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Density of dental practitioners and access to dental care for the elderly: A multilevel analysis with a view on socio-economic inequality

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ABSTRACT

Objectives: To examine the relations between density of dental practitioners (DDP) and socio-economic and demographic factors shown to affect access to dental care for the elderly.
Methods: Data are taken from a cross-sectional survey – 2008 Disability Healthcare – Household section Survey (HSM). HSM is a representative random sample of French people living in their own domiciles. Our study focuses on the 9233 individuals aged 60 years and above. Multilevel models are employed to disentangle the relations between the determinants of dental care utilisation and DDP. Statistical analyses are conducted using SAS 9.2 and HLM 6.
Results: Low-income and lack of complementary health insurance are associated with higher odds of not having visited a dentist, revealing a high unequal access to dental care. By using multilevel modelling, DDP appears to be a significant factor to access to dental services. When considering the intricate relations between income gradient and DDP, the latter lessens the income-related inequality to access dental services.
Conclusion: DDP seems favouring a more equitable access to dental care, mitigating undercaring of the poorest. This point is to be added in the debate about density of healthcare suppliers.

1. Introduction

Thanks to advances in dental prevention, adults are now able to keep healthy teeth for life. Typically however, their dental needs increase at a time when they may also be undergoing a diminished capacity to access care because of retirement, which often implies reducing income and health coverage. Oral health is essential to general health and well-being [1]. Poor general health and poor dental health are interrelated primarily because of common risk factors that lead to complex relations between oral infections – particularly periodontitis – and risk of chronic disease [1,2]. Therefore, the elderly may face significant hurdles before obtaining the necessary dental care [3]. Indeed, previous studies conducted elsewhere have already demonstrated that not only the physically impaired, but also the economically and socially disadvantaged elderly, are more likely to experience tooth loss and

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edentulism, untreated dental decay and periodontal diseases [4–10]. Inequalities in access to medical or dental care by income have already been demonstrated [11,12]. However, such analysis has never been carried out in the French context, where density of practitioners varies a lot between regions, offering an occasion to refresh the issue of inequality in access with cross information on the geographical organization of the healthcare providers.

In 2008, there were 37,810 dentists in France. The average density was 65 per 100,000 individuals however substantial regional disparities were marked, with values ranging from single to double. The providers usually work in private clinics (almost 90%). Dental care services are not fully covered by the health insurance system in France: while conservative and surgical care services are rather cheap and well reimbursed with a fixed-price schedule, the prosthetic care is costly and only covered by private funding, essentially through complementary insurance schemes or direct out-of-pocket payments.

The observed discrepancy between conservative and prosthetic treatments has culminated in unbalanced load activities: while conservative and surgical cares correspond to more than two-thirds of the total dentists' activities they only represent 35% of their total sales. Out-of-pocket dental expenditures borne by patients have noticeably increased over the last decade. This is mainly due to the development and utilisation of new techniques, which are not listed in the French "nomenclature", and the population aging, which has amplified the needs for prosthetic care. By contrast, non-dental services and particularly GPs services are still well reimbursed especially in the aged population (benefiting sometimes of a 100% coverage rate), justifying a reference of access to dental-care with for ex. GPs services.

Although equity has long been considered as a key pillar of the public healthcare financing and of the extensive regulations of providers' practices in France [13] regulations regarding the practices of dental providers remain significantly limited when compared with other healthcare services in France and with other countries of similar socio-economic conditions [14]. Such limited public involvement in this vital field of healthcare services is likely to exacerbate socio-economic related inequalities in health, particularly for those who are in most need; the elderly. This study aims to examine inequalities in dental care utilisation of non-institutional elderly while taking into account the density of dental practitioners (DDP), using national data from the 2008 (HSM) survey.

2. Methods

2.1. The HSM survey and study population

The Disability Healthcare Household section Survey (Enquête Handicap Santé – Ménages, HSM) was undertaken between April and October 2008 by the French National Institute of Statistics and Economic Studies (INSEE) and the French Directorate for Research, Studies, Evaluation and Statistics (DREES). HSM is a national cross-sectional survey that focuses on health and impairment, as well as the difficulties encountered by individuals in their daily lives [15]. The survey collected information from 28,500 individuals residing in French metropolitans and overseas departments. Individuals of all ages were asked about their health status (diseases, disabilities, functional limitations, activity restrictions, need help). In addition, the survey contained information about household's socio-demographic (e.g., household composition, formal and informal caregivers), and socio-economic (e.g., income, education) characteristics. All information was gathered directly in the domiciles by special-trained interviewers using face-to-face interviews. In case individuals were unable to respond to the questionnaire themselves, another person was asked to offer help. Respondents were informed about the objective of the survey and asked to give their consent before the interviews. For the purpose of this study, the unit of analysis was all subjects aged 60 and above who were able to provide full information on their oral health. In all, the study included 9233 subjects.

Sample weights calculated by the INSEE were used to adjust for missampling and to assure a more representative sample at the national level. To ensure sufficient numbers to produce reliable national estimates, socio-demographic variable categories were combined when necessary.

Measurement of utilisation of dental services in the HSM was based on the question "Have you consulted a dentist during the past 12 months?". Among the socio-economic characteristics included in the analysis were: age grouped in six categories, starting from 60–64 until 85 and over), gender, level of education, number of people in the household, income per consumption unit, using a 3-level scale: less than 999€ up to more than 2000€, and the dwelling place (rural or urban). Healthcare variables were apprehended through a set of indicators including: health insurance status, a general indicator of morbidity, assessed by both the self-reported general health and the reported degree of disability (regrouped in three classes).

Density of dental practitioners (DDP) was captured by the number of dentists per 100,000 individuals, as obtained by the French Ministry of Health. Using census data, a regional socio-economic level was also defined using the median income per consumption unit of French administrative departments. Mainland France (excluding overseas territories) was subdivided into 95 administrative departments, referred to below as areas of residence. This area-level has already been used in a previous study focusing on the use of specialty care [16]. Each area-level variable was then divided into four categories (low, medium-low, medium-high, high) with the 25th, 50th and 75th percentiles as cut-off points.

2.2. Statistical analysis

We used the Pearson's Chi-square to compare qualitative variables and ANOVA *F*-statistic for quantitative variables in order to outline the characteristics of the studied population. For each part of our analysis, we started by using logistic models to select potential covariates of dental care utilisation, after adjustments for some individual characteristics. Then, we included all the variables showing a univariate association with our dependant variables

(use of dental services or use of GPs services) with a p value <0.25, in the final multivariable logistic regression model.

The use of dental services is assumed to be influenced by external factors operating at the departmental level and not by the elderly's own characteristics. They were investigated using a two-level hierarchical logistic model. Multilevel models are adapted to data with a hierarchical structure as this is the case with the HSM survey where observations are nested within departments. Correlation between individuals of a same group may then bias the estimated coefficients if standard statistical models are used [17]. The models were estimated using a predictive quasi-likelihood method, implemented in HLM®6. The relevance of using these models was confirmed by the estimation of the intra-class correlation coefficient (ICC) obtained in empty models indicating that 2.9% of the total variance of the use of dental services was explained by the departmental level. The likelihood ratio test indicated that the ICC were significantly different from zero. Logistic regression analyses are used to study how dental attendance (or GP visits) varied with individual characteristics in each department. The logistic regression model with random intercept and random slope at level-1 (the individual level) can be formally expressed as:

$$\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_{0j} + \beta_{ij}x_{1ij} + \cdots + \beta_{kj}x_{kij} + e_{ij},$$

$$i = 1, 2, \ldots, n$$

where $n = 97$ departmental levels. π_{ij} is the probability of the ith individual in the jth department attending a dentist during the previous year and k is the number of independent variables in the model.

Therefore, taking into account departmental level-2, there will be $(k+1)$ models:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$
$$\vdots$$
$$\beta_{kj} = \gamma_{k0} + u_{kj}$$

As one random slope β_h of variable x_h (income per consumption unit), was significant while we tested all possible random effects on β_k in the list of the k independent variables ($1 < h < k$), we also test the assumption that $\beta_{hj} = \gamma_{h0} + \beta_h Z_j + u_{hj}$ where Z_j is the independent variable (density of practitioners) observed at the departmental level.

The statistical analyses were conducted using SAS 9.1 and HLM 6 packages.

3. Results

Table 1 reports descriptive statistics on the distribution of the surveyed population according to socio-demographic, socio-economic and health characteristics.

Our sample examined 9233 individuals aged 60 years or older. About 60% of whom were women with a median age of 74 years (range: 60–106 years). The majority of respondents (90.3%) had a complementary public or private health insurance. However, some differences in the rates of insurance coverage were noticed in terms of income, age, education, and dwelling place ($p < 0.0001$). Besides, it is worth noting that gender had no statistically significant effect on the probability of having a complementary health insurance ($p = 0.23$). Overall, more than one-third of the sample (40.3%) reported a dental visit during the year 2007. All variables, including those that appeared to be insignificant in the exploratory analyses, are listed in Table 1.

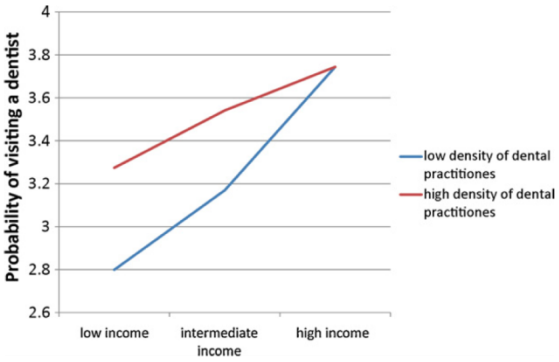

Fig. 1. Probability (%) of visiting a dentist during the previous year, by income and DDP.

Results of the hierarchical analysis on the utilisation of dental services are presented in Table 2. Multivariate model reveals different patterns of predictors of non-visiting the dentist during the past year. Several individual factors and two geographical factors are associated with the outcome. Table 2 highlights the relationships that exist between dental services utilisation and a range of potential confounders, including age, gender, income, education and health insurance. The effect of median departmental income emerges significant and negative, suggesting that the elderly living in affluent areas are more likely to visit a dentist than their counterparts living in deprived areas. After adjusting for individual factors, the odds of consulting a dentist appears to be even higher for wealthy people compared with their low-income counterparts. Nonetheless, testing for level-2 random effects on slopes reveals that this latter relationship with income is geographically dependent: we obtained that the income-gradient of dental care utilisation has to be related to the supply of dental practitioners, i.e., DDP observed at the departmental level (the interaction effect between the level of income and the DDP is demonstrated by a series of significant odds ratios listed in the upper panel of Table 2).

Fig. 1 depicts the probabilities of visiting a dentist at least once during the previous year, for three levels of income holding other independent variables constant. Overall, the slope of the regression line relating the DDP to the probability of visiting a dentist is positive and statistically significant, indicating that the probabilities of visiting a dentist tend to increase with individuals' income, regardless of the differences in the degree of DDP. Quite interestingly, income-related differences in the use of dental services appear to be even more marked by the side of low DDP. Indeed, when DDP is low, the probability of using

Table 1
Use of dental and GPs services in the surveyed population.

	n (%)	Number of subjects who consulted a dentist during the past year (%)	p^{*}	Number of subjects who consulted a GP during the past year (%)	p^{**}
	9233 (100.00)	3718 (40.3)		8866 (96.0)	
Age					
[60–64]	1834 (19.86)	949 (51.7)		1713 (93.4)	
[65–69]	1420 (15.38)	668 (47.0)		1345 (94.7)	
[70–74]	1704 (18.46)	736 (43.2)	0.000	1642 (96.4)	0.000
[75–79]	1824 (19.76)	680 (37.3)		1774 (97.3)	
[80–84]	1343 (14.55)	425 (31.6)		1305 (97.2)	
85 and over	1108 (12.00)	260 (23.5)		1087 (98.1)	
Gender					
Men	3721 (40.30)	1484 (39.9)		3524 (94.7)	
Women	5512 (59.70)	2234 (40.5)		5342 (95.8)	
Education					
Less than baccalaureat	3123 (33.82)	939 (30.1)		3011 (96.4)	
Baccalaureat	4862 (52.66)	2020 (41.5)	0.000	4697 (96.6)	0.000
More than baccalaureat	1248 (13.52)	759 (60.8)		1158 (92.8)	
Income					
Unknown	904 (9.79)	360 (39.8)		862 (95.4)	
<999 euros	2950 (31.95)	874 (29.6)	0.000	2843 (96.4)	0.000
[1000–1999 euros]	3968 (42.98)	1652 (41.6)		3836 (96.7)	
>2000 euros	1411 (15.28)	832 (58.9)		1325 (93.9)	
People in the household					
1	2979 (32.26)	1117 (37.5)		2865 (96.2)	
2	4667 (50.55)	2116 (45.3)	0.000	4486 (96.1)	0.450
3 and more	1587 (17.19)	485 (30.6)		1515 (95.5)	
Dwelling place					
Rural	2338 (25.32)	851 (36.4)		2262 (96.7)	
Urban	6895 (74.68)	2867 (41.6)		6604 (95.8)	
Health insurance					
Complementary insurance	7950 (86.10)	3369 (42.4)		7677 (96.6)	
CMUC	389 (4.21)	112 (28.8)	0.000	363 (93.3)	0.000
No complementary insurance	894 (9.69)	237 (26.5)		826 (92.4)	
Self-reported general health					
Self-reported general health good or very good	2278 (24.67)	1100 (48.3)	0.000	2054 (90.2)	0.000
Self-reported general health fair	3327 (36.03)	1347 (40.5)		3241 (97.4)	
Self-reported general health poor or very poor	3628 (39.29)	1271 (35.0)		3571 (98.4)	
Self-reported oral health					
Self-reported oral health good or very good	3770 (40.83)	1665 (44.2)	0.000	2933 (94.9)	0.000
Self-reported oral health fair	2970 (32.17)	1173 (39.5)		2545 (95.9)	
Self-reported oral health poor or very poor	2493 (27.00)	880 (35.3)		3388 (97.1)	
Reported disability					
Not impaired in daily life	3830 (41.48)	1309 (34.2)		3766 (98.3)	
Slightly impaired in daily life	2720 (29.46)	1119 (41.1)	0.000	2646 (97.3)	0.000
Very impaired in daily life (ref.)	2683 (29.06)	1290 (48.0)		2454 (91.5)	

* Chi-square test: use dental services versus not.
** Chi-square test: use GP services versus not.

dental services is almost 1.5 as high when income is high, suggesting that the current structure of the supply-side of dental care play a central role in generating and protracting the prevailing income-related inequalities in dental care utilisation.

In order to allow for comparisons, we conducted similar analysis for the case of general practitioners (GP). In our sample, 96.03% of the elderly consulted a GP during the last year, whereas only 40.27% visited a dentist. Results, which are presented in Appendix A, reveal that at odds with the case of dental care, both income and density variables emerge to have insignificant effect on the utilisation of GP services. In effect, the latter appear to depend only on complementary health insurance coverage.

4. Discussion

This paper attempts to uncover the factors that shape dental care utilisation for the elderly in France, with a particular focus on the contextual factors beyond the