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Oral health related to general health. A mobile app to support treatment for patients suffering from periodontal disease

The mechanisms linking oral infections, such as periodontal disease, and systemic diseases are not yet clear, but enough studies are showing a high correlation between the two. This is the case, for the endocrine system, especially for diabetes and rheumatoid arthritis, cardiovascular diseases, such as atherosclerosis, increased risk of infants presenting low weight at birth, sepsis, or being born pre-term due to periodontal disease of the mother, as well as cognitive impairment, and susceptibility to oral cancers (1).

The most accepted mechanism linking oral health to general health is the deterioration of the oral microbiome, also known as oral dysbiosis. The oral microbiome mainly consists of commensals, more than 2000 species of bacteria, fungi, viruses, and archaea, but there are also species labeled as opportunistic pathobionts. Oral dysbiosis occurs when opportunistic pathobionts rise in number, turning the commensal-pathobionts ratio in their favor (2).

Regarding pregnancy, the generally accepted mechanism of pregnant women developing periodontitis is the increased hormone levels of progesterone and estrogen during pregnancy, which make periodontium more vulnerable to dental plaque, mainly due to the increased vascularity of the tissues, resulting in higher chances of developing periodontal disease (3). This sensitivity puts the baby at risk, studies show that pregnant women who develop periodontitis during pregnancy have a higher risk of giving birth to premature, low-weight children (4).

The prevalence of periodontitis developed during pregnancy varies. One meta-analysis found that, among 20 studies, the prevalence of periodontitis in pregnant women was 40% (5). Another study found that 63% of the enrolled mothers developed periodontal disease during pregnancy, out of which 18% developed a severe form of this disease. Periodontitis was diagnosed at an average of 26.5 weeks of pregnancy time. This study found that women with periodontal disease had an 11 times higher chance of giving birth to children suffering from growth restriction than those not suffering from periodontal disease (6).

Patients suffering from periodontitis develop endothelial dysfunction, a greater thickness of the carotid intima-media, and are more likely to develop a first coronary, as well as a first cerebrovascular event compared to patients not suffering from periodontal disease (7, 8). Moreover, people diagnosed with periodontitis have a higher risk of developing atrial fibrillation (9).

Regarding intervention, several studies have shown that people who brushed twice a day, increased dental visits, and received a non-surgical, first-step, treatment, had a lower risk of developing cardiovascular diseases than those who did not. To continue, there is strong evidence of the presence of Porphyromonas gingivalis and Aggregatibacter Actinomycetemcomitans in samples collected from atheroma lesions, bacteria well-known to be periodontal pathogens (10). These 2 bacteria have also been shown to play an important role in auto-antibody formation in the case of patients susceptible to rheumatoid arthritis (11). The Consensus Report on periodontitis and cardiovascular diseases clearly states that patients suffering from periodontitis should be warned that they are at a higher risk of developing cardiovascular diseases (8).

One meta-analysis draws attention to the link between periodontitis, dementia, and cognitive impairment. They concluded that individuals suffering from periodontal disease had an increase of 77% in cognitive impairment compared to healthy individuals. Also, individuals not suffering from periodontitis were 2.13 times less likely to suffer from dementia, compared to people with moderate or severe periodontitis (11).

Regarding diabetes, studies show that hyperglycemia correlates with the severity of periodontitis, impacting the quality of life of these patients. People suffering from diabetes are at a major risk of developing periodontitis, and patients suffering from periodontitis are less likely to control their sugar levels due to the disease (12).

Periodontitis is currently affecting >40% of adults in the United States, and it is one of the many diseases in which prevalence increases with age (13). As demographics show visible aging in the population (14), we can only expect these numbers to rise in the future.

Only in the UK, it is estimated that stopping the current cases of periodontitis from developing could save 5.5 billion euros in the following 10 years.

Being a resident of Romania, I looked up some statistics about my country and the National Institute of Statistics shows that in 2018, only 1 in 5 adults visited the dentist.

In the treatment of periodontitis, according to the latest guide of treatment (2020), the first step of the treatment consists of non-surgical treatment, including the education and motivation of the patient in developing good oral hygiene, otherwise, the treatment cannot proceed. Informative and motivational sessions should be held by the dentist together with the patient suffering from periodontitis in order to assure that. This might be the most difficult part of the treatment,

because it is patient-dependant, and, in many cases, poor oral hygiene has led the patient to develop periodontal diseases. It is also time costly for dentists and patients can be reluctant to achieve good oral hygiene.

Here comes our solution, STARTBrushing, a mobile app designed to educate patients suffering from periodontitis. This app provides video-audio guides on how to perform a proven-effective brushing technique (Bass-modified technique), together with guides on how to use dental floss and interdental brushes. Our app strives to solve this problem using psychologically-proven mechanisms (the Theory of Planned Behaviour (15)) to achieve the behavior of brushing, and ultimately, good oral hygiene.

Firstly, we are creating the means necessary for the patient to develop good oral hygiene. This is achieved via daily reminders to brush twice a day, which encapsulate positive reinforcement techniques, positive feedback for brushing, tops with the users' friends as well as educational content.

Secondly, we need to make sure that this behavior is mentained as a patient that develops periodontal disease needs to remain under supervision for the rest of his life. This is achieved via in-app rewards and gamification.

Moreover, this app also provides personalized statistics, progress check that can be done both by the patient and by the periodontologist, to know when to best intervene. Patients are reminded of their dental consults, in correlation to the dentist's plan of treatment.

The second innovative part involves public health systems. As more and more research show strong evidence regarding consequences of poor oral health on general health, communication between dentists and doctors of general medicine should be strengthened, especially in the case of patients suffering from oral cancer, cardiovascular disease, diabetes, and women during pregnancy.

This could be achieved with an additional form given by the general doctors to these patients. This form should assess the periodontal status of each patient, as they should be referred to a dentist/periodontologist and this assessment should be done during their general treatment to ensure the best results. Dentists and general doctors should communicate and inform each other regarding the status of their patients.

In conclusion, demographics show aging in the population, and doctors should only expect the prevalence of diseases to rise. To solve this problem, we should be focusing on prevention and the 2 solutions I am proposing could reduce periodontitis-related complications, strengthen the relationship between dentists and general medicine doctors, as well as ensure a higher quality of life for patients suffering from periodontal disease.

Citations

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