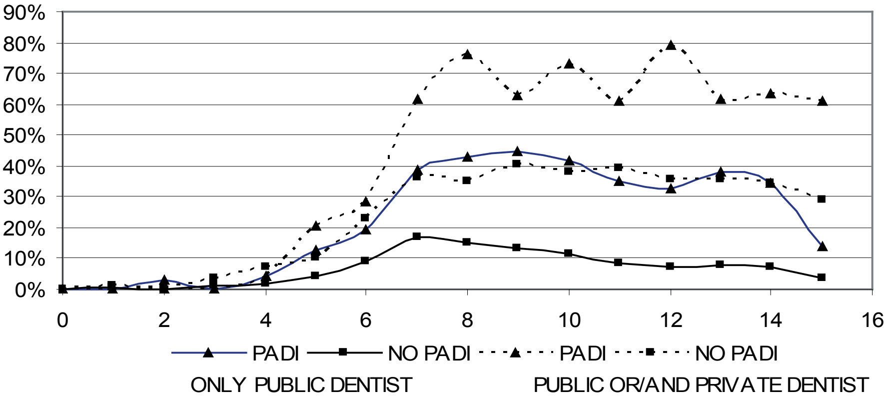

Figure 1. *Percentages of children, aged 0-15 years old, who have visited a dentist within the previous year*

standard Poisson and ZINB is preferable to simple NB model. For evaluating the relative fits of ZIP and ZINB we use the Bayesian information criterion, BIC, proposed by Raftery (1996). Based on a difference in BIC, ZIP is preferable to ZINB, hence we use the ZIP model. Table 3 shows the estimated coefficient and standard errors for a Zero Inflated Poisson model (ZIP), which takes into account that more than 70 per cent of the children in our sample never visited the dentist.

People living in the same area have some unobserved environmental characteristics that could influence the use of the dentist, such as parental education in dental health, quality of dentistry, etc. Because of these "common shocks" there are non-zero correlations between people living in the same area. Robust standard errors account for these correlations.

The ZIP model estimates a non-participation equation (Table 3 column 2), "no visiting" the dentist office, this is the "inflate" equation, and a count equation for the number of visits, for those individuals who did visit the dentist (Table 3 column 1). The results of this inflated model are similar, but with different significance, from the previous base non-inflated model. Coverage by a public programme of dental health influences in a positive way the number of visits. The PADI programme has also a large positive influence in utilization. The effect of age is non linear.

The ZIP model suggests that access is unequal among small village children. Those living in small villages (size of residence area < 10,000 inhabitants) have smaller probabilities of access to the public dentist. Furthermore, poorer families have lower probabilities of consultation. Results provide support for the income inequality hypothesis.

PADI makes the greatest difference. It influences very significantly in the access, but the intensity of use is lower in PADI regions as is shown in the second equation (Poisson part of ZIP). This is coherent with the prevention-cure arguments. A notable difference was found between the two regions with a consolidated programme and the rest of the country. In the former, the percentage of users is larger but utilization is less concentrated.

In order to further investigate the differences in utilization between the regions with PADI programme and the rest of Spain, binary logistic models of utilization were estimated for the whole sample and also for each group (PADI regions and non-PADI regions). (Table 4).

Regions with consolidated PADI are by far more equitable than the rest. After controlling for other explanatory factors, the percentage of users is by far larger in PADI regions, odd ratio 3.47 (95% confidence interval 2.38 to 5.07). According to the logistic model of utilization for the whole sample, family income has a significant positive impact on the probability of utilization. However, when the logistic model of utilization is estimated separately for the PADI and the non-PADI regions, one can appreciate that some important differences emerge. PADI regions are more equitable because the probability of utilization is independent to the family income. In addition, in each region, inequalities discriminating against those children that live in small villages cannot be found in PADI regions.

Discussion

At the present time, there are few approaches to the study of equity in dental services in Spain. Some studies focus on family dental expenses, and use data from the Family Budget Surveys (Murillo and González, 1993; Regidor et al., 1996). They conclude that dental services in Spain are luxury goods in the economic sense: their income elasticity is greater than one. As family income increases, the demand for dental services increases more than proportionally. Other studies, like the study reported here, focus on utilization of dental services, and use data from National or Regional Health Surveys. Only a few Spanish studies of this type have been published, mainly because of the lack of specific databases on habits and use of dental services. Guillen (1991) studied the demand for private dental services by adults, and Álvarez and Delgado (2002) studies the demand by adults without distinguishing between the type of provision, public or private.

Although the focus of the studies are different, all seem to concur in that the use of the dental services is very unequal among the population. The hygienic habits and the dental health status influence the demand strongly. The young and the upper class exhibit larger demands than the rest of the population. Those with higher education levels visit the dentist at double the rate of those without it. Those results agree with those reported by the international literature, (Antunes et al. 2004, Grytten et al. 2001 and Sintonen and Linnosmaa 2000).

For the last few years the public dental services in Spain have experienced an enormous growth, mainly those for children and adolescents. At present more than half of the Spanish regions have approved some strategic lines and specific dental health programmes, (Cortés and Llodra 2002). In 1999 (the year our data refers to) all regions had some level of public coverage for fissure sealing for children, but there were large differences between regions. The PADI regions (Basque Country and Navarra) provided full coverage, while Castilla y León only covered children aged 6 or 7 years. Coverage for reparative treatments showed even larger differences between regions. The Basque Country and Navarra were the only two regions providing free public coverage for basic reparative treatment of permanent teeth though most regions in Spain had some restricted public coverage for this treatment. Coverage was generally limited to simple filling of permanent teeth. Some regions, like Extremadura and Galicia, did not cover these services at all, and Madrid only in some public health centres.

It is difficult to estimate the effect of PADI in the presence of confounding factors, as is the case in our study. The Basque Country and Navarra, the PADI regions, are different from the rest of Spain not only because they have better dental public coverage, but also because they enjoy specific tax privileges and their public health care budgets are larger than in the rest of Spain. Modern econometrics provides some tools to account for these factors. Our model allows for a positive correlation between the unobserved random errors for children living in the same area. As far as they share "common socks", they are affected by unobservable environment influences on their behaviour as dental visitors.

The PADI programme makes a tangible difference in the probability of public dentist utilization. This programme has managed to drop any income-based discrimination in access, and it has also succeeded in equalizing access in small villages and in urban areas, while non PADI areas discriminate against small village areas.

After almost 15 years implementing PADI, children in the Basque Country and Navarra have healthier teeth, and any eventual dental problems are solved quickly due to the annual check-up visit to the dentist. Children's dental health indicators for these PADI regions by far outperform those for the rest of Spain. Specifically, in 1997 57.8 per cent of the 12 year old children from Navarra and 57.2 per cent of the Basque Country's children were cavity free. This percentage is 28 per cent higher than in 1988. The percentage with caries has also decreased in the PADI regions (64 per cent in Navarra and 50 per cent in Basque Country), García, 2000, Cortés at al. 2003).

In the PADI regions utilization of dental visits (public and private) is significantly higher than in the non-PADI regions. In the PADI regions only approximately 20 per cent of the 12 year old children have not visited a dentist (public or private) in the last year, a percentage between UK (28 per cent) and Germany (11 per cent) but far higher than Nordic countries (9 per cent), (Petersen et al. 1994), which are benchmarks in public dental programmes. In non PADI regions the percentage of the 12 year old without a yearly visit is approximately 63 per cent.

Table 3. ZIP model for the number of visits to the dentist in the last year

Independent variables	*Poisson part for ZIP*	*Inflate part for ZIP*
	IRR	*Logistic coefficients Prob(Y=0) no visit*
Gender: female=1		-0.10 (0.06)
Age	1.24 (0.04)*	-0.74 (0.07)*
Age2	1.49 (0.07)*	0.04 (0.01)*
Family income per capita in logarithmic	0.99 (0.01)*	-0.49 (0.06)*
Nº of dentist per 1,000 resident aged 0-15 years	1.16 (0.03)*	0.002 (0.01)
Coverage	0.99 (0.01)*	-0.14 (0.10)
Small village	1.14 (0.05)*	0.20 (0.08)*
PADI	1.07 (0.04)*	-1.74 (0.21)*
Intercept	0.66 (0.04)*	9.40 (0.69)*
Number of observations= 7154 Nonzero observations= 1868	Vuong test of ZIP vs. standard Poisson Z= 17.62 Prob>Z = 0.0000	
	Bayesian Information Criterion BIC to compare ZIP vs. ZINB ZIP: BIC -2002.025	ZINB: -1282.194
	Difference of 719.83 provides very strong support for ZIP model	

Dependent variable: number of visits to the dentist
IRR= Incidence rate ratios [exp(beta)].
Robust standard error in brackets. Robust standard errors were calculated, allowing nonzero correlations between individuals living in the same area (province)
*p < 0.05

Table 4. Logistic models for the probability of visits to a dentist in the last year

	PADI regions			*NonPADI regions*			*Total*		
	Odds Ratio	*[95% Conf. Inter.]*		*Odds Ratio Z(*)*	*[95% Conf. Inter.]*		*Odds Ratio Z(*)*	*[95% Conf. Inter.]*	
Gender	0.92 (0.32)	0.47	1.82	1.19 (0.07)*	1.06	1.33	1.18 (0.07)*	1.06	1.31
Age	5.47 (1.57)*	3.09	9.66	2.56 (0.19)*	2.22	2.96	2.68 (0.20)*	2.32	3.10
Age2	0.93 (0.01)*	0.91	0.95	0.96 (0.003)*	0.95	0.96	0.96 (0.003)*	0.95	0.96
F_Income	1.29 (0.22)	0.92	1.81	1.68 (0.09)*	1.50	1.88	1.67 (0.09)*	1.50	1.86
Nº of dentist	0.69 (0.10)*	0.51	0.93	0.99 (0.007)	0.98	1.01	0.99 (0.01)	0.98	1.001
Coverage	0.85 (0.43)	0.31	2.29	1.20 (0.16)	0.93	1.55	1.20 (0.15)	0.93	1.54
Small village	1.31 (0.19)	0.99	1.73	0.83 (0.03)*	0.69	1.01	0.85 (0.010)	0.71	1.02
PADI							3.47 (0.67)*	2.38	5.07
Nº obs	337			6817			7154		

Robust standard error in brackets. Robust standard errors were calculated, allowing nonzero correlations between individuals living at the same area (province)
*p < 0.05

Our results contribute to the knowledge of the determinants of dental utilization in Spain, but they could probably be applied to other countries. The Spanish case is interesting because it allows for the evaluation of "quasi natural" experiments of public dental care coverage, because such interventions were selectively implemented in some particular regions. The specific programmes of children's dental health (PADI) were implemented at the beginning of the nineties in two regions. Enough time has elapsed since then to evaluate the results of the PADI by comparing the two groups of regions, those with PADI and those without it.

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