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Factors associated with the performance of primary dental health care in Brazil
A multilevel approach

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Abstract
This study evaluated the factors associated with the performance of Brazilian Oral Health Teams (OHTs).

This is multilevel research that used data from 12,386 Brazilian OHTs in 2012. The OHTs performance was estimated in previous research by using Item Response Theory model, which employed 20 questions about dental procedures in Primary Care. The first level covariates were based on OHTs procedures such as: the record of pregnant woman dental appointment, provision of dentistry home care, dental appointments scheduled choices, and OHTs in charge for more than 5000 individuals. Moreover, the use of guidelines was accessed concerning delivering prostheses in primary care, referring to secondary care, referring to suspected oral cancer, and providing care towards patients with special needs. Variables included in level 2 were GINI and Human Development Index. Multilevel linear regression models were constructed, estimating linear regression coefficients, 95% confidence intervals, and *P* values.

OHTs performance was different among the 3,613 municipalities analyzed ($P < .001$), with 36.7% of the variation in the performance of the OHTs being attributed to the variability between municipalities. The adjusted model showed that higher performance OHTs reported attention to pregnant women, dentistry home care and use of dental care guidelines ($P < .001$). There were lower performance scores for those OHTs with more restricted scheduling ($P < .05$), compared to those that reported scheduling appointments at any day and time. The best OHTs and population ratio led to a better performance score ($P = .010$). At the municipal level, better socioeconomic status was associated with better performance of the OHTs ($P < .001$).

OHTs with higher performance are associated with oral health services organizations and municipalities' socioeconomic status.

Abbreviations: IRT = item response theory, OHTs = Brazilian Oral Health Teams, PHC = primary health care, PMAQ-AB = Programa Nacional de Melhoria do Acesso e Qualidade da Atenção Básica [Portuguese].

Keywords: health care evaluation, public health dentistry, primary health care

1. Introduction

In 2000, the Brazilian Ministry of Health included oral health services in primary health care (PHC) program creating oral health teams (OHTs). This was an important mark for spreading oral health care services in Brazil. In 2004, national oral health policy was launched aimed to improve access to OHTs in PHC centers and to provide secondary care services creating the Dental Specialties Centers.[1,2]

Since then, the number of OHTs implemented has increased around the country. Despite the advances, many challenges are still found such as: an excess of demand, precarious evaluating actions, and inefficient integration between primary and secondary oral health care.[3,4]

In 2012, pay for performance program was launched to evaluate the quality of PHC services, including oral health care provided by OHTs (Programa Nacional de Melhoria do Acesso e Qualidade da Atenção Básica—[PMAQ-AB]).[5,6] Since then, studies have been conducted to demonstrate the working process of those OHTs based on PMAQ-AB data. Recent research used Item Response Theory (IRT) to produce an OHT score performance-based on PMAQ-AB dataset.[7] This study found that OHTs that provide rehabilitation by prostheses and emphasize actions for oral cancer prevention pursue higher performance score.[7] Also, the research showed that OHTs performance varies in the Brazilian regions, with poor regions demonstrating a tendency to have lower performance scores.[7]

Evidence showed that higher PHC teams' performance is associated with organizational and structural factors[8] and socioeconomic status[9] in Brazil. According to Starfield,[10] PHC oriented systems tend to decrease disparities in accessing health services or reaching the best levels of health.

The social context has also been taken into consideration in Andersen and Davidson's behavioral model[11] to understand users' access to health care services. The model integrates individual factors, social context, and health system features to explain the use of health services. The behavioral model has been used in dentistry,[12–15] but there is a lack of knowledge about if those factors also contribute to higher OHTs performance.

2. Methods

This multilevel cross-sectional study received ethical approval by the Ethics Committee for Human Research of the Universidade Federal de Minas Gerais (protocol number 31525514.9.0000.5149). The study used secondary data from a public dataset.

This study used the oral health component from the 2012 PMAQ-AB national survey questionnaire.[5,6] Dentists working at OHTs responded to the questionnaire oral health component. The first PMAQ-AB cycle limited each Brazilian municipality to enroll up to 50% of OHTs into the program. Thus, municipal health managers selected OHTs based on their own criteria to be part of the survey. In 2012, Brazil counted with 29,180 OHTs, but given that the first cycle program limit, only 14,590 OHTs could engage in 2012 PMAQ-AB. Of those teams, 12,403 dentists responded to the survey questions used in this study. From those, 12,340 OHTs without missing data were included in this study (response rate = 84.6%).

A previous study conducted with the same database (PMAQ-AB 2012) developed a performance score for each OHT in Brazil using IRT.[7] This IRT score (performance of primary dental care) is the dependent variable of this study. The score was estimated based on graded response model proposed by Samejima (1968)[16] using 20 variables: "patient welcoming," "disease risk classification at the first appointment," "oral health services according to patient risk," "guidelines for patient welcoming with documentation", "ensure continuity of care with documentation, "references for prosthetics services," and clinical dental procedures, such as "sealants," "fluoride application," "amalgam filling," "composite filling," "dental extraction," "temporary restorations", "endodontic medication use in emergencies",

"drainage of oral abscesses," "supragingival scaling, root planing, and coronal polishing," "denture impressions with documentation," "provide the dentures and follow the patients with documentation," "oral lesions and referring suspected cases of oral cancer", "register and follow cases of oral cancer with documentation" and "identifying people who need dentures." The estimated performance score for each OHTs varied between -2.76 and 2.12. The mean was -0.04 (SD = 0.89) and the median was -0.01. More details on IRT analysis are described in a previous publication that constructed the OHT performance score.[7]

The independent variables were drawn from the PMAQ-AB questionnaire with regard to the OHTs working process and the referral for secondary oral health care. Those variables were not used to build the IRT score. In addition, the GINI Index and Municipal Human Development Index (MHDI) were included in the analysis.

Data was hierarchically structured in two levels: OHTs variables (Level 1) nested within municipal variables (Level 2). Variables included in Level 1 were the record of some structural and organizational[8] variables such as pregnant woman dental appointment, provision of dentistry home care, dental appointments scheduled choices, and OHTs in charge for more than 5,000 individuals. Moreover, the use of guidelines was accessed concerning delivering prostheses in primary care, referring to secondary care, referring to suspected oral cancer, and providing care towards patients with special needs. Variables included in Level 2 were 2 contextual variables[9] Gini Index and MHDI.

Multilevel analyses were used to assess the association of individual and municipal variables according to IRT score performance. The multilevel structure of analyses included 12,340 OHTs variables (Level 1) from 3,601 municipalities (Level 2) and was achieved through linear link function analyses that used the scheme of fixed effects/random intercept. Parameters were estimated using the maximum likelihood method. A multilevel linear regression model was constructed. In the first stage, a "null model" estimated the basic partition of data variability between the two levels before the inclusion of OHTs and municipal characteristics were taken into account.

All Level 1 variables were initially incorporated into the model altogether. Then, another model with only municipal variables (Level 2) was adjusted. The final model of multilevel analyses was constructed with all the individual and municipal variables. Beta coefficients (CI 95%) were estimated for each model. Variance Inflation Factor was calculated for evaluating multicollinearity. Residuals were graphically evaluated for homoscedasticity and normal distribution.

3. Results

The results of the multilevel approach showed the need for the use of a linear multilevel procedure to analyze the variables. The "null-model" was statistically significant for dental PHC performance ($P < .001$) and demonstrated significant differences in this performance among 3601 municipalities. The partition of data variability 36.7% of the total variance in dental PHC performance was due to municipal characteristics.

In the Level 1, the variables positively associated with the OHTs performance were: a dental appointment for pregnant women; provision of dentistry home care; the use of guidelines for prostheses provision, referral for secondary care, and referral for checking oral cancer. In the Level 2, municipalities with better

Table 1

Multilevel analysis showing the association of individual and municipal variables according to IRT score performance.

Variables	Null model β (CI 95%)	Model 1* β (CI 95%)	Model 2†, β (CI 95%)	Model 3‡ β (CI 95%)
Intercept	−0.144 (−0.167 to −0.121)	−0.533 (−0.568 to −0.499)	−1.493 (−1.816 to −1.170)	−0.763 (−1.034 to −0.492)
Dental appointment for a pregnant woman		0.148 (0.121 to 0.176)		0.149 (0.122 to 0.176)
Provision of dentistry home care		0.175 (0.148 to 0.203)		0.166 (0.014 to 0.194)
How dental appointments are scheduled				
Anyday, anytime		1		1
Anyday, specific time		−0.054 (−0.095 to −0.013)		−0.042 (−0.083 to −0.001)
Fixed d - up to 3 d		−0.128 (−0.164 to −0.092)		−0.099 (−0.135 to −0.063)
Fixed days − more than 3 d		−0.241 (−0.290 to −0.191)		−0.206 (−0.259 to −0.191)
Others		−0.243 (−0.278 to −0.209)		−0.225 (−0.259 to −0.191)
Are there guidelines for providing prosthesis in primary care?		0.344 (0.309 to 0.380)		0.338 (0.303 to 0.373)
Are there guidelines for referral for secondary care?		0.193 (0.157 to 0.228)		0.177 (0.142 to 0.212)
Are there guidelines for referral for checking oral cancer?		0.249 (0.213 to 0.285)		0.229 (0.194 to 0.265)
Are there guidelines for providing care for individuals with special needs?		0.121 (0.086 to 0.156)		0.118 (0.083 to 0.153)
OHT in charge for more than 5000 individuals		−0.056 (−0.102 to −0.010)		−0.060 (−0.106 to −0.014)
MHDI			2.908 (2.598 to 3.226)	1.183 (0.909 to 1.457)
Gini Index			−1.151 (−1.524 to −0.778)	−1.092 (−1.034 to −0.491)
Variance partition				
Level 1	0.474	0.414	0.474	0.412
Level 2	0.275	0.134	0.219	0.124

IRT = item response theory, OHTs = Brazilian oral health teams, MHDI = municipal human development index.

* Model with variables at Level 1.
† Model with variables at Level 2.
‡ Model with variables at Level 1 and 2.

MHDI coefficients were positively associated with OHTs performance (Table 1).

Homoscedasticity and normality were not violated as checked by residuals analysis. VIF values were lower than two for all level 1 variables indicating no multicollinearity problems.

4. Discussion

This research showed that Brazilian OHTs with higher performance were positively associated with better oral health care organizational and better socioeconomic status. The OHT structural factors positively associated with higher performance were a recording of pregnant women's dental appointment, provision of dentistry home care, and the use of guidelines for guiding the work process. At the municipal level, the MHDI was positively associated.

The Brazilian Oral Health Policy emphasizes the need to provide dental care according to an individual's life condition such as during pregnancy and facing special needs conditions. Thus, the results that linked OHTs higher performance with dental care provided to pregnant women and individuals with special needs are in concordance with the Oral Health Policy.[17,18] Providing home dentistry care has been shown as an important device to promote health care.[19] This study shows that higher performance OHTs tend to provide more than service which indicates an improvement in the OHTs work process.

Those results might represent an improvement in the access to vulnerable populations into dentistry primary care services access, which is important to minimize disparities among population subgroups. For Starfield, reducing inequalities is a key goal of primary care facilities.[10]

The use of guidelines was positively associated with OHTs higher performance. Guidelines are developed to support health care providers in the diagnosis and treatment of patients. In dental care, those guidelines reinforce dentists' continuing education to improve clinical practice. The scientific support provided by using guidelines may reduce the gap between the dentistry research and clinical practice, and contribute to enhancing the quality of care provided.[20,21] At the municipal level, better socioeconomic status was associated with OHT higher performance. This result shows that contextual factors[11] as MHDI might contribute to higher OHTs performance. The

assessment of enabling contextual factors on dental services utilization has identified the association between some contextual variables with dental services utilization.[12,22] The "Inverse Care Law" proposed by Hart (1971)[23] says that "the availability of good medical care tends to vary inversely with the need for it in the population served." This statement is also applied to the Brazilian National Health System. In fact, municipalities with better socioeconomic status tend to deliver better oral health care services counting with more structured health care units, and more qualified OHTs. Thus, usually, those municipalities provide more dental appointments and a variety of procedures.[24,25] On the contrary, municipalities facing worse socioeconomic status tend to present oral health care services in worse conditions. Besides the quality of the services provided, the patient-dental professional communication tends to be worse in economically disadvantaged areas.[25]

As a Ministry of Health mandate, the 2012 PMAQ-AB was limited to evaluate only 50% of the Brazilian OHTs, and the municipal managers were responsible for selecting those teams. This could have caused selection bias. Also, information bias might be considered, as PMAQ-AB is a pay for performance program, which could lead to positive responses. The strengths of this study are that the results are based on a large dataset and in an innovative analysis, based on the psychometric properties of dental questions of PMAQ-AB through the IRT application and multilevel analyses. Future studies should evaluate other covariables that may be influencing the performance of OHTs and are encouraged, especially in other PMAQ-AB evaluation cycles.

Author contributions

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