Impact of COVID-19 on Oral Health Services Utilization among Peruvian Children: A Cross-Sectional Study

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DECLARATION

I, Katherine Quiroz Gonzales, affirm that the study title “Impact of COVID-19 on Oral Health Services Utilization among Peruvian Children: A Cross-Sectional Study” is presented as a thesis to fulfill the requirements for my Master’s Degree in the Department of Global Health and Disease Control, Division of Health Policy and Financing at Yonsei University, Seoul. This thesis encompasses the comprehensive findings of my research, and due credit is given to all ideas, references, and content included. Moreover, I confirm that the outcomes of this investigation have not been presented for any other academic degree and are not presently under consideration for such candidacy.

Katherine Quiroz Gonzales December 2023

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADA	American Dental Association
ARDS	Acute Respiratory Distress Syndrome
CI	Confidence Interval
COVID-19	Coronavirus Disease 2019
CDC	Center for Disease Control and Prevention
ENDES	Demographic and Family Health Survey
GDP	Gross Domestic Product
ICU	Intensive Care Unit
MINSA	Ministry of Health of Peru
NCDs	Non-Communicable Diseases
OR	Odd Ratio
PHEIC	Public Health Emergency of International Concern
PPE	Personal Protective Equipment
SARS-CoV-1	Severe Acute Respiratory Syndrome Corona Virus
SDG	Sustainable Development Goals
UHC	Universal Health Coverage
WHO	World Health Organization

ABSTRACT

Background: Oral Health is the first step for general health and well-being. Unfortunately, Oral health conditions have consistently ranked as some of the most widespread Non-Communicable Diseases (NCDs) globally (WHO, 2022), affecting the financial burden and compromising the country's health expenditure. Therefore, early diagnosis, treatment, and monitoring through visits to oral health services are essential to reduce the burden of Oral Health Diseases (Di Spirito et al., 2022; Huang & Chang, 2022; Kazeminia et al., 2020).

Due to the emergence of the novel Coronavirus Disease (COVID-19) different public health measures were triggered exacerbating health inequalities affecting access to health services (Bambra et al., 2020; Gudipaneni et al., 2023). In addition, the patterns of children's dental attendance could be influenced by different factors involving parents/caregivers, household characteristics, and others that were changed by the pandemic context (Gudipaneni et al., 2023; Torres-Mantilla & Newball-Noriega, 2023).

In Peru, Oral Health Services Utilization has remained relatively low in the past years while caries prevalence remained high for the past 20 years, especially in children, becoming a public health concern (MINSA, 2019)

Purpose: The objective of this research was to assess the impact of the COVID-19 pandemic on oral health services utilization among Peruvian children under 12 years old.

Method: A cross-sectional study with secondary data from the Demographic and Family Health Survey (ENDES, in Spanish) from the years 2019 (before COVID-19), 2020 (during COVID-19), and 2022 (after COVID-19) was carried out. This study involved children aged 0-11 years old. Those with complete data of all variables and who were habitual residents were considered, resulting in a total sample of 40,341 children for 2019, 19,530 for 2020, and 39,863 for 2022. The main variable was Oral Health Services Utilization in the last 6 months and the independent variables were the sociodemographic factors classified according to Andersen's Healthcare Utilization Model into predisposing

(child's age and sex; parent/caregiver's sex, age, marital status, relationship with the head of the household; natural region of residence; area of residence; and altitude) and enabling factors (child's insurance, wealth index, parent/caregiver's education level and knowledge about oral healthcare). Descriptive analysis involving absolute and relative frequencies was conducted, for the bivariate analysis Chi-square test was employed. Finally, to determine the association between predisposing and enabling factors with Oral Health Services Utilization Hierarchical Logistic Regression was performed for the multivariate analysis.

Results: The prevalence of Oral Health Services Utilization (within the last 6 months of ENDES surveys) in Peruvian children under 12 years of age was 40.4% in 2019, 31% in 2020, and 41.2% in 2022. For the bivariate analysis, Oral Health Services Utilization showed a significant association (p□0.001) with the following predisposing factors: child's age, parent/caregiver's age, natural region of residence, and area of residence before, during, and after the COVID-19 pandemic. All enabling factors (child's insurance, wealth index, parent/caregiver's education level, and knowledge about oral healthcare) showed significant association (p□0.001) with Oral Health Services Utilization before, during, and after the COVID-19 pandemic. The parent/caregiver's sex showed a significant association (p□0.001) with Oral Health Services Utilization only before the pandemic. While. parent/caregiver's marital status (p□0.05) and their relationship with the head of the household (p□0.001) were significantly associated with Oral Health Services Utilization only after the pandemic. On the other hand, the child's sex and the altitude showed insignificantly association.

Within the multivariate analysis, the child's age, the parent/caregiver's sex, the natural region of residence, the parent/caregiver's level of education, the parent/caregiver's information received about oral Healthcare, and the wealth quintile of the household were significantly associated with Oral Health Services Utilization before, during and after the COVID-19 pandemic. The parent/caregiver's age was associated with Oral Health Services Utilization only before and after the COVID-19 pandemic. The parent/caregiver's marital status, the area of residence, and the health insurance were

associated with Oral Health Services Utilization only before and during the COVID-19 pandemic. The child's sex was associated with Oral Health Services Utilization in children only after the COVID-19 pandemic. Finally, after analyzing samples as a whole and adding the "year" as a variable, this was significantly associated with Oral Health Service Utilization, therefore Peruvian children in 2019 (OR: 1.11, 95%CI: 1.07-1.14, p=0.000) were more likely to use Oral Health Services before the COVID-19 than after COVID-19 (2022). In addition, there was a negative association between the year 2020 (during the COVID-19) and Oral Health Services Utilization, then Peruvian children in 2020 (OR: 0.65, 95%CI: 0.63-0.68, p=0.000) were less likely to use Oral Health Services during the COVID-19 (2019) than after COVID-19 (2022).

Conclusion: The pre-existing low rate of Oral Health Services Utilization in Peruvian children under 12 years was exacerbated during the COVID-19 pandemic, as well as the sociodemographic factors determining Oral Health Services Utilization that were affected or even modified, changing the patterns of Oral Health Services attendance in Peruvian children. Therefore, the COVID-19 pandemic had a negative impact on Oral Health Services Utilization which is increasing again nowadays after 2 years.

Keywords: COVID-19, pandemic, oral health services, utilization, children, Peruvian

I. INTRODUCTION

1.1 Background

In December 2019, a new infectious disease emerged in Wuhan, Hubei Province, China, known as Coronavirus Disease (COVID-19), caused by the SARS-CoV-2 virus, which quickly spread globally (Guan et al., 2020). In March 2020, the World Health Organization (WHO) declared it as a “pandemic disease” (Yuce et al., 2021). To control the infection, several public health measures were triggered, such as mask-wearing, social distancing, transit/travel restrictions, lockdowns, contact tracing, and vaccination aimed at “flattening the spread curve” and limiting its impact on the healthcare systems. (Dickson- Swift et al., 2022; Mac Giolla Phadraig et al., 2021)

Latin American countries experienced the arrival of the COVID-19 virus later in the beginning of 2020. Although the same public health measures were implemented, the result was catastrophic, with the highest number of COVID-19 infections and deaths especially during the first waves of the pandemic. This humanitarian crisis was determined by several social, cultural, and economic factors. These factors include the lack of response and preparedness capacity, poor investment in the public sector, a high level of poverty, and informal labor, in addition to the already existing social and economic inequalities. It was also influenced by the lack of trust in the authorities and the lack of commitment of the population towards the well-being of society.

The overall impact of COVID-19 worldwide has been devastating, especially in developing countries exacerbating health inequalities (Bambra et al., 2020). There was a reduction in household income, and an increase in poverty, labor informality, and the unemployment rate. Also, there was a high number of school dropouts, leading to a consequent decrease in the level of literacy among both children and parents. Moreover, COVID-19 pandemic caused fear, panic, and insecurity in the population, affecting the general well-being (Ali & Alharbi, 2020; Poudel & Subedi, 2020).

In addition, this stressful environment during a pandemic can affect learning abilities, adaptive behaviors, physical and mental health, and adult productivity thereby risking the appropriate growth and development of children. Such effects could compromise the achievement of some Sustainable Development Goals (SDG) (Araujo et al., 2021).

The health sector faced significant challenges and strain as a result of the rapid increase in COVID-19 cases and the substantial deficiencies in the healthcare systems (Ali & Alharbi, 2020; Schwalb et al., 2022). In addition, some medical specialties, areas, or departments modified their protocols for healthcare delivery, prioritizing only emergencies resulting in a low rate of utilization of other health services mainly for the prevention and treatment of chronic diseases and non-communicable diseases (NCDs), such oral health diseases (Dickson-Swift et al., 2022).

Oral health diseases are among the most prevalent NCDs, affecting almost 3.5 billion people worldwide (WHO, 2022), they share the same risk factors with most common NCDs (cardiovascular disease, cancer, chronic respiratory disease, and diabetes). Therefore, good Oral Health can prevent life-threatening systemic conditions and improve life quality and general well-being. However, the global burden of Oral diseases has remained unchanged for several years, causing a financial burden worldwide (Huang & Chang, 2022). Fortunately, most Oral health diseases are preventable, then early diagnosis and monitoring of oral healthcare through visits to oral health facilities are essential to reduce the burden of oral health diseases and health expenditure (Di Spirito et al., 2022; Huang & Chang, 2022; Kazeminia et al., 2020).

Several studies indicate that the patterns of children's dental attendance could be influenced by different factors, such as maternal education level, household income level, preventive mother-child counseling, insurance coverage, financial feasibility, the age of the child, and the attitudes of parents, and other sociodemographic information about parents or caregivers (Gudipaneni et al., 2023; Torres-Mantilla & Newball-Noriega, 2023).

During the first waves of the COVID-19 pandemic, access to oral health services was

affected as it became a high-risk medical procedure for the spread of SARS-CoV-2 (Gudipaneni et al., 2023). Therefore, the Center for Disease Control and Prevention (CDC) and the American Dental Association (ADA) recommended prioritizing only dental emergencies to prevent the further spread of SARS-CoV-2 infection (Brian & Weintraub, 2020; Di Spirito et al., 2022).

In Peru, Oral Health Services Utilization has been relatively low in the past years reflecting the high dental caries prevalence, especially in children, which has remained the same in the last 20 years, becoming a public health concern consuming an important proportion of health expenditure (MINSA, 2019). In addition, in the context of the COVID- 19 pandemic, the Peruvian government was unable to contain the exponential transmission of the virus, recording one of the highest mortality rates in the world, making it one of the most severely affected countries (Cajachagua-Torres et al., 2022; Worldmeter, 2021). In this context, the COVID-19 pandemic also influenced health-seeking behaviors and decisions regarding Oral Health Services Utilization (Meisha et al., 2021).

Currently, most dental health offices/facilities have returned to a new normal, providing routine elective and emergency dental care with a limited understanding by the competent authorities (Ministry of Health) of the impact of COVID-19 on children's oral health service attendance patterns (Gudipaneni et al., 2023).

Several studies have been conducted to investigate the factors that would determine the use of oral health services in children in past years finding different and contradictory results. Therefore, the present study aims to analyze current Oral Health Services Utilization patterns through different years including the year of the COVID-19 pandemic to identify the critical determinants of Oral Health Services Utilization and their changes due to the COVID-19 pandemic to develop oral health strategies and implement oral health policies to tackle the most important determinants of Oral Health Services Utilization and improve their limited utilization among Peruvian children. In this way the Ministry of Health can prioritize financial and human resources for the Oral Health field.

1.2 Purpose

1.2.1 General Objective

The purpose of this study was to determine the impact of the COVID-19 pandemic on oral health services utilization among Peruvian children under 12 years old.

1.2.2 Specific Objectives

- Describe the socio-demographic factors of Peruvian children under 12 years old before, during, and after the COVID-19 pandemic.
- Describe Oral Health services utilization in Peruvian children under 12 years old before, during, and after the COVID-19 pandemic.
- Determine the relationship between socio-demographic factors of Peruvian children under 12 years old and their utilization of oral health services before, during, and after the COVID-19 pandemic.
- Compare the relationship between socio-demographic factors of Peruvian children under 12 years old and their utilization of oral health services before, during, and after the COVID-19 pandemic

1.3 Research Question

What is the impact of the COVID-19 pandemic on oral health services utilization among Peruvian Children under 12 years of age?

1.4 Hypotheses

The COVID-19 pandemic is negatively associated with Oral Health Services Utilization among Peruvian Children under 12 years of age.

1.5 Definitions

COVID-19 (Coronavirus disease):

COVID-19 is an infectious disease caused by the SARS-CoV-2 virus, which spreads when an infected person talks, sings, coughs, sneezes, or even breathes heavily through small droplets expelled from the mouth or nose (Fernandes et al., 2022; Serrano-Cumplido et al., 2020)

Pandemic:

A pandemic is an epidemic illness that disseminates globally or across an extensive geographic expanse, crossing international borders (impacting numerous countries), and typically afflicting a substantial population within a specific region.(Guan et al., 2020).

Oral Health:

Oral health, as outlined by the World Health Organization (WHO, 2022), refers to the condition of the mouth, teeth, and orofacial structures that allow individuals to carry out fundamental activities like eating, breathing, and speaking. It also encompasses psychological aspects such as self-confidence, well-being, and the capacity to engage in social and work-related activities without experiencing pain, discomfort, or embarrassment.

II. LITERATURE REVIEW

2.1 COVID-19 Pandemic

In early December 2019, an outbreak of pneumonia with an unknown origin emerged in Wuhan, the capital of Hubei province, China (Fernandes et al., 2022; Serrano-Cumplido et al., 2020). Due to the rapid propagation and high mortality, it was linked to previous epidemics like the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) in 2003, and the Middle East respiratory syndrome (MERS) in 2012 (Serrano-Cumplido et al., 2020).

The pathogen virus was identified as a novel enveloped RNA betacoronavirus belonging to Coronaviridae family, known for its high virulence attributed to viral structural proteins, (nucleocapsid protein, the membrane glycoprotein, and the spike glycoprotein) (Fernandes et al., 2022).

This virus was formally named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), leading to the disease becoming known as COVID-19. (Guan et al., 2020; Serrano-Cumplido et al., 2020). This new strain of the coronavirus was initially and temporarily named by the WHO as the '2019 novel coronavirus' (2019-nCoV). Then, on February 11, 2020, the International Committee on Taxonomy of Viruses formally renamed it as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), and the WHO called the viral disease triggered by this virus Coronavirus Disease 2019 (COVID-19) (Fernandes et al., 2022).

This disease is highly contagious in humans, capable of rapid spread, and is life-threatening (Guan et al., 2020; Lippi et al., 2023). Due to the increasing number of infections in China on the 1st of January, the World Health Organization (WHO) requested more information from Chinese health authorities to assess the real extent and risk of the epidemic (Serrano-Cumplido et al., 2020). As a result, on the 5th of January, the WHO published its first report about the outbreak in Wuhan, China. Within two

weeks, new cases were reported in other provinces of China, including among healthcare workers, as well as in other countries such as Thailand, Japan, United States, and Korea (Huang et al., 2020; Mac Giolla Phadraig et al., 2021).

On January 30, 2020, following the recommendations of the Emergency Committee, the WHO Director-General declared the outbreak a worldwide Public Health Emergency of International Concern (PHEIC) (WHO, 2020). By mid-March, COVID-19 had spread exponentially around the globe, leading the WHO to classify it as a pandemic.

Although the origin of the SARS-CoV-2 virus is still under investigation, studies showed that was likely originated from wild animals sold illegally at the seafood market in China (Huanan Seafood market) to humans. Huang et al., reported in their study the first 41 cases of individuals infected with COVID-19 had a history of exposure to the seafood in that market, and most of them were male.

The clinical symptoms of this disease were characteristic of pneumonia, including common signs such as fever, sore throat, cough, runny nose, fatigue, body ache, headache, and dyspnea, along with radiographic evidence of pneumonia. Less common symptoms include sputum production, hemoptysis, diarrhea, and lymphopenia (Huang et al., 2020).

Most COVID-19 patients developed severe cases of the disease, often accompanied by Acute Respiratory Distress Syndrome (ARDS), and in some cases, organ dysfunction such as acute cardiac injury and/or acute kidney injury. These severe cases required intensive care and oxygen supplementation (Jahangir MA et al., 2020; Wang et al., 2020). There is an increased risk of developing complications and mortality in the elderly population and those suffering from or having a history of chronic diseases (Jahangir MA et al., 2020).

COVID-19 has spread very quickly primarily through close human interactions like talking, laughing, coughing, and sneezing, where the virus can spread from the nose or mouth of an infected individual through small liquid particles that can range from larger respiratory droplets to smaller aerosols (Fernandes et al., 2022; Yuce et al., 2021).

According to the WHO and the CDC, early detection, epidemiology tracking, and the suppression of t transmission chains are recommended to lower the number of cases.

COVID-19 diagnosis relies on collecting samples from the nasopharyngeal region using a swab for SARS-COV-2 testing (Jahangir MA et al., 2020). Various technologies for detecting SARS-CoV-2, including antigen tests (for proteins), serological tests (for anti- SARS-CoV-2 antibodies), and molecular tests (for specific viral nucleic acids), Currently, this last one is the golden key of diagnosis (Fernandes et al., 2022).

Rapid and efficient diagnosis of COVID-19, followed by early and timely quarantine, contact tracing, and appropriate treatment, are the most important aspects in flattening the curve of infectious disease spread and successfully containing epidemics (To et al., 2021). The treatment when the symptoms are mild, only requires home isolation, monitoring,

and specific drugs for those current symptoms. Severe cases with persistent symptoms and dyspnea, require admission to a hospital to receive comprehensive monitoring of vital signs, respiratory support, and an additional therapeutic approach with anticoagulation therapy to prevent thromboembolic events.

According to the WHO's multinational solidarity trial involving 11,330 adult patients, certain known drugs for COVID-19 treatment (including remdesivir, lopinavir-ritonavir, interferon β-1a, and hydroxychloroquine) administered as monotherapy was shown to have little or no successful clinical efficacy, mainly in case of respiratory failure. On the other hand, another randomized clinical trial demonstrated that early administration of combined therapy of drugs (interferon β-1b, lopinavir-ritonavir, and ribavirin) decreased the duration of hospitalization and viral load. In addition, it has been shown that several immunomodulators (dexamethasone and baricitinib) improve patient survival when administered with other antiviral drugs. In cases requiring respiratory assistance, non-invasive mechanical ventilation is appropriate in the initial stages of the disease. However, in more severe cases of ARDS, intubation and prone ventilation are fundamental (To et al., 2021).

2.1.1 Public Health Measures and Implications

In the context of pandemic disease, successful infection control was crucial, requiring the implementation of public health policies and strategies. The target of these containment measures during COVID-19 was initially focused on decreasing the spread curve by stopping the importation of cases and reducing the spread in the community through the use of several non-pharmaceutical interventions such as social distancing, universal mask- wearing, disinfection of homes and workplaces, border closure and control, stringent lockdowns. The latter resulted in the closure of schools, colleges, recreational and worship places, banning of private and public events to prevent gatherings allowing only essential activities such as healthcare services, transportation, food services, and supply chains (Ali & Alharbi, 2020; Mac Giolla Phadraig et al., 2021; To et al., 2021).

All these measures combined with active surveillance for early and extensive case detection, accurate contact tracing, and timely isolation, played a crucial role in the fight against the COVID-19 pandemic. The arrival of COVID-19 vaccines marked a new chapter in the fight against this pandemic.

All these strategies and public health measures had significant socioeconomic implications worldwide. These implications affected various sectors, including the primary sectors (agriculture, petroleum, and oil export), secondary sectors (manufacturing industry), and tertiary sectors (education, finance industry, tourism and aviation, housing sector, sports industry, information technology, media, research & development, food sector, social impact and one of the most important fields healthcare services and pharmaceutical industry) (Nicola et al., 2020).

As a result, many jobs were lost. Consequently, the unemployment rate increased, especially in developing countries. Access to quality education and healthcare became limited, and there was a shortage of workers in all sectors, mainly in the healthcare sector. This was due to the overwhelming number of COVID-19 cases, which simultaneously increased the need for medical supplies (Ali & Alharbi, 2020)

At the same time, fear, anxiety, and panic, as well as stigma and discrimination, increased in society. Poudel and Subedi (2020), conducted a literature review about the impact of the COVID-19 pandemic on socioeconomic and mental aspects in Nepal, they found that public health measures adopted during the pandemic affected the physical, mental, social, and spiritual health of the population, mainly in developing countries and vulnerable populations (Poudel & Subedi, 2020). All of these factors contribute to high levels of stress in both parents and children, potentially posing a latent threat to achieving the Sustainable Development Goals (Araujo et al., 2021).

Inequalities in the social determinants of health have been highlighted by the COVID-19 pandemic. Evidence published by the Catalan government in Spain indicates that the percentage of COVID-19 infection is higher in the most disadvantaged areas compared to the least disadvantaged regions in the same area. Likewise, concerning racial inequalities with COVID-19, publications in England and Wales have shown that black, Asian, and ethnic minority people represented 34.5% of critical COVID-19 patients during a specific period (Stennett & Tsakos, 2022).

Khanna et al. (2021), carried out a cross-sectional study to evaluate the association of COVID-19 with race and socioeconomic factors, they found that the number of COVID-19 patients was higher among black non-Hispanic, and Hispanic individuals, as well as those residing in deprived areas (Khanna et al., 2021).

Similarly, inequalities in NCDs are influenced by social determinants of health such as living conditions, housing, working conditions, unemployment, economic development, access to essential goods and services (water, sanitation, and food), and access to healthcare. All of these were exacerbated during the initial waves of the COVID-19 pandemic (Stennett & Tsakos, 2022)

Furthermore, the COVID-19 pandemic has had a significant impact on health systems around the world. It has overwhelmed hospitals due to a shortage of Intensive Care Unit (ICU) beds and mechanical ventilators, health personnel, and protective equipment, including N95 masks. Ultimately, the pandemic has also exposed the weaknesses and

limitations in access to patient care services, mainly in the case of Non-Communicable Diseases (NCDs) This is due to the high costs of medical care, a lack of health insurance, difficulties in physically accessing health centers due to pandemic-related transit restrictions, and fear of contagion among the population. Consequently, there has been a reduced use of health services for the prevention, promotion, and treatment of NCDs (Dickson-Swift et al., 2022; Nicola et al., 2020).

According to official information published by the WHO on its COVID-19 update dashboard as of 19th August 2023, there have been 769 million confirmed cases of SARS-CoV-2 infection, resulting in more than 6,9 million deaths reported worldwide to WHO (WHO, 2023). remaining as a real health problem that exacerbates the wide social gaps.

2.1.2 COVID-19 Pandemic in Latin America and Peru

While the rest of the world began grappling with the COVID-19 pandemic in December 2019, the Latin American continent reported its first case in February 2020 (Brazil). Even though countries within this continent had more time to prepare and respond to the COVID-19 pandemic, the consequences they faced were catastrophic resulting in the highest number of positive cases and deaths, making it the epicenter of the pandemic during its first year. This occurred even before the arrival of the Omicron variant which, further exacerbated the social and economic impacts. The rapid spread of the virus was mainly due to failures in the response capacity due in large part to fragmented health systems, social disparities, and poor government involvement, investment, and support (Schwalb et al., 2022).

Peru is a Latin American country located in western South America. It is bordered by Ecuador and Colombia (north), Brazil (east), Chile (south), Bolivia (southeast), and the Pacific Ocean (west). It's a tropical country with diverse climates, and a heterogeneous territory of more than 1,2 million square kilometers (World Bank, 2020). It has a population of more than 33 million inhabitants (49.6 % males and 50.4% females) of which 82.6% live in the urban areas, and 21.1% are children under 12 years of age (CPI,

2022). Although the official language is Spanish, numerous indigenous languages are also spoken throughout the country.

Regarding the economic performance in Peru, so far in 2023 the Gross Domestic Product (GDP) growth would be barely 0.8%, which represents the lowest rate in the past two decades, excluding the initial period of the COVID-19 pandemic (IPI, 2023). The unemployment rate in the first quarter of 2023 at 5.9%, slightly lower than the rate recorded during the same period in 2022 (6.2%). Additionally, 76.8% of informality in the economically active population (INEI, 2023).

Over the last few decades, Peru has experienced remarkable socioeconomic growth, allowing it to be classified as an upper-middle-income country, although it still falls within the group of developing countries (OECD, 2019).

Due to the outbreak of the COVID-19 virus and the confirmation of its rapid spread and lethality in early 2020, the government of Peru, through the Minister of Health, introduced the National Preparedness and Response Plan against the Risk of SARS-CoV-2 Virus Introduction (Ministerial Resolution No. 039-2020-MINSA of January 31, 2020).

Likewise, the National Center for Disease Epidemiology, Prevention, and Control identified the daily arrival of a significant number of tourists from the Asian continent as one of the main risks for the COVID-19 virus introduction. They also recognized the poor hospital infrastructure, equipment shortages, a scarcity of healthcare workers, overcrowding, and a low number of ICU beds (1.6 ICU beds per 1000 inhabitants) in the country as major limitations in the country's response capacity (Lossio, 2021; Schwalb et al., 2022). Throughout February, efforts were focused on preventing the virus from reaching the country.

However, on March 6, 2020, Peru confirmed its first case of COVID-19. The patient was a 25-year-old man who worked as a pilot for Latam Airlines and had been on vacation in Europe. The very next day, six more cases were recorded. In response, the Peruvian government declared a National Health Emergency and adopted different

measures to prevent the virus's spread and take advantage of the time gained by prioritizing financial resources to improve hospital infrastructure and, the healthcare system's response capacity. This includes reinforcing testing and diagnosis protocols and strengthening international health management (Garces-Elias, Castillo-Lopez, et al., 2022).

At the same time, various prevention and control measures were established such as surveillance and control of ports, airports, and land entry points, temporary suspension of classes in educational institutions, and the adoption of preventive health measures in transportation, workplaces, and both public and private spaces (Government of Peru, 2020a).

On March 15, 2020, a National State of Emergency (Government of Peru, 2020b) was declared in Peru with a stringent lockdown for two weeks in the beginning and was subsequently extended several opportunities through various presidential decrees (Peru, 2020b) until June 26 of the same year. These extensions came with different measures such as strict curfews, transit restrictions, flight suspensions, border closure, the closure of educational institutions, bans on public events, and the closure of nonessential businesses including dental centers and dental departments at hospitals. All these public health measures aimed to delay infections and the number of deaths to avoid the collapse of the Peruvian health system (Lossio, 2021).

Although Peru was the first country in Latin America to implement a drastic and mandatory lockdown for its entire population, unfortunately, it did not work as expected conversely, the number of confirmed cases increased exponentially. At the beginning of the quarantine, there were 71 COVID-19-positive cases while at the end of it, a total of 268,602 positive cases and 8,761 deaths were recorded, leading Peru to be among the five countries with the highest number of confirmed cases of coronavirus worldwide (Lossio, 2021).

During the first year of the COVID-19 pandemic (until December 2020) Peru faced significant challenges, especially during the first wave. Peru reported approximately

30,387 confirmed cases per million inhabitants and approximately 1,131 deaths from COVID-19 per million inhabitants. becoming the country with the highest mortality rate in Latin America and the third-highest in the world (Worldmeter, 2021). Furthermore, it was considered the country with the highest excess of deaths per million inhabitants (Times, 2021), increasing the number of hospitalizations and the eventual collapse of the Peruvian health system. Consequently, Peru was classified as one of the most affected countries worldwide (Worldmeter, 2021).

During this initial wave, elderly people and those suffering from comorbidities were the most vulnerable population group experiencing the highest death rates. In addition, some regions, such as Loreto were significantly affected, and the healthcare personnel were among the groups at the highest risk.

At the beginning of September 2020, a decrease in cases began to be observed, which led to the accelerated lifting of the restriction measures, with the belief that the pandemic was nearing its end. However, at the beginning of 2021, an increase in the number of COVID-19 cases was observed again, due to the emergence of new variants. This marked the onset of the second wave of COVID-19, with some regions returning to full quarantine. Younger individuals were particularly affected, once again putting immense strain on the healthcare system due to a shortage of ICU beds, oxygen, healthcare personnel, etc.

Although there was a high number of cumulative deaths during this period, the lethality of the virus decreased from the peak of 15% recorded during the first wave to 8%- 10% in the second wave (Araujo-Castillo R, 2022).

Therefore, the Peruvian government focused on strengthening healthcare systems by implementing several directives for the comprehensive monitoring of COVID-19 cases. They increased the number of hospital beds, and mechanical ventilators at the national level, also, the government acquired more diagnostic tests, Personal Protective Equipment (PPE), and medications for the treatment of COVID-19.

Likewise, on May 20, 2021, the government issued an Emergency Decree (DU-Nº046-

2021) with the target of expanding Universal Health Coverage (UHC) in the context of the pandemic. This initiative enrolled more than 9 million Peruvians in the Comprehensive Health Insurance called SIS, effectively closing the health insurance gap in the country. some native Amazonian and high Andean communities remained excluded (Government of Peru, 2021).

During this period, a positive development was the arrival of the COVID-19 vaccines in the country. The first dose was administered on February 9, 2021, prioritizing front-line workers, the elderly population, and people with comorbidities. Additionally, starting in October, the administration of booster doses to the vulnerable population began.

The third wave of COVID-19 in Peru began in December 2021, driven by the emergence of the Omicron variant, which was more contagious. It resulted in the highest number of confirmed cases. However, it produced a lower number of deaths and hospitalizations, presenting a much lower lethality. Consequently, in the other upcoming waves, the measures were no longer strict, and the country gradually returned to normalcy.

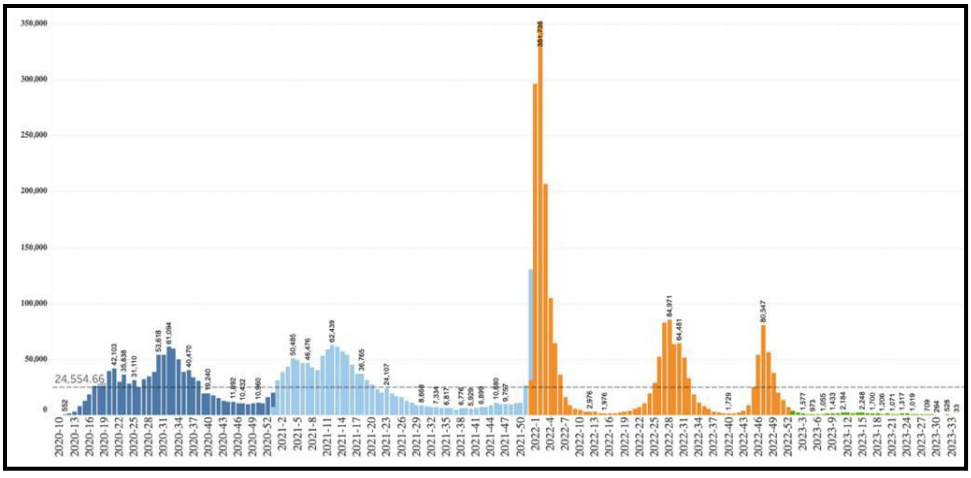

Figure 1. Bar graph showing the number of COVID-19 confirmed cases per Epidemiological week between 03/06/2020 and 03/09/2023.

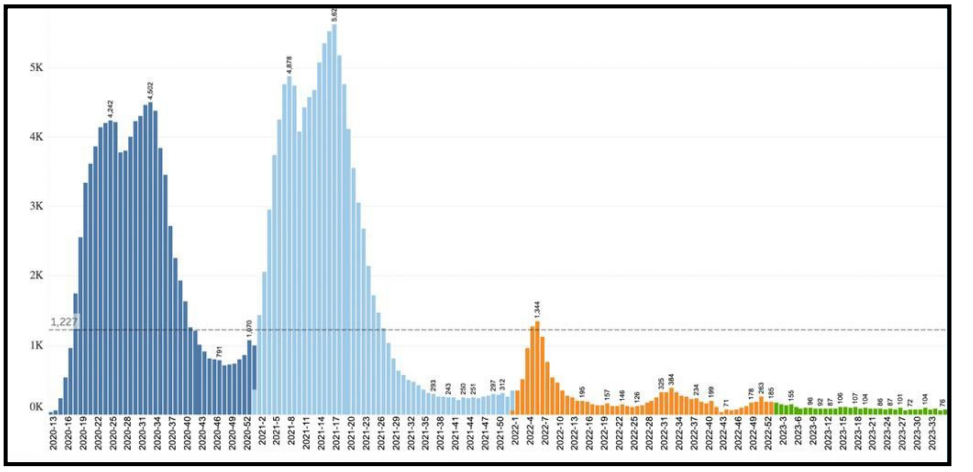

Figure 2. Bar graph showing the number of COVID-19 confirmed deaths per Epidemiological week between 03/06/2020 and 03/09/2023.

Source: Government of Peru, National Open Data Platform. https://www.datosabiertos.gob.pe/dataset/casos-positivos-por-covid-19-ministerio-de-salud-minsa.

Table 1. Summary of the COVID-19 situation analysis by years.

DATA BY YEAR OF COVID-19	2020	2021	2022
Total number of Confirmed Cases in Peru	1,087,692	1,364, 514	2,021, 237
Total number of Confirmed Deaths in Peru	95,335	107,986	15,452
Incidence rate per 100 thousand inhabitants	3,333.82	4,182.30	6,195.18
Mortality rate per 100 thousand inhabitants	292.2	331	47.36
Lethality	8.76%	7.91%	0.76%

Source:
Government of Peru, National Open Data Platform.
https://www.datosabiertos.gob.pe/dataset/casos-positivos-por-covid-19-ministerio-de-salud-minsa.

Since 2022, including this third year of the COVID-19 pandemic (2023), due to the coverage of the vaccination campaigns, there has been an almost complete return to normal coexistence. Students have already returned to school, and the use of masks is voluntary. There are no longer transit or travel restrictions persist for the population. However, this is a new coexistence in which we still live with the COVID-19 virus,

registering some infections in the national territory. As of September 03, 2023, the Ministry of Health Situation Room reported a total of 222,161 citizens who have lost their lives due to the coronavirus, while the confirmed cases to date stand at 4,519,594 (Government of Peru, 2020c).

It is important to highlight that vaccination plays a crucial role in preserving this new coexistence. As of September 10, 2023, the Ministry of Health has 90,278,587 doses. Only about 21 million correspond to the third dose, which is very important as part of the immunization progress nevertheless, received less attention from citizens. Thus, only 74.84% of the target population has this application. The case of the bivalent vaccine is more worrying. So far only 17.44% of eligible individuals have visited vaccination centers to receive it. In the case of children under eleven years of age, the statistics show that only a few even have the first dose (MINSA, 2020).

2.1.2.1 Socioeconomic Impact of COVID-19 in Peru

The stringent measures implemented to contain the spread of SARS-CoV-2 led to cultural and economic consequences. During this devastating crisis, all basic public services experienced a collapse causing fragmentation in the relationship between the population and the government. Health, education, labor, and security services were the most affected, exposing the lack of compliance of the state regarding its functions. This placed Peru among the least efficient countries in dealing with the pandemic.

According to the information available during the first waves of the COVID-19 pandemic, it was observed that (Bermúdez Tapia, 2022):

- The female population between 18 and 65 years old was the most affected, especially those located in the poorest regions of the country.
- The country recorded the highest birth rate.
- The highest rates of complaints for acts of family violence, with cases of femicide as well as cases of family abandonment.
- High levels of sexual violence in Andean areas of the country.
- The highest levels of illiteracy and school dropouts.

- In rural populations, the lack of capacity for social interaction with the State was exacerbated due to the limited use of their vernacular languages, which also limited access to most public services.
- In addition to the female population, there are other human groups in vulnerable situations like the child and youth population, essentially in poverty-stricken regions.
- Limited public health services, especially for ethnic and rural populations.

In the economic context, the economic flows were stopped, which produced a fall in the GDP, as only 40% of the country's economic sectors remained active. This situation increased the unemployment rate and a decrease in income levels for the economically active population, hitting both the formal and informal sectors. Consequently, it had an impact on the increase in poverty (Huaman Fernández JR, 2021).

The health sector was one of the most affected in Peru, mainly due to the pre-existing fragmentation in the health systems, inefficient decentralization of healthcare services, a lack of hospital infrastructure and medical equipment, an insufficient number of ICU beds, a shortage of workforce, a lack of medications, PPE, medical supplies, and N95 masks. All of these factors led to the concentration of health response being concentrated mainly in urban areas, hospitals, and their installed capacity (hospital beds and ICU beds). and not focusing on the social needs leaving aside rural areas, demonstrating that the health reform implemented in 2009 was not successful due to a lack of financing and development of infrastructure (Cajachagua-Torres et al., 2022). In addition, health services at the first level of care were either halted or limited in accessibility due to the increase in infections during the first wave of COVID-19 and the saturation of health services, resulting in a decrease in the quantity and quality of healthcare personnel in (Castro-Baca AM & AE, 2021).

A weak inclusion of social and community participation was also observed. Additionally, there were aggravations of mental health problems in the population, an absence of a well-planned communication strategy for behavioral changes, and setbacks

in the progress of the main health indicators such as immunizations, maternal health, neonatal health, sexual and reproductive health, anemia, and more. This situation resulted in the postponement of other key health interventions such as NCDs prevention and treatment.

2.2 Oral Health

Oral health is a fundamental component of general health and well-being. Through the mouth, essential physiological functions are carried out, contributing to the quality of life. Therefore, oral health should be the first step toward achieving SDG number three (3) for UHC (Brian & Weintraub, 2020).

According to the World Health Organization (WHO), it is estimated that globally at least 50% of the population suffers from some oral health diseases (see Figure 3), with the majority residing in middle-income countries. This highlights the failure of current oral health policies and strategies. The most prevalent oral diseases include dental caries (deciduous and permanent dentitions), periodontal disease, edentulism, and oral cancer. The combined prevalence of these oral diseases surpasses that of other major NCDs (mental disorders, cardiovascular diseases, diabetes, chronic respiratory diseases, and cancers).

Even though these oral diseases can be largely prevented they remain a low priority in many countries, lacking the necessary financial investment for prevention and treatment (Jain et al., 2023; WHO, 2022).

Across the world, countries with the highest population density also bear the greatest burden of oral health diseases, particularly in regions like Southeast Asia and the Western Pacific (see Table. 2). These oral health diseases are a significant public health problem, resulting in annual expenditures of around 710 billion in direct and indirect costs. It is important to mention that the prevalence of oral diseases in different age groups also triggers adverse health effects such as stigmatization of body image, a decrease in self-confidence, sleep problems, social isolation, pain, fear, anxiety, and functional

limitations. Another persistent problem that governments face in their dental healthcare system is a shortage of dentists, dental technicians, and other related professionals (Jain et al., 2023).

To improve oral health at the global level, prevention, and promotion are fundamental approaches, as well as optimal support, commitment, investment, and allocation of financial resources to the field of oral health by governmental bodies. The active participation of the population, civil society, and other interested parties is also important. Including oral care services in the Universal Health Coverage BBP (basic benefits package) is important and represents one of the goals in achieving UHC (WHO, 2022).

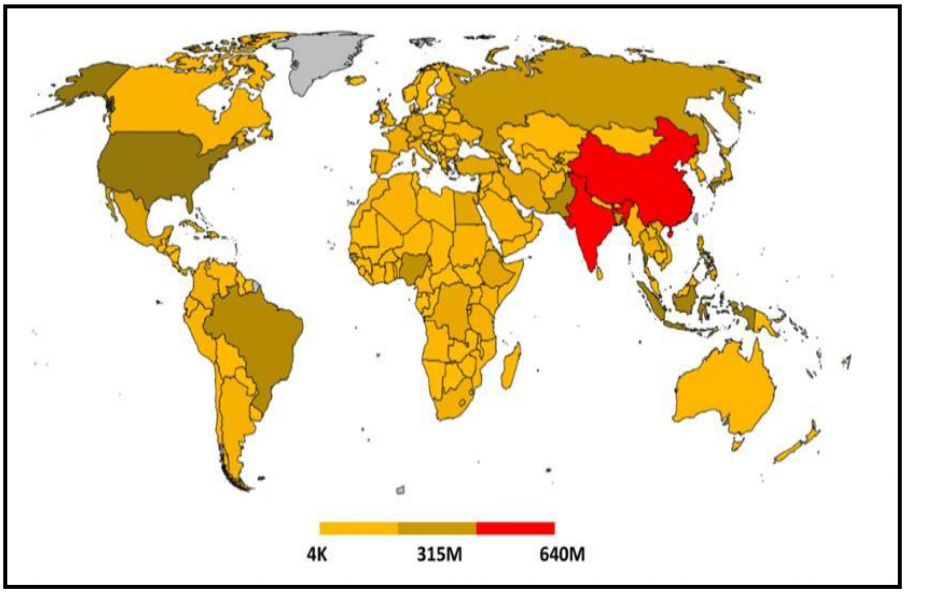

Figure 3. Cumulative prevalence of top five leading causes of oral diseases (Global Burden of Disease 2019). India and China had the highest caseloads.
Source: WHO's global oral health status report 2022: Actions, discussion, and implementation. online publication. https://doi.org/10.1111/odi.14516

Table 2. Top five countries with the highest prevalence of the leading causes of oral disease burden in 2019 (for all ages and both sexes combined)

Oral disease	Total cases with 95% confidence interval (global; 2019)	Countries with highest Oral disease caseload	No. of cases per country (2019)	% share of global caseload
Caries of permanent teeth	Estimate—2,029,495,070 Upper—2,348,141,439 Lower—1,737,975,382	India	366,858,183	18.1%
		China	330,136,487	16.3%
		United States of America	75,034,853	3.7%
		Indonesia	69,024,654	3.4%
		Pakistan	52,232,325	2.6%
Severe periodontal disease	Estimate—1,086,825,543 Upper—1,379,710,922 Lower—810,684,261	India	221,084,427	20.3%
		China	209,627,097	19.3%
		United States of America	42,149,181	3.9%
		Indonesia	38,105,664	3.5%
		Pakistan	32,999,906	3.0%
Caries of deciduous teeth	Estimate—520,065,521 Upper—639,369,160 Lower—405,848,491	India	98,199,025	18.9%
		China	67,172,112	12.9%
		Pakistan	24,968,276	4.8%
		Nigeria	21,082,438	4.1%
		Indonesia	18,343,127	3.5%
Edentulism	Estimate—351,808,988 Upper—450,669,731 Lower—274,129,977	China	64,187,526	18.2%
		India	34,905,533	9.9%
		United States of America	24,995,120	7.1%
		Brazil	21,880,208	6.2%
		Russian Federation	15,849,308	4.5%
Lip and oral cavity cancer	Estimate—1,401,286 Upper—1,723,916 Lower—1,128,231	India	327,648	23.4%
		China	177,782	12.7%
		United States of America	170,538	12.2%
		Pakistan	92,840	6.6%
		Spain	36,953	2.6%

Source: WHO's global oral health status report 2022: Actions, discussion, and implementation. online publication. https://doi.org/10.1111/odi.14516

We are still far from achieving a significant improvement in oral health worldwide, which is why the WHO recently published the Global Action Plan for Oral Health (2023-2030) on January 11, 2023.

2.2.1 Children's Oral Health

Children’s oral health worldwide is primarily affected by dental caries, which is a multifactorial chronic disease with social determinants. It is characterized by the destruction of the tooth’s surface and structure, leading to discomfort and pain. In some very severe cases, the infection can spread throughout the body, causing even death. As

well as other NCDs, dental caries are influenced by a combination of various biological, environmental, and behavioral factors (Crall & Vujicic, 2020).

In recent years, the burden of untreated dental caries in primary and permanent dentition in children has remained relatively unchanged, with more than three-quarters of cases in primary teeth found in middle-income countries (Di Spirito et al., 2022).

Kazeminia et al., in a systematic review and meta-analysis, determined that the global prevalence of dental caries in children was 46.2% in primary teeth and 53.8% in permanent teeth. Likewise, they also observed that as the size and year of the study sample increased, the prevalence of dental caries in primary teeth increased while it decreased in permanent teeth (Kazeminia et al., 2020).

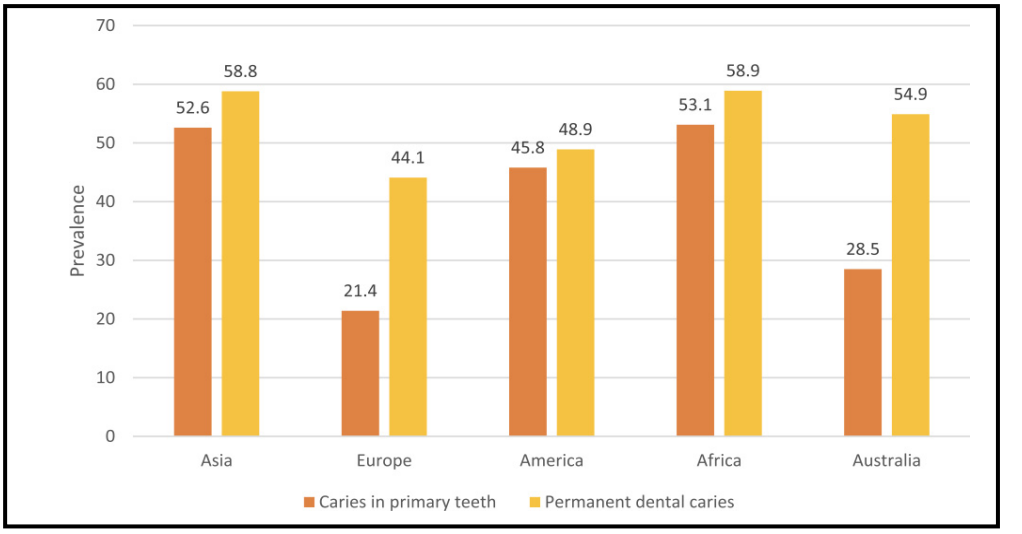

Figure 4. Worldwide prevalence of Dental Caries in primary and permanent teeth in children by continents.

Source: Kazeminia et al. (2020). Dental caries in primary and permanent teeth in children worldwide, 1995 to 2019: a systematic review and meta-analysis. Head & face medicine, 16(1), 22. https://doi.org/10.1186/s13005- 020-00237-z

Poor oral health in children can affect in a different level including their growth and development, self-esteem, relationships with their peers, and school performance because

dental pain produces difficulty in carrying out essential physiological functions such as eating, speaking, laughing, and sleeping. On the other hand, dental treatments can be expensive, especially when sedation or general anesthesia is needed (Crall & Vujicic, 2020). Therefore, oral health diseases in children can impact their quality of life and simultaneously, the economic well-being of their families and society, making it a public health concern. (Pitts et al., 2021).

Almost all oral health diseases, especially the most common one dental caries, are preventable. Therefore, early dental care, along with preventive treatments during routine dental checkups, is key to reducing the burden of oral diseases. Sabbagh et al. reported in a research study that the occurrence of oral health diseases in children was associated with the non-use of oral health services (Sabbagh et al., 2022). In this context, visits to the dentist are important for the early diagnosis, prevention, and treatment of dental caries, as well as for maintaining good oral health and general well-being (Garces-Elias et al., 2023; Torres- Mantilla & Newball-Noriega, 2023).

However, constant disparities in oral health constitute a major problem in reducing the prevalence of dental caries in children. This issue is exacerbated by existing social inequalities, where the most socioeconomically disadvantaged, such as children residing in families with low-income or limited education, indigenous children, refugees, immigrants, individuals with special needs, and those in rural areas, experience more barriers to accessing care. A research study reported that there were more barriers to accessing oral health services in families with parents with low education and a larger number of children (Sabbagh et al., 2022).

Therefore, public oral health policies and strategies should aim to reduce the high prevalence and the impact of oral health diseases on the population, taking into account social, economic, and cultural inequalities that act as barriers limiting the necessary access to oral health care services (Edelstein, 2002; Hachey et al., 2019; Kino et al., 2019).

2.2.1.1 Children's Oral Health Service Utilization

Upon birth, newborns must receive a comprehensive oral health examination to detect anomalies, diagnose oral health risks timely, and prevent the development of Oral Health diseases. The American Academy of Pediatric Dentistry suggests that a child's initial dental appointment should take place with the eruption of their first teeth or by the age of one year. Then, subsequent regular visits are very important to maintaining optimal oral health or treating oral health diseases, especially dental caries, through routine check-ups and treatments (Finlayson et al., 2018; Gao et al., 2020; Nagdev et al., 2023).

In addition, oral health visits can help identify the risk of developing oral health diseases, enabling early diagnosis and treatments if necessary and setting the appropriate timing for dental check-ups. In the case of low-risk children, they should visit oral health services at least once a year while other high-risk ones should do it every 3 to 6 months. Another important aspect of visiting oral health services is the identification of feeding patterns and oral habits that can impact oral health. Earlier research has indicated that children who availed oral health services in the preceding 12 months exhibited a notably lower average number of decayed, missing, and filled teeth (dmft) compared to those who did not seek such services (Gao et al., 2020).

The regularity of visits for oral health services per year or the number of individuals who visited oral health services at least once within the preceding year is employed as a standard measure for analyzing oral health service utilization (Onyejaka et al., 2016).

In developed countries, a higher proportion of children utilize oral health services compared to developing countries. report that the low proportions of children's oral health services utilization in preschool children have remained unchanged over the years (Gao et al., 2020).

2.2.1.2 Factors Associated with Oral Health Services Utilization in Children

Pain caused by severe dental caries is a fundamental factor in the utilization of oral health services in children. Additionally, as children are not the decision-makers regarding visits to oral health services, various sociodemographic, economic, and cultural

factors can affect children's oral health services utilization acting as barriers to seeking oral health care These factors include aspects related to pediatric populations (age, sex, birth rank, number of siblings, etc.), parents or caregivers (age, civil status, language, parents' literacy level, employment status, insurance type, attitudes, practices and behaviors related to child's oral health, access to oral health facility) and households (place of residence, socioeconomic status) (Curi et al., 2018; Mohammed et al., 2023; Nagdev et al., 2023).

Studies report that parents or caregivers play a fundamental role in their children's oral health as predictors of oral health service utilization. Parents with high education levels and those living in urban areas are associated with better outcomes regarding the use of oral health services for their children (Hu et al., 2023).

Household income may be a limiting factor in children's access to oral health services. Crall and Vujicic analyzed the progress of oral health in children, observing that children belonging to families with limited financial resources tend to have limited use of oral health services. Conversely, the expansion of health insurance coverage has been shown to increase their access to such services (Crall & Vujicic, 2020). Additionally, studies indicate that children belonging to lower socioeconomic status backgrounds tend to have fewer visits on average compared to their counterparts belonging to higher socioeconomic status (John et al., 2017).

Public health insurance often imposes on the age of the insured patient or the coverage of dental care services, resulting in the exclusion of many children's dental treatments from the benefit package. Consequently, partial or total out-of-pocket payment by the patient becomes necessary to access oral health services, which may lead to household impoverishment, since oral health services costs can be very high sometimes (Nagdev et al., 2023).

John et al., in a cross-sectional study, determined the factors that influence visits to oral health services (within 6 and 12 months before the survey) in schoolchildren aged 6 to 13 years old (n=667) living in a rural community in Australia. Their findings revealed that

53% of children visited oral health services within six months, and 77% within twelve months before the survey. In addition, in multiple logistic regression analyses indicated that the child's age and private health insurance coverage were significantly associated with 6 and 12-month oral health service visits. The study concluded that sociodemographic factors influence oral health and must be considered when designing oral health strategies and policies (John et al., 2017).

The place of residence of children's households also influences the use of oral health services. Studies indicate that children residing in rural or remote areas tend to have fewer annual visits to the dentist on average compared to those living in major urban cities (John et al., 2017).

Nagdev et al., in a cross-sectional study, evaluated the factors that influencing the utilization of oral health services in 1,100 children between 13 and 15 years old. They applied a questionnaire based on Andersen's health use concepts to the parents, finding that 78.1% of children did not use oral health services in the past year. Also, in the bivariate analysis, they found that age, gender, education, employment of household's head, as well as monthly household income, economic status, and accessibility to oral health services were significantly associated with the use of oral health services in children ($p<0.05$). In the multiple regression analysis, the use of oral health services was directly related to age, education, family size, and frequency of brushing. Conversely, no relationship was found between the distance to the oral health center, the number of visits and socioeconomic status. Concluding that the use of dental health services by children was low and that sociodemographic, economic, and cultural factors play an important role in the utilization of oral health services in children (Nagdev et al., 2023).

Curi et al., in a literature review, about factors associated with the utilization of dental health services by the pediatric population published between 2006 and 2016, found that the main factors associated with the utilization of oral health services in children were the child's age, maternal education level, household income, health insurance coverage, frequency of tooth brushing, and parents' perception of the child's oral health (Curi et al.,

2018).

Mohammed et al., in a cross-sectional study, analyzed the factors affecting the utilization of oral health services in Ethiopian schoolchildren (n=398) through questionnaires and interviews with their parents. The study revealed that the percentage of dental services utilization was 10.6%. Additionally, multivariate logistic regression analysis showed that the mother's education level, household income, and dental pain were significantly associated with the use of oral health services in the last year. Concluding that only a small number of children used oral health services in the past year and that the aforementioned factors influenced it Therefore, oral health programs should focus on increasing the use of oral health services, taking into account the sociodemographic and economic factors of the population (Mohammed et al., 2023).

Hu et al., in two cross-sectional studies, analyzed the factors influencing the use of oral health services in 5-year-old children in 2005 (n=399) and 2015 (n=492), through questionnaires administered to parents. They used chi-square tests to analyze the utilization of oral health services and socioeconomic variables. Logistics regression was used to identify the main factors influencing the use of oral health services in children. The study revealed the proportion of children's oral health services utilization in 2005 and 2015 was 20.8% and 20.0% respectively. Additionally, the use of oral health services was 1.62 times higher in urban areas compared to rural ones. The use of oral health services was very low in the last decade, and health policies must consider the socio-demographic factors that influence oral health (Hu et al., 2023).

Gao et al., in a cross-sectional study, aimed to assess the utilization of oral health services in Chinese children aged 3 to 5 years (n=40,305) through a questionnaire administered to their parents and clinical evaluation of the children, applying Andersen's healthcare model. They performed descriptive statistics, bivariate correlations, and hierarchical logistic regression. The findings indicated that the lowest percentage of children's oral health services utilization was in the 4-year-old group, at 12.1%. Moreover, factors positively influencing the use of oral health services influenced a

higher parent's education level, higher annual household income, dental pain, and a poor perception of the oral health status of their children. Concluding that the prevalence of the use of oral health services was relatively low in preschool children, emphasizing the need to strengthen oral health education in both parents and children. This involves improving knowledge, and attitudes, and promoting the use of oral health services (Gao et al., 2020).

2.2.2 Oral Health in Peruvian Children

In Peru, oral health diseases are affecting general health, with dental caries being the most prevalent disease among the child population. The latest Oral Health National Study conducted by the Ministry of Health in 2017, reported a prevalence of 85.6% for dental caries in schoolchildren aged 3 to 12 years (MINSA, 2017). Furthermore, a national report in 2019 indicated that dental caries ranked as the second most common diagnosis in outpatient consultations, with an incidence of 42.5% of cases occurring in children under 12 years of age (MINSA, 2019).

The prevalence and severity of this disease drastically increase with age in the first 6 years of life. Despite the existence of a significant number of dentists and pediatric dentists, the poor oral health status in the child population has remained without much variation when comparing results with the previous Oral Health National Study carried out in 2001-2002.

Ramos Escobar CS et al., conducted a literary review to determine the prevalence of dental caries in children under 12 years of age in Peru between 2010 and 2022 This review concluded that, despite the public health strategies developed by the Ministry of Health to improve oral health over the past twelve years, a high prevalence of dental caries persists. This prevalence is also associated with factors such as age, sex, lifestyle, socioeconomic level, and accessibility, thereby exerting a significant impact on oral health and quality of life (Ramos Escobar CS et al., 2022).

All this evidence demonstrates that oral health is also a public health concern in Peru. Therefore, a thorough analysis of each aspect of the factors contributing to its appearance

is necessary to implement comprehensive and focused oral health strategies targeted to specific objectives according to the needs of the population groups.

2.2.2.1 Children's Oral Health Utilization in Peru and Associated Factors

According to some studies, the utilization of oral health services in Peruvian children within the appropriate timeframes suggested by the American Academy of Pediatric Dentistry has remained constant in recent years. On average, only 30% of children have visited oral health services within an appropriate time,

The patterns of children's oral health services utilization are influenced by different factors, as discussed earlier. However, being a developing country with significant sociodemographic diversity, Peru faces more drastic inequalities in income levels compared with developed countries. Additionally, it contends with lower government response capacity, limited resources, poor infrastructure, and a constrained dental services workforce. Moreover, the wide gap between the urban and rural populations further exacerbates these challenges. Likewise, the diversity among the population based on their place of residence can exacerbate health inequalities (Aravena-Rivas & Carbajal- Rodriguez, 2021).

Furthermore, the effects of COVID-19 have exposed and aggravated social and economic inequalities, influencing health-seeking behaviors and decisions about health-seeking dental care within households (Meisha et al., 2021).

Azanedo et al., evaluated the factors that determine access to oral health services in children under 12 years of age (n=71,614) in Peru between 2014 and 2015. They conducted the analysis using data from a survey of their parents carried out as part of the Survey on Demography and Family Health 2014-2015 (ENDES). Access to oral health services within the 6 months prior to the survey as the dependent variable and categorical variable (yes/no), as well as the Andersen Healthcare Model to select the independent variables considering the predisposing factors (mother's language, level of wealth, parental education level, place and region of residence, sex, and age) and enabling factors (type of insurance). Descriptive statistics and multivariate analysis were performed using linear models (Poisson family).

It was found that approximately 30% of children under 12 years of age used oral health services. In the univariate analysis, all variables, except sex and primary education level, were statistically associated with oral health services utilization. When adjusting the regression model, the variables of sex, area of residence, and language spoken were found to be insignificantly associated (Azanedo et al., 2017).

Aravena-Rivas & Carbajal-Rodriguez, in a cross-sectional study, evaluated the existence of inequalities in the use of oral health services in children under 12 years of age (n=39,881) based on wealth quintile and natural region of residence. They utilized data from the 2017 Demographic and Family Health Survey of Peru (ENDES). They analyzed the association between the wealth quintile and the use of oral health services, employing the Poisson regression model adjusted for age, gender, maternal ethnicity, place of residence, and type of insurance.

Additionally, the study included stratified models according to the natural place of residence (Metropolitan Lima, coast, Andes mountains, and jungle) and predicted probability graphs to analyze the presence of inequalities in the use of oral health services regarding the natural region of residence. The findings revealed the existence of inequalities in the use of oral health services based on wealth quintile and natural region of residence. The coast and the jungle were the regions with the greatest inequalities in the use of oral health services among households with wealth quintiles classified as richest and poorest. Likewise, in the jungle, it was observed the lowest proportion of the use of oral health services in children, while the highest proportion was presented in Metropolitan Lima. No significant differences were observed between wealth quintiles and the use of oral health services in the Metropolitan Lima region. The study concludes that socioeconomic inequalities influence, along with geographical and demographic characteristics, significantly influence the use of oral health services in children (Aravena- Rivas & Carbajal-Rodriguez, 2021)

Torres-Mantilla & Newball-Noriega, in a cross-sectional study, determined the factors associated with the use of oral health services in Peruvian children under 12 years of age

(n=40,751) through the analysis of the 2019 Demographic and Family Health Survey database. The dependent variable was the use of oral health services within the 6 months before the survey, and the independent variables included gender, age, place of residence, wealth quintile, type of health insurance, information received on oral health, age, and educational level of the parents.

The variables were analyzed with descriptive statistics, using relative and absolute frequencies, differences in proportions, and multivariate analysis using generalized linear models. The study found that the use of oral health services in Peruvian children in 2019 was 31%. In the univariate analysis, all variables (children living in urban areas, in the highland region, those who belong to the highest wealth quintile, with the highest educational level of parents, and those who have private health insurance) were statistically associated with the use of oral health services. The calculation of prevalence ratios (crude model), showed a correlation of all variables except gender, level of education (primary education), and caregiver's age (70 years and more).

Conversely, in the adjusted model, no correlation was observed between the caregiver's age (from 50 to 69 years old group), type of health insurance (Armed Forces or Police versus no insurance), and the geographical domain (living in the rest of the coast with respect to Metropolitan Lima) (Torres-Mantilla & Newball-Noriega, 2023).

Garcés-Elías et al., in a cross-sectional study, evaluated the impact of the COVID-19 pandemic on the time elapsed since the last use of oral health services in Peruvian children from 0 to 11 years. The analysis involved the examination 2019 and 2020 Demographic and Family Health Survey databases, focusing on individuals who responded to the question; "how long ago did you go to the dentist?" This resulted in a population of 22,166 children (2019) and 9,945 (2020).

The dependent variable was the time since the last visit to the oral health service, and the other variables were grouped into three dimensions: health, geographical, and sociodemographic characteristics. Descriptive statistics and multivariate analysis using multiple linear regression were applied to analyze the variables. The study found that the

average time elapsed since the last dental visit was 5.25 ± 4.30 years in 2019 and 6.64 ±4.90 in 2020. The year of the pandemic harmed the timing of using oral health services in Peruvian children.

In the univariate analysis for 2019, health insurance, area of residence, natural region of residence, altitude, age, and sex of the child were statistically associated with the time elapsed since the last use of oral health services. However, in 2020, only the place of dental care and natural region of residence were statistically associated (Garces-Elias, Castillo- Lopez, et al., 2022).

Garcés-Elías et al., in another cross-sectional study, determined the association between the time elapsed since the last visit to oral health services and the educational level of parents of Peruvian children under 12 years of age. They utilized the 2021 Demographic and Family Health Survey database, including a final population of 8,012 participants. The dependent variable was the time elapsed since the last visit to the oral health services, and the independent variable was the parent's level of education. Other covariates, such as natural region of residence, place of residence, altitude, wealth quintile, type of health insurance, sex, and age, were also considered. Descriptive, bivariate, and multivariate statistics were employed.

The study revealed that the time elapsed since the last visit to oral health services in 2021 was 5.68 years and was associated with the place of care, type of insurance, altitude, and age. However, no association was found between the parent's education level and the time elapsed since the last dental care (Garces-Elias et al., 2023).

Considering the high prevalence of dental diseases in the Peruvian children population, it is important to consider the existing inequalities in access to oral health services. These disparities have been further exacerbated during the COVID-19 pandemic, significantly impacting oral health.

2.3 Impact of COVID-19 on Oral Health

Due to the high transmissibility of COVID-19, with droplets of saliva from infected

individuals being the primary mode of transmission, oral health services became highly risky for both patients and professionals. Therefore, at the beginning of the COVID-19 pandemic, most countries around the world suspended oral health activities until the appropriate international entities in the field of oral health established new regulations and guidance to ensure the provision of safe dental care (Gudipaneni et al., 2023).

The CDC and the ADA recommended prioritizing only dental emergency procedures to limit cross-infections of the SARS-CoV-2 virus. This approach aimed to protect both patients and oral health professionals while ensuring rational management of PPE at the same time.

These COVID-19 pandemic measures in the field of oral health, coupled with the other general public health measures implemented to contain the transmission of the SARS-CoV- 2 virus affected the utilization of oral health services by the pediatric population. Delays in timely and appropriate maintenance, diagnosis, and treatment were observed, exacerbated by the lack of routine oral checkups, poor oral hygiene, and changes in dietary habits. These factors may have contributed to an increase in the appearance and progression of dental caries, resulting in acute symptoms of dental pain and an upsurge in the use of emergency dental services (Azanedo et al., 2017; Brian & Weintraub, 2020; Di Spirito et al., 2022)

In addition, the COVID-19 pandemic brought about drastic changes that triggered critical scenarios in general health, including oral health, especially for vulnerable population groups such as children. This has exacerbated existing inequalities in the use of dental services (Chhibber et al., 2022; Garces-Elias et al., 2023)

2.3.1 Impact of COVID-19 on Oral Health in Peru

In the field of oral health in Peru, as the number of COVID-19 infections increased exponentially, all oral health services were suspended at the beginning. Subsequently, regulations were aligned with international guidelines set by the CDC and the ADA. reactivating dental services in May 2020, through the Peruvian government's Supreme

Decree No. 094-2020-PCM (Peru, 2020b), which included oral health care among the essential services.

Likewise, the Ministry of Health, through Ministerial Resolution RM N° 288-2020-MINSA, approved Health Directive N°100-MINSA-2020-DGIESP (Peru, 2020a). This directive outlined the management of dental care in the context of the COVID-19 pandemic, prioritizing only emergency and urgent oral health procedures with an approach that promotes the reduction of infections through the implementation of biosafety measures, guidance for the use of personal protective equipment (PPE), in addition to disinfection and sterilization protocols, and identification of risk factors for dental health care personnel (Garces-Elias, Castillo-Lopez, et al., 2022).

On the other hand, to reduce infections and the risk of mortality due to infection, the COVID-19 immunization schedule prioritized people who work on the front line of defense, including healthcare sector workers. This measure aims to guarantee the strengthening and continuity of the healthcare system (Peru, 2021).

On July 16, 2020, in the context of the pandemic, the Ministry of Health, through a Ministerial Resolution RM N° 498-2020-MINSA, approved the Health Directive N°110-MINSA-2020-DGIESP, providing guidelines for the comprehensive healthcare of people with non-communicable diseases (NCDs) during the COVID-19 pandemic to reduce the impact of the pandemic on the health system.

Since the issuance of these directives, oral health services have been progressively reactivated until the end of 2021. This process considers new biosafety guidelines for safe and quality care, including increased spacing in care hours between patients to avoid agglomerations. which impacted the patient's flow in addition to the fear of contracting the COVID-19 virus. In addition, only a few invasive procedures were carried out to prevent cross-contamination. All these new guidelines within the context of the COVID-19 pandemic have marked a before and after in the delivery of oral health services, causing an increase in the price of supplies, uncomfortable biosafety protocols, and an increase in the price of treatment (Medina UCJ, 2023).

Furthermore, in Peru, the highest percentage of dental professionals belong to the private sector (88%), and only the remaining 12% of them are dependent on the government (Ministry of Health). Therefore, during the pandemic with all the drastic measures adopted, the dental industry was greatly affected from the point of view of patients and professionals (Navarro EA, 2021).

Finally, on October 27, 2022, the Peruvian government with the Supreme Decree DS-130-2022-PCM, announced the end of the state of national emergency due to the COVID- 19 pandemic. establishing new measures for the re-establishment of social coexistence.

2.4 Andersen's Healthcare Utilization Model (AHM)

One of the well-known theoretical framework models available to identify the factors associated with the utilization of oral health services by people is Andersen's healthcare utilization model (Fig. 5). Developed in the late 1960s, the model combines three key concepts to explain how and why health services are used (Gao et al., 2020; Nagdev et al., 2023):

- Predisposing factors: These are related to individual characteristics that indicate the propensity to use oral health services such as age, sex, level of education, etc.
- Enabling factors: These are related to resources available for oral health services utilization and accessibility to them such as household income, health insurance, etc.
- Need factors: These are related to the need for care including perceived oral health condition and clinical examination.

Some studies have considered the Modified version, which takes into account only predisposing and enabling factors to analyze Oral Health Services Utilization (Ali et al., 2016; Azanedo et al., 2017)

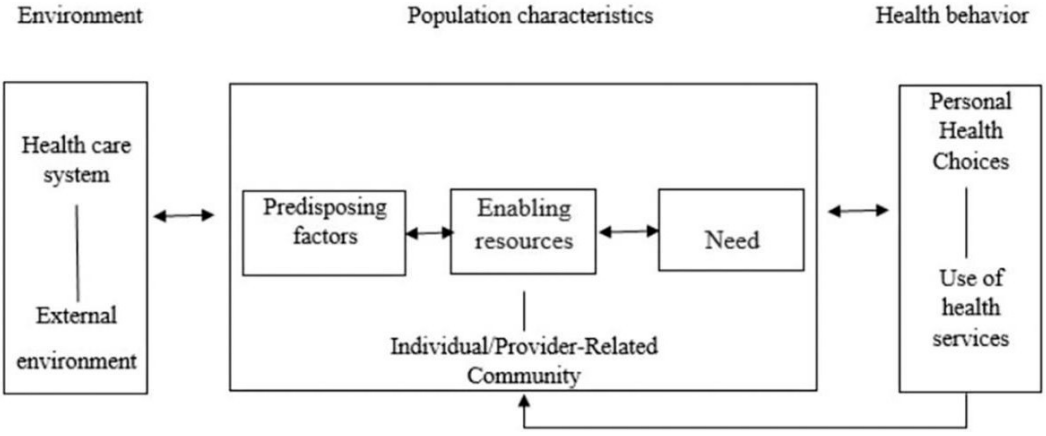

Figure 5. Andersen's Theoretical Model

Source: Nagdev P, Iyer MR, Naik S, Khanagar SB, Awawdeh M, Al Kheraif AA, et al. (2023) Andersen health care utilization model: A survey on factors affecting the utilization of dental health services among school children. PLoS ONE 18(6): e0286945. https://doi.org/10.1371/journal. pone.0286945

III. METHODOLOGY

3.1 Study Design

The present study was observational, cross-sectional, and analytical (Wang & Cheng, 2020). Observational because it involved observing data from the Peruvian population at one specific moment in time without intervention and/or manipulating survey participants. The study was cross-sectional as both the exposure (Predisposing and Enabling Factors) and the outcome (use of oral health services) in children were measured at the same time simulating a “snapshot”.

3.2 Study Subjects

The reference population of this study was Peruvian children under 12 years of age. For this purpose, secondary data from the Demographic and Family Health Survey (ENDES, in Spanish) databases from the years 2019, 2020, and 2022 were used. This survey is at a national level and contains representative information on the Peruvian population.

3.2.1 Criteria for Inclusion and Exclusion

The inclusion criteria were:

- Peruvian children aged 0 to less than 12 years old.
- Children under 12 years old who submitted complete data of all variables assessed in this research.
- Children under 12 years old who are frequent residents (who have spent the night before the survey in the selected home).

The exclusion criteria were:

- Children aged 0 to less than 12 years old who were not habitual residents of households or had not spent the night before the survey in the selected dwelling.

- Children aged 0 to less than 12 years old with incomplete data on all variables assessed in this study.

3.3 Data Source and Sample

In the present study, three (03) subsamples were obtained from the ENDES survey corresponding to each year analyzed (2019, 2020, and 2022).

The sample sizes of each year of the ENDES surveys were carried out on an "X" total number of dwellings in Peru, in which a "Y" total number of children under 12 years of age lived in rural/urban areas and those who have stayed overnight, including visitors in the dwellings at the time the survey was carried out, as follows:

- On ENDES 2019, a total number of 36,760 dwellings were surveyed with a total number of 42,115 children under 12 years of age.
- On ENDES 2020, a total number of 37,390 dwellings were surveyed with a total number of 22,600 children under 12 years of age.
- On ENDES 2022, a total number of 36,650 dwellings were surveyed with a total number of 42,154 children under 12 years of age.

After applying the inclusion and exclusion criteria mentioned in the previous item, a subsample of children under 12 years of age was finally used each year as follows:

- 40,341 children under 12 years of age in the ENDES 2019 survey.
- 19,530 children under 12 years of age in the ENDES 2020 survey.
- 39,863 children under 12 years of age in the ENDES 2022 survey.

3.3.1 Sampling

The ENDES survey is performed annually by the National Institute of Statistics and Informatics of Peru (INEI, in Spanish) and collects information from dwellings throughout the entire Peruvian territory, generating important data about demographic and health characteristics at a national level from representative samples of children and adults. The sampling frame, for the selection of the raw sample considered statistical and

cartographic information from the XI National Population and VI Housing Censuses of 2007, along with the updated information from the 2012-2013 Household Targeting System (SISFOH, in Spanish), and updated cartographic material for the execution of the ENDES.

The ENDES survey sample of each year analyzed in this research was:

- **Probabilistic**: Each home of the Peruvian population had the same chance of being chosen as part of the study sample.
- **Stratified**: The population was divided into segments, according to the socioeconomic stratum, and a sample was chosen from each one.
- **Two-stage and by clusters**: Initially, homes were selected for each area of residence in each department in Peru, and then for each cluster or rural registration area.
- **Independent**, and at the departmental level, by urban and rural areas.

The sampling units for the ENDES surveys (2019, 2020, and 2022) were made up of private dwellings from the clusters in urban areas and from rural registration in rural areas of each department in Peru (Table 3).

Table 3. Sampling Units of ENDES Survey

Sampling	Primary sampling	Secondary Sampling	Tertiary Sampling
Each department in Peru	Urban Area	Cluster list	Private homes
	Rural Area	Rural registration list	Private homes

3.4 Variables Description

3.4.1 Dependent Variable

The dependent variable was Oral Health Services Utilization defined as the attendance to Oral Health Services by children in the last six months before the ENDES survey of each evaluated year (attended in that period of time was classified as “Yes” and not

attended in that period of time or did not attend at all was classified as “No”).

3.4.2 Independent Variables

The independent variables were the socio-demographic factors classified according to the Modified Anderson’s Healthcare Utilization Model (Fig 6).

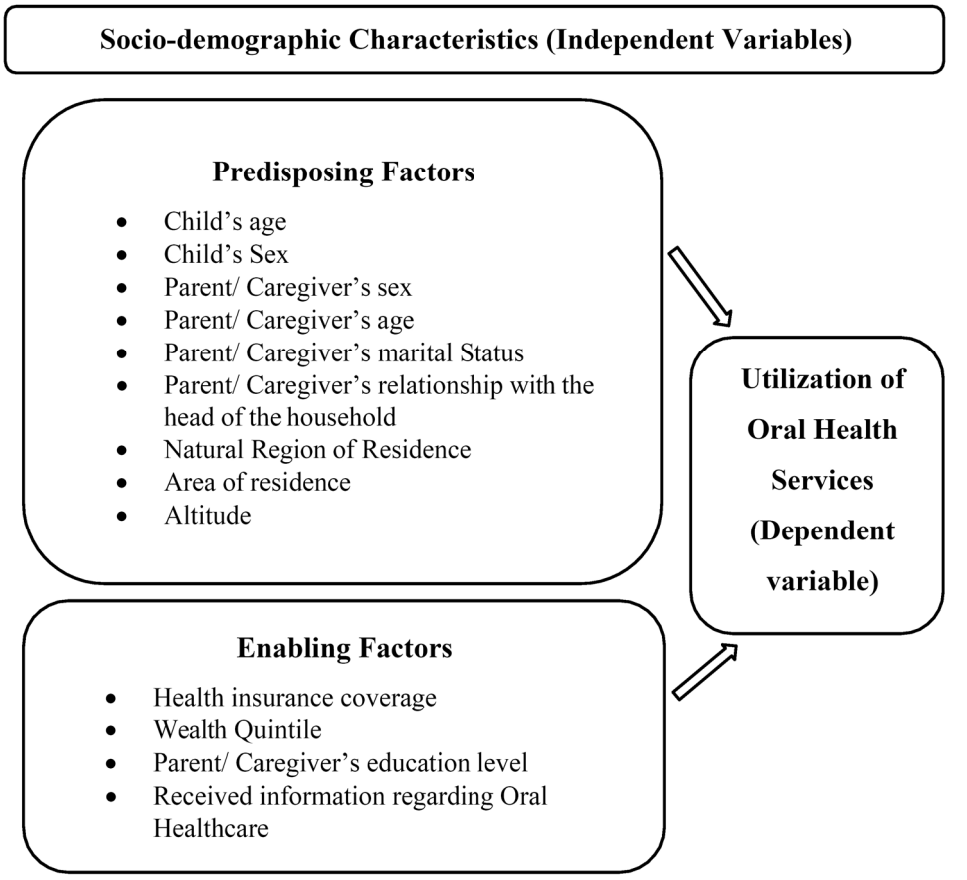

Figure 6. Modified Andersen’s Healthcare Utilization Model

Table 4. Description of the selected Variables

Variables	Categories/Indicator	Classification	Definition
(Dependent Variable) Oral Health Services Utilization within the last 6 months	Attendance to oral health services within the 6 months prior to the survey	Yes No	Use of Oral Health Services by children under 12 years old in the last 6 months
(Independent variable) Socio-demographic Factors	**Predisposing Factors**		
	Child's age	0 to 3 years old 4 to 6 years old 7 to 11 years old	Time that the child has lived, measured by years
	Child's sex	Male Female	Physical organic characteristics that differentiate male and female children
(Independent variable) Socio-demographic Factors	Parent/caregiver's age	15 to 26 years old 27 to 43 years old 44 to 59 years old 60 years old and over	Time that the parent/caregiver has lived, measured by years
	Parent/caregiver's sex	Male Female	Physical organic characteristics that differentiate male and female parent/caregiver
	Parent/caregiver's Marital Status	Single Married Previously married	Civil status of the parent/caregiver
	Relationship with the head of the household	Household responsible Wife/Husband Daughter/Son Other	Relationship of the parent/caregiver with the household reference person who provides financial support.
	Natural Region of Residence	Metropolitan Lima Rest of Cost Highlands Jungle	Refers to the natural geographical characteristics of the region of residence.
	Area of Residence	Urban Rural	Refers to the population, housing, and territory

Variables	Categories/Indicator	Classification	Definition
(Independent variable) Socio-demographic Factors			(land) characteristics of the area where the house is located.
	Altitude	≤2,500 MAMSL >2,500 MAMSL	Refers to the height measured in meters above the sea level (MAMSL) where a dwelling is located.
	Enabling Factors		
(Independent variable) Socio-demographic Factors	Children's Health Insurance Coverage	Public Health Insurance-SIS ESSALUD Others Uninsured	Refers to the type of health insurance coverage scheme a child has
	Parent/caregiver's education level	No education Primary Secondary Superior	It refers to the highest level of education the parent/caregiver has achieved
	Wealth Quintile	Very poor Poor Middle Rich Very Rich	Refers to the capability to spend money and the availability for the consumption of goods and services that each household has
	Received Information regarding Oral Healthcare	Yes No	it refers to the information regarding Oral Healthcare and oral hygiene received by someone.

3.5 Measures

The Demographic and Family Health Survey (ENDES, in Spanish) is conducted annually from January through December, with databases published the following year on the INEI public website (https://proyectos.inei.gob.pe/microdatos/). This survey is a

national population-based with departmental and area of residence level representation which includes several questions on updated demographic dynamics (characteristics of homes and population), the health status of mothers and children, as well as access to health services (diagnostic and treatment).

Three questionnaires are applied, each containing the same number of questions as follows:

- **Home Characteristics and Demographic Dynamics Questionnaire**: This questionnaire gathers information on home characteristics and demographic dynamics of its members. It covers access to health insurance, economic activity, educational information of household members, as well as characteristics of the home such as access to services (water, drainage, and lighting), home equipment, structural (floor, walls, and ceiling), social programs and different measures (anthropometric, hemoglobin levels, Iodine Salt Test and Residual Chlorine Water Test).
- **Individual Information Questionnaire for Women:** This questionnaire collects important individual information about all eligible women, from 12 to 49 years of age, which included the history of the spouse and work of the woman (Work experience), reproductive history, contraceptive methods, prenatal care, childbirth assistance, and postpartum care, pregnancy, and many other topics related to woman's health and development.
- **Individual Information Questionnaire:** This questionnaire collects health information about different diseases such as hypertension, diabetes, oral health in adults and children, tuberculosis, HIV AIDS, mental health, and anthropometry/ blood Pressure measurements.

In addition, on all ENDES surveys, an electronic device is used (Tablet) for the collection of information.

Table 5. Number of Questions of ENDES surveys.

QUESTIONNAIRE TYPE	NUMBER OF QUESTIONS			
	ENDES 2020			
	ENDES 2019	Before March	After March	ENDES 2022
Home Questionnaire	101	101	82	101
individual Questionnaire	489	489	203	489
Health Questionnaire	161	161	64	161

Table 6. Number of Questions of ENDES surveys used for this research each year (2019,2020, and 2022)

QUESTIONNAIRE TYPE	NUMBER OF QUESTION
Home Questionaire	17
Health Questionaire	10

It should also be noted that the ENDES survey employed a complex sample design with inference capacity and weighting factors, allowing researchers to restructure the reference population.

3.6 Data Collection

The standard method used to collect data for the ENDES surveys is the direct interview conducted by trained personnel who visit the selected homes to fill out the different questionnaires. However, in 2020, due to the strict measures imposed by the Peruvian government in response to the COVID-19 pandemic, the ENDES survey was conducted via telephone interview from March until the lifting of the measures. This approach prioritized some important areas for the country's health indicators. Starting in 2022, the ENDES survey was reversed to being entirely through direct interviews.

The variables for this research focused on access to Oral Health Services within the

last 6 months (Dependent Variable) and the Socio-demographic Factors (Independent variable). The independent variables were classified into two (02) subgroups according to the Modified Andersen's Healthcare Utilization Mode (Azanedo et al., 2017): the predisposing factors (child and parent/ caregiver's sex, child and parent/caregiver's age, parent/caregiver's marital status, parent/caregiver's relationship with the head of the household, natural region of residence, place/area of residence, altitude) and the enabling factors (parent/caregiver's education level, wealth index, child's health insurance coverage, received information regarding Oral healthcare).

To obtain the merged final database of each year, all the databases were initially imported into the R Statistical Program. Subsequently, following the purpose of this research, the "**CSALUD08"** database from the "Health Questionnaire" was established as the main database. Other databases (RECH0, RECH1, RECH4, RECH23, and CSALUD01) of interest belonging to the "Household Questionnaire" were merged with the main database using the identifiers of household and person through the "left join" command. After this, variables not relevant to the study were eliminated, and the inclusion and exclusion criteria were applied.

Finally, the merged databases for each year (2019, 2020, 2022) were imported into the SPSS statistical program to recategorize the variables (Table 4. Description of selected Variables) based on the literature review, the researcher's criteria, and the objectives of the study. It should be noted that some numerical variables were presented in a categorical format for better understanding according to the purpose of this research.

3.7 Data Analysis

Data analysis was conducted using IBM SPSS version 26.0 for complex samples, taking into account the stratum, cluster, and statistical weight corresponding to the "Health Questionnaire" for children under 12 years of age design. All analyses were estimated using sampling weights. A descriptive statistical analysis was performed for each year (2019, 2020, and 2022), presenting absolute unweighted frequencies (for better

visualization of cases) and relative weighted frequencies for categorical variables, with 95% confidence intervals.

For the bivariate analysis, the dependent variables were compared with the independent variables using the Chi-square test to evaluate the association between Oral Health Services Utilization and Predisposing and Enabling Factors for each year (2019,2020, and 2022), p-value < 0.05 was considered statistically significant.

Finally, for the multivariate analysis, a hierarchical logistic regression model was built to determine the association of predisposing/enabling factors with the Child's Oral Health Services Utilization. In "Model 1" (First Step) all predisposing factors were controlled and then for "Model 2" all enabling factors were added (Second Step). Odd Ratios (ORs) were presented with 95% confidence intervals (Cis) to estimate the association. Statistical significance was set at p🖫0.05.

3.8 Ethics Statement

This research did not require the approval of an Ethics Committee since it relied on secondary databases. The use of those databases had no risk to the physical, psychological, or moral integrity of any participant since each one has been assigned a special coding (identifier) that safeguards their identity and/or privacy. Furthermore, the databases analyzed were uploaded into the public domain and accessible on the National Institute of Statistics and Informatics of Peru website (https://proyectos.inei.gob.pe/microdatos/) and they were only used for academic purposes.

IV. RESULTS

4.1 Descriptive Analysis

The descriptive analysis of the predisposing and enabling factors for 2019, 2020, and 2022 is summarized in Table 7. Relative frequencies were weighted to estimate proportions in the Peruvian population (children under 12 years of age), and results were presented with 95% CI.

The percentage of Oral Health Services Utilization (within the last 6 months of ENDES surveys) in Peruvian children under 12 years of age was 40.4% in 2019, 31% in 2020, and 41.2% in 2022. (Figure 7).

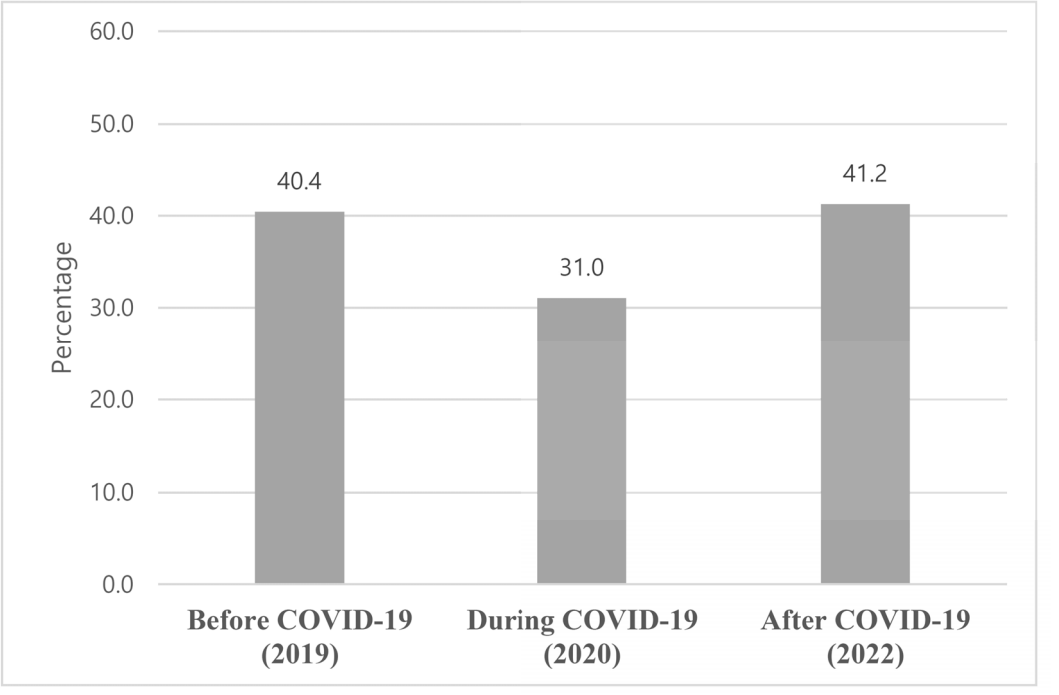

Figure 7. Oral Health Services Utilization in Peruvian children under 12 years old

4.1.1 Predisposing and Enabling Factors in 2019

In 2019, the total sample size included in the study was 40,341 children under 12 years of age. Analyzing the predisposing factors (Table 7) most of the Peruvian children were male (51.0%) between 7 and 11 years of age (42.9%), and lived in urban areas (75.2%) in the geographical domain of Metropolitan Lima (31.3%), within an altitude of less or equal to 2500 MAMSL (78.2%). The highest percentage of caregivers were female (97.5%) between 27 and 43 years of age (70.5%), with a marital status of married or with an unmarried partner (83.5%), who are mostly the wife/husband of the head of the household (62.1%).

Regarding the enabling factors (see Table 7), most of the Peruvian children under 12 years of age were affiliated with the Public Health Insurance-SIS (56.6%) and belonged to the lowest wealth quintile “very poor” (24.2%). Likewise, most parents/caregivers reached the Secondary level of education (44.4%) and received information on oral health care (74.5%).

4.1.2 Predisposing and Enabling Factors in 2020

In 2020, 19,530 children under 12 years of age were included in the study. Within the predisposing factors (Table 7), most of the Peruvian children were male as well (51%) between 7 and 11 years of age (44.1%), and lived in urban areas (75%) in the geographical domain of Metropolitan Lima (30.6%) within an altitude of less or equal to 2500 MAMSL (78.5%). The highest percentage of caregivers were female (96.7%) between 27 and 43 years of age (72.1%), with a marital status of married or with an unmarried partner (82.7%), who are mostly the wife/husband of the head of the household (61.9%).

Regarding the enabling factors (Table 7), most children were affiliated with the Public Health Insurance-SIS (60.3%) and belonged to the lowest wealth quintile “very poor” (23.3%). Likewise, most parents/caregivers reached the Secondary level of education (46.7%) and received information on oral health care (69.3%).

4.1.3 Predisposing and Enabling Factors in 2022

In 2022, the final sample size of children under 12 years of age included in the study was 39,863. Analyzing the predisposing factors (Table 7) most of the Peruvian children were male (51.1%) between 7 and 11 years of age (45.5%), and lived in urban areas (77.4%) in the geographical domain of Metropolitan Lima (31.2%) within an altitude of less or equal to 2500 MAMSL (78.8%). The highest percentage of caregivers were female (97.1%) between 27 and 43 years of age (72.6%), with a marital status of married or with an unmarried partner (80.9%), who are mostly the wife/husband of the head of the household (59.2%).

Regarding the enabling factors (Table 7), most children were affiliated with the Public Health Insurance-SIS (65.9%) and belonged to the lowest wealth quintile “very poor” (24.1%). Likewise, most parents/caregivers reached the Secondary level of education (47%) and received information on oral health care (68%).

4.1.4 Predisposing and Enabling Factors Comparative Analysis (2019.2020 and 2022)

The most relevant results when comparing the years 2019 (before COVID-19), 2020 (during COVID-19), and 2022 (after COVID-19) are as follows:

Concerning the predisposing factors the Peruvian children population between 7 to 11 years old was the most prevalent in the three years of the ENDES survey, with an increasing percentage every year (42.9% in 2019, 44.1% in 2020, and 45.5% in 2022), the caregiver’s age between 27 to 43 years old was the most prevalent with an increasing percentage every year as well (70.5% in 2019, 72.1% in 2020 and 72.6% in 2022), on the other hand the caregiver’s marital status of married/unmarried partner was the most frequent with a decreasing percentage across the years evaluated (83.5% in 2019, 82.7% in 2020 and 80.9% in 2022). The most frequent caregiver’s relationship with the head of the household was been wife/husband with a decreasing percentage (62.1% in 2019, 61.9% in 2020, and 59.2% in 2022). The area of residence more frequent for Peruvian children was urban with a decreasing prevalence in 2020 which increased in 2022 (75.2%

in 2019, 75% in 2020, and 77.4% in 2022). Regarding the altitude, most Peruvian children lived in areas located less than 2500 MAMSL with an increasing percentage (78.2% in 2019, 78.5% in 2020, and 78.8% in 2022).

Regarding enabling factors, the child's Health Insurance Coverage most frequent was Public Health Insurance-SIS with an increasing percentage through all years evaluated in this study (56.6% in 2019, 60.3% in 2020, and 65.9% in 2022). Within the caregiver's education level, the secondary level was the most frequent with an increasing percentage across the years studied (44.4% in 2019, 46.7% in 2020, and 47.0% in 2022). Most of the children lived in households that belonged to the very poor wealth quintile with a decreasing percentage from 2019 (24.2%) to 2020 (23.3% in 2020) which increased in 2022 (24.1% in 2020). Finally, most of the caregivers of Peruvian children received information about Oral Healthcare in the three years with a decreasing percentage from 2019 to 2022 (74.5% in 2019, 69.3% in 2020, and 68% in 2022).

Table 7. Descriptive Characteristics of the samples of Peruvian children under 12 years old

Variables	2019				2020				2022			
	n 40,341	Weighted %	(95%CI)		n 19,530	Weighted %	(95%CI)		n 39,863	Weighted %	(95%CI)	
Predisposing Factors												
Child's sex												
Male	20,668	(51.0)	50.4	51.7	10,062	(51.0)	50.0	51.9	20,506	(51.1)	50.4	51.8
Female	19,673	(49.0)	48.3	49.6	9,468	(49.0)	48.1	50.0	19,357	(48.9)	48.2	49.6
Child's age												
0-3	16,595	(30.2)	29.8	30.7	8,059	(30.5)	29.8	31.2	16,955	(29.1)	28.6	29.6
4-6	10,165	(26.9)	26.3	27.5	4,847	(25.5)	24.7	26.3	9,680	(25.4)	24.8	26.0
7-11	13,581	(42.9)	42.3	43.5	6,624	(44.1)	43.2	44.9	13,228	(45.5)	44.9	46.2
Parent/Care- giver's sex												
Male	1,128	(2.5)	2.3	2.8	628	(3.3)	2.9	3.9	1,033	(2.9)	2.7	3.2
Female	39,213	(97.5)	97.2	97.7	18,902	(96.7)	96.1	97.1	38,830	(97.1)	96.8	97.3

Variables	2019				2020				2022			
	n 40,341	Weighted %	(95%CI)		n 19,530	Weighted %	(95%CI)		n 39,863	Weighted %	(95%CI)	
Parent/Care-giver's age												
15-26	9,255	(19.2)	18.6	19.9	4,170	(18.1)	17.2	19.1	8,554	(17.5)	16.8	18.1
27-43	27,274	(70.5)	69.6	71.3	13,612	(72.1)	71.0	73.3	27,834	(72.6)	71.8	73.4
44-59	3,388	(9.2)	8.7	9.7	1,560	(8.7)	8.0	9.5	3,137	(9.0)	8.5	9.5
> 60	424	(1.1)	1.0	1.3	188	(1.0)	0.8	1.3	338	(1.0)	0.8	1.2
Parent/Care-giver's Marital Status												
Single	1,724	(4.0)	3.7	4.3	885	(4.6)	4.1	5.2	1,401	(3.5)	3.2	3.9
Married-w/Partner	33,810	(83.5)	82.8	84.2	16,260	(82.7)	81.7	83.7	32,706	(80.9)	80.1	81.6
Previously Married	4,807	(12.5)	11.9	13.1	2,385	(12.7)	11.8	13.5	5,756	(15.6)	14.9	16.4
Relationship with the Head of the Household												
Household responsible	7,130	(17.5)	16.8	18.2	3,617	(18.6)	17.6	19.7	9,336	(23.6)	22.8	24.4
Wife/Husband	25,140	(62.1)	61.1	63.1	12,127	(61.9)	60.5	63.2	24,231	(59.2)	58.2	60.2
Daughter/Son	5,406	(13.6)	12.9	14.2	2,602	(13.6)	12.6	14.6	4,234	(11.7)	11.1	12.4
Other	2,665	(6.9)	6.4	7.4	1,184	(6.0)	5.4	6.6	2,062	(5.5)	5.1	6.0
Natural Region of Residence												
Metropolitan Lima	4,657	(31.3)	30.3	32.3	2,561	(30.6)	29.1	32.1	4,600	(31.2)	30.2	32.2
Rest of Cost	11,713	(25.5)	24.5	26.5	5,752	(26.5)	25.0	28.0	11,025	(21.5)	20.9	22.1
Highlands	13,286	(26.4)	25.2	27.7	5,864	(25.8)	24.1	27.6	10,718	(24.7)	24.4	25.3
Jungle	10,685	(16.7)	15.9	17.7	5,353	(17.1)	15.8	18.5	13,520	(22.6)	22.0	23.3
Area of Residence												
Urban	27,409	(75.2)	74.3	76.0	13,445	(75.0)	73.8	76.2	26,343	(77.4)	76.7	78.0
Rural	12,932	(24.8)	24.0	25.7	6,085	(25.0)	23.8	26.2	13,520	(22.6)	22.0	23.3
Altitude												
≤ 2,500 MAMSL	29,085	(78.2)	77.0	79.3	14,569	(78.5)	76.7	80.2	28,649	(78.8)	77.7	79.8
> 2,500 MAMSL	11,256	(21.8)	20.7	23.0	4,961	(21.5)	19.8	23.3	11,214	(21.2)	20.2	22.3

Variables	2019				2020				2022			
	n 40,341	Weighted %	(95%CI)		n 19,530	Weighted %	(95%CI)		n 39,863	Weighted %	(95%CI)	
Enabling Factors												
Child's Health Insurance Coverage												
Public Health Insurance-SIS	26,003	(56.6)	55.6	57.6	13,091	(60.3)	58.8	61.7	29,284	(65.9)	64.9	66.9
ESSALUD	9,169	(26.3)	25.4	27.3	4,173	(24.8)	23.6	26.0	7,515	(23.5)	22.7	24.4
Other	521	(2.1)	1.8	2.5	219	(1.6)	1.1	2.3	399	(1.6)	1.3	2.0
Uninsured	4,648	(15.0)	14.2	15.7	2,047	(13.3)	12.4	14.4	2,665	(9.0)	8.4	9.6
Parent/Care-giver's education level												
No education	1,101	(2.5)	2.2	2.9	424	(2.3)	1.8	2.9	790	(1.7)	1.5	1.9
Primary	9,701	(22.0)	21.2	22.9	4,487	(20.6)	19.5	21.8	8,735	(19.5)	18.8	20.3
Secondary	18,007	(44.4)	43.4	45.5	9,148	(46.7)	45.2	48.3	19,085	(47.0)	45.9	48.0
Superior	11,532	(31.0)	30.1	32.0	5,471	(30.3)	28.9	31.8	11,253	(31.8)	30.8	32.8
Wealth Quintile												
Very poor	12,484	(24.2)	23.4	25.2	5,647	(23.3)	21.3	24.0	13,201	(24.1)	23.2	25.0
Poor	10,869	(23.8)	22.9	24.8	5,150	(22.6)	21.9	24.7	10,592	(23.3)	22.4	24.2
Middle	7,665	(20.1)	19.3	21.0	3,974	(21.4)	20.2	22.7	7,504	(20.6)	19.7	21.5
Rich	5,536	(17.4)	16.5	18.3	2,801	(17.7)	16.4	19.0	5,192	(17.9)	17.0	18.8
Very Rich	3,787	(14.4)	13.6	15.3	1,958	(15.1)	13.9	16.4	3,374	(14.2)	13.4	15.0
Received Information regarding Oral Healthcare												
Yes	30,558	(74.5)	73.9	75.2	13,887	(69.3)	68.0	70.6	27,920	(68.0)	67.2	68.7
No	9,783	(25.5)	24.8	26.1	5,643	(30.7)	29.4	32.0	11,943	(32.0)	31.3	32.8

Unit: number (%); CI: Interval of Confidence

4.2 Bivariate Analysis

4.2.1 Association between Predisposing and Enabling Factors and Oral Health Services Utilization Before COVID-19 (2019)

According to the bivariate analysis, there was a statistical significance ($p < 0.001$) in the association between Oral Health Services Utilization by Peruvian children under 12

years of age and all predisposing factors except for the child's sex, the parent/caregiver's marital status, the relationship of the parent/caregiver with the head of the household, and the altitude of the place where the children live (Table 8).

Therefore, Oral Health Services Utilization in Peru was more frequent in children aged between 4 to 6 years old (44.7%), living in urban areas (43.1%), and their natural region of residence was Metropolitan Lima (46.4%). In addition, children with a female parent/caregiver, aged between 27 and 43 years old showed a higher prevalence of oral health services utilization (40.6 and 42.2% respectively).

Regarding the enabling factors, there was a statistical significance ($p < 0.001$) in the association between all of them and Oral Health Services Utilization by Peruvian children under 12 years of age (Table 2), being more frequent in children with other Health Insurance (private and others) different from Public Health Insurance (SIS) or ESSALUD (49.5%), belonging to the highest wealth quintile (49.6%), whose parent/caregiver reached the superior education level (47.9%) and received information about oral health care (43.5%).

For all the variables evaluated, the weighted percentage of negative responses about Oral Health Services Utilization in the last 6 months by Peruvian children was higher.

Association between Predisposing and Enabling Factors and Oral Health Services Utilization during COVID-19 (2020)

In the bivariate analysis, there was a statistical significance ($p < 0.001$) in the association between Oral Health Services Utilization by Peruvian children under the age of 12 and the following predisposing factors: the child's age, the parent/Caregiver's age, the natural region of residence, and the area of Residence (Table 3). Oral Health Services Utilization was more frequent in children aged between 7 to 11 years of age (40.4%), living in urban areas (33.5%), within the natural region of residence of Metropolitan Lima (37.2%). Furthermore, children with a parent/caregiver aged between 27 and 43 years old (33.1%) showed a higher prevalence of oral health services utilization.

Compared with 2019, there was also no statistical significance for the association

between Oral Health Services Utilization and the child's sex, the parent/caregiver's marital status, her/his relationship with the head of the household, and the altitude of the place where they live in addition to the parent/caregiver's sex.

Regarding the enabling factors, there was also a statistical significance ($p < 0.001$) in the association between all of them and Oral Health Services Utilization (Table 8). Compared with 2019 the prevalence of Oral Health Services Utilization was higher in children with ESSALUD health insurance (38.9%) rather than with other health insurance schemes, and also in children belonging to the highest wealth quintile (41.1%), whose parent/caregiver reached the superior education level (36.8%) and received information about oral health care as well (33.1%).

For all the variables evaluated, the weighted percentage of negative responses about Oral Health Services Utilization in the last 6 months by Peruvian children was higher.

Association between Predisposing and Enabling Factors and Oral Health Services Utilization after COVID-19 (2022)

From the bivariate analysis, there was a statistical significance ($p < 0.05$) in the association between Oral Health Services Utilization by Peruvian children under the age of 12 and the following predisposing factors: the child's sex and age; the parent/Caregiver's age, marital status, and his/her relationship with the head of the household; the natural region of residence, and the area of Residence (Table 8). Oral Health Services Utilization was more frequent in children aged between 7 to 11 years old (55%), living in urban areas (44.3%), and within the natural region of residence of Metropolitan Lima (48.2%). In the same way, the prevalence of oral health services utilization was higher in children with parents/caregivers between 27 and 43 or 44 to 59 years of age (43.5%), those previously married (43.8%), and those who are head of their household (43.9%).

Compared with 2019 and 2020 there was only no statistical significance for the association between Oral Health Services Utilization and the following predisposing factors: parent/caregiver's sex and altitude where children live.

Regarding the enabling factors, there was also a statistical significance (p <0.001) in the association between all of them and Oral Health Services Utilization (Table 8). Compared with 2019 and 2020 the prevalence of Oral Health Services Utilization was higher in children with ESSALUD health insurance (38.9%), belonging to the highest wealth quintile (41.1%), whose parent/caregiver reached the superior education level (36.8%) and received information about oral health care (33.1%).

The weighted percentage of negative responses about Oral Health Services Utilization in the last 6 months by Peruvian children was higher for all the variables evaluated in the study.

Table 8. Oral Health Services Utilization considering the Predisposing and Enabling factors

Variables	2019 Oral Health Services Utilization				2020 Oral Health Services Utilization				2022 Oral Health Services Utilization			
	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value
Total	40,341	15100 (40.4)	25241 (59.6)		19,530	5283 (31.0)	14247 (69.0)		39,863	13868 (41.2)	25995 (58.8)	
Predisposing Factors												
Child's sex				0.939				0.822				0.011
Male	20,668	7725 (40.4)	12943 (59.6)		10,062	2696 (31.2)	7366 (68.8)		20,506	7026 (40.3)	13480 (59.7)	
Female	19,673	7375 (40.4)	12298 (59.6)		9,468	2587 (30.9)	6881 (69.1)		19,357	6842 (42.2)	12515 (57.8)	
Child's age				**<0.001** ***				**<0.001** ***				**<0.001** ***
0-3	16,595	4052 (24.1)	12543 (75.9)		8,059	1174 (15.1)	6885 (84.9)		16,955	2873 (17.1)	14082 (82.9)	
4-6	10,165	4439 (44.7)	5726 (55.3)		4,847	1552 (34.0)	3295 (66.0)		9,680	4014 (44.2)	5666 (55.8)	
7-11	13,581	6609 (40.4)	6972 (50.8)		6,624	2557 (40.4)	4067 (59.6)		13,228	6981 (55.0)	6247 (45.0)	
Parent/Caregiver's sex				**<0.001** ***				0.062				0.461

Variables	2019 Oral Health Services Utilization				2020 Oral Health Services Utilization				2022 Oral Health Services Utilization			
	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value
Male	1,128	348 (32.2)	780 (67.8)		628	146 (25.9)	482 (74.1)		1,033	359 (42.9)	674 (57.1)	
Female	39,213	14752 (40.6)	24461 (59.4)		18,902	5137 (31.2)	13765 (68.8)		38,830	13509 (41.2)	25321 (58.8)	
Parent/Caregiver's age				**<0.001 *****				**<0.001 *****				**<0.001 *****
15-26	9,255	2952	6303		4,170	872	3298		8,554	2314		6240
		(34.0)	(66.0)			(23.5)	(76.5)			(30.9)		(69.1)
27-43	27,274	10734 (42.2)	16540 (57.8)		13,612	3932 (33.1)	9680 (66.9)		27,834	10268 (43.5)		17566 (56.5)
44-59	3,388	1296 (40.3)	2092 (59.7)		1,560	434 (29.5)	1126 (70.5)		3,137	1185 (43.5)		1952 (56.5)
> 60	424	118 (33.7)	306 (66.3)		188	45 (31.6)	143 (68.4)		338	101 (31.7)		237 (68.3)
Parent/Caregiver's Marital Status				0.561				0.224				**<0.05***
Single	1,724	653	1071		885	253	632		1,401	423	978	
		(42.4)	(57.6)			(34.8)	(65.2)			(37.4)	(62.6)	
Married-w/Partner	33,810	12624 (40.3)	21186 (59.7)		16,260	4387 (31.0)	11873 (69.0)		32,706	11275 (40.9)	21431 (59.1)	
Previously Married	4,807	1823 (40.5)	2984 (59.5)		2,385	643 (30.3)	1742 (69.7)		5,756	2170 (43.8)	3586 (56.2)	
Relationship with the Resp of the Household				0.360				0.974				**<0.001 *****
Household responsible	7,130	2651 (39.7)	4479 (60.3)		3,617	988 (31.2)	2629 (68.8)		9,336	3437 (43.9)	5899 (56.1)	
Wife/Husband	25,140	9572 (40.7)	15568 (59.3)		12,127	3329 (31.0)	8798 (69.0)		24,231	8415 (40.9)	15816 (59.1)	
Daughter/Son	5,406	1974 (40.8)	3432 (59.2)		2,602	669 (30..9)	1933 (69.1)		4,234	1413 (40.2)	2821 (59.8)	
Other	2,665	903 (38.3)	1762 (61.7)		1,184	297 (31.9)	887 (68.1)		2,062	603 (35.7)	1459 (64.3)	
Natural Region of Residence				**<0.001 *****				**<0.001 *****				**<0.001 *****

Variables	2019 Oral Health Services Utilization				2020 Oral Health Services Utilization				2022 Oral Health Services Utilization			
	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value
Metropolitan	4,657	1970	2687		2,561	812	1749		4,600	1867	2733	
Lima		(46.4)	(53.6)			(37.2)	(62.8)			(48.2)	(51.8)	
Rest of Cost	11,713	4405 (38.6)	7308 (61.4)		5,752	1513 (28.2)	4239 (71.8)		11,227	3960 (38.2)	7267 (61.8)	
Highlands	13,286	5419 (40.5)	7867 (59.5)		5,864	1699 (30.2)	4165 (69.8)		13,256	5016 (41.3)	8240 (58.7)	
Jungle	10,685	3306 (31.7)	7379 (68.3)		5,353	1259 (25.8)	4094 (74.2)		10,780	3025 (33.0)	7755 (67.0)	
Area of Residence				**<0.001 *****				**<0.001 *****				**<0.001 *****
Urban	27,409	10764 (43.1)	16645 (56.9)		13,445	3899 (33.5)	9546 (66.5)		26,343	9834 (44.3)	16509 (55.7)	
Rural	12,932	4336 (32.1)	8596 (67.9)		6,085	1384 (23.7)	4701 (76.3)		13,520	4034 (30.7)	9486 (69.3)	
Altitude				0.688				0.264				0.793
≤2,500 MAMSL	29,085	10491 (40.3)	18594 (59.7)		14,569	3861 (31.4)	10708 (68.6)		28,649	9629 (41.3)	19020 (58.7)	
>2,500 MAMSL	11,256	4609 (40.7)	6647 (59.3)		4,961	1422 (29.8)	3539 (70.2)		11,214	4239 (41.0)	6975 (59.0)	
Enabling Factors												
Child's Health Insurance Coverage							**<0.001 *****				**<0.001 *****	**<0.001 *****
Public Health	26,003	9246	16757	13,091	3269	9822	29,284	9705	19579			
Insurance-SIS		(37.4)	(62.6)		(27.7)	(72.3)		(38.4)	(61.6)			
ESSALUD	9,169	4137 (48.7)	5032 (51.3)	4,173	1419 (38.9)	2754 (61.1)	7,515	3202 (50.0)	4313 (50.0)			
Other	521	228 (49.5)	293 (50.5)	219	76 (36.1)	143 (63.9)	399	174 (46.2)	225 (53.8)			
Uninsured	4,648	1489 (35.8)	3159 (64.2)		2,047	519 (31.1)	1528 (68.9)		2,665	787 (38.0)	1878 (62.0)	
Parent/Caregiver's education level				**<0.001 *****				**<0.001 *****				**<0.001 *****
No education	1,101	312 (26.3)	789 (73.7)		424	64 (16.4)	360 (83.6)		790	177 (23.6)	613 (76.4)	

Variables	2019 Oral Health Services Utilization				2020 Oral Health Services Utilization				2022 Oral Health Services Utilization			
	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value	n	Yes n (%)	No n (%)	P-value
Primary	9,701	2986 (31.0)	6715 (69.0)		4,487	1033 (24.7)	3454 (75.3)		8,735	2376 (30.0)	6359 (70.0)	
Secondary	18,007	6722 (40.6)	11285 (59.4)		9,148	2417 (30.8)	6731 (69.2)		19,085	6636 (41.3)	12449 (58.7)	
Superior	11,532	5080 (47.9)	6452 (52.1)		5,471	1769 (36.8)	3702 (63.2)		11,253	4679 (48.9)	6574 (51.1)	
Wealth Quintile				**<0.001 *****				**<0.001 *****				**<0.001 *****
Very poor	12,484	3858 (29.9)	8626 (70.1)		5,647	1221 (22.3)	4426 (77.7)		13,201	3690 (30.0)	9511 (70.0)	
Poor	10,869	4022 (38.7)	6847 (61.3)		5,150	1349 (28.6)	3801 (71.4)		10,592	3704 (38.7)	6888 (61.3)	
Middle	7,665	3077 (42.3)	4588 (57.7)		3,974	1160 (32.7)	2814 (67.3)		7,504	2852 (44.6)	4652 (55.4)	
Rich	5,536	2385 (47.6)	3151 (52.4)		2,801	857 (34.9)	1944 (65.1)		5,192	2116 (47.1)	3076 (52.9)	
Very Rich	3,787	1758 (49.6)	2029 (50.4)		1,958	696 (41.1)	1262 (58.9)		3,374	1506 (52.2)	1868 (47.8)	
Received Information regarding Oral Healthcare				**<0.001 *****				**<0.001 *****				**<0.001 *****
Yes	25,241	7104 (43.5)	18137 (56.5)		13,887	4049 (33.1)	9838 (66.9)		27,920	10333 (43.0)	17587 (57.0)	
No	15,100	2679 (31.4)	12421 (68.6)		5,643	1234 (26.5)	4409 (73.5)		11,943	3535 (37.5)	8408 (62.5)	

MAMSL – meters above mean sea level, n – number, CI – Confidence Interval, n: unit number, %: weighted percentage Note: $p \leq 0.05$*, $p \leq 0.01$**, $p \leq 0.001$***

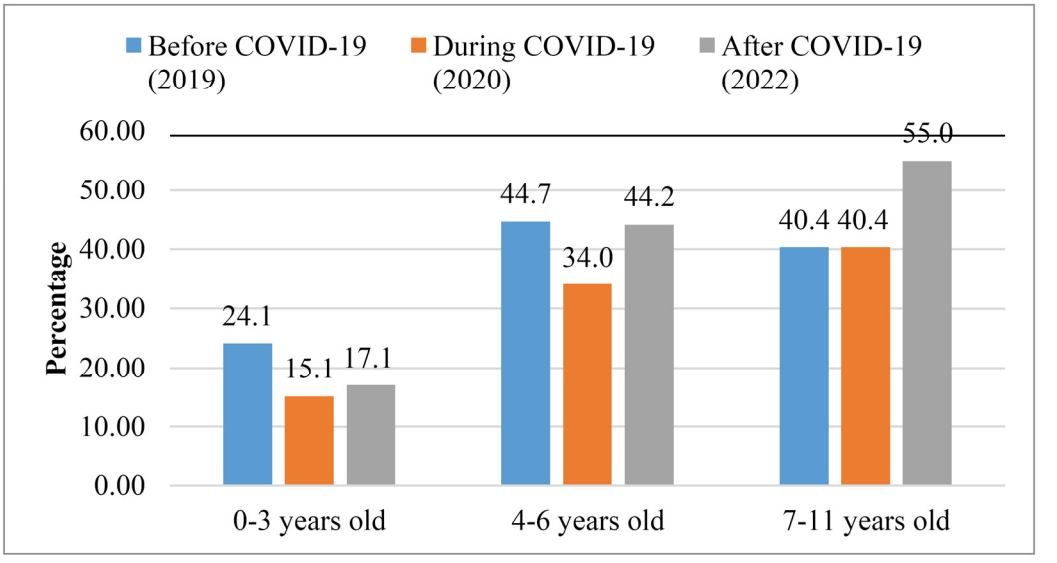

Figure 8. Oral Health Services Utilization in Peruvian children according to age

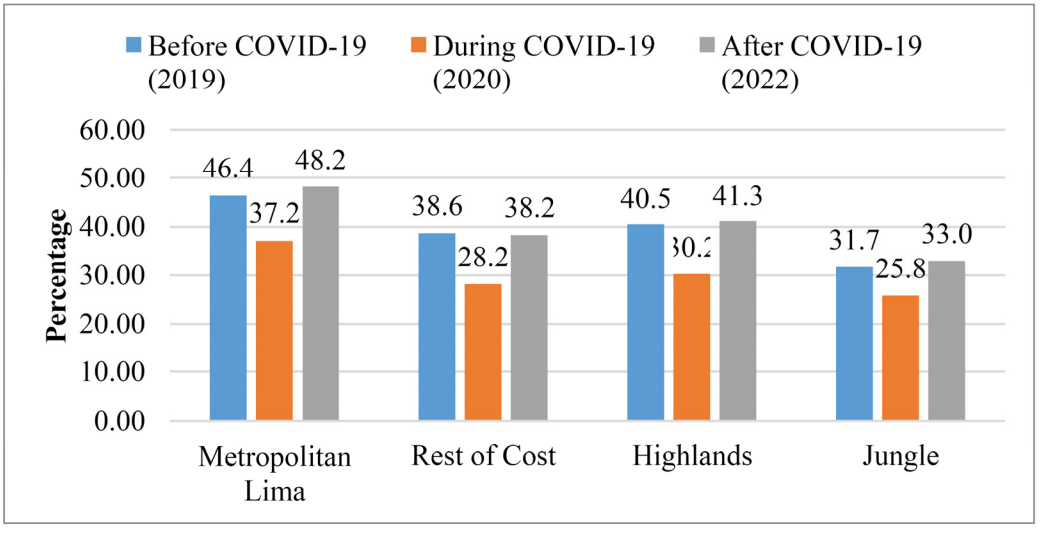

Figure 9. Oral Health Services Utilization in Peruvian children according to natural region of residence

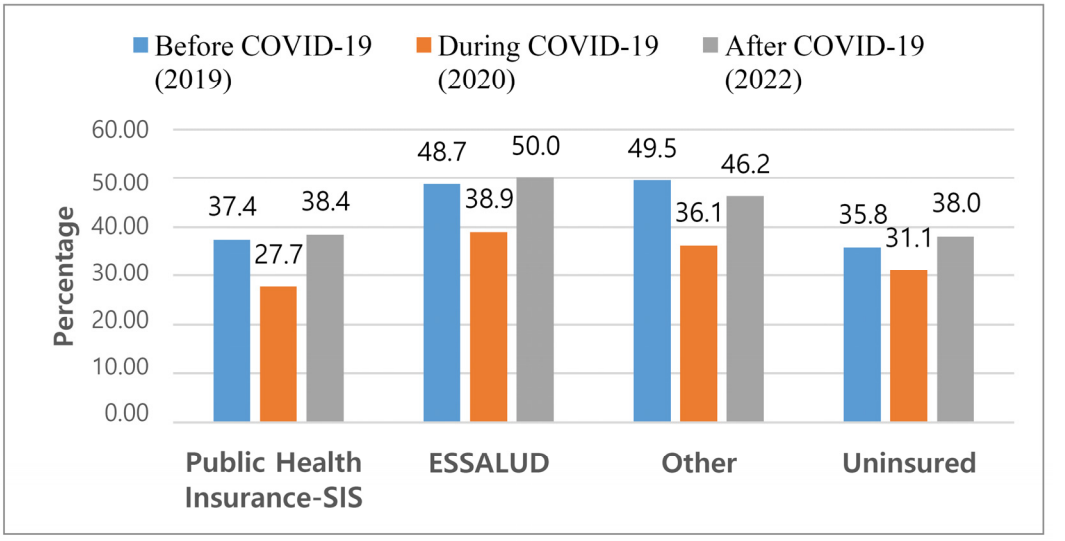

Figure 10. Oral Health Services Utilization in Peruvian children according to health insurance

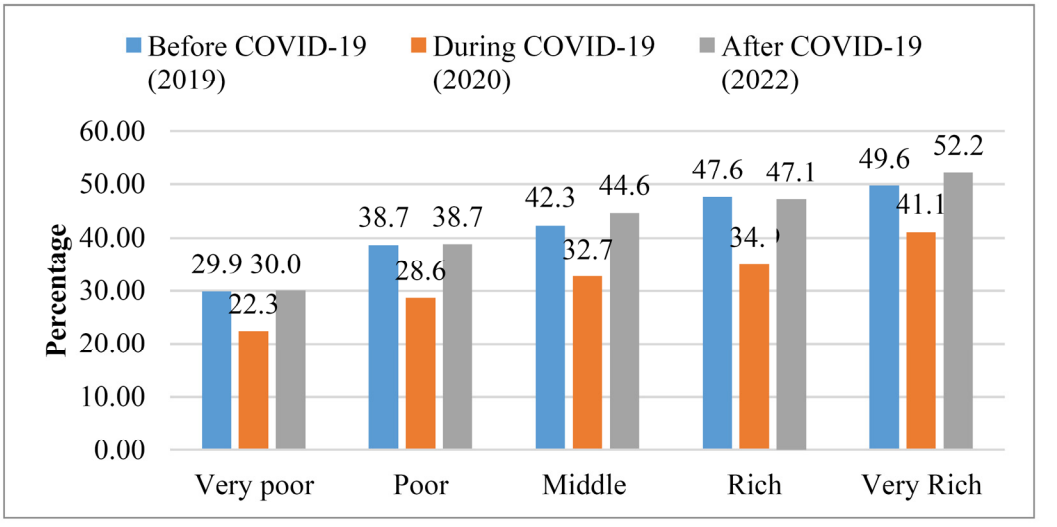

Figure 11. Oral Health Services Utilization in Peruvian children according to wealth quintile

4.3 Multivariate Analysis

A hierarchical logistic regression analysis was performed. The association between the sociodemographic factors (predisposing and enabling factors) and the Child's Oral Health Service Utilization before, during, and after COVID-19 are presented in Table 9.

For the first analysis, two models were developed for each year (2019,2020, and 2022) separately, in "Model 1" all predisposing factors were considered, and then in "Model 2", all enabling factors were added. For the second analysis, three models were developed for all the years as a whole, in "Model 1" all predisposing factors were considered, in "Model 2", all enabling factors were added, and in "Model 3" the year as a variable was added.

4.3.1 Factors associated with Oral Health Services Utilization in the last 6 months of the ENDES survey (2019) before the COVID-19

In "Model 1" from all the predisposing factors: the child's age, the parent/caregiver's sex and age, the parent/caregiver's marital status, the natural region of residence, and the area of residence were significantly associated with Oral Health Services Utilization among Peruvian children under 12 years old. On the other hand, the child's sex, the relationship of the parent/caregiver with the head of the household, and the altitude were insignificant. In "Model 2" after adding all enabling factors, in terms of predisposing factors, the variables that significantly were associated with Oral Health Services Utilization among Peruvian children were: **1)** the child's age, where children with higher ages from 7 to 11 years old (OR: 3.91, 95%CI: 3.70-4.13, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those who had lower ages (from 0 to 3 years old); **2)** the parents/caregiver's sex, children with female caregivers were 1.36 (95%CI: 1.18-1.56, p=0.000) times more likely to be taken to Oral Health Services compared with children with male caregivers; **3)** the parent/caregiver's age, those with younger ages from 15 to 26 (OR: 1.46, 95%CI: 1.16-1.84, p=0.002) were more likely to take their children to Oral health Services than the older ones (more than 60 years old); **4)** the parent/caregiver's marital status, married parent/caregiver or those

living with unmarried partner (OR: 1.16, 95%CI: 1.03-1.31, p=0.018) were more likely to take their children to Oral Health Services in the last six months than those previously married; **5)** the natural region of residence, the children who lived in the highlands (OR: 1.37, 95%CI: 1.24-1.52, p=0.000) were more likely to visit Oral Health Services than those who lived in the jungle; **6)** the area of residence, children living in urban areas were 0.92 (95%CI: 0.86-0.98, p=0.015) less likely to use Oral Health Services than those living in rural areas; **7)** the altitude, children living in areas located more than 2,500 MAMSL were 1.14 (95%CI: 1.03-1.26, p=0.010) times more likely to visit Oral Health Services in 2019 (before COVID-19).

The predisposing factors: the child's sex and the parent/caregiver's relationship with the head of the household did not show a statistically significant association with Oral Health Services Utilization among Peruvian children in 2019 (Model 2)

Concerning enabling factors (Model 2), all variables were significantly associated with Oral Health Service Utilization among Peruvian children. Those with ESSALUD health insurance coverage were more likely to visit Oral Health Services in the last 6 months (OR: 1.64, 95%CI: 1.52-1.78, p=0.000) than uninsured children. Parents/caregivers with higher education levels (OR: 2.07, 95%CI: 1.78-2.42, p=0.000) were more likely to take their children to Oral Health Services than those who had no education. Children from households with a wealth quintile classification as very rich (OR: 1.82, 95%CI: 1.63-2.04, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those from households with a wealth quintile classification as very poor. Parents/caregivers who received information about Oral Healthcare were 2.0 times (95%CI: 1.90-2.11, p=0.000) more likely to take their children to visit Oral Health Services compared with those who did not receive it.

4.3.2 Factors associated with Oral Health Services Utilization in the last 6 months of the ENDES survey (2020) during COVID-19

In "Model 1" from all the predisposing factors: the child's age, the parent/caregiver's

sex, the parent/caregiver's marital status, the natural region of residence, and the area of residence were significantly associated with Oral Health Services Utilization among Peruvian children under 12 years old. On the other hand, the child's sex, the parent/caregiver's age, the relationship of the parent/caregiver with the head of the household, and the altitude were insignificant.

In "Model 2" after adding all enabling factors, the predisposing factors that significantly were associated with Oral Health Services Utilization among Peruvian children were: **1)** the child's age, where children with higher ages from 7 to 11 years old (OR: 4.53, 95%CI: 4.15-4.93, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those who had from 0 to 3 years old; **2)** the parent/caregiver's sex, children with female caregivers were 1.24 (95%CI: 1.01-1.52, p=0.044) times more likely to be taken to Oral Health Services compared with children with male caregivers; **3)** the parent/caregiver's marital status, married parent/caregiver or those living with unmarried partner (OR: 1.28, 95%CI: 1.06-1.55, p=0.009) were more likely to take their children to Oral Health Services in the last six months than those previously married; **4)** the natural region of residence, hence the children who lived in the highlands (OR: 1.39, 95%CI: 1.18-1.63, p=0.000) were more likely to visit Oral Health Services than those who lived in the jungle; **5)** the area of residence, children living in urban areas were 1.14 (95%CI: 1.02-1.26, p=0.017) more likely to use Oral Health Services than those living in rural areas.

The predisposing factors: the child's sex, the parent/caregiver's age, their relationship with the head of the household, and the altitude where dwellings were located did not show a statistically significant association with Oral Health Services Utilization among Peruvian children in 2020 (Model 2)

Within the enabling factors (Model 2), all variables were significantly associated with Oral Health Service Utilization among Peruvian children. Those with ESSALUD health insurance coverage were more likely to visit Oral Health Services in the last 6 months (OR: 1.47, 95%CI: 1.29-1.67, p=0.000) than uninsured children. Parents/caregivers with

higher education levels (OR: 2.70, 95%CI: 2.01-3.61, p=0.000) were more likely to take their children to Oral Health Services than those who had no education. Children from households with a wealth quintile classification as very rich (OR: 1.58, 95%CI: 1.33-1.88, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those from households with a wealth quintile classification as very poor. Parents/caregivers who received information about Oral Healthcare were 1.59 times (95%CI: 1.47-1.72, p=0.000) more likely to take their children to visit Oral Health Services compared with those who did not receive it.

4.3.3 Factors associated with Oral Health Services Utilization in the last 6 months of the ENDES survey (2022) after COVID-19

In “Model 1” all the predisposing factors: the child’s sex and age, the parent/caregiver’s sex and age, the natural region of residence, and the area of residence were significantly associated with Oral Health Services Utilization among Peruvian children under 12 years old. On the other hand, the parent/caregiver’s relationship with the head of the household, the parent/caregiver’s marital status, and the altitude were insignificant.

In “Model 2” after adding all enabling factors, the predisposing factors that significantly were associated with Oral Health Services Utilization among Peruvian children were: **1)** the child’s sex, where female children were 1.05 times (95%CI: 1.01-1.10, p=0.025) more likely to use Oral Health Services compared to the male children; **2)** the child’s age, then children with higher ages from 7 to 11 years old (OR: 7.52, 95%CI: 7.08-7.97, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those who had lower ages (from 0 to 3 years old); **3)** the parent/caregiver’s sex, children with female caregivers were 1.31 (95%CI: 1.13-1.52, p=0.000) times more likely to be taken to Oral Health Services compared with children with male caregivers; **4)** the parent/caregiver’s age, those with younger ages from 15 to 26 (OR: 1.38, 95%CI: 1.07- 1.79, p=0.014) were more likely to take their children to Oral health Services than

the older ones (more than 60 years old); **5)** the natural region of residence, then children who lived in the highlands (OR: 1.49, 95%CI: 1.34-1.66, p=0.000) were more likely to visit Oral Health Services than those who lived in the jungle.

The predisposing factors: the parent/caregiver's marital status, their relationship with the head of the household, the area of residence, and the altitude where dwellings were located did not show a statistically significant association with Oral Health Services Utilization among Peruvian children in 2022 (Model 2)

Regarding enabling factors in "Model 2", almost all variables were significantly associated with Oral Health Service Utilization among Peruvian children, except the child's health insurance coverage. The parents/caregivers with higher education levels (OR: 2.82, 95%CI: 2.33-3.40, p=0.000) were more likely to take their children to Oral Health Services than those who had no education. Children from households with a wealth quintile classification as very rich (OR: 1.68, 95%CI: 1.49-1.90, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those from households with a wealth quintile classification as very poor. Parents/caregivers who received information about Oral Healthcare were 1.77 times (95%CI: 1.68-1.86, p=0.000) more likely to take their children to visit Oral Health Services compared with those who did not receive it.

Table 9. Predisposing and enabling Factors associated with Oral Health Services Utilization in Peruvian Children

Variables	2019		2020		2022	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
	AOR (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)
Predisposing Factors						
Child's sex						
Male	1	1	1	1	1	1
Female	1.00 (0.96-1.05)	1.01 (0.97-1.05)	1.02 (0.96-1.09)	1.02 (0.96-1.09)	**1.05** (1.00-1.10)*	**1.05** (1.01-1.10)*

Variables	2019		2020		2022	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)
Child's age						
0-3	1.00	1.00	1.00		1.00	1.00
4-6	**2.50** (2.37-2.64)***	**2.71** (2.57-2.87)***	**2.87** (2.63-3.13)***	**2.98** (2.72-3.25)***	**3.65** (3.44-3.86)***	**3.93** (3.70-4.17)***
7-11	**3.20** (3.03-3.37)***	**3.91** (3.70-4.13)***	**3.96** (3.64-4.31)***	**4.53** (4.15-4.93)***	**6.05** (5.72-6.40)***	**7.52** (7.08-7.97)***
Parent/Caregiver's sex						
Male	1.00	1.00	1.00	1.00	1.00	1.00
Female	**1.30** (1.13-1.49)***	**1.36** (1.18-1.56)***	**1.27** (1.03-1.55)*	**1.24** (1.01-1.52)*	**1.25** (1.08-1.44)**	**1.31** (1.13-1.52)***
Parent/Caregiver's age						
15-26	**1.86** (1.49-2.33)***	**1.46** (1.16-1.84)**	1.27 (0.89-1.82)	1.06 (0.73-1.53)	**1.87** (1.45-2.40)***	**1.38** (1.07-1.79)*
27-43	**1.90** (1.53-2.37)***	**1.35** (1.07-1.69)*	1.39 (0.98-1.97)	1.05 (0.74-1.51)	**1.87** (1.46-2.39)***	1.28 (1.00-1.65)
44-59	**1.56**	**1.28**	1.10	0.95	**1.48**	1.20
> 60	(1.24-1.96)*** 1.00	(1.01-1.62)* 1.00	(0.76-1.58) 1.00	(0.65-1.37)	(1.14-1.90)** 1.00	(0.93-1.56) 1.00
Parent/Caregiver's Marital Status						
Single	1.00 (0.93-1.09)	0.94 (0.87-1.02)	1.05 (0.93-1.19)	0.98 (0.86-1.11)	1.01 (0.93-1.08)	0.95 (0.88-1.03)
Married-w/Partner	**1.16** (1.03-1.31)*	**1.16** (1.03-1.31)*	**1.33** (1.11-1.60)**	**1.28** (1.06-1.55)**	0.94 (0.82-1.08)	0.94 (0.82-1.08)
Previously Married	1.00	1.00	1.00	1.00	1.00	1.00
Relationship with the Resp of the Household						
Household responsible	0.97 (0.88-1.08)	1.03 (0.93-1.14)	0.87 (0.74-1.02)	0.92 (0.78-1.08)	1.02 (0.91-1.14)	1,06 (0.95-1.20)
Wife/Husband	1.03 (0.94-1.13)	1.08 (0.98-1.18)	0.93 (0.80-1.08)	1.00 (0.86-1.16)	1.01 (0.90-1.12)	1.06 (0.95-1.19)
Daughter/Son	1.06 (0.96-1.17)	1.00 (0.90-1.11)	0.92 (0.78-1.09)	0.89 (0.75-1.06)	1.10 (0.97-1.24)	1.03 (0.91-1.17)
Other	1.00	1.00	1.00	1.00	1.0	1.00

Variables	2019		2020		2022	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)
Natural Region of Residence						
Metropolitan Lima	**1.52** (1.40-1.64)***	**1.26** (1.16-1.37)***	**1.36** (1.22-1.52)***	**1.17** (1.03-1.32)*	**1.59** (1.47-1.72)***	**1.33** (1.22-1.45)***
Rest of Cost	**1.26** (1.19-1.34)***	**1.10** (1.03-1.17)**	1.07 (0.97-1.17)	0.96 (0.87-1.05)	**1.31** (1.23-1.39)***	**1.13** (1.06-1.21)***
Highlands	**1.57** (1.43-1.74***	**1.37** (1.24-1.52)***	**1.56** (1.33-1.83)***	**1.39** (1.18-1.63)***	**1.72** (1.55-1.91)***	**1.49** (1.34-1.66)***
Jungle	1.00	1.00	1.00		1.00	1.00
Area of Residence						
Urban	**1.43** (1.36-1.51)***	**0.92** (0.86-0.98)*	**1.57** (1.45-1.70)***	**1.14** (1.02-1.26)*	**1.63** (1.54-1.72)***	1.05 (0.98-1.12)
Rural	1.00	1.00	1.00		1.00	1.00
Altitude						
❶2,500 MAMSL	1.00	1.00	1.00	1.00	1.00	1.00
>2,500 MAMSL	1.06 (0.96-1.17)	**1.14** (1.03-1.26)*	0.93 (0.79-1.09)	0.98 (0.83-1.15)	1.04 (0.93-1.15)	1.11 (0.99-1.23)
Enabling Factors						
Child's Health Insurance Coverage						
Public Health Insurance-SIS		**1.54** (1.43-1.65)***		**1.31** (1.17-1.47)***		1.07 (0.85-1.33)
ESSALUD		**1.64** (1.52-1.78)***		**1.47** (1.29-1.67)***		1.12 (0.90-1.40)
Other		**1.44** (1.18-1.75)***		**1.41** (1.03-1.93) *		0.66 (0.52-0.84)
Uninsured		1.00				1.00
Parent/Caregiver's education level						
No education		1.00	1.00	1.00		1.00
Primary		**1.18 (1.02-1.37)***		**1.75 (1.32-2.32)*****		**1.37 (1.14-1.64)*****
Secondary		**1.67** (1.44-1.93)***		**2.16** (1.62-2.87)***		**2.16** (1.80-2.59)***

Variables	2019		2020		2022	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)
Superior		**2.07** (1.78-2.42)***		**2.70** (2.01-3.61)***		**2.82** (2.33-3.40)***
Wealth Quintile						
Very poor		1.00		1.00		1.00
Poor		**1.42** (1.32-1.52)***		**1.22** (1.09-1.36)**		**1.36** (1.26-1.46)***
Middle		**1.58** (1.45-1.72)***		**1.36** (1.19-1.55)***		**1.50** (1.38-1.64)***
Rich		**1.70** (1.54-1.88)***		**1.38** (1.19-1.60)***		**1.59** (1.43-1.76)***
Very Rich		**1.82** (1.63-2.04)***		**1.58** (1.33-1.88)***		**1.68** (1.49-1.90)***
Received Information regarding oral Healthcare						
Yes		**2.00** (1.90-2.11)***		**1.59** (1.47-1.72)***		**1.77** (1.68-1.86)***
No		1.00				1.00

Adjusted Odd Ratio (AOR) are presented with 95% Confidence Intervals (CI) Note: $p \leq 0.05$*, $p \leq 0.01$**, $p \leq 0.001$***

4.3.4 Factors associated with Oral Health Services Utilization in the last 6 months of the ENDES survey (2019,2020 and 2022)

When analyzing data as a whole taking into account the “year” as a variable with all the other ones (predisposing and enabling factors), three models were developed: model 1, adjusting all predisposing factors; model 2, adding all enabling factors and finally model 3, adding the variable year (Table 10).

In “Model 1” almost all the predisposing factors were significantly associated with Oral Health Services Utilization among Peruvian children less than 12 years old, except the child’s sex, the parent/caregiver’s relationship with the head of the household, and the

altitude that were insignificant. Then “Model 2”, after adding all enabling factors, in terms of the predisposing factors almost all of them were significantly associated with Oral Health Services Utilization among Peruvian children under 12 years old, except the child’s sex, the parent/caregiver’s relationship with the head of the household, and the area of residence were insignificant.

Finally, in “Model 3” after adding the variable “Year”, the predisposing factors that significantly were associated with Oral Health Services Utilization among Peruvian children were: **1)** the child’s age, children with higher ages from 7 to 11 years old (OR: 5.19, 95%CI: 5.00-5.38, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those who had lower ages (from 0 to 3 years old); **2)** the parent/caregiver’s sex, children with female caregivers were 1.31 (95%CI: 1.19-1.43, p=0.000) times more likely to be taken to Oral Health Services compared with children with male caregivers; **3)** the parent/caregiver’s age, those with younger ages from 15 to 26 (OR: 1.37, 95%CI: 1.17-1.60, p=0.000) were more likely to take their children to Oral Health Services than the older ones (more than 60 years old). **5)** the parent/caregiver’s marital status, those married or with unmarried partners (OR: 1.10, 95%CI: 1.01-1.19, p=0.025) were more likely to take their children to Oral Health Services than those previously married; **6)** the natural region of residence, then children who lived in the highlands (OR: 1.42, 95%CI: 1.33-1.52, p=0.000) were more likely to visit Oral Health Services than those who lived in the jungle; and **7)** the altitude, children who live in areas located more than 2,500 MAMSL were 1.10 times (95%CI: 1.03-1.17, p=0.006) more likely to visit Orla Health Services compared with children living in areas located less or equal to 2,500 MAMSL. On the other hand, the following predisposing factors: the child’s sex, the parent/caregiver’s relationship with the head of the household, and the area of residence did not show a statistically significant association with Oral Health Services Utilization among Peruvian children under 12 years of age.

Regarding enabling factors in “Model 3”, all variables were significantly associated with Oral Health Service Utilization among Peruvian children. **1)**The child’s health

insurance coverage, children with the ESSALUD insurance scheme (OR: 1.64, 95%CI: 1.55-1.73, p=0.000) were more likely to use Oral Health Services in the last 6 months than uninsured children; **2)** the parents/caregivers with higher education levels (OR: 2.41, 95%CI: 2.15-2.69, p=0.000) were more likely to take their children to Oral Health Services than those who had no education; **3)** children from households with a wealth quintile classification as very rich (OR: 1.73, 95%CI: 1.61-1.86, p=0.000) were more likely to have Oral Health Services Utilization in the past 6 months than those from households with a wealth quintile classification as very poor; **4)** the parents/caregivers who received information about Oral Healthcare were 1.81 times (95%CI: 1.75-1.87, p=0.000) more likely to take their children to visit Oral Health Services compared with those who did not receive it.

Finally, in “Model 3” the variable “year” was significantly associated with Oral Health Service Utilization, therefore Peruvian children in 2019 (OR: 1.11, 95%CI: 1.07-1.14, p=0.000) were more likely to use Oral Health Services before the COVID-19 than after COVID-19 (2022). In addition, there was a negative association between the year 2020 (during the COVID-19) and Oral Health Services Utilization, then Peruvian children in 2020 (OR: 0.65, 95%CI: 0.63-0.68, p=0.000) were less likely to use Oral Health Services during the COVID-19 (2019) than after COVID-19 (2022).

Table 10. Hierarchical Logistic Regression for Predisposing/Enabling Factors and Year with Oral Health Services Utilization in Peruvian Children (N=99,734)

Variables	**Model 1**	**Model 2**	**Model 3**
	AOR (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)
Predisposing Factors			
Child's sex			
Male	1	1	1
Female	1.02 (1.00-1.05)	1.03 (1.00-1.06)	1.03 (1.00-1.06)
Child's age			

Variables	Model 1	Model 2	Model 3
	AOR (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)
0-3	1	1	1
4-6	**2.94** (2.84-3.05)***	**3.15** (3.04-3.27)***	**3.18** (3.07-3.30)***
7-11	**4.23** (4.08-4.38)***	**5.13** (4.95-5.32)***	**5.19** (5.00-5.38)***
Parent/Caregiver's sex			
Male	1	1	1
Female	**1.28** (1.17-1.39)***	**1.32** (1.20-1.44)***	**1.31** (1.19-1.43)***
Parent/Caregiver's age			
15-26	**1.75** (1.51-2.04)***	**1.36** (1.17-1.59)***	**1.37** (1.17-1.60)***
27-43	**1.78** (1.53-2.06)***	**1.26** (1.08-1.47)**	**1.28** (1.10-1.49)**
44-59	**1.43** (1.23-1.67)***	**1.19** (1.01-1.39)*	**1.20** (1.02-1.40)*
> 60	1	1	1
Parent/Caregiver's Marital Status			
Single	1.01 (0.96-1.06)	0.95 (0.90-1.00)	0.95 (0.90-1.00)
Married-w/Partner	**1.09** (1.01-1.19)***	**1.09** (1.00-1.18)*	**1.10** (1.01-1.19)*
Previously Married	1	1	1
Relationship with the Resp of the Household			
Household responsible	0.97 (0.90-1.04)	1.02 (0.95-1.09)	1.02 (0.95-1.10)
Wife/Husband	1.00 (0.93-1.06)	1.05 (0.98-1.12)	1.05 (0.99-1.12)
Daughter/Son	1.04 (0.97-1.12)	0.98 (0.91-1.06)	0.99 (0.92-1.06)
Other	1	1	1
Natural Region of Residence			
Metropolitan Lima	**1.50** (1.43-1.58)***	**1.27** (1.20-1.34)***	**1.27** (1.21-1.34)***

Variables	Model 1	Model 2	Model 3
	AOR (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)
Rest of Cost	**1.24** (1.19-1.29)***	**1.09** (1.05-1.13)***	**1.09** (1.04-1.13)***
Highlands	**1.64** (1.53-1.75)***	**1.43** (1.34-1.53)***	**1.42** (1.33-1.52)***
Jungle	1	1	1
Area of Residence			
Urban	**1.53** (1.48-1.58)***	1.01 (0.97-1.06)	1.01 (0.96-1.05)
Rural	1	1	1
Altitud			
≤2,500 MAMSL	1	1	1
>2,500 MAMSL	1.02 (0.96-1.09)	**1.09** (1.02-1.17)**	**1.10** (1.03-1.17)**
Enabling Factors			
Child's Health Insurance Coverage			
Public Health Insurance-SIS		**1.52** (1.44-1.60)***	**1.53** (1.45-1.61)***
ESSALUD		**1.64** (1.55-1.73)***	**1.64** (1.55-1.73)***
Other		**1.49** (1.30-1.71)***	**1.48** (1.29-1.70)***
Uninsured		1	1
Parent/Caregiver's education level			
No education		1.00	
Primary		**1.30** (1.17-1.45)***	**1.32** (1.19-1.46)***
Secondary		**1.87** (1.68-2.07)***	**1.90** (1.71-2.11)***
Superior		**2.38** (2.14-2.66)***	**2.41** (2.15-2.69)***
Wealth Quintile			
Very poor		1	1

Variables	Model 1	Model 2	Model 3
	AOR (95%CI)	**AOR** (95%CI)	**AOR** (95%CI)
Poor		**1.35** (1.29-1.41)***	**1.36** (1.30-1.43)***
Middle		**1.48** (1.40-1.56)***	**1.51** (1.43-1.60)***
Rich		**1.56** (1.47-1.66)***	**1.60** (1.50-1.70)***
Very Rich		**1.68** (1.56-1.81)***	**1.73** (1.61-1.86)***
Received Information regarding Oral Healthcare			
Yes		**1.82** (1.76-1.88)***	**1.81** (1.75-1.87)***
No		1	1
Year			
2019			**1.11** (1.07-1.14)***
2020			**0.65** (0.63-0.68)***
2022			1

Adjusted Odd Ratio (OR) are presented with 95% Confidence Intervals (CI) Note: $p \leq 0.05$*, $p \leq 0.01$**, $p \leq 0.001$***

V. DISCUSSION

According to the WHO Oral health is considered the main indicator of the quality of life, health, and well-being (Sihuay Torres, 2022). The presence of oral health diseases in children may continue throughout their growth until they become adults, affecting their development and social relationships, being part of the high prevalence of oral health diseases in the world. Therefore, oral health services utilization is important to identify the risk of developing oral health diseases and prevent them or to treat them at early stages or when pain has been established. Different studies (Curi et al., 2018; Mohammed et al., 2023; Nagdev et al., 2023; Nicola et al., 2020; Sabbagh et al., 2022) have identified several sociodemographic factors associated with Oral Health Service Utilization. In the context of the COVID-19 pandemic, many aspects of society in different countries were changed resulting in socioeconomic and demographic implications, triggering critical scenarios in health which exacerbated health inequalities (Ali & Alharbi, 2020; Dickson-Swift et al., 2022; Poudel & Subedi, 2020; Stennett & Tsakos, 2022). In Peru, those changes stood out because it was considered one of the countries worldwide with the highest number of infections and mortality in the first year of the pandemic.

The present study analyzed the impact of COVID-19 on Oral Health Services Utilization among Peruvian children under 12 years of age by identifying the association of sociodemographic factors in three different years: 2019 (before COVID-19), 2020 (during COVID-19), and 2022 (after COVID-19) using the ENDES surveys.

The prevalence of children under 12 years of age who visited Oral Health Services in Peru within the last 6 months before, during, and after the COVID-19 pandemic was 40.4%, 31%, and 41.2% respectively. This means that the Use of Oral Health Services was more frequent before (2019) than during the COVID-19 pandemic (2020) which decreased to less than one-third of the Peruvian children population and increased again two years after (2022). However, within the three years evaluated in this study, the

percentage of children who didn't use Oral Health Services was higher. According to WHO the prevalence of dental caries among children ranges from 64-75% which can be explained with the findings of this study, regarding the prevalence of Oral Health Services Utilization. Based on the results of the present study and the information mentioned before, it can be inferred that there is limited access to Oral Health Services by Peruvian children, which is reflected in the high prevalence of the most common Oral Health Diseases (dental caries) that haven't changed within the last decade in Peru.

Before the COVID-19 pandemic, Torres-Mantilla and Newball-Noriega (2023) found a prevalence of 31% for Oral Health Services Utilization in the last six months by Peruvian children (Torres-Mantilla & Newball-Noriega, 2023) , which is lower compared with the result in the present study, probably because in the present study it was excluded from the sample children who were not habitual habitant of the evaluated households (visitors were excluded), considering only habitual residents of the household taking into consideration that children who don't live continuously in the evaluated household may be affected by other sociodemographic factors of their habitual environment different to the evaluated household. They also found that the prevalence of children who didn't use Oral Health Services was higher coinciding with the findings of this investigation. On the other hand, John et al (2017), found a high prevalence of Oral Health Services Utilization (53%), before COVID-19, among children in rural Australia, which is higher than the prevalence found in this study in 2019, which can be explained because in their study they only took into account rural areas instead of the entire country, and also is a developed country. Mohammed et al (2023) on 2016 found an overall dental service utilization among 398 children in Northern Ethiopia of only 10.6% (Mohammed et al., 2023), which is much lower than the results in this study,

It is also documented that the COVID-19 pandemic has affected Oral Health services delivery and utilization worldwide due to the implementation of all the public health measures to contain the virus (SARS-COV-2) which impacted different sectors of society, especially the health field (Di Spirito et al., 2022; Gudipaneni et al., 2023). This is

reflected in the decrease in Oral Health Services utilization during COVID-19 in this study. Therefore, the already limited utilization of Oral Health Services was exacerbated during the first year of the COVID-19 pandemic (2020).

Two years after the first case of the COVID-19 pandemic in Peru, all activities, including the health sector returned to new normality after the government lifted the state of emergency (Supreme Decree DS-130-2022-PCM), this is reflected in the increase of Oral Health Services Utilization found in this study. In this sense, based on everything mentioned above, it can be confirmed that the COVID-19 pandemic negatively affected the use of Oral Health Services among Peruvian children under 12 years of age, especially in developing countries.

To understand deeply these changes in the prevalence of Oral Health Services utilization, several types of research have identified sociodemographic factors that could influence the use of Oral Health Services (Curi et al., 2018; Gao et al., 2020; Hu et al., 2023; Mohammed et al., 2023; Nagdev et al., 2023; Torres-Mantilla & Newball-Noriega, 2023). In the present investigation when determining the relationship between sociodemographic factors and Oral Health Services Utilization in the last 6 months among Peruvian children under 12 years of age in three different years according to the modified Andersen's Theoretical Model of Healthcare Utilization (Ali et al., 2016; Azanedo et al., 2017) classifying the demographic factors into predisposing and enabling factors, first, it was found that, few predisposing factors as the child's age, parent/caregiver's sex and the natural region of residence, and almost all enabling factors as the parent/caregiver's education level, the household's wealth quintile and the received information about oral healthcare by the parent/caregiver were associated with Oral Health Services Utilization equally in the three years (2019, 2020 and 2022).

Regarding the child's age, children with higher ages from 7 to 11 years old were more likely to have Oral Health Services Utilization in the past 6 months than those who had lower ages. The same results were reported by Azañedo et al, who found a correlation between the child's age and access to Oral Health Services among Peruvian children over

6 years of age (Azanedo et al., 2017). Furthermore, Garces determined that age was a factor associated with the time that takes for Peruvian children to get dental care (Garces-Elias et al., 2023). These findings can be attributed to the big influence of parents/caregivers' lack of knowledge, habits, and beliefs about Oral Healthcare in children under 6 years of age, this same situation was reported in other countries such as India where 59.08% of children first visited a dentist at the age of 6 years old, therefore the prevalence of Oral Health Services utilization is higher in the group of children with more than 6 years old, as it was found in this study with the percentages of 49.2% (2019), 40.4% (2020), and 55% (2022) while in children less than 3 years old the prevalence was much lower 24,1% (2019), 15.1% (2020), and 17.1% (2022). On the other hand, these results may not be in accordance with the recommendation of the American Academy of Dentistry which states that children must begin their regular visits to the dentist upon the eruption of the first teeth or at the age of 1 year old and every 6 to 12 months (Finlayson et al., 2018; Gao et al., 2020). Lastly, is reflected from the results that the COVID-19 pandemic worsened this incorrect pattern of Oral Health Service utilization according to child's age.

It was also found (in 2019, 2020, and 2022) that children with female caregivers were 1.31 times more likely to be taken to Oral Health Services compared with children with male parent/caregiver. This could be because from the child's birth mothers are the main ones in charge of taking the child to their first health check-ups, where they receive information related to general health and oral health. They are also the main ones in charge of school activities where they are often provided with oral health campaigns, which could influence their children's greater use of dental services. On the other hand, Hu et al (2023), found in 2005 that male caregivers were more likely to take their children to Oral Health Services among preschool children in northwest China (Hu et al., 2023) due to they were responsible for the household. Analyzing these results, it can be concluded that the gender of the caregiver could be positively or negatively associated with Oral Health Services Utilization depending on the social, economic, and political

context of the country, in the case of Peru the COVID-19 pandemic did not change this positive association. In terms of the natural region of residence according to this study, Peruvian children who lived in the highlands and metropolitan Lima were more likely to visit Oral Health Services than those who lived in the jungle. These results are consistent with Azañedo et al, who identified also that the natural region in Peru with the highest access to Oral Health Services was the highlands (Azanedo et al., 2017). Similarly, Torres-Mantilla and Newball-Noriega, found that the Peruvian jungle recorded a lower probability of Oral Health Services utilization than inhabitants in Metropolitan Lima (Torres-Mantilla & Newball-Noriega, 2023), likewise, Aravena and Carbajal found in their research that residents of the Peruvian jungle were less likely to seek dental care (Aravena-Rivas & Carbajal-Rodriguez, 2021). These findings could be explained by the implementation many years before the COVID-19 pandemic of the Peruvian health program named “JUNTOS” which remained for the longest period in the highlands and Metropolitan Lima according to its report (http://goo.gl/9psqai). This program provided economic incentives to families in extreme poverty in exchange these families had to use preventive health services, general check- ups, and health education, engaging them in good health practices and behaviors. Another reason could be due to the geographical location of the highlands and Metropolitan Lima, they are close to each other facilitating transportation from the highlands to Metropolitan Lima where many health centers with higher levels of complexity can be founded while in the jungle few health centers and health workforce are available and also transportation to these ones are sometimes very difficult from some isolated districts within the jungle. All these geographical difficulties and infrastructure conditions haven’t changed in the last few years. Conversely, during the COVID-19 pandemic, these geographical disparities worsened due to the stringent restrictions on transportation and the implemented lockdowns to contain the virus.

Regarding the enabling factors associated with Oral Health Services in the three years, the parents/caregivers with higher education levels were more likely to take their children to Oral Health Services than those who had no education. Similar results were found in

different research (Azanedo et al., 2017; Curi et al., 2018; Gao et al., 2020; Mohammed et al., 2023; Sabbagh et al., 2022). Also, it was found that children from households with a wealth quintile classification as “very rich” were more likely to have Oral Health Services Utilization than those from households with a wealth quintile classification as “very poor”. These results are consistent with different studies in Peru (Azanedo et al., 2017; Garces-Elias, Del Castillo-Lopez, et al., 2022; Torres-Mantilla & Newball-Noriega, 2023) and in other countries worldwide (Mohammed et al., 2023; Onyejaka et al., 2016) before the COVID-19. Access to Oral Health Services has been always influenced by the social determinants of health (de Abreu et al., 2021), wealth plays a fundamental role in Oral Health Services utilization. It is also known that children who belong to lower socioeconomic status experienced higher rates of dental caries, poor oral health, untreated oral health diseases, and dental pain. This is explained by the fact found in several research where children of low income, and limited parental education obtain fewer visits, despite their higher oral health needs (Edelstein, 2002). In Peru, local research has identified the highest prevalence of dental caries in the poorest departments (Torres-Mantilla & Newball- Noriega, 2023). In addition, those parents/caregivers who received information about Oral Healthcare were more likely to take their children to visit Oral Health Services compared with those who did not receive it, which agrees with the findings of Torres and Newball’s Peruvian research (Torres-Mantilla & Newball-Noriega, 2023). Likewise, Garces-Elias, found that access to oral health information and educational programs has a positive impact on the use of Oral Health Services which is very related to the income level, considered a mediator for the acquisition of health information (Garces-Elias, Del Castillo-Lopez, et al., 2022). Peru as a developing country has been facing disparities in education accessibility and socioeconomic deprivation even before COVID-19, setting these factors as barriers to dental care, which were exacerbated by the COVID-19 pandemic that impacted directly the economy of households due to the implementation of public health measures and the high rate of informal employment status affecting, even more, the Oral Health Services Utilization among children even

after the COVID-19 pandemic, this is why all these enabling factors mentioned above have shown significant association with the use of Oral Health Services before, during and after the COVID-19 pandemic.

Otherwise, in this study, some predisposing and enabling factors were also modified in their association with the use of Oral Health Services due to the COVID-19 pandemic, as the child's sex, which was not found to be significantly associated with Oral Health Services utilization in the adjusted "Model 2" before and during the pandemic. Similar results were found in different research before and during the pandemic (Aravena-Rivas & Carbajal-Rodriguez, 2021; Azanedo et al., 2017; Dho, 2018; Gao et al., 2020; Garces-Elias, Castillo-Lopez, et al., 2022; Garces-Elias et al., 2023; John et al., 2017; Mohammed et al., 2023; Sabbagh et al., 2022; Torres-Mantilla & Newball-Noriega, 2023). Conversely, Hu et al. (Hu et al., 2023) and Nadgev et al. (Nagdev et al., 2023), found that Oral Health Services utilization was higher in male children in 2005 and 2015 respectively. Regarding these results, it could be understood that when analyzing the variable sex with other variables, most of the time it became not an important barrier or predictor of oral health access, taking into consideration that the main reasons for visiting the dentist back then besides pain were also for preventive treatments and oral check-ups. On the other hand, after the pandemic (2022), the child's sex showed a significant association with the use of Oral Health Services in the last six months among children, where females were more likely to use Oral Health Services compared to males, this could be associated to the fact that according to some studies, dental caries is more prevalent in female children (Chen et al., 2020) and during the pandemic, access to dental care was limited worsening oral health conditions, therefore after the pandemic most of the visits to Oral Health Services were due to pain or advance oral health diseases. This higher utilization of Oral Health Services by female children could reflect findings in another study among the adult population ((Slack-Smith et al., 2007).

Another predisposing factor impacted by the pandemic was the parent/caregiver's age, those younger ones (from 15 to 26) were more likely to take their children to Oral Health

Services than older ones (more than 60 years old) only before and after the pandemic (2019 and 2022). Normally older adults are the heads of the households and, therefore are responsible for providing the money for their households then the younger couple is in charge of the health appointments and health needs of their children due to they are the ones who spend more time with their children. However, during the COVID-19 pandemic, this normality changed due to all the triggered scenarios with the implementation of public health measures changing the patterns inside households where all members had to stay at home and most families were economically and mentally negatively impacted, then oral health became not as important as finding resources for food, as getting back to school, etc. Also, the parent/caregiver's marital status, married parent/caregiver, or those living with an unmarried partner were more likely to take their children to Oral Health Services in the last six months than those previously married or single ones before and during the COVID-19 pandemic. These results could be explained to married parents/caregivers who feel more supported by their couple and environment in terms of income, time to take their children to Oral Health Services not only when they feel pain but also for regular checkups and also to be part of preventive programs with their children and showing their selves more accessible to acknowledge health education. After the COVID-19 pandemic (2022), this variable did not show any significant association with Oral Health Services utilization when adjusting with other variables, probably because coexistence at home has undergone changes that are reflected in the increase in divorces, family and gender violence, and because family priorities have been modified, focusing on economic income and employment.

Another variable that modified its association with Oral Health Services utilization was the area of residence (urban vs rural areas). Before the COVID-19 pandemic, it was significantly associated, then children living in urban areas were less likely to use Oral Health Services than those living in rural areas. Similar results were reported in previous national research (Aravena-Rivas & Carbajal-Rodriguez, 2021; Hernandez-Vasquez et al., 2019; Torres-Mantilla & Newball-Noriega, 2023), attributing these findings to the

increment of the number of health facilities in rural areas and also to the health programs (JUNTOS) that are mainly focused in rural areas, in addition to the lower density of population that live in rural areas compared to urban ones where getting health appointments in the public health facilities takes longer waiting times. During the COVID-19 pandemic (2020) the association with Oral Health Services utilization remained significant, however, those children living in urban areas were more likely to use Oral Health Services than those living in rural areas. The association of both variables changed its patterns in accordance with other studies (Aravena-Rivas & Carbajal-Rodriguez, 2021; Gudipaneni et al., 2023; Hu et al., 2023; Meisha et al., 2021). This may have occurred because, during the COVID-19 pandemic, transportation was restricted, health education and prevention programs were stopped, and only emergency treatments were allowed during the first months especially handled in big hospitals in urban areas instead of primary healthcare centers existing in rural areas where prevention/routine visits are more often (Meisha et al., 2021), in addition to the fear, panic of getting infected. On the other hand, after the pandemic (2022), no significant association was found with the use of Oral Health Services, probably due to NCDs prevention and treatment returned slowly to new normality and when adjusting the model with other more relevant factors determinants of health, living in urban or rural areas does not affect in a positive or negative way Oral Health Services utilization, knowing that health system is decentralized and there is an important number of primary health facilities where children can be taken for emergency or prevention dental treatment.

In terms of enabling factors, only the health insurance of the child was modified by the pandemic. Then, children with ESSALUD and SIS Public health insurance coverage were more likely to visit Oral Health Services in the last 6 months than uninsured children before and during the COVID-19 pandemic. Similar to the results found by Azañedo before the pandemic (Azanedo et al., 2017). Garces in 2021 (during the pandemic) found that children with no health insurance delay their time of Oral care more than children with health insurance (Garces-Elias et al., 2023) which is consistent with findings in this

study during the pandemic. This enabling factor influences the use of Oral Health Services reflecting that the Peruvian health system was inequitable even before the COVID-19 pandemic (Hernandez-Vasquez et al., 2019) and that Universal Health Coverage (UHC) was not fully implemented leaving children with no insurance. It is also important to highlight that although free public health insurance (SIS) has more children enrolled than other health insurance schemes, they use Oral Health Services less than the ones owing ESSALUD health insurance (social security) due to the existence of several gaps on the SIS health insurance regarding lack of health professionals, medicines, long waiting times, poor infrastructure which were exacerbated during the COVID-19 pandemic, therefore several health reforms were implemented by the Peruvian government to tackle those gaps and reinforce the public health system by extending the coverage to all Peruvians with no insurance to leave no one behind during the pandemic (2020-2021), through the issuance of different acts and regulatory framework (Government of Peru, 2021). As a result, after the pandemic, the coverage of public health insurance increased, impacting the higher Oral Health Services utilization in children with the SIS insurance scheme (38.4% in 2022) compared with the one during the pandemic (27.7% in 2020). However, the other gaps in the SIS insurance scheme returned to what they were before the pandemic making accessibility to oral health services more difficult compared with the ESSALUD health insurance scheme, therefore Oral Health Services utilization after the pandemic remains higher (50% in 2022). All these changes in health insurance schemes could have modified the association between health insurance and Oral Health Services utilization which was found to be insignificant after the COVID-19 pandemic.

Finally, after analyzing the three years 2019, 2020, and 2022 as a whole adjusting all variables with the variable “year”, the predisposing factors significantly associated with Oral Health Services Utilization were: the child’s age, the parent/caregiver’s age, sex, marital status, the natural region of residence, and the altitude, and regarding the enabling factors, all of them were significantly associated with Oral Health Services Utilization in

the last 6 months among children under 12 years of age. In addition, the variable “year” was also significantly associated with Oral Health Services Utilization, thus Peruvian children were more likely to use Oral Health Services before COVID-19 (2019) than after COVID-19 (2022), in the same way, during COVID-19 (2020) they were less likely to use Oral Health Services than after COVID-19 (2022), in this sense “year” as a variable had a negative impact during the COVID-19 pandemic on the Oral Health Services Utilization in children, in accordance with these findings Garces-Elias found that timing of dental care was negatively impacted by the year during the COVID-19 pandemic (Garces-Elias, Castillo-Lopez, et al., 2022), due to many factors determinants of health that were exacerbated by the pandemic causing critical scenarios where children even stopped receiving dental care. Likewise, Lyu et al., reported that having a dental visit in the past 12 months among children was lower in 2020 compared with 2019, therefore oral health in children worsened having a higher risk of developing dental caries and bleeding gingivae (Lyu & Wehby, 2022). In addition, Brian and Weintraub reported that oral health services accessibility was limited, especially during the first waves of the COVID-19 pandemic (2020), emphasizing that at the beginning of the pandemic Oral health departments were closed and the population was advised to avoid using Oral Health Services unless it was an emergency, same situation was faced in Peru during the first months of the COVID-19 pandemic (Peru, 2020a).

It is also important to mention that, even though Peru tried to implement stringent health measures such as lockdowns to contain the spread of the virus, the number of infections and deaths surpassed all the capacity of the health sector, especially because of the existing gaps in the health system, the economic and social disparities which were exacerbated impacting the population general health.

After the pandemic, the health sector is returning to “new normality” coexisting with the COVID-19 virus and facing its consequences, in the case of the oral health field, there was an important increment in the cost of the services due to new biosecurity guidelines; the lack and/or the interruption of preventing programs and oral health education for

children and caregivers at schools, homes, and communities; and the fear, anxiety and panic of children and their parents, had lead to visiting dentist only when pain is presented. Hopefully, in the next years, Oral Health Services Utilization return to what it was before the pandemic and rise shortly surpassing the lack of use of Oral Health Services as it was maintained during the last 10 years.

VI. CONCLUSIONS AND SUGGESTIONS

6.1 Conclusions

According to the formulated objectives, the results, and the discussion, the following conclusions are detailed:

1. Regarding the sociodemographic factors (predisposing and enabling factors) in children under 12 years of age before, during, and after the COVID-19 pandemic (2019, 2020, and 2022), they have followed the same distribution patterns in each evaluated variable in the three years because it's a representative data of the population from the same country in three years in a row, with little modifications in terms of prevalence.
2. The Oral Health Services utilization prevalence in the last 6 months in Peruvian children has been impacted by the COVID-19 pandemic decreasing its prevalence in 2020, compared with 2019, and increasing again after the pandemic (2022).
3. Regarding the relationship between sociodemographic factors (predisposing and enabling factors) in children under 12 years of age and Oral Health Services utilization in the last 6 months, before, during, and after the COVID-19 pandemic (2019, 2020, and 2022):
   - The child's age, the parent/caregiver's sex, the natural region of residence, the parent/caregiver's level of education, the parent/caregiver's information received about oral Healthcare, and the wealth quintile of the household were associated with Oral Health Services Utilization before, during and after the COVID-19 pandemic.
   - The parent/caregiver's age was associated with Oral Health Services Utilization only before and after the COVID-19 pandemic.
   - The parent/caregiver's marital status, the area of residence, and the health insurance were associated with Oral Health Services Utilization only before and

during the COVID-19 pandemic.

- The child's sex was associated with Oral Health Services Utilization in children only after the COVID-19 pandemic.

4. Two years after the first case of COVID-19 (2022) arrived in Peru, according to the findings in the present study regarding the predisposing and enabling factors associated with Oral Health Services Utilization, it was concluded that the first year of the COVID-19 pandemic (2020) harmed Oral Health Services Utilization which is increasing slowly again nowadays.

6.2 Suggestions

According to the factors associated with Oral Health Services Utilization before, during, and after the COVID-19 pandemic (2019, 2020, and 2022). The Ministry of Health (MINSA) with the Peruvian government must implement public policies on oral health that take into account the results found. For example:

- Multidisciplinary and intersectoral work must be implemented taking into account other health professionals such as obstetricians, gynecologists, and pediatricians, among others to educate, motivate, and sensitize parents since the pre-and post-natal check-ups about the importance of visiting Oral Health Services even before the child is born to learn and modified oral health habits and behaviors such as regular Oral Health Services visits in younger ages that would impact their children's oral health.
- Visits to Oral Health Services should be implemented in the child's Growth and Development Control plan and card (CRED, in Spanish), in this way it will be guaranteed that the use of oral health services is carried out at the appropriate time to prevent, treat, and maintain Oral Health. In addition, with this measure parents' education, attitudes, and practices about oral health can be reinforced to internalize that oral health is fundamental for the general health and well-being of their children.

- The government of Peru and MINSA need to focus again on efficient Oral Health programs, that include mainly oral health education, promotion, and prevention targeted to families who live in isolated areas with difficult access and experiencing high levels of poverty, starting with the rural areas in the jungle where despite the existence of primary health centers, there are gaps in personnel and medical supplies that limit the access and quality of oral health care. In this situation, those Oral Health programs should be delivered through campaigns by visiting vulnerable communities regularly with mobile Oral Healthcare Centers and the education needs to be focused mainly on older and male adults using tools according to their knowledge and preferences.
- After all the health reforms implemented during the pandemic, the affiliates to public health insurance (SIS) have grown exponentially which is important to facilitate access to Oral Health Services, however, it remains the same gaps in the health exposed during the COVID-19 pandemic. Therefore, after two years of the COVID-19 pandemic, the government must continue to improve the other fundamental pillars of the UHC to guarantee an increase in Oral Health Services utilization by providing enough number and equal distribution of dentists throughout the country, as well as medical supplies, and reinforce infrastructure, technology, and connectivity, avoiding delays in health appointments, therefore the quality and use of Oral health services in the public sector could be improved.
- It is also important to implement an Oral Health digital system with new digital tools as the use of Teledentistry in Primary Health Care Services to improve access to Oral Health for the most remote populations, providing oral health education, and have the possibility of contacting specialists to deliver better quality of care, and in this way improve patient's satisfaction and motivate then to continue to use Oral Health Services.
- Finally, regarding the ENDES survey, it is time to reformulate and add more relevant

questions regarding the type of treatment children get when using Oral Health Services, and the feedback from parents about reasons for not taking their children to Oral Health Services, in addition to a complementary clinical evaluation to get better outcomes to address Oral Health assessment in the Peruvian population. In this sense, those questions must be proposed by a committee of experts with the participation of academy members and stakeholders.

6.3 Limitation

The limitation in the development of the present study could come from the fact that secondary data from three years (2019, 2020, and 2022) was analyzed coming from the ENDES national survey which is collected by self-reported/phone interview therefore possible memory bias could be included as well as the loss of information due to missing data for the statistical analysis.

It's important to mention that the instrument used in the ENDES survey does not include a clinical evaluation of the Oral Health status of the child, which does not allow the analysis of the need factors according to Andersen's Healthcare Utilization Model, therefore only predisposing and enabling factors were evaluated. In addition to the limited questions regarding Oral Health Services Utilization

Furthermore, weighted percentages were used for the statistical analysis although the prevalence of Oral Health Services utilization in the last 6 months by children under 12 years of age was low in the three years.

Finally, this study's cross-sectional design limits the possibility of establishing a causal relationship between independent variables and the outcome, therefore only an association relationship could be evaluated.

6.4 Significance

The results of the present study provide updated comprehensive evidence-based

information and data on the use of Oral Health Services in Peru by children under 12 years of age and their evolution before, during, and after the COVID-19 pandemic, as well as the association with various sociodemographic factors, identifying its role in the access to Oral Health. In this sense, this study identified the main socio-demographic factors that act as barriers to access to Oral Health and also the changes in the use of Oral Health Services in children produced by the COVID-19 pandemic. All this information can contribute as a starting point in the overall Oral Health Assessment by identifying and prioritizing the main gaps that need to be addressed through the development of Oral Health policies and strategies, in addition to being able to evaluate the implications of the COVID-19 pandemic to reinforce the preparedness for future pandemics.

Therefore, the Peruvian government and the Ministry of Health can include this Oral Health information in the situational analysis of access to general health to implement intersectoral health policies in coordination with other ministries such as the Ministry of Finance, Education, Labor, Women, and others.

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Appendix 1

TABLE OF EVIDENCE						
Autor	**Study design**	**Population**	**Data Source**	**Variables**	**Data Analysis**	**Conclusion**
Azañedo D, et al. (2017). Peru	Cross-sectional	71,614 Peruvian children	Survey on Demography and Family Health (ENDES, Spanish) 2014-2015.	**Dependent variable:** access to an oral health service within the previous 6 months. **Independent Variable:** Sociodemographic factors classified according Andersen Healthcare model.	Poisson generalized linear models were used.	Wealth index, caregivers' education level, natural region of residence, age, and type of health insurance are factors that determine access o oral health services.
Torres-Mantilla, et al. (2023). Peru	Cross-sectional	40,751 Peruvian children	ENDES 2019	**Dependent variable**: the use of oral health services in the last 6 months. **Independent variables:** wealth quintile and sociodemographic factors.	Chi-square test. Generalized linear Poisson models were used to determine their correlation.	Several socio-demographic factors were correlated with the use of oral health services in Peruvian children and the percentage of their use was low.
Aravena-Rivas, et al. (2020). Peru	Cross-sectional	39 881 children.	ENDES 2017	**Dependent variable**: the use of dental services. **Independent variables**: Sociodemographic factors.	Chi-square test. The prevalence ratio (PR) was estimated by generalized Poisson regression models.	Differences in socioeconomic inequalities in the use of dental services among natural regions were observed.
Meisha et al. (2021). Saudi Arabia	Cross-sectional	4372 participants	Survey	**Dependent variables:** Participants' decision to go or not to go to the dental clinic. **Independent variable:** social determinants.	Chi-square, Mann Whitney tests or Kruskal–Wallis tests. Logistic regression models were performed for predicting variables.	Social disparities were found in emergency dental care seeking decision-making in Saudi Arabia during the COVID-19 pandemic.
Hernández-Vásquez et al. (2019).	Cross-sectional	85,436 (2004), 88,673	Peruvian National Household	**The dependent variable:** Oral health services utilization.	Health services utilization inequality	The use of oral health services in Peru increased and

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Autor	**Study design**	**Population**	**Data Source**	**Variables**	**Data Analysis**	**Conclusion**
Peru		(2008), 87,074 (2010) and 124,142 (2017) participants.	Survey on Living Conditions and Poverty (ENAHO)	**The independent variable** is the monthly per capita expenditure and sociodemographic factors.	measurement was estimated based on the concentration curves (CC) and concentration indexes (CI	inequality decreased in the period 2004-2017, coinciding with the implementation of the AUS. However, the use of these services continues having a distribution in favor of the richest populations.
Dho. (2018). Argentina	Cross-sectional	381 individuals, distributed in 204 (53.5%) women and 177 (46.5%) men.	Household survey	The dependent variable: use of dental services: inquired about dental consultation in the last 12 months. Independent variable: sex, dental coverage, knowledge of oral health, oral hygiene habits, socioeconomic level.	Logistic Regression	Measures should be implemented to increase the Use of Dental Health Services for prevention purposes in men and women of all particularly in less-privileged individuals.
Carvalho Curi et al. (2018). Brasil	Literatur e review	Pediatric population between zero and 15 years old,	Articles in the Lilacs and Medline databases	----------	----------	These findings suggest socioeconomic inequalities that may result from structural barriers to public services.
Hu et al. (2023). China	two cross-sectional studies (2005 and 2015)	492 and 399 caregiver-child pairs in 2015 and 2005 respectively.	Questionnaire and oral examination	**Dependent variable:** How long has it been since your child visited a dentist last time **Independent variables** (Andersen's behavioral model): Predisposing factors, enabling factors, and need factors.	Chi-square test. Logistic regression.	The utilization of dental care services over the past decade is insufficient among pre-school children in northwest China. Policymakers should place greater emphasis on raising awareness among caregivers about the oral health status of their children.
Xu et al. (2019). China	Cross-sectional	7206 adults	4th National Oral Health Survey (2015-	**Dependent variable:** Oral health service utilization in the past 12 months	Bivariate associations: chi-square test. Logistic	Use of oral health services depended on sex and self-perceived oral health conditions.

TABLE OF EVIDENCE						
Autor	**Study design**	**Population**	**Data Source**	**Variables**	**Data Analysis**	**Conclusion**
			2016) in China	**Independent variable: Andersen's behavioral model:** Predisposing, enabling, and need factor.	regression	In addition, household income and insurance coverage were determinants of dental visits among older adults.
Goswami et al.(2021). India	**Cross-sectional**	120 parents	Structured questionnaire	Demographic details Five questions assessing attitude Five questions assessing the practices of parents in maintenance of oral hygiene of their children	Chi-square test and Student's t-test.	The overall attitude and practices of the parents were poor toward the oral health of their children during the lockdown period in COVID-19 pandemic.
Gao et al. (2020). China.	Cross-sectional	40,305 children.	Fourth National Oral Health Survey and Clinical evaluation	Attitude and knowledge were measured by a scoring system. Background.	Chi-square tests and t-tests were used. A hierarchical logistic regression was performed for all variables	The prevalence of dental service utilization was relatively low among preschool children. It is necessary to strengthen oral health education for parents and children, thereby improving oral health knowledge as well as attitude, and promoting dental utilization.
John et al. (2017). Australia	Cross-sectional	667 children	Questionnaire and clinical examination	**Dependent variable**: dental visits in the last 6 months. **Independent variable**: socio- demographic characteristics of the children and their parents	Multiple logistic regression analyses	The socio-demographic and dietary factors that influence child oral health must be effectively addressed when developing the oral health promotion and policies.
Kumar et al. (2023). Saudi arabia	Cross-sectional	total of 960 parents or guardians of schoolchildren	Data were collected using Google Forms	**Independent variable:** Andersen's behavioral model: predisposing, enabling, and need factor.	Binary logistic regression, and multinomial logistic regression.	Children of rural areas, uneducated, unemployed, widow/ divorced, low- and middle-income parents

TABLE OF EVIDENCE						
Autor	**Study design**	**Population**	**Data Source**	**Variables**	**Data Analysis**	**Conclusion**
						and nursery school children were linked to poorly predictive outcomes of child oral health during the pandemic.
Mohammed et al. (2023). Ethiopia	Cross-sectional	405 school children and their parents	Questionnaire	**Dependent variable:** if the child had a past year dental visit or not. **Independent variable:** socio- demographic characteristics	Pearson's chi-square statistical test. Univariate and multivariable logistic regression.	Our findings showed that a small proportion of the study population visited a dentist in the past year. Maternal educational status, monthly income, and dental pain were associated with past year dental service utilization.
Nagdev et al. (2023). India	Cross-sectional	1100 school children aged 13 to 15 in Bangalore.	A questionnaire was developed using the concepts of the Andersen healthcare usage model	**Dependent variable:** Dental health service utilization by children **Independent variable**: socio- demographic characteristics, child's oral hygiene practices, oral health status, and parental attitude towards the child's oral health.	Chi-square analysis was used to assess the association between each variable and dental care visits. Multiple logistic regression analysis	Dental health service utilization was low in the past year. The age, number of family members, parent's education level, travel time to the dental facility, the child's oral health behaviors, and positive parental attitude all play a role in a children's utilization of dental health service.
Finlayson et al. (2018). United States	Cross-sectional	2,806 children	National Survey of Child and Adolescent Well-Being	**Dependent variable:** was past- year dental utilization. **Independent variable**: Andersen's behavioral model: predisposing, enabling, and need factor.	Single-level multivariable logistic regression model.	Many children, especially younger children (ages 2-5), did not have a reported dental visit in the past year. Cost was a barrier, and caregiver status was associated with the likelihood of obtaining dental care. Health and social service providers should refer these

TABLE OF EVIDENCE						
Autor	**Study design**	**Population**	**Data Source**	**Variables**	**Data Analysis**	**Conclusion**
						children for dental care.
Onyejaka et al. (2016). Nigeria	Cross-sectional	1406 primary school children	Survey	**Dependent variable**: dental service utilization **Independent variable**: sociodemographic factors.	Chi-square test and logistic regression.	Dentists can be strong motivators for children to utilize oral health care. Time is a significant barrier for the utilization of dental services.
Lyu et al. (2022). United States	Cross-sectional	91,626 through 92,428 children (depending on outcome).	National of Survey Children's Health	**Dependent variable**: Oral healthcare use **Independent variable**: sociodemographic factors.	Regression model.	There was a widespread decline in children's oral health status and access to oral health care early during the COVID-19 pandemic.
Sabbagh et al. (2022). Saudi Arabia	Cross-sectional	The suggested sample size for each region was 138 subjects.	Validated questionnaire	**Dependent variable**: Oral health needs and barriers to oral health care needs. **Independent variable**: general information sociodemographic factors.	Chi-square test and he t-test. A binary regression analysis was conducted to identify factors predicting barriers to dental care.	Parents reported a high frequency of unmet oral health needs. Education could play an important role in improving oral health care in children and as a predictor of public health concerns.