Environmental education in dentistry: Perceptions about mercury in dental amalgam and its harmful effects

https://doi.org/10.56238/sevened2023.005-014

Júlia Rangel de Souza Pereira
Undergraduate student of the Dentistry Course at Veiga de Almeida University – UVA
E-mail: juliarangelmalik@gmail.com
LATTES: http://lattes.cnpq.br/9067213370278407

Vera Lúcia Rangel de Souza
Graduated from the Mathematics Degree Course at Castelo Branco University – UCB
E-mail: luciaerangel@gmail.com
LATTES: http://lattes.cnpq.br/8223868306085702

ABSTRACT

This scientific research deals with the harms and risks of Mercury, found in amalgam dental restorations made in dental activities. It aimed to answer the guiding question: what are the harms of the Mercury component in dental amalgam with a view to the academic-work environment and the natural environment? The general objective was to analyze, together with Dentistry students, the perceptions they have about the environmental theme and their actions in the environments. From the qualitative interpretative approach, the methodology used was the search for publications on the following platforms: Brazilian Digital Library of Theses and Dissertations (BDTD), Google Scholar, Scielo Platforms, etc., without obeying a specific period of time. In addition, the Likert Scale, Free Word Association Techniques and Content Analysis were also used in the Google Forms for students who are in the 2nd period or higher. There were some inconsistencies in the students' answers, such as: they did not know how to work with dental amalgam without polluting. We conclude that there are challenges for students and teachers, in the sense that the methodology used in the classroom is aimed as innovative, as a parameter of Environmental Education. In addition, it is necessary for the community of the school institution to think of ecosystems that involve entrepreneurial actions that meet the awareness of professionals who teach and those who learn, so that it is possible to dialogue between teaching and learning and the development of creating a "pleasant environment".

Keywords: Amalgam, Environmental Education, Harm, Mercury, Dentistry.

1 INTRODUCTION

This article deals with the harms and risks of Mercury (Hg), a component found in silver amalgam (or metallic amalgam) for dental restorations and widely used in laboratory activities in educational institutions, by Dentistry students, in the field of teaching and learning. In this sense, this article aims to answer the guiding question: what are the harms of the Mercury component in dental amalgam in the academic, professional and environmental environments? And whose intention is to reflect on the risks that Mercury (Hg) can cause to individuals, such as: Dentistry students, teachers, patients and the environment and what implies actions that may lead to the acquisition of knowledge of Dentistry students in the scope of laboratories and dental clinics of universities and the minimization of possible damage to the health of these subjects and their patients.

Grigoletto *et al* (2008) address that the high production of this component, for years, has caused environmental contamination and problems related to various health problems for human beings, and not unlike the inadequate disposal in the environment. These events will be discussed in the following sections. Also, in Grigoletto *et al* (2008) report that environmental contamination by Hg happens due to its exploitation, for many years, by society, in various areas, whether in industry, mining, dentistry, etc. The latter, occurring for more than 190 years for various purposes in labor practices, recalled by Costa, (2017).

In view of the concern with Education and, as a result, with the training of future Dentistry professionals and the working conditions of dentists and patients and the environment in which the subjects live, it appears as an important issue in society, in the light of contemporary demands, such as: environmental and occupational that occupy a space of great speed, This study was based on the presence of the substance mentioned above, Hg as toxic to humans and the environment, and that this research was motivated. In this societal context, the question arises: can Environmental Education (AE) in the contexts of future academics and dental professionals subsidize changes that minimize the consequences of the unfortunate use of amalgam in dental environments? Because, AE represents life: human, fauna, flora, aquatic and in order for it to be sustained, some actions are pronounced in the impetus to preserve and sustain the environment, being a dimension of Education, which aims to form ethical citizens in relationships, whether in relation to nature and between men or in the professional; promote reflection on their behaviors, attitudes, values and beliefs, as listed by Reigada and Reis (2004); in addition to inducing social dynamics at first in the local community, i.e., at work, and later, in broader networks in which there should be. (SAUVÉ, 2005). In this way, EE will be able to contribute to critical education and with its enactment, Law 9.795, of April 27, 1999, it was possible to make it mandatory in all Brazilian educational establishments (BRASIL, 1999).

It is in this context that it (EE) has as one of its objectives the participation of subjects in discussions, proposals and decisions on environmental issues, as well as in the impetus of dental teaching and learning within academic institutions. Thus, the relationship and participation of the subjects become important to seek solutions to the harms of environmental and social problems. (REIGOTA, 1994). The following is a look at the methodology and procedures.

2 METHODOLOGY (OR MATERIALS AND METHODS)

The methodology used was the search for articles, in the year 2022, on the following platforms: Brazilian Digital Library of Theses and Dissertations (BDTD), Google Scholar, Scielo Platforms, etc. The research did not follow a period, that is, a period of years.

Initially, it was proposed to carry out a research only with students of the 2nd period of the Dentistry Course. However, when thinking about the questions, the periods of choices were from the

2nd year onwards, since in colleges in Brazil there is no standardization of the beginning of classes in laboratories and dental clinics, practices that are part of the school curriculum. Based on this, the Free and Informed Consent Form (ICF) was presented[1] and two questionnaires were created, on the *Google Forms*[2] platform, for Dentistry students from all over Brazil: research on the knowledge of Dental Students about the harm of Dental Amalgam and Free Word Association Technique (TALP), the latter being "a strategy for collecting material that requests, to the students, the choice of words evoked and classified within a category". (SOUZA, 2020, p. 151). There were no responses referring to the data collection instrument, the Liket Scale. Therefore, the researcher preferred to continue with the research, using only the instruments mentioned above. It is alleged that this action did not prejudice the answer to the guiding question of the research.

Regarding the number of participants, 22 (twenty-two students) answered the form "Survey on the knowledge of Dental Students about the harm of Dental Amalgam" and 7 (seven students) answered the form "Technique of Free Association of Words" – evoked words. Regarding the choice of the target audience, it is thought that there has probably already been some theoretical and practical knowledge about the use of Dental Amalgam, whether in laboratories or dental clinics. As well as the criteria for choosing the educational institutions, that is, there was no criterion for the choice of the faculties, allowing many students to reach and answer the questionnaires with open and closed questions more quickly, given the distance of the subjects. Thus, planning to collect through *Google Forms* made the process easier. In addition, the Content Analysis Technique (CAT) was used for the treatment and analysis, whose objective is to adequately describe, systematize, inferentiate and interpret qualitative and quantitative studies (BARDIN, 2007).

From the qualitative interpretative approach, other questions arose: can Environmental Education in academic and professional dental contexts support changes that minimize consequences in the use of amalgam in dental environments? Are future professionals aware to act in an innovative way, minimizing environmental pollution and health hazards? In this way, we processed the data produced for future analysis, which was carried out in two stages. These can be enlivened in the results.

[1] - It was delivered in advance to all participants and 100% accepted the document.
[2] - Free tool for creating online forms available to any user who has a Google account for the purpose of conducting field research, also aiming to facilitate the process of data collection and analysis of results. DA SILVA MOTA, Janine. Use of *Google Forms* in academic research. Humanities & Innovation, v. 6, n. 12, p. 371-373. (2019, p. 1).

3 THEORETICAL FRAMEWORK

3.1 DENTAL AMALGAM: CONCEPT, ADVANTAGES AND DISADVANTAGES

A low-cost, easy-to-handle, long-lasting, high-strength material, dental amalgam has been used in the field of dentistry for more than 150 years (De Oliveira *et al., 2022) for direct restorations*[3]. As components, it has silver, tin, copper, zinc, indium, palladium and mercury. (REIS *et al*, 2006). However, it has the following disadvantages that help to minimize its current use (Moura, 2021): the anti-aesthetic, "does not reinforce the weakened tooth structure and subject to corrosion"[4] Reis *et al* (2006, p. 321) and its mercury component, which is a substance of great risk, both for the Dental Surgeon (DC), Dental Students, Patient and for the Environment, There is a possibility that there is a lack of knowledge about the proper handling and disposal of amalgam waste.

3.2 MERCURY IN DENTISTRY: ITS HARM TO INDIVIDUALS AND THE ENVIRONMENT

Mercury is classified into three forms: Organic and Inorganic Mercury and Metallic Mercury, the latter being the one of choice in private and public practices and in universities with dental clinics. (PÉCORA, 2003).

The concern with this component of amalgam is so great because, according to reports by Aciole (2022), it is painless, odorless, can be present in the environment for up to a year and even if it is in low concentrations, mercury can cause toxicity to humans. And depending on its concentration and quantity, systemic signs and symptoms may appear: tremors, altered personality, agitation, anxiety, sleep disorders, memory loss, dementia, attention deficit, depression and hearing and vision impairment, which can cause irreversible effects and, in more severe cases, even death. Pécora (2003, p. 2) argues that in relation to local signs and symptoms (oral cavity), there are "gingival bleeding, loss of alveolar bone, loss of teeth, excess salivation, bad breath, metallic taste, oral leukoplakia[5], stomatitis[6] and tissue pigmentation".

3.3 SUGGESTIONS FOR THE CORRECT DISPOSAL OF AMALGAM AND FOR THE REDUCTION OF ITS USE

Also in Aciole (2022), unnecessary exchanges of old amalgam restorations for aesthetic restorations of composite resin, ceramics, etc., improper disposal of amalgam in the garbage, incorrect handling of the material, and the presence of Hg residues in the sewage system because of suckers and

[3] - Procedures done in a single dental visit.
[4] - It is the degradation of materials.
[5] - Potentially malignant disorder of the oral cavity. RAMOS, Ruth Tramontani *et al*. Oral leukoplakia: concepts and clinical repercussions. Brazilian Journal of Dentistry, v. 74, n. 1, p. 51, 2017.
[6] Inflammation in the stomatognathic system (in the lining of the mouth)

spittoons in an office without sieves are the causes of amalgam toxicity by humans and the environment, as listed below.

> Mercury settles into methylmercury, contaminating plankton, which serves as food for fish, thus contaminating the entire food chain, including humans. (ACIOLE, 2022, p. 15).

Therefore, it is important that students and their professors pay attention to the correct disposal of dental amalgam. It is essential to have, in the dental field, refrigeration during handling, finishing and polishing of the restoration and a cool environment during its storage, because heat sources, such as autoclaves and ovens, increase mercury toxicity. In addition, storing used amalgam capsules and sending them to a chemical waste laboratory provides a minimized contamination environment. Well, these capsules have traces of mercury, use mechanical amalgamators during their handling, use new drills and a high-speed pen with refrigeration to avoid the appearance of heat, always use PPE (Personal Protective Equipment) to protect, mainly, the skin, mouth and eyes and acquire spittoons with sieves to prevent amalgam residues from going into the sewer, as discussed by researchers Reis *et al* (2006); Aciole (2022). These are actions that avoid or reduce harmful risks to humans and the environment. And also of great importance: professors delve deeper into theories about the use of amalgam in the faculty and thoroughly evaluate each case of patients and reach a correct diagnosis to observe if the choice of using amalgam is really necessary during restoration or if it can be replaced by composite resin.

4 RESULTS AND DISCUSSION

Bardin (2016, p. 135) argues that "making a thematic analysis consists of discovering the 'nuclei of meaning' that make up the communication and whose presence, or frequency of appearance, can mean something for the chosen analytical objective". For the classification of categories, the units were established in the context of the thematic investigation, in such a way that we seek to understand the textual indications of the undergraduates in their reports during the research. Therefore, they were grouped as follows.

The 1st Stage refers to the questionnaire with structured and semi-structured questions. Among them, the questions chosen are those that deal with the disposal of amalgam in activities(1), risks that harm human beings(2), risks that harm the environment(3) and discipline of environmental issues in dentistry – referencing environmental education(4). According to the testimonies of the participants, respectively, we can cite some textual records: 1- specific garbage and container with water; 2- toxicity and alteration in the gastrointestinal tract and nervous system; 3- environmental pollution and contamination of water and soil and 4- there is an awareness of our actions – prevention and insertion of content in various disciplines on socio-environmental impacts.

In view of some of the reports of the deponents, Grigoletto (2008) argues that there can be a control of this toxic material through preventive measures, regarding Mercury, its residues, the manipulation of amalgam and its disposal, such as a container with a lid, water and specialized collection, also presented in D17. To complement this, D2 states that a possible risk to humans is toxicity and, to avoid this, awareness of our actions is the solution to prevent the harm that Amalgam can cause.

As previously mentioned, Aciole (2022, p. 28) reports that mercury can "cause tremors, altered personality, agitation, anxiety, sleep disturbances, memory loss, dementia, attention deficit, depression and impairment of hearing and vision, irreversible effects, and even death." Pécora (2003) also addresses that there may be oral leukoplakias, stomatitis and other signs and symptoms. This is in line with the D19 report.

Therefore, below we find some of the testimonies of the participants.

> Toxicity to the body due to the presence of mercury. The more we are aware of the effects of our actions, the better prepared we will be to prevent and solve those that harm our environment (D2). Contamination of water and soil, which can lead to Minamata disease (D6). It is not used. However, we use it and it is placed in a container with a lid and water and the specialized collection comes to remove it (D17). Although it is important to know the social and environmental impacts caused by the use of materials in the dental area, I do not consider it necessary to have a discipline on the subject. However, inserting this topic with emphasis and revision in other subjects of the course can be interesting (D18). Intoxication, changes in the gastrointestinal tract and nervous system (D19).

In the 2nd stage, there is a questionnaire with unstructured questions using the Free Word Association Technique, TALP" – evoked words. The ones of choice address the text units and their categories, for example, Environmental Education in Dentistry - Environment and Individual Protection(1); Benefits of Amalgam – Advantages(2); Amalgam manipulation awareness - Education and Awareness(3). Regarding the reports, we obtained them in the following order: 1- health and environment; procedure and protective gloves; 2- durability and resistance; 3- Education, campaigning and responsibility.

From the words evoked from the participants, we can enliven the following statements.

> Endurance, as it also ensures longevity. [...] responsibility, because as professionals and conscientious citizens, we must do our part and contribute to the reduction of risks, toxicity and pollution to the environment (D6). Disposal ends up becoming more important when it comes to the execution of Environmental Education, because discarding (or not) is what will impact the environment (D7). [...] protection, as it will ensure the individual's health (D7).

In the report of Student 6, we witnessed the commitment to the benefits of amalgam in the treatment of patients, for example, it is remembered resistance, longevity of the material and minimization of risks due to the toxicity generated and harmful to the Environment. In addition, Student 7 also reports that it is important to protect the individual during the use of Amalgam. These

word choices are associated with the author Grigoletto (2008, p. 8), where she states that "mercury must then be handled in hermetically sealed systems and within hygiene standards". In this sense, student D7 corroborates when he lists that the issue of disposal is pertinent to minimize the damage to health.

These are some of the aspects said by researcher Aciole (2022, p.14) that in his speeches about Amalgam; "It has "excellent mechanical resistance, with durability of around 20 years of use in the oral cavity" are issues that have in relation to the scope of economic education as well. Sauvé (2005, p.3017) states that thinking about Environmental Education is part of a true economic education: it is not only about "environmental management", but rather about the "management" of our own individual and collective behaviors with respect to the resources extracted from the environment"; in a critical and innovative way.

5 FINAL THOUGHTS

We conclude that it requires challenges from students, in the sense that the methodology used in the classroom is objectified as innovative, as a parameter to Environmental Education. It is necessary for the community of the school institution to think of ecosystems that involve entrepreneurial actions that meet the awareness of the professionals who teach and those who learn, so that the dialogue between teaching and learning is possible and the development of creating a "pleasant environment". Even with its harms, many patients still have amalgam restorations and because it is a cheap material, it is still widely used, especially in public clinics. Based on the research done in this study, it was observed that students still do not have in-depth knowledge on the subject.

Therefore, it is concluded that it is of paramount importance that there is not only learning of Dentistry students about its use and correct disposal in chemical waste laboratories, but also lectures, courses and/or an extra discipline of Environmental Education in the curriculum of the Dentistry course, so that there are no consequences for future dentists. to the patient and to the environment.

REFERENCES

ACIOLE, J. M. dos S. Impacto da contaminação do mercúrio proveniente do amálgama dentário na saúde e no meio ambiente. 2022.

BRASIL. Ministério do Meio ambiente. Lei nº 9.795/1999. Dispõe sobre a Educação Ambiental, institui a Política Nacional de Educação Ambiental e dá outras providências. Disponível: <https://www.planalto.gov.br/ccivil_03/LEIS/L9795.htm>. Acesso em: 29 abr. 2023.1999.

DA SILVA MOTA, J. Utilização do Google Forms na pesquisa acadêmica. Humanidades & Inovação, v. 6, n. 12, p. 371-373. (2019, p. 1).

DE OLIVEIRA, O. L. *et al.* O futuro do amálgama dentário. O que acham os estudantes de Odontologia? *Research, Society and Development*, v. 11, n. 6, p. e57511629530-e57511629530. 2022. Disponível em: <http://www.forp.usp.br/restauradora/lagro/guia_pratico.html>. Acesso em: 29 abr. 2023.

GRIGOLETTO, J. C. *et al.* Exposição ocupacional por uso de mercúrio em odontologia: uma revisão bibliográfica. Ciência e Saúde Coletiva 13 (2). Abr 2008.

JORGE, R. C. Toxicidade do amálgama dentário na saúde do paciente: uma revisão sistemática. Rio de Janeiro, 2017. Dissertação (Mestrado em Odontologia – Área de concentração: Dentística) – Faculdade de Odontologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro. 2017.

MOURA, Hudson Luiz do Nascimento. Panorama do uso do Amálgama na clínica odontológica. 2021. Trabalho de Conclusão de Curso. Universidade Federal do Rio Grande do Norte.

PÉCORA, J. D. *et al.* Análise qualitativa da presença de mercúrio em cápsulas de amálgama utilizadas. Robrac, v. 11, p. 27-29, 2002.

_____ D. Guia prático sobre resíduos de amálgama odontológico. (Projeto FAPESP 01/01065-1). 2003.

RAMOS, Ruth Tramontani et al. Leucoplasia Oral: conceitos e repercussões clínicas. Revista Brasileira de Odontologia, v. 74, n. 1, p. 51, 2017.

REIGADA, C. *et al.* Educação Ambiental para crianças no ambiente urbano: uma proposta de pesquisa-ação. Ciência e Educação, v. 10, n 2, p 149-159. 2004.

REIGOTA, M. Fundamentos teóricos para a realização da Educação Ambiental popular. São Paulo: Cortez. 1994.

REIS, A.; LOGUERCIO, A. D. Materiais dentários diretos: dos fundamentos à aplicação clínica. Santos. 2006.

SOUZA, Vera Lucia Rangel de. Representações sociais acerca da avaliação da aprendizagem de conteúdos matemáticos por estudantes do curso de licenciatura em Matemática. 2020.