

A Survey on Knowledge about Oxidative Stress and Inflammatory Disease among Dental Students

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Abstract

Oxidative stress is caused by an imbalance between production and accumulation of oxygen reactive species in cells and tissues which can lead to various neuronal degenerative diseases and also oral diseases such as periodontitis and dental caries. Long term inflammation can lead to an inflammatory disease which is also due to impairment of the immune system in healthy tissue. In oral cavity it may cause conditions such as periodontitis, gingivitis. The aim of the study was to assess the knowledge and awareness regarding oxidative stress and inflammatory disease among dental students. A survey was conducted among 100 dental students in a private dental college. The questionnaire was circulated through google forms. Ten questions related to oxidative stress and inflammatory disease were included in the study and the responses were collected and analysed using SPSS. Chi-Square test was carried out and $p < 0.05$ was considered as significant. It was observed that 80% of students were aware about increase in oxidative stress and 60% of students were aware of oral disease such as periodontitis which helps in treatment plan of the patients. 85% of students think that stress was also one of the reasons for increasing oxidative stress. 80% of students were with the opinion that increased oxidative stress increase the chance of getting various inflammatory disease. 50% of students were aware that using antioxidant supplements increase the survival rate of patient and showed better therapeutic response. It was observed that students were aware of clinical symptoms and the effects of oxidative stress in oral health and various reasons for causing inflammatory disease. However, still more knowledge regarding this will help in early diagnosing of disease caused by oxidative stress and inflammatory disease.

Keywords: Oxidative stress; inflammatory disease ; oral disease ; anti oxidants ; free radicals.

Introduction

Oxidative stress is imbalance between oxidants and antioxidants in the body. It is the result of overproduction of free radicals including reactive oxygen species. Oxidative stress may be systemic as well as localised

¹; which can lead to cell damage. Oxidative stress can be responsible for the induction of several diseases both chronic and degenerative and also speeds up the ageing process and causes acute pathologies². Oxidative stress plays an important role in the pathogenesis of various chronic liver diseases (CLD) and increasing evidence has confirmed the contributory role of oxidative stress in the pathogenesis of drugs and chemical-induced CLD³. Oxidative stress can even cause cancer as it damages DNA. It causes various other diseases such as cardiovascular disease, neuroscience disease, respiratory disease and kidney disease⁴. Oxidative stress affects different tissues and systems and it also plays a significant role in delayed sexual maturation both in male and female⁵. Besides the detrimental effects on human health, it plays a significant role in radiotherapy by

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using prooxidant agents⁶. Oligonucleotide therapy can also be used for treating various COPD and respiratory diseases⁷.

Radiation therapy plays a key role in cancer treatment, where prooxidants are used which are chemicals that induce oxidative stress. But recent studies showed that redox dysregulation originating from metabolic alteration represents the specific vulnerability of malignant cells so it is used in radiation therapy⁸. Since oxidative stress plays an important role in the pathogenesis of metabolic disease mainly diabetes mellitus, *Caralluma fimbriata* extract may help in diabetes by inhibition of alpha-amylase and alpha-glucosidase⁹. Many articles documented that DNA damage caused by the increased oxidative stress can result in colon cancer due to the eventual progression of adenoma to carcinoma. The cytotoxic effect of *Caralluma fimbriata* showed a good effect on colon cancer cell line¹⁰. Increased oxidative stress causes various cancers in which effective nano-carrier-loaded therapeutic drug delivery methods have shown promising potential in treating lung cancer as its target is to control the growth of tumour cell¹¹. Coumarin is explored due to their diverse biological activity¹². The effect of *A. catechu* ethanolic bark extract on human squamous carcinoma SCC-25 cells showed in apoptosis induction possibly by molecular mechanisms and has good result in treating human oral carcinoma¹³. SeNps can open ways to new regular strategies for treating illnesses like malignancy, various cancer radiation therapy¹⁴. Biosynthesized zinc nanoparticles can be used as a good antioxidant¹⁵. Hence, various research shows plants are good candidates for managing different diseases including oxidative stress and inflammatory diseases.

Inflammatory disease is when the immune system attacks the body tissues, resulting in inflammation. Inflammatory bowel inflammatory disease is one of the most prevalent diseases¹⁶. Various other inflammatory diseases such as rheumatoid arthritis, vasculitis, myositis, are also present. This is due to inflammation that can be sometimes misdirected and it attacks its immune system which leads to various other diseases. The inflammatory process significantly affects the periodontium and causes the periodontitis. Endotoxins, cytokines and protein toxins released as a result of inflammation can penetrate the gingival epithelium which ultimately

results in gingivitis¹⁷. Phenotypic activation of hepatic stem cells plays a central role in the progression of hepatic fibrosis which is caused majorly due to chronic inflammation¹⁸. There is no curing of the condition, the only treatment for the inflammatory disease is available such as medication, rest, surgical means and exercise. Many articles suggested that periodontitis can be treated with plant extract *Azadirachta Indica* (neem) which has excellent activity against periodontal pathogens¹⁹. *Acacia catechu* Willd (*Fabaceae*), commonly known as catechu, has good anti-inflammatory properties which prevent many inflammatory diseases²⁰. Syringic acid (SA) has been studied for its hepatoprotective, anti-inflammatory, immunomodulatory, free radical scavenging, and antioxidant activity²¹. The antibacterial activity of zinc oxide nanoparticles was determined by agar well diffusion method against Gram-positive and Gram-negative bacteria.

Many studies documented the relationship between oxidative stress and inflammatory disease²². Oxidative stress is the main pathogenic role in chronic inflammation which leads to inflammatory disease such as rheumatoid arthritis^{23,24}. Recent studies proved that damage caused by oxidative stress results in various inflammation, even neuroinflammation and cell death which ultimately leads to memory loss²⁵. Aim of the study is to analyse the knowledge and awareness among oxidative stress and inflammatory disease and the relationship between oxidative stress and inflammation. Many articles convey either oxidative stress or inflammatory disease. But this article emphasizes the importance of knowledge about oxidative stress and inflammatory disease.

Materials and Methods

In this study, a survey was conducted among 100 dental students of a private dental college by circulating questionnaire. Google forms and links were shared in various social media. 10 questions consisting related to oxidative stress, inflammatory disease and relationship between oxidative stress and inflammation were included in the study. Undergraduates, postgraduate students of the private dental colleges were only included in the study. The data was collected and analysed using SPSS software version 23 and the statistical significance was checked using Chi-Square analysis. ($p < 0.05$ was considered as statistically significant)

Result and Discussion

The responses received were analysed using SPSS software and were used for the discussion. Figure-1a depicts that 92.4% of students were aware of the increase in oxidative stress. This awareness helps in early diagnosis of disease caused by oxidative stress and helps in quick recovery of patients. Increase in oxidative stress may be due to increased production of free radicals and these excess free radicals will damage various cells and cause disease. So, awareness of the increase in oxidative stress is more important. 83.8% of students were aware and knew that oxidative stress is a diagnostic marker in diseases such as cardiovascular disease,(fig-1b). This knowledge helps students to diagnose that rapid increase in oxidative stress may lead to various cardiovascular disease, neurogenic disease and even cancer. So, understanding the importance of oxidative stress and diagnostic disease. In the case of cardiovascular disease, there is a significant increase in oxidative stress which can be diagnosed by chemiluminescence assay, direct assay etc

81.1% of students were aware that due to oxidative stress increase oral disease such as periodontitis occurs (fig-1c). Since periodontitis is one of the most common diseases, students must be aware that oxidative stress can also cause periodontitis which can even cause various other diseases. Diagnosing and treating oxidative stress can prevent patients from various diseases by oxidative stress. Bacteria such as *Streptococcus mutants* are the main cariogenic bacteria causing dental caries. Zinc is used as an antimicrobial, it has been added to mouthrinses and toothpaste to control dental plaque, inhibit calculus formation, and reduce halitosis.²⁶

86.7% of students felt that stress can also be one of the reasons for developing the inflammatory disease (fig-1d). But studies on this reveal that inflammation will damage joints and bones which leads to abnormality. So chemicals are released as a result of stress which increases the inflammation in the body which leads to chronic inflammation causing inflammatory disease. So, awareness about this can prevent inflammatory disease.

Fig-1e depicts that 65.7% of students felt that using an antioxidant supplement during radiation therapy is useful whereas 27.6% of students feel that supplemental antioxidants during chemotherapy may cause side

effects. But recent studies on radiation therapy with antioxidant supplements reveal that antioxidants don't interfere with therapy, increasing patient survival and therapeutic responses²⁷. So, using antioxidants will increase the survival rate of patients. 78.1% of students were aware about prevalence among inflammatory diseases bowel inflammatory disease is more prevalent (fig-2a). The immune system may be attacked by the virus, bacteria attack their immune system and also a virus, bacteria, which leads to inflammation of the bowel. If this inflammation is chronic and continuous for a long time it causes bowel inflammatory disease. Since there is more probability to enter bacteria, virus to get is more prevalent of bowel inflammatory disease. Extraintestinal complications may occur in the oral cavity which causes aphthae, uncommon lesions etc which are symptoms of bowel inflammatory disease. An article suggested that biosynthesized silver nanoparticles have the potential in treating the inflammatory bowel disease²⁸.

Figure-2b depicts that 82.9% of students know that due to oxidative stress, the inflammatory disease occurs. But even the fact is many studies reveal that oxidative stress is also one of the causative agents in developing inflammation. This is due to increased oxidative stress causing various damage to tissues and cells that leads to inflammation which causes inflammatory disease. From the figure-2c, 66.7% of students are aware that x-ray reveals oxidative stress causing inflammatory disease. The major diagnosing tool to diagnose inflammatory disease is x-ray. The wide availability, low cost, limited time helps in easy accessing of joint space and diagnosing of inflammatory disease. So, students must know the uses of x-ray in diagnosing inflammatory disease. 66.7% of students were aware that joint stiffness and loss of function in the inflamed area is also a clinical symptom of inflammatory disease(fig-2d). Since these are major clinical symptoms associated with inflammatory disease, it is mandatory to know how to diagnose inflammatory disease and treat it. From figure-2e, it is clear that 84.8% of students know that rheumatoid arthritis is also an inflammatory disease. Rheumatoid arthritis occurs due to autoimmune response of the body causing joint inflammation, pain and stiffness in joints. There is also treatment available such as administration of NSAIDs, steroids can be helpful but this condition cannot be cured. An article suggested that consuming *Brassica oleracea* which includes broccoli, cabbage which is rich

in antioxidants and plays an important role in decreasing oxidative stress and particular tissue level which tends to decrease condition²⁹.

Pie charts representing questionnaire no 2,3,5,8,9

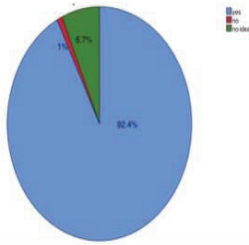


Fig-1(a):The pie chart representing the percentage distribution on the awareness about oxidative stress among dental students . It represents that 92.4% are aware about increase in oxidative stress(blue) and 1% were not aware(red) and 6.7% had no idea(green) about the reason for oxidative stress

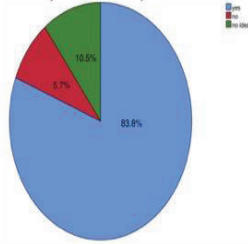


Fig -1(b) The pie chart representing the percentage distribution on the knowledge about increase in oxidative stress in diagnosing complications. It represents that 83.8% were aware and knowledgeable about oxidative stress as diagnosing complications(blue)and 5.7% were not unaware about this(red)and 10.5% had no idea of it (green)

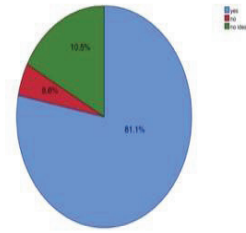


Fig -1(c): The pie chart representing percentage distribution on the awareness of oral disease such as periodontitis which results from the increase in oxidative stress. It represents that 81.1% were aware about oxidative stress causing oral disease (blue) and 8.6% were not aware about this(red) and the remaining 10.5% had no idea regarding it (green).

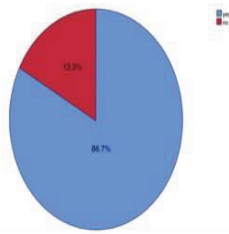


Fig-1(d): The pie chart representing the percentage distribution on the knowledge of dental students in correlation between stress causing inflammatory disease.It represents that 86.7% were aware about stress causing inflammation (blue) and 13.3% were not aware about this (red).

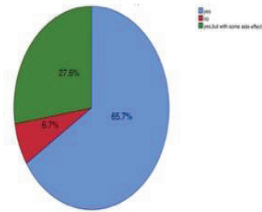


Fig-1(e):The pie chart representing the percentage distribution on the treatment in radiation therapy with antioxidant supplements is useful or not among dental students.It represents that 65.7% were aware about treatment with antioxidant supplements (blue) and 6.7% were not aware (red) and 27.6% had suggested it as useful but with some side effects(green).

Figure 1: Pie Chart representing questions 2,3,5,8 and 9

Pie charts representing questionnaire no 10,4,11,12,13

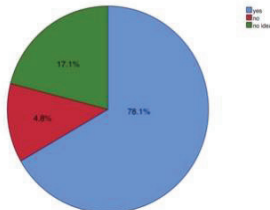


Fig- 2(a) The pie chart representing the percentage distribution on the prevalence of bowel inflammatory disease. It represents that 78.1% were aware of the prevalence of bowel inflammatory disease(blue) and 4.8% were not aware about this(red) whereas 17.1% had no idea regarding it(green).

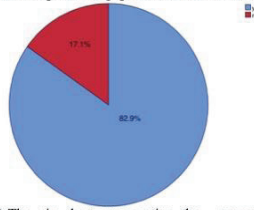


Fig-2(b):The pie chart representing the percentage distribution on the students' knowledge whether oxidative stress causes inflammatory disease.It represents that 82.9% were aware and have knowledge about oxidative stress causing inflammatory disease(blue) and 17.1% were not aware about this (red).

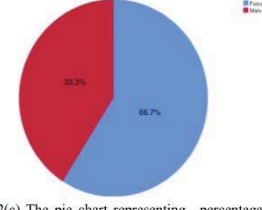


Fig-2(c) The pie chart representing percentage distribution on the knowledge among dental students about inflammatory disease diagnosis using X-ray.It represents that 66.7% had knowledge about diagnosing inflammatory disease (blue) and 33.3% were not aware about this(red).

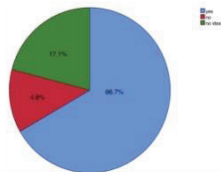


Fig-2(d):The pie chart represents the percentage distribution of the awareness among students about general symptoms such as joint stiffness and loss of function in inflammatory diseases. 66.7% were aware of general symptoms of inflammatory disease(blue) whereas 4.8% were not aware about this (red) and the remaining 17.1% had no idea (green).

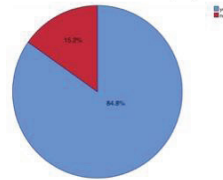


Fig-2(e):The pie chart representing the percentage distribution on the knowledge of dental students about various inflammatory diseases such as rheumatoid arthritis. It represents that 84.8% of students were aware and knowledgeable about various inflammatory diseases(blue) whereas 15.2% were not aware about this(red).

Figure 2: Pie Chart representing questions 4,10,11,12 and 13

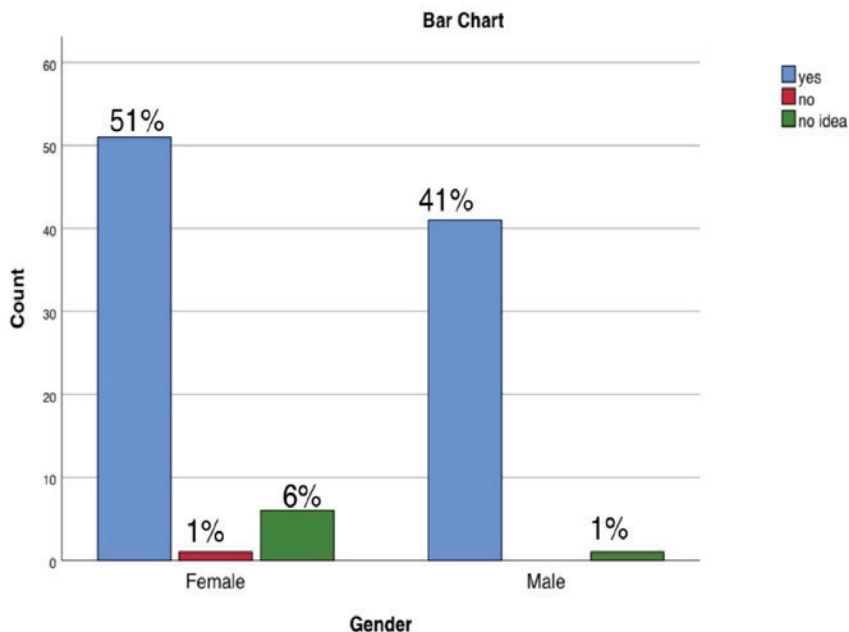


Figure 3 : The bar chart representing the association between gender and awareness about increase in oxidative stress. (X- axis represents Gender and Y- axis represents no.of. responses). Blue colour represents the awareness about increase in oxidative stress and red colour represents that they were not aware about oxidative stress and green colour represents that they have not any idea regarding it. 51% of the female dentists and 41% male dentists were aware of oxidative stress .Chi -Square test was carried out for statistical analysis ; p value = 0.204 , which was not statistically significant.

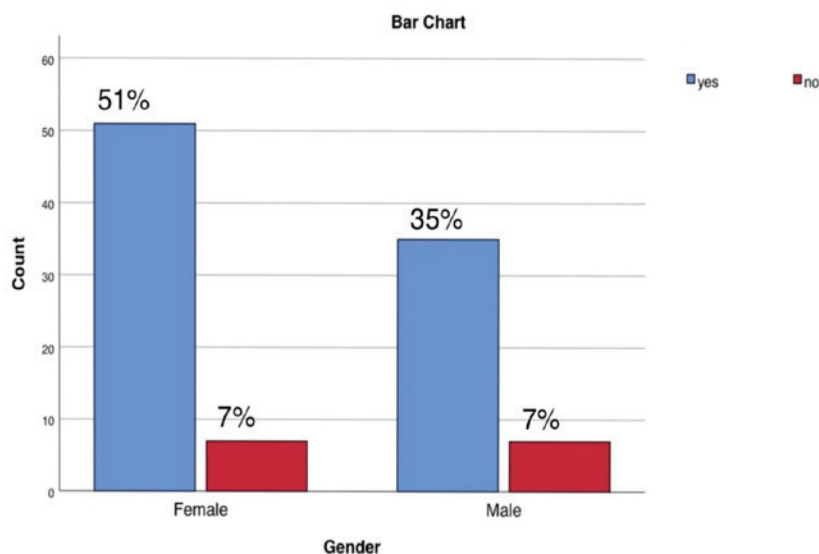


Figure 4: The bar chart represents the association between gender and awareness about oxidative stress causing inflammatory disease. (X- axis represents gender and Y - axis represents no.of. responses). Blue colour represents the awareness and red colour represents lack of awareness .51% female dentists and 35% male dentists were aware that oxidative stress can lead to inflammatory disease. Statistical analysis was done with Chi -Square test ; p value = 0.513 , which was not statistically significant.

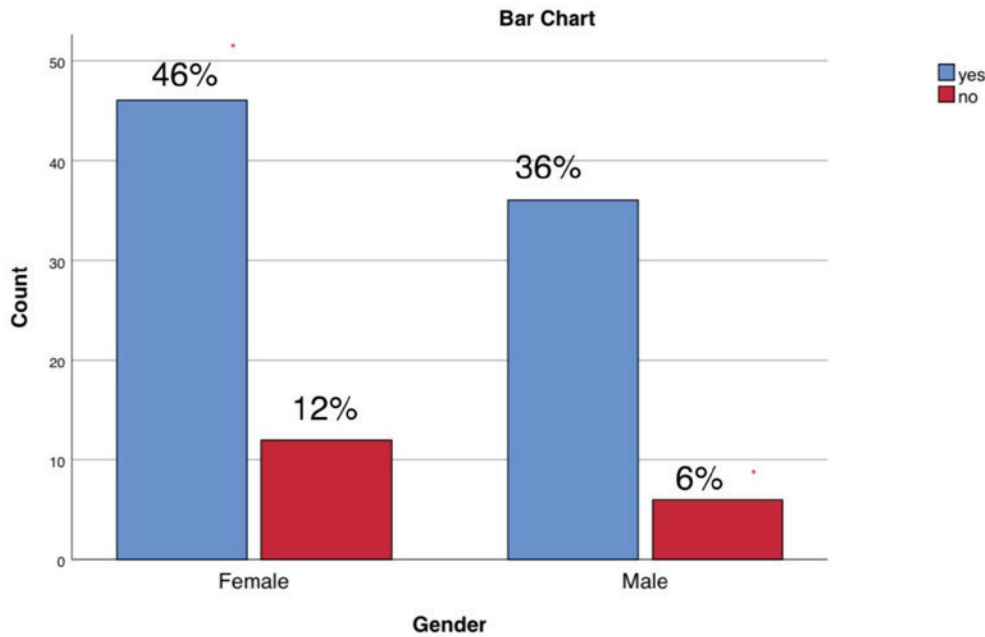


Figure 5: The bar graph represents the correlation between age and correlation between stress causing inflammatory disease. (X axis represents Gender and Y axis represents no.of. responses).Blue colour represents the awareness and red colour represents lack of awareness. 46% of dentists among the female population and 36% male population were aware that stress can lead to inflammatory disease Statistical analysis was carried out with Chi -Square test ; p value = 0.411, which was not statistically significant.

From the charts, it is clear that an increase in oxidative stress leads to various other health issues and also various other oral health problems which ultimately leads to loss of teeth. Tracing the reasons for increased oxidative stress can help in protecting from various diseases. Since increased oxidative stress has an important role in the pathological process of inflammatory disease, awareness of oxidative stress will help in preventing disease caused by inflammation. Since there is no medication and treatment of condition caused by inflammation, only treating the condition helps in temporary pain relief of the patients. So wide knowledge and awareness of the interconnection between oxidative stress and inflammation help in the prevention of various diseases.

Conclusion

Lifestyle and dietary measures can help in reducing oxidative stress. Oxidative stress reduction helps in preventing inflammatory disease. Eating balanced food, healthy food, limiting the intake of processed foods, exercising regularly, quitting smoking, reducing stress, reducing exposure to pollution can decrease oxidative

stress. Inflammation and oxidative stress are closely related and linked with pathophysiological processes and both of them take part in chronic inflammatory disease. Although identification and treatment of primary abnormality are of great clinical importance, there must be more awareness among the practitioners which help in easy and quick understanding . Hence, students must be aware of all the reasons for oxidative stress and inflammatory disease. Awareness programmes and workshops may be conducted to improve the knowledge on oxidative stress and inflammatory diseases.

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