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Literature Review

Impact of oral health on physical fitness for the master category

Impacto da saúde bucal na aptidão física para a categoria master

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ABSTRACT

Objective: To carry out a literature review on the influence of oral health status on the physical fitness of individuals over 40 years old and to discuss its importance for good sports development. **Methods:** A literature review was carried out in the Medline database via Pubmed, considering the articles published from the year 2000 onward. The search was carried out using combinations of terms in English: tooth loss, oral health, fitness physics, master athlete, elderly, athlete. Articles that did not address the proposed theme, that evaluating other populations or dependent elderly people, institutionalized or bedridden, that had no relationship with aspects between oral health and physical fitness, review studies and case reports were excluded. At the end, 20 studies were selected. **Results:** It was possible to observe an interesting association between different oral health conditions and characteristics of physical fitness, in subjects over 40 years old. The variables corresponding to oral health included tooth loss, occlusal aspects, prosthetic rehabilitation and oral infectious and inflammatory diseases. The analyzed variables associated with physical fitness included the strength and power of lower limbs, static balance, walking speed and handgrip strength. **Conclusion:** The impact of oral health can have a negative influence in the physical fitness, especially on athletes of the master categories, as they are subjected to a situation conditioned by the effects of aging. Oral health care strategies are important tools to assist in maintaining sports performance.

Key-words: Physical functional performance, Preventive dentistry, Physical education and training.

RESUMO

Objetivo: Realizar uma revisão de literatura sobre a influência do estado de saúde bucal na aptidão física de indivíduos acima de 40 anos e discutir a importância desta para o bom desenvolvimento esportivo. **Métodos:** Foi realizado uma revisão de literatura na base de dados Medline via Pubmed, considerando os artigos publicados a partir do ano 2000. A busca foi realizada utilizando as combinações de termos em inglês: perdas dentárias, saúde bucal, aptidão física, atleta máster, idoso, atleta. Foram excluídos os artigos que não tratavam do tema proposto, que avaliavam outras populações ou idosos dependentes, institucionalizados ou acamados, que não apresentavam relação com aspectos entre saúde bucal e aptidão física, estudos de revisão e relatos de caso. Ao final, foram selecionados 20 estudos. **Resultados:** Foi possível observar uma interessante associação entre diferentes condições de saúde bucal e características da aptidão física, em sujeitos com mais de 40 anos. As variáveis correspondentes à saúde bucal incluíram perdas dentárias, aspectos oclusais, reabilitação protética e doenças infectoinflamatórias. As variáveis analisadas associadas à aptidão física compreenderam a força e potência de membros inferiores, equilíbrio estático, velocidade de marcha e a força de preensão manual. **Conclusão:** O impacto da saúde bucal pode repercutir de modo negativo sobre a aptidão física, especialmente sobre atletas das categorias máster, pois estes estão submetidos a uma situação particular condicionada aos efeitos do envelhecimento. As estratégias de cuidado com a saúde bucal são importantes ferramentas para auxiliar na manutenção do desempenho esportivo.

Palavras-chave: Desempenho físico funcional, Odontologia preventiva, Educação física e treinamento.

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Introduction

Within several sports modalities, there are subdivisions groups of athletes, according to their age. The master categories are comprised of individuals over 35 years old, both experienced professionals, with many years of training and participation in various competitions, and beginners starting their career in the sport when they approach middle age or beyond [1,2]. In the last few decades, there was a marked increase in athletes participating in master sports events, especially in endurance sports. Considering ultra-marathon races, master runners are among most finalists (approximately 73%) [3,4]. In other similar competitions, such as triathlon, which involves swimming, cycling, and running, we can also observe this trend, with the representation of more than 50% of these athletes [5].

This increase in participants of the master categories in different sports ends up modifying the average age of the finalists, which is consistently close to 40 years [3,4,6]. To explain this phenomenon, we must consider several factors such as increased life expectancy, a greater search for physical activity and concern for health, greater availability of training centers, specific programs aimed at conditioning and training older populations, and continuity in sport by retired athletes [7]. With this change in the demographic profile in sport, there is also a crescent interest in the search performance-improving strategies, aimed at this stage of life specific concerns and physiological adaptations, such as the gradual loss of muscle mass, strength, and cardiorespiratory fitness.

Oral health has been studied as a possible modifying factor of physical capacity whilst some studies point out diseases of dental origin as possible causes of sarcopenia and delayed recovery time from muscle injuries [8-11]. The loss of muscle mass is directly linked to decreased strength and power, fundamental criteria for maintaining performance in terms of functional capacity, endurance, adaptation, and speed [12-14]. The physical performance with advancing age is not only a relevant factor for sports, but it is also a significant criterion associated with life expectancy and quality. Sarcopenia is a syndrome characterized by progressive and widespread muscle loss with adverse risks associated with a physical disability, low quality of life, and death [15,16]. Thus, special attention to oral health care is primordial to sports practitioners, preventing and treating possible diseases [17].

The decline in physical fitness related to age directly affects overall health in older individuals, from the sports performance to the performance of daily activities. Reduced lower limb function, for example, is associated with an increased risk of falls, loss of balance, and difficulty climbing stairs [18]. The deterioration of the state of oral health and tooth loss is associated not only with oral function but also to general health and quality of life. Some studies have pointed out a relationship between missing teeth and occlusal conditions in motor performance and muscle strength of the lower limbs, as well as in grip strength and postural instability [12,19-21].

Recent studies report that oral health is associated with other systemic conditions, directly influencing the performance of physical activities [22]. The literature indicates that the oral health of athletes can impact sports performance, as observed in 41% of evaluated athletes [23]. Considering elite athletes, the impact on the physical condition was observed in 32% of cases [24]. Considering the investment made in an athlete's career, it is important to pay attention to all factors associated with the performance of activities, competitions, and training. Thus, knowing the importance of physical condition for the optimal performance of master athletes, the present study aims to conduct a review of the literature on the influence of oral health sta-

tus on physical fitness of athletes over 40 years old and discuss the importance from maintaining oral health to good sports development.

Methods

This study is a literature review. The research was carried out between the months of November and December of 2019 and included articles indexed in the Medline database via Pubmed. For updating purposes, only articles published since 2000 were considered. The search for articles was carried out using the following combinations of terms: *dental loss, oral health, physical fitness, master athlete, elderly, athlete* (Table I).

Table I - Combination of terms and key words for the initial search of indexed articles.

Keywords	Number of studies
Dental and loss and athlete	17
Dental and loss and physical and fitness	12
Dental and loss and physical and fitness and elderly	9
Oral and health and physical and fitness and elderly	220
Oral and health and physical and fitness and master and athlete	23
Oral and health and master and athlete	2
Oral and health and physical and fitness	378
Physical and fitness and master and athlete	56
Total	**717**

After analyzing the title and available summary, the inclusion and exclusion criteria mentioned below were followed. At the end of the analysis, 20 studies were selected to form the final review (Figure 1).

Inclusion criteria

a) Population over 40 years old;
b) Evaluation of at least one criterion related to physical fitness;
c) Evaluation of at least one criterion related to oral health;
e) Publication in English.

Exclusion criteria

a) Individuals over 40 years of age, disabled, dependent or institutionalized;
b) Presence of neurodegenerative or muscular disorders;
c) Publications without available abstracts;
d) Literature review and case reports;
e) Divergence from the proposed theme;
f) Publications prior to the year 2000.

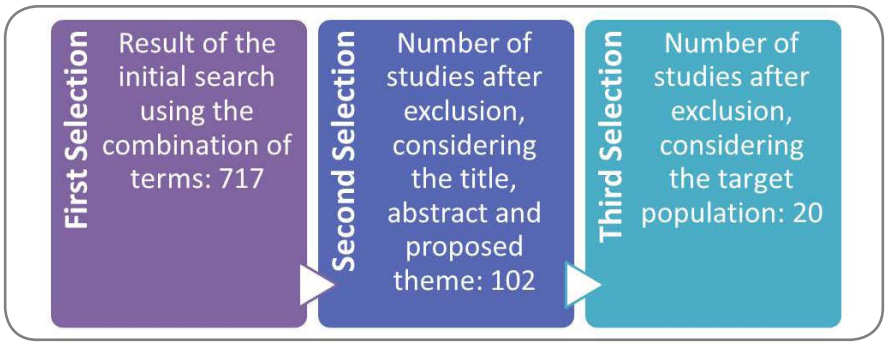
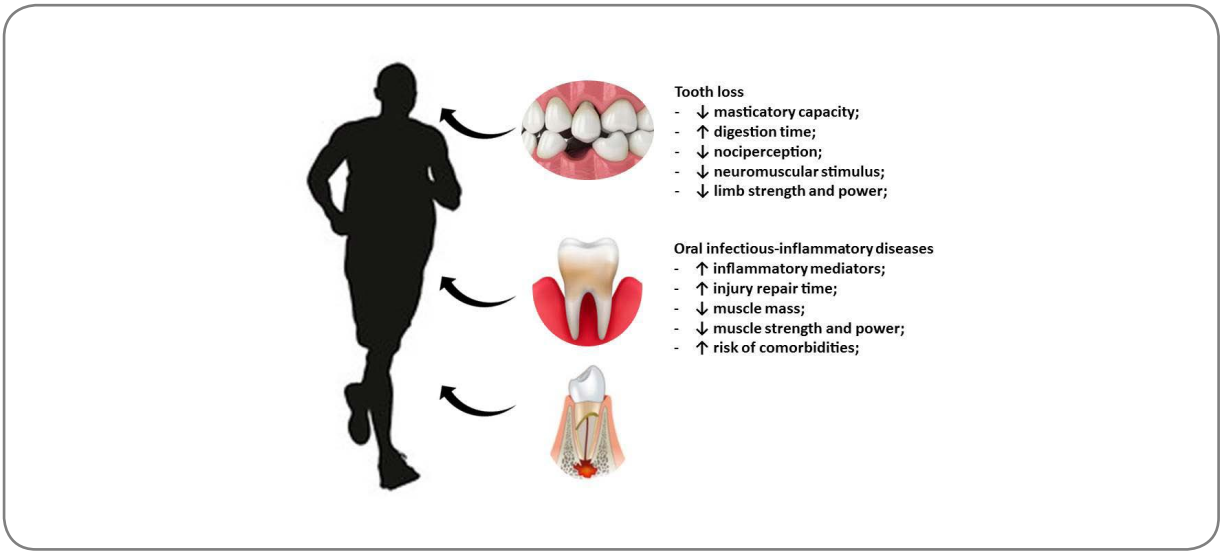


Figure 1 – Systematic selection of studies.

Results e Discussion

The selected studies mostly evaluated Japanese individuals (45%). Regarding the type of methodological design, cross-sectional studies, case-control studies, longitudinal studies, and cohort studies were found (60%, 15%, 15%, and 10% respectively). The variables corresponding to the oral health condition included tooth loss, occlusal contact points, types of prosthetic rehabilitation, and infectious and inflammatory diseases. The analyzed variables associated with physical fitness comprised mainly the strength of lower limbs, static balance, walking speed, and handgrip strength. (See Chart I after References).

According to the studies found, it is possible to observe an interesting association between different oral health conditions and characteristics of physical fitness, in subjects over 40 years old (Figure 2). Tooth loss was related to reduced gait speed, increased postural instability, reduced handgrip strength, reduced muscle strength of lower limbs, decreased static balance, and physical capacity [9,20,21,25-32]. The homogeneity between the occlusal contacts showed conformity with physical agility, the balance associated with the visual stimulus, the height of the vertical jump, and, also, with the muscular strength of the lower limbs [18,19,33,34]. These findings can be explained, in part, by the physiological mechanisms that link masticatory and occlusal forces to the maintenance and improvement of neuromuscular function [35,36].



Source: Author.
Figure 2 – Relationships between oral health and physical fitness.

Although still unclear, it is possible to observe a close relationship between the activity of peripheral members and oral motor skills. There is also an interesting and discussed relationship between brain activity and strength levels of the muscles of the upper and lower limbs with stimulation of the stomatognathic system [37-39]. This association can be partially explained by teeth clenching, commonly performing during physical efforts. Due to tooth absences, reduced stimulation of the motor nerve center occurs through the receptors present in the periodontal ligament. Thus, limited occlusal contacts can affect the function of remote muscles through cortical activation and, consequently, minimize nervous stimulus, contributing to the decrease in muscle strength and physical function [9,40,41].

Another important finding was the relationship between the presence of periodontal diseases and decreased handgrip strength, reduced muscle mass, and physical capacity a [12-14,42,43]. Besides, it was also observed that the greater the number of associated oral problems, the greater the risk of physical frailty. Periodontal diseases are pathologies with an infectious-inflammatory profile, which acts on the tissues that support the teeth [10,11]. These diseases can modulate inflammatory mediators, such as interleukin 6 (IL-6) and tumor necrosis factor-alpha (TNF-α) [10]. In a broader review, it was shown that the inflammatory cytokines can stimulate the loss of muscle mass, inciting the mechanisms of protein catabolism [44]. Additionally, the biological effects of aging lead to a progressive reduction in muscle mass and function, which are involved in the production of strength, power, and endurance. The advancement of age is accompanied by low muscle strength, mobility disorders, increased falls, and risk of fractures, impaired functionality, loss of independence, and increased risk of death [45]. Thus, the concomitant presence of these events favors negative responses to the loss of muscle tissue strength and power.

With advancing age, we observed a gradual and inevitable loss of muscle fibers, with more expressiveness from the age of 50 and progresses in a way that, at the age of 80, a reduction of approximately 50% in muscle mass can be observed [46]. The degree of fiber atrophy seems to depend largely on factors related to nutritional status, general health conditions, and the individual's usual level of physical activity [47-49]. The decrease in muscle mass is accompanied by at least an equal, but usually even greater, decrease in strength and power, as well as an increase in muscle weakness (the strength per unit area of the muscle) and fatigue. All of these effects have an impact on the performance of sports activities in the master categories [50].

Older athletes also need to maintain a high level of fitness throughout the competition period, which is related to well-designed training programs. Nevertheless, the loss of muscle mass, weakness, and fatigue associated with age could still occur, highlighting the importance of identifying the additional factors capable of overlapping the complementary risks to sarcopenia [44,51]. Also, master athletes present increased susceptibility and magnitude of muscle damage contributing to the decline in physical fitness, health, and quality of life [52-54]

Several studies observed a positive association between parameters of physical fitness and oral health, considering the presence of oral infectious and inflammatory diseases. Mostly, poor oral health was associated with reduced strength of the lower limbs, static balance, walking speed, and the handgrip strength [12-14,42,43]. These results can be justified by reduced muscle function due to increased catabolic factors such as oxidative stress, pro-inflammatory cytokines, and glucocorticoid hormones [45]. Inflammatory mediators, present in oral diseases, are also associated with impaired differentiation of muscle cells, corroborating these findings [10,11].

The condition of oral health is important both for the physical fitness and for the well-being and general health of the athletes. Dental diseases seem to be very present among athletes and may have a negative impact on physical performance, even with the practice of physical activity and a healthier lifestyle [10,11,17]. In addition, there is also a concern with other factors that interfere with people's expectations and their psychosocial responses, such as self-esteem, anxiety and insecurity, comfort, the ability to eat, the occurrence of pain, function, and aesthetic [42].

Oral health seems to have direct implications for physical capacity, in different aspects addressed. The maintenance of conditioning factors of physical fitness and the control of risk factors, such as alterations and oral diseases, are fundamental for the performance desired by athletes, especially those in the master categories,

considering the physiological and functional limitations already present resulting from age of this population. Thus, understanding these singularities and knowing how to plan and execute a treatment aimed at the oral health of this particular group seems to have major importance in the success of the physical training plan and in the attenuation of inflammatory stimuli and risk of tooth loss.

Conclusion

The health and performance of athletes in the master categories must be considered from a unique perspective since these athletes are subjected to a particular situation conditioned by the effects of aging. The impact of the different health conditions of the oral cavity can have a negative impact on the practice of sports and the quality of life of this group, deserving better attention. Therefore, this review suggests that the strategies for oral health care are important tools to assist in maintaining master athletes' sporting performance.

Conflict of interest
No conflicts of interest have been reported for this article.

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Authors' contribution
Conception and design of the research: Souza BC. **Data collection:** Souza BC, Lopes AL. **Analysis and interpretation of data:** Souza BC, Lopes AL. **Writing of the manuscript:** Souza BC, Carteri RB, Lopes AL. **Critical review of the manuscript for important intellectual content:** Souza BC, Carteri RB, Lopes AL.

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Chart I– Summary of articles found in the research.

Author	Objetives	Design	Sample	Main Results
Yamaga *et al.* [18]	Examine the relationship between physical fitness and the occlusal condition of natural teeth.	Cross-sectional study	749 functionally independent elderly people.	The strength of the extensor muscles of the legs, the rate of staggering, and the time spent on a leg with the eyes open showed significant correlations with the Eichner index (occlusal contacts). These findings suggest that the dental occlusal condition is associated with the dynamic strength of the lower limbs, agility, and balance function in elderly adults.
Tada *et al.* [20]	Assess the relationship between oral health and physical or cultural activities.	Cross-sectional study	101 functionally independent elderly people.	People with 20 or more teeth remaining were more active in sports than those with less than 20 teeth remaining. This data suggests that the number of remaining teeth is associated with physical activity in the elderly.
Takata *et al.* [25]	Assess the relationship between masticatory capacity or number of teeth with measures of physical fitness.	Cross-sectional study	697 functionally independent elderly people.	There is a relationship between the perceived masticatory capacity and physical fitness in this population. Masticatory capacity can be an independent predictor of physical fitness, therefore, preventive dental care designed to preserve masticatory capacity can improve activities of daily living and quality of life.
Hämäläinen *et al.* [26]	To study the state of oral health as a risk factor for loss of muscle strength.	Longitudinal study	193 functionally independent elderly people.	The grip strength correlated positively with the number of teeth present. In perspective analyzes the presence of periodontitis at the beginning of the study showed a clear association with a more pronounced decline in handgrip over the five years of follow-up.
Hashimoto *et al.* [27]	Investigate the differences in oral condition and health status of the elderly with 20 teeth or more.	Case-Control study	308 volunteers.	The condition of oral health and the number of teeth is associated with a better physical capacity in the elderly.
Moriya *et al.* [33]	Show relationships between oral conditions and physical performance.	Cross-sectional study	821 functionally independent elderly people.	Masticatory capacity may be related to muscle strength and the function of static balance. The pattern of occlusive pairs may be related to the static balance function.
Yoshida *et al.* [21]	Compare body balance control between toothless and toothed teeth.	Case-Control study	70 individuals.	Tooth loss can be a risk factor for postural instability. This further suggests that the proprioceptive sensation of the receptor of the periodontal ligament may play a role in controlling body balance.
Okuyama *et al*, [19]	Clarify the relationship between dental occlusion and physical fitness.	Longitudinal study	349 functionally independent elderly people.	The partial or total loss of occlusion (considering the number of teeth) was associated with a decline in the strength of the leg extensor muscle or a decrease in standing time on a leg with the eyes open.

Chart I – Continuation.

Author	Objetives	Design	Sample	Main Results
Castrejón-Pérez *et al.* [42]	Test the hypothesis that poor oral health conditions are associated with a greater likelihood of physical frailty.	Cross-sectional study	699 functionally independent elderly people.	The greatest associations with the likelihood of frailty in the elderly were conditioned by females, myocardial infarction, urinary incontinence, worse oral health, less access to dental services, age, and use of medications.
Andrade *et al.* [28]	Test the hypothesis that clinical oral health conditions are associated with physical frailty.	Cohort Study	1,374 functionally independent elderly people.	Elderly individuals in need of dental prostheses were significantly more likely to be pre-frail and frail. Participants with 20 or more teeth were less likely to be fragile than toothless individuals.
Oliveira *et al.* [14]	Assess whether periodontal disease is a risk indicator of a lack of physical fitness.	Cross-sectional study	111 male volunteers.	Individuals with higher rates of loss of clinical insertion had progressively lower scores of physical fitness.
Tsakos *et al.* [29]	To analyze the effect of tooth loss on the decline in physical and cognitive functioning.	Cohort study	3,166 functionally independent elderly people.	Toothless participants showed a significant reduction in gait speed and memory. Total tooth loss was associated with physical and cognitive decline in the elderly.
Brand *et al.* [30]	To investigate the effects of tooth loss on gait stability.	Case-control study	49 volunteers.	Participants with natural teeth and rehabilitated with fixed prostheses had a significantly higher gait speed compared to users of dentures, in conditions of normal walking and dual-task performance. Tooth loss is associated with slower gait speed and therefore can have a negative impact on your stability.
Inui *et al.* [9]	Evaluate the relationship between muscle mass and its function and oral conditions.	Cross-sectional study	552 volunteers.	The number of teeth proved to be an independent risk factor for the 10 m walk test (in females) and for the skeletal muscle mass of the entire body (in males). The results also revealed that the improvement in the 10 m walk test was significantly correlated with a greater number of occlusal contacts.
Hoope *et al.* [13]	To evaluate the association between chronic oral inflammatory load and physical fitness.	Cross-sectional study	112 male police officers.	There was no significant association between endodontic parameters and physical fitness. However, periodontal parameters and chronic inflammatory burden were significantly associated with low physical fitness.
Eremenko *et al.* [12]	Evaluate the associations between handgrip strength, periodontitis, and the number of teeth.	Cross-sectional study	2,089 volunteers.	Body mass index, waist-to-hip ratio, and periodontal disease were associated with lower physical fitness, assessed by handgrip strength.

Chart I – Continuation.

Author	Objetives	Design	Sample	Main Results
Kim *et al.* [31]	Examine the correlation between the number of natural teeth and the muscle mass index.	Cross-sectional study	2,378 functionally independent elderly people.	Male participants with more than 20 teeth showed a positive association with a higher percentage of muscle mass.
Ramsay *et al.* [32]	Investigate the associations between oral health measures and physical frailty.	Longitudinal study	1,284 functionally independent elderly people.	The risk of physical frailty was greater among edentulous participants and those who had 3 or more oral health problems.
Kotronia *et al.* [43]	To investigate the association between oral health and physical disability.	Cross-sectional study	2,147 functionally independent elderly people.	Markers of oral health problems, especially dry mouth, self-assessment of oral conditions, and the presence of more than one oral health problem, were associated with disability and poor physical function.
Morita *et al.* [34]	Evaluate the association between vertical jump height and oral function.	Cross-sectional study	231 functionally independent elderly people.	The height of the vertical jump was significantly associated with grip strength in men and women. In women, it was associated with masticatory performance, occlusal strength, and occlusal contact area.