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ACCESS AND FINANCIAL IMPACTS OF PUBLIC ORTHODONTIC PROVISION ON GLOBAL HEALTH SYSTEMS: INTEGRATIVE REVIEW

Acesso e impactos financeiros da provisão ortodôntica pública nos sistemas de saúde mundiais: revisão integrativa

Acceso e impactos financieros de la provisión pública de ortodoncia en los sistemas de salud globales: revisión integradora

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Submetido: 22/05/21
Aprovado: 01/10/21

ABSTRACT

Introduction: The supply of public orthodontic services is still unable to meet the demand for treatment of malocclusions. The resources available are sometimes mismanaged and significant financial impacts contribute to limited access to the services. **Objective**: To carry out an integrative review regarding the access and financial impacts of public orthodontic service among the various health systems worldwide, considering social inequalities and the referral and counter-referral systems for services. **Methodology:** A survey was conducted using the BVS (Biblioteca Virtual em Saúde / Virtual Health Library), PubMed, and Cochrane databases, including articles available from 1970 to 2019, which elucidated the guiding question "How does access work and what are the financial impacts of the provision of orthodontic services in different public health systems worldwide?". **Results:** 211 articles were found, of which 20 were analyzed. The chronological distribution was relatively uniform. The topic 'access to orthodontic services' was most frequently reported and there was a predominance of studies addressing the provision of treatment for children and adolescents. **Conclusions:** There are significant financial impacts and demographics have a strong influence on access to services. The provision of orthodontic treatments by the private sector predominates, preventive approaches are scarce, and an optimization in the use of available resources is necessary. Primary Care has much to contribute in increasing access, reducing costs, and making the referral / counter-referral system effective.

Keywords: Orthodontics; Corrective Orthodontics; Preventive Orthodontics; Health Services Accessibility; Healthcare Financing.

RESUMO

Introdução: A oferta de serviços ortodônticos públicos ainda não consegue suprir a demanda de tratamento de má oclusões. Os recursos disponíveis, por vezes, mal alocados e os impactos financeiros significativos contribuem para a restrição do acesso aos serviços. **Objetivo**: Realizar uma revisão integrativa pertinente ao acesso e aos impactos financeiros da provisão ortodôntica pública nos diversos sistemas de saúde mundiais, sob a luz das iniquidades sociais e dos sistemas de referência e contrarreferência de serviços. **Metodologia:** Foi realizado um levantamento nas bases de dados BVS (Biblioteca Virtual em Saúde), PubMed e Cochrane Reviews, incluindo os artigos disponíveis no período de 1970 a 2019, que elucidavam a questão norteadora "Como se dá a provisão de serviços ortodônticos nos diversos sistemas públicos de saúde mundiais?". **Resultados:** Foram encontrados 211 registros, dos quais 20 foram analisados. A distribuição temporal foi relativamente uniforme. A temática "acesso aos serviços ortodônticos" foi mais frequentemente relatada e houve um predomínio de estudos abordando a oferta de tratamentos a crianças e adolescentes. **Conclusões:** Há impactos financeiros significativos e os determinantes sociais exercem forte influência sobre o acesso aos serviços. Predomina a oferta de tratamentos ortodônticos pelo setor privado, abordagens preventivas são escassas e é necessária uma otimização no uso de recursos disponíveis. A Atenção Básica tem muito a contribuir para aumento do acesso, diminuição de custos e efetivação do sistema de referência/contrarreferência dos serviços.

Palavras-Chave: Ortodontia; Ortodontia Corretiva; Ortodontia Preventiva; Acesso aos Serviços de Saúde; Financiamento da Assistência à Saúde.

RESUMEN

Introducción: La provisión de servicios públicos de ortodoncia aún no puede satisfacer la demanda de tratamientos de maloclusión. Los recursos disponibles a veces están mal asignados y los impactos financieros significativos contribuyen a restringir el acceso a los servicios. **Objetivo:** Realizar una revisión integradora pertinente al acceso y los impactos económicos de la provisión pública de ortodoncia en los diferentes sistemas de salud a nivel mundial, a la luz de las inequidades sociales y los sistemas de derivación y contrarreferencia de servicios. **Metodología:** Se realizó una encuesta en las bases de datos de la BVS (Virtual Health Library), PubMed y Cochrane Reviews, incluidos los artículos disponibles desde 1970 hasta 2019, que dilucidó la pregunta orientadora "¿Cómo es la prestación de servicios de ortodoncia en los diferentes sistemas públicos?". **Resultados:** Se encontraron 211 registros, de los cuales se analizaron 20. La distribución temporal fue relativamente uniforme. El tema "acceso a servicios de ortodoncia" fue el que se informó con mayor frecuencia y hubo un predominio de estudios que abordan la provisión de tratamientos a niños y adolescentes. **Conclusiones:** Hay impactos económicos significativos y los determinantes sociales tienen una fuerte influencia en el acceso a los servicios. Predomina la oferta de tratamientos de ortodoncia por parte del sector privado, los abordajes preventivos son escasos y es necesario optimizar el uso de los recursos disponibles. La Atención Primaria tiene mucho que contribuir para aumentar el acceso, reducir costos e implementar el sistema de derivación / contrarreferencia de servicios.

Palabras clave: Ortodoncia; Ortodoncia correctiva; Ortodoncia preventiva; Acceso a los servicios de salud; Financiamiento de la atención médica.

Introduction

Malocclusion is considered a public health problem, since it is the third most prevalent oral condition in the world. Edward Hartley Angle defined malocclusion as any deviation from ideal occlusion, at the dental or bone level. Such abnormalities can affect aesthetic, functional, psychological, and social aspects of affected individuals[1].

Malocclusions are identifiied from pre-school age (28%a 80%) with a wide variation in prevalence due to different assessment methods. However, there is evidence tha socioeconomic and educational conditions influence the recognition of the severety of the condition and access, as well as the structure of the municipality[2].

Given the high prevalence of malocclusions, the predominance of the private sector in offering treatment, and being aware of the inequities in access to services in developing countries, the need to formulate public policies that encompass the provision of orthodontic treatments worldwide is evident, especially in the preventive and interceptive spheres. Teaching and research institutions, such as public universities, can help to reverse this predominance of private contracts in the specialty, through the provision of orthodontic services, exercising a social policy concomitant with the formation of specialized human resources.

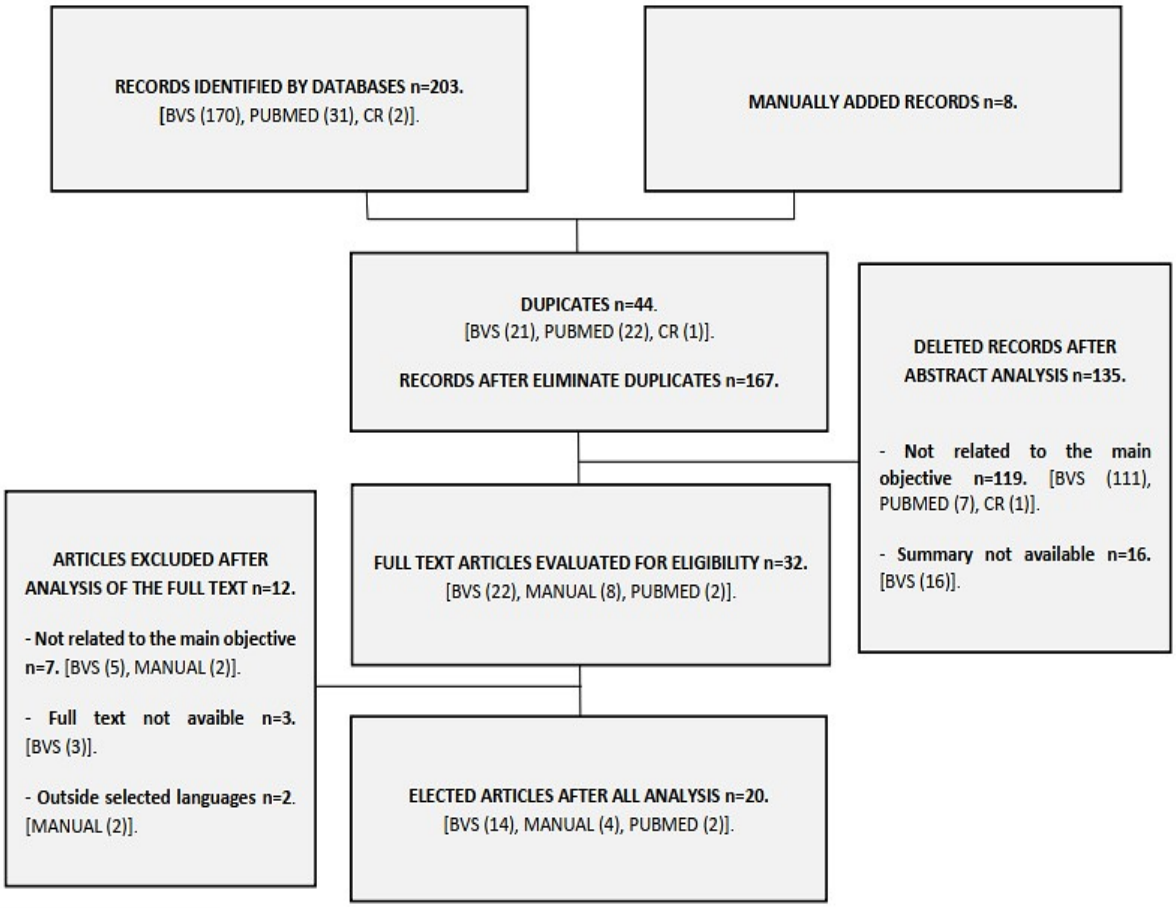
The intent of the present study was to carry out an integrative review regarding the access and financial impacts of public orthodontic service among the various health systems worldwide, considering the social determinants and inequities, and the referral and counter-referral systems for services.

Methodology

The following methodological description met the recommendations of the PRISMA protocol (Main items for reporting systematic reviews and meta-analyses). In order to elucidate the guiding question "How does access work and what are the financial impacts of the provision of orthodontic services in the different public health systems worldwide?", a survey was conducted using the BVS (Biblioteca Virtual em Saúde/Virtual Health Library), PubMed, and Cochrane Reviews (CR)

databases, including articles available from january of 1970 to march of 2019, and using the keywords “Orthodontics”, “Orthodontics Preventive” or “Orthodontics Interceptive” combined, one at a time, with “Public Health and Utilization”. In BVS and CR, a Boolean operator “and” was used between the terms, while in Medline, it was not necessary, just select the option "and" on the search site was enough. The initial list of articles found was submitted to an analysis of the title and abstract, by two independent evaluators. In cases of disagreements in the analyses, we opted for a joint assessment to obtain a consensus between both. Articles in Portuguese, Spanish, and English were included. Duplicate records, those that did not relate to the main objective of the research, and those that did not have abstracts available were excluded. A second analysis was carried out, based on the full texts. The exclusion criteria used in the second stage were: language different from the pre-selected ones; studies that were limited exclusively to the design of epidemiological profiles or to comparisons of orthodontic techniques and materials; and the absence of full text availability. Relevant articles not found in full text in the databases consulted were added manually (Figure 1). The selected articles were read and categorized, according to their objectives and main findings, in "Access to public orthodontic services" and "Financial impacts of public orthodontic provision".

Figure.1: Search strategy for selecting articles. Juiz de Fora-MG, 2019.



Results

The continental distribution of the 20 articles selected is shown in Figure 2. The studies that evaluated access to orthodontic services were mostly from America and Europe; while those that addressed the financial impacts were mainly from Europe (Figure 2.c). Publications from nine countries were found: United States (7), United Kingdom (5), Australia (2), Brazil (1), Canada (1), Finland (1), Lithuania (1), Norway (1), and Sweden (1).

The chronological distribution of the articles proved to be relatively uniform, with small variations in the last two decades. The access theme was more frequently reported, with the first studies dating back to 1990, while the financial impacts theme presented a smaller number of reports, but more recent, starting in 2006.

The objectives and main findings of the selected articles were summarized and presented in Tables 1 and 2, categorized under "Access to public orthodontic services" and "Financial impacts of public orthodontic provision".

The influence of social determinants on orthodontic access was addressed, most significantly, by U.S. studies. Issues regarding waiting times for treatment were raised by European studies. There was a predominance of analyses on the provision of treatment to children and adolescents.

Figure.2: Continental distribution of: a) all articles; b) articles categorized in "Access to public orthodontic services"; c) articles categorized under "Financial impacts of public orthodontic provision". Juiz de Fora-MG, 2019.

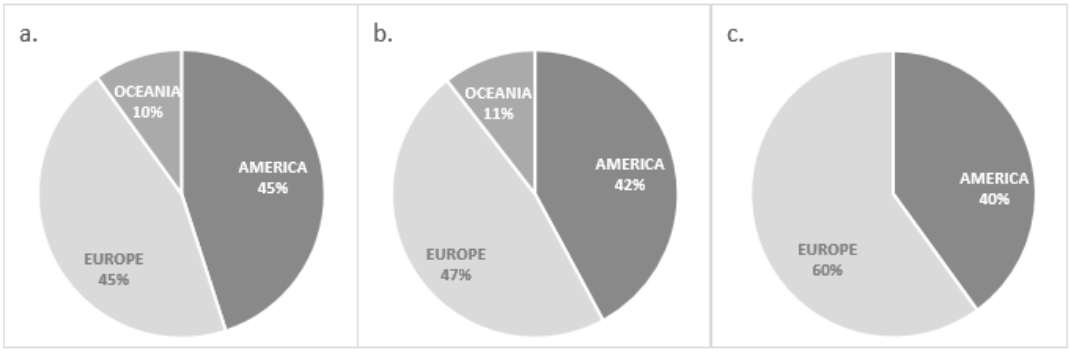


Table.1: Summaries of the articles categorized under "Access to public orthodontic services". Juiz de Fora-MG, 2019.

ACCESS TO PUBLIC ORTHODONTIC SERVICES		
AUTHOR(YEAR)/PLACE/JOURNAL	OBJECTIVE	MAIN FINDINGS
O'brien (1990)/England/British Journal of Orthodontics.	Determine the regional distribution of human, dental, and orthodontic resources; the variation and number of procedures provided by the Community Dental Service in Wales, in the years 1985 and 1987.	Large regional variations were observed in the allocation and distribution of human and financial resources. The mean ratio of community orthodontists for children and adolescents, from 5 to 15 years old, was 1.57:100.00; and the rate of orthodontic treatments performed was 5.78:1,000. In 1987, there was an increase in the number of fixed appliance installations.
Willmot, et al. (1995)/United Kingdom/British Journal of Orthodontics.	Assess' the mean waiting time for obtaining first orthodontic consultation and for the start of treatment and compare the rates between completed and discontinued treatments in UK hospitals.	The mean waiting time for obtaining first orthodontic consultations was 31.6 weeks and for urgent consultations, it was 3.6 weeks. The treatments lasted, on average, 20.3 months and were usually started at around 14.2 years of age. The mean rate of discontinuation was 9.2% and was more prevalent when coordinated by less experienced professionals and/or using removable appliances. The discontinued

		treatments were interrupted when they presented a mean of 58% of progress. It was concluded that the region's demand is not being adequately met.
Allister, Spencer & Brennan (1996)/Australia/Australian Dental Journal.	Identify the orthodontic care provided by general dentists and/or orthodontists, in the public and private sectors, for 3,323 Australian adolescents.	Most of the fixed orthodontic treatments were provided by orthodontists in the private sector, while for removable appliances, by dentists in the public sector. Consultations were provided by both sectors. Only 32% of the adolescents who had consultations exclusively in the public sector received some type of orthodontic treatment. The large participation of the private sector may reflect the unavailability of orthodontists in the public sector.
Manski, Davidson & Moeller (2000)/USA/ American Journal of Orthodontics and Dentofacial Orthopedics.	Present and assess data published in two national surveys (NMES and MEPS) taken in the United States, in the years 1987 and 1996.	There was an increase in the use of orthodontic visits among Non-white individuals, however, even so, these rates remained lower when compared to those referring to White users. Just over 3% of the population had at least one orthodontic visit in the years evaluated. People with lower incomes and lower levels of education were less likely to report a visit.
Masnki, & Moeller (2002)/USA/ The Journal of the American Dental Association.	Assess the distribution pattern of dental visits and identify changes that had occurred over 10 years in the United States.	Of all the dental visits analyzed, only 7% were to orthodontists. Individuals with lower incomes and lower levels of education had lower rates of visits to specialists, while young people reported higher rates. The variables race and sex did not significantly influence the usage patterns.
Suchitra, et al. (2004)/USA/ Journal of Public Health Dentistry.	Assess disparities in the use of orthodontic services and the orthodontic treatment need in high school students in Cuyahoga County.	The overall rate of orthodontic use in the study was 37% and the rate of unmet treatment need was 29%. Caucasian individuals and/or those who had dental consultations in the year prior to the study were more likely to be treated orthodontically, while males, African-Americans, and those with lower incomes had lower rates of treatment. Higher rates of mean current satisfaction with appearance (VAS) were observed in treated individuals.
Kruger & Tennant (2006)/ Australia/Australian Dental Journal.	Assess distribution of patients referred for government-subsidized orthodontic care in Western Australia.	Orthodontic treatment need was not uniform across all areas analyzed. Individuals with higher incomes and residents in more accessible and metropolitan regions had higher access rates.

Okunseri, et al. (2007)/USA/ Journal of Public Health Dentistry.	Assess racial and ethnic disparities in access to orthodontic visits by American children and adolescents, from 1996 to 2004.	The prevalence of orthodontic visits proved to be relatively constant - ranging from 14.3% to 16.8%. White children and users of private insurance were more likely to have access, while male children, those with lower incomes, users of public insurance or the uninsured had lower rates of orthodontic visits.
Janulyte et al. (2008) /Lithuania/ Stomatologija, Baltic Dental and Maxillofacial Journal.	Assess public access to orthodontic care in specialized and highly specialized outpatient facilities in Lithuania, from 2002 to 2007.	In 2007, there were 73 orthodontists in service, but with limited access due to their high concentration in the main cities of the country. Orthodontic treatment in the public service is practically restricted to the use of removable appliances, since the State Patients Fund only reimburses comprehensive orthodontic treatment (use of fixed or removable appliances) for cases of cleft lip and/or palate, or facial bone formation defects. Clinics prioritize patients with higher rates of orthodontic treatment need.
Nihtila & Widstrom (2009)/ Finland/European Journal of Paediatric Dentistry.	Identify the frequency of use of public dental services among children and adolescents, in the city of Espoo, in 2004.	7% of the participants were categorized as "heavy users" of the services and represented about 26.3% of all dental consultations done. In 66.7% of these consultations, at least one orthodontic procedure was performed, while only 7.9% of those considered "light users" received some type of orthodontic treatment in the same period.
Grytten, Skau, & Stenvik (2010)/ Norway/Community Dentistry and Oral Epidemiology.	Assess inequalities in access to orthodontic services and study the costs generated by these services, in Norway, in the period from 2004 to 2007.	The mean waiting time to start orthodontic treatment was approximately 4.7 months in almost all areas analyzed. The mean orthodontist ratio for 12-year-old children undergoing treatment was 1:370 - since in most regions there are few specialists available. However, the system was able to provide equal access to users.
Richmond & Karki (2012)/ Wales/British Dental Journal.	Detail orthodontic provision, its costs and management in the National Health Service of Wales, in the years 2008 and 2009.	The mean ratio of professional to children, age 12, in need of treatment was 1:107. High rates of inadequate referrals were found. There was a potential deficit of 4.4% in the provision of orthodontic treatments. The 11-to-15-year age group was the most treated in the period (60.3%). The rate of treatment discontinuation was 7%. The mean travel distance from patients to professional service providers was 8.9 miles.

Telford, et al. (2012)/Northern Ireland/ Community Dentistry and Oral Epidemiology.	Assess socioeconomic variations in the use of dental services by adolescents in Northern Ireland in 2001.	Lower levels of education and belonging to lower socioeconomic groups made access to treatment more difficult. Differences in the perceived treatment need and its level of prioritization were pointed out as probable explanations for the variations found in the pattern. It was concluded that horizontal equity of access in this country was not provided.
Ulhaq, et al. (2012)//United Kingdom/British Dental Journal	Assess the relation between the socioeconomic deprivation and the access to orthodontic services of primary care NHS, in Scotland, from 2008 to 2009.	There was a non-egalitarian access by the population, with the poorest portion being less served by orthodontic services. Wealthier children have almost twice as much access to treatment, regardless of the degree of need they have.
Mckernan, et al. (2013)/USA/ Journal of Public Health Dentistry.	Describe Medicaid-funded fees, geographic barriers to access, and factors associated with the use of orthodontic services provided to adolescents in the United States.	The general rate of orthodontic use in cities was 3.1%, with greater use by individuals from rural areas, from cities with lower population densities, and for those more distant from orthodontists. Women, Whites, and children 12 to 18 years of age received higher rates of treatment. Children who had, in the previous year, an oral assessment provided by a Primary Health Care (PHC) worker were more likely to use orthodontic services.
Goranson, Lundstrom & Bagesund (2014)/ Sweden/ Swedish Dental Journal.	Assess the results of orthodontic treatments provided at a public oral health clinic in the city of Linköping.	Of the 207 records evaluated, 53.1% had access to orthodontic consultations. Of these, 41.6% received orthodontic treatment and only 13.5% presented residual treatment need. There was no significant difference between genders in terms of receiving treatments, but there was a higher rate of completion for women and of residual treatment need for men.
Berdahl et al. (2016)/USA/ Academic Pediatrics.	Assess the use and costs of dentistry and orthodontics, among children 0 to 17 years of age, in the United States.	The use of orthodontic services was less than the general dental services use. The following variables implied greater access to orthodontic consultations and treatments: age (10-14 years), use of private insurance, female, White, higher family income and parental education levels.
Martins, et al. (2016)/Brazil/ PLOS One.	Describe the reality of referral and counter-referral services by oral health professionals in secondary health care in Brazil.	Of those interviewed, 62% reported having centers for case referrals. The orthodontics specialty was relatively little mentioned - only 20.5% of professionals referred patients to orthodontists. The mean waiting

		time varied from 30 to more than 90 days.
Laniado, Oliva & Matthews (2017)/USA/ American Journal of Orthodontics and Dentofacial Orthopedics.	Assess the dental and orthodontic use by children and adolescents; estimate the prevalence of orthodontic treatment; and examine the need for new orthodontic monitoring in the United States, from 2009 to 2013.	Orthodontic procedures were the third largest category of dental procedures performed (14.5%). Children with public insurance, Blacks, and those with lower incomes had the lowest rates of orthodontic visits. During the study, there was no orthodontic monitoring in place in the country.

Table.2: Summaries of the articles categorized under "Financial impacts of public orthodontic provision"

FINANCIAL IMPACTS OF PUBLIC ORTHODONTIC PROVISION		
AUTHOR(YEAR)/PLACE/JOURNAL	OBJECTIVE	MAIN FINDINGS
Leake, et al. (2006)/Canada/ Journal of Public Health Dentistry.	Assess patterns of use of dental services in the population of Canada, from 1994 to 2001.	More regular visitors generated higher expenses - presenting a mean final expense of US $2,925 - mainly in procedures related to prevention, surgery, and orthodontics. With orthodontic services, expenses ranged from US $204 for more frequent visitors to US $13 for less frequent visitors. In the years 2000 and 2001, orthodontics was the category of greatest expense in the country.
Grytten, Skau, & Stenvik (2010)/ Norway/Community Dentistry and Oral Epidemiology.	Assess inequalities in access to orthodontic services and study the costs they generated, in Norway, in the period from 2004 to 2007.	The National Insurance Administration reimbursed around 48 million euros spent on orthodontic treatments in 2007. The assistance system then in effect, with state subsidy depending on the severity of the malocclusion, proved to be effective in containing costs.
Richmond & Karki (2012)/Wales/ British Dental Journal.	Detail orthodontic provision, its costs and management in the National Health Service of Wales, in the years 2008 and 2009.	Total orthodontic expenditure was £12,718,370, representing 11.7% of the country's overall dental expenses. The estimated cost of a treatment case ranged from £972 to £2,133. Despite the inefficiencies found, the orthodontic budget would be sufficient to meet the needs of the population, provided that good and efficient contracts were executed.
Telford, et al. (2012)/Northern Ireland/ Community Dentistry and Oral Epidemiology.	Assess socioeconomic variations in the use of dental services by adolescents in Northern Ireland in 2001.	Orthodontic treatments represented 67% of total dental expenses. A lower educational qualification meant lower expenses with orthodontics and adolescents whose reference person at home never worked, had a significantly lower cumulative expenditure on orthodontics.
Berdahl et al. (2016)/USA/ Academic Pediatrics.	Assess the use and costs of dentistry and orthodontics,	In the 2010-2012 period, total annualized expenses for children

	among children 0 to 17 years of age, in the United States.	in general dental care were US $9.13 billion and US $9.66 billion for orthodontic care. In both categories, the public sector represents the largest expenses.

Discussion

In Brazil, the Unified Health System (SUS) includes "equity" as one of its principles, aiming to reduce disparities in access to health services - whether these are due to regional or socioeconomic aspects. However, due to the scarcity of resources, it is difficult to guarantee the effective fulfillment of this concept[3]. With regard to dentistry, the context is not very different, especially in orthodontics, throughout the world.

The prioritization of orthodontic treatment, the perceived need for it, and satisfaction with the final result are directly affected by the environment in which patients live, their beliefs, opinions, and interpersonal relationships[4,5,6]. However, although subjectively, individuals treated orthodontically tend to have greater satisfaction with their appearance compared to those untreated[5]. Thus, access to orthodontic treatment can directly influence the patient's quality of life.

In view of this situation and in order to complement the private treatment offered, in 2011, procedures for preventive, interceptive, and corrective orthodontics and orthopedics - fixed and removable - were included in the SUS, through ordinance no. 718/SAS (Secretaria de Assistência à Saúde/Health Assistance Departament). Of these, some had to be performed exclusively in Secondary Care, while others could also be carried out in Primary Care (PC)[1].

Nordic countries offer free orthodontic services in their Public Dental Services (PDS), prioritizing the most serious cases. In Finland, all adolescents under the age of 18 have access to free treatment and only 1% of schoolchildren use private services[7]. In Sweden, all inhabitants have universal access to the health system, including dental procedures, for a small co-participation fee[3] and the Municipal Councils offer free treatments for young people up to 19 years of age[8]. However, in Norway, the private sector is still the main provider of orthodontics, with the State partially financing services provided to children and adolescents[9].

In the United Kingdom, there is wide provision, being possible through private contracts or, in the public sector, through general dental services (GDS), personal (PDS), hospital (HDS), and community (CDS) dental services[10], while in Australia the public scope is smaller, aided by universities for providing treatment, especially with removable appliances. Fixed appliances are more commonly provided by private services[11].

There is also a predominance of private provision of orthodontics in Lithuania[12], Canada[8], and the United States. However, in Lithuania, the National Fund finances part of the treatment costs in the public sphere[12]; in some Canadian provinces, there is a state subsidy for the treatment of specific groups or those enrolled in vulnerability programs[8]; and in the USA, there is the AFDC (Aid to Families with Dependent Children) benefit that includes dental services, but only a small portion of the population has access[3].

In Brazil, referrals for orthodontic treatment in regional CEOs (Centros de Especialidades Odontológicas/Dental Specialties Centers) are established through a Consortium Agreement Program, which provides for a specific number of vacancies for the associated municipalities, and the scheduling of consultations is done through the SISREG (Regulation System). Even so, in 2012, Orthodontics was one of the specialties least referred by professionals in Primary Health Care (PC). Only around 20% of the patients seen were referred to specialists[13]. In 2018, there was a municipality with no records of referred cases[14]. Thus, it is necessary to stimulate the practice of referring cases from PC, since Mckernan et al.[15] pointed out that referrals to orthodontists, by primary care dentists in the USA, improved patient access to specialized care in that country. An 8.7 times greater chance of access to orthodontic treatments was found for Americans who did a previous dental visit[5]. Despite the low rate of referrals, the referred Brazilian patients waited, on average, from 30 to more than 90 days to obtain orthodontic procedures[13]. This is a relatively acceptable timeframe, compared to the mean waiting times to begin treatment of 4.7 months in Norway[9], and 7.9 months in the United Kingdom[16].

However, greater access and greater coverage of services do not necessarily imply greater resolution. It is important to know the profile of the users who seek

treatment, to analyze the prevalent malocclusion patterns and local needs so that there is a better targeting in the provision of services and better use of resources. The prioritization of cases by age group and by the type of orthodontic treatment need can also optimize services[17]. Not ascertaining the real seriousness of the malocclusions prevalent in the country is to consent to the social exclusion in force. Hundreds of Brazilian children will never have their malocclusions treated unless it is through the SUS.

Inequities in access were widely associated with the variables age, sex, income, education level, ethnicity, type of patient insurance, availability and location of professionals and services. White children, older, privately insured, with higher family incomes, and a better education level had greater access to the services[4,5,6,11,15,18,19,20,21,22,23]. The low use of the services by Black children, educationally and economically disadvantaged, reinforces the direct influence exercised by social determinants in access to health. Women tended to look more for orthodontic care[4,6,15,19,22,23], while men presented greater residual treatment need[6].

However, the variables race and sex did not directly influence American usage patterns and younger individuals were more likely to visit specialists[20]. In Australia, greater access was seen for inhabitants of metropolitan areas[21], while in the United States there was a greater use by residents of small towns, rural areas, and those more distant from health centers[15].

There was a strong predominance in the provision of fixed orthodontic treatments by the private sector, while the public sector tended to limit its provision to the more severe cases, placing greater emphasis on the provision of consultations, orthodontic assessments, and the installation of removable appliances[11,12]. Of all the adolescent consultations exclusively in the Australian public sector, only 32% actually received orthodontic treatment[11]. In Finland, the most regular patients represented about 66.4% of the orthodontic treatments provided, while the less regular patients represented only 7.9% - both with a predominance of the use of removable appliances, but with great variation in the use of fixed appliances: only one less-recurring patient received fixed appliances and about 20.9% of the more regular patients received them[7].

The mean values for orthodontists per capita varied widely around the world. In 2007, while there were 165 active professionals in Norway[9] on average, in Lithuania, the average was 73 active orthodontists[12]. However, a greater number of professionals does not exactly guarantee a greater number of consultations. There are various factors that influence this issue, from populational to economic. Norway, although it had 165 active professionals, presented a proportion of 1 orthodontist for every 370 12-year-old children in the country[9], while Wales with only 108 orthodontists, had a better proportion of 1:107[10].

Limited access in Lithuania is partly due to the high concentration of professionals in large centers and to the reimbursement criteria for procedures adopted by the State Fund. Comprehensive treatments, with fixed appliances, are only granted to patients with bone defects, cleft lip, palate or both. Thus, the prioritization of care is linked to higher levels of need for treatment[12].

In England, the great regional variation in the distribution of the workforce did not influence the rates of treatments carried out[24]. Orthodontic treatments provided in Australian public systems tended to have lower rates of continuation when compared to those provided by the private sector[11]. In Sweden, men had lower rates of completed treatments and higher rates of residual treatment need compared to women[8]. In the UK, the rate of treatment discontinuation was 9.2%, inversely proportional to the provider's length of experience and more frequently associated with the use of removable appliances[16]. According to Richmond and Karki[10], in 2008 and 2009, in Wales, about 7% of treatments were discontinued. The large number of inappropriate or untimely referrals reported and the absence of an adequate database on the quality of the services provided further worsened orthodontic provision in that country. In Brazil, in the state of Ceará, discontinuation rates were significantly associated with changing professionals during treatment. With the change, there was twice as much chance of the patient missing appointments. The break in the bond, the changes in the previously explained plan, and the increase in the duration of treatment resulted in demotivation of the patient[14].

In terms of financial impacts, the usage patterns found are similar. Children covered by private insurance, whites, those with higher incomes[23], living in a salaried

household[5], and with higher levels of education, had higher total orthodontic expenditures[5,23]. Patients who visited orthodontists more frequently represented higher expenditures compared to less regular ones, negating the idea that continued care would generate lower costs. Mean individual treatment costs varied widely in Canada, from $13 to $204 (USD), according to Leake et al[25].

The financial impacts of orthodontic provision are significant: Orthodontics was among the three most expensive dental specialties in Canada, in 2001[25]. In the same year, orthodontic expenses in Northern Ireland constituted 67% of all dental expenditures in the country[5]. The USA had total annualized expenditures of $9.66 billion on orthodontic care from 2010 to 2012[23], and orthodontic treatment reimbursements by the Norwegian National Insurance Administration totaled 48 million euros in 2007[9]. In Wales, a total of around £12.7 million was spent on orthodontic services, approximately 11.7% of the entire dental budget available in the years 2008 and 2009. The average cost for a treated case ranged from £972 to £2,133 and, although the budget available in the country was sufficient, it was emphasized that the full capacity to provide services is linked to the execution of good and efficient contracts by local managers[10].

There are a number of challenges faced by health systems in orthodontic provision. These stem from structural problems, as in the United Kingdom[16]; from inefficiency and low resolution of care, as in Wales[10]; access inequities, as in Northern Ireland[7]; even low availability of specialists, as in Norway. However, with the proper planning and conditioning of the state subsidy to the severity of the malocclusion, the Norwegian national system has nevertheless managed to contain costs and provide equal access to its population[9]. Therefore, better organization of orthodontic services provision is essential in these countries, in order to expand access and avoid waste and misallocation of human, physical, and financial resources. Actions aimed at prevention guarantee simpler and cheaper treatments.

Conclusions

Public orthodontic provision is incipient in various countries, with the private sector predominating in providing services, especially when using fixed

appliances. Preventive approaches are scarce and there is a need to optimize available resources. Access inequities are closely related to social determinants.

There is a need to develop public policies, especially in the context of preventive and interceptive orthodontics. Primary Care, as a guide for care in the network, has much to contribute, since correct and timely referrals of patients to specialized care, through the prioritization of complex cases and early diagnosis of malocclusion, prevent the worsening of cases, decrease costs, and increase access to services.

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