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Association between periodontal disease and low PFT (Physical Fitness Test) score: A Cross Sectional Study

Amit Kumar[1], Swati Singh[1]

1 *N & D Square, Hanuman Chowk, Opp-Chanakya City Appartment Gola Road, Patna, India*

Abstract

Background: Physical activity has been shown to have a protective relationship with several chronic diseases. Recently, periodontal disease has been considered a risk indicator for poor physical fitness. **Aim:** The aim was to assess if there is an association between periodontal diseases and poor physical fitness. **Materials and Methods:** This cross-sectional study comprised of 125 subjects of age 20 to 40 years. Physical fitness was assessed through physical fitness test (PFT) which comprised of sit-ups, push-ups and two-mile run. A PFT score (range of 1 to 300) was determined for each subject. Subjects scoring less than 180 were considered physically unfit. The periodontal clinical examinations were done for physically fit and unfit subjects by a single periodontist. The periodontal clinical examination included Gingival index (GI), Clinical attachment loss (AL), Probing pocket depth (PD). **Results:** The mean age of the sample was 26.65 (± 4.07 Standard Deviation [SD]) years. The sample size comprised of 76 %males and 24 %females. Higher percentage of body fat subjects showed significantly lower PFT scores [152.31 (± 24.50 SD) points] than low percentage body fat subjects [188.73 (± 21.10 SD) points]. The unfit individuals had an average gingival index of 1.89 (± 0.67 SD) compared to 0.96 (± 0.78 SD) for the fit individuals (p=0.03). Mean probing depth and clinical attachment level were 4.89 (± 1.89 SD) mm and 4.28 (± 1.47 SD) mm in unfit individuals and 2.87 (± 1.39 SD) mm and 1.33 (± 1.88 SD) mm in fit individuals, respectively ($p < 0.001$). **Conclusion:** Our study confirms the significant association between periodontal diseases and poor physical fitness and periodontal disease may be considered one of the risk factors for poor physical fitness.

Keywords: Periodontal disease, Physical fitness test, Gingival index, Clinical attachment loss, Probing pocket depth.

INTRODUCTION

Studies within the past ten years have suggested an association between periodontal disease and the likelihood of delivering preterm,[1] low-birth weight babies,[1] developing cardiovascular disease, [2] and having difficulty controlling blood sugar levels in people with diabetes. [3] Some studies have also linked periodontal disease to respiratory infection in people with pulmonary problems. [4] For a long time it was thought that bacteria was the factor that linked periodontal diseases to other disease in the body; however, more recent researches have demonstrated that a low-grade inflammatory process, characterized by elevated blood concentrations of biomarkers, may be responsible for the association.[5,6]

The adverse effect of obesity on periodontium has been studied and consolidated in the past years. This effect is mediated through pro-inflammatory cytokines like interleukins (IL-1, IL-6 and TNF-α), adipokines (leptin, adiponectin, resistin and plasminogen activator inhibitors-1) and several other bioactive substances like reactive oxygen species (ROS), which may affect the periodontal tissues directly. In this scenario, obesity has been considered one of the major risk factors for periodontitis, and it may also be part of the biologic plausibility linking periodontal diseases with systemic conditions.[7,8]

Physical fitness is a measure of the body's ability to function efficiently and effectively in work and leisure activities, resist hypokinetic diseases (diseases from sedentary lifestyles), and to meet emergency situations. Two recent analyses of NHANES III data found an inverse association between physical activity and the level of inflammatory markers such as C-reactive protein in the plasma. Thus, physical activity may protect against periodontitis by reducing inflammation, which is important in the pathogenesis of periodontitis. Diabetes is known to be a risk factor for periodontitis, and now it is well accepted that physical activity may reduce the incidence of type II diabetes. Furthermore, physical activity has been suggested to enhance sensitivity to insulin and thus prevent type II diabetes. [9]

The theoretical construct of physical fitness comprises various dimensions, including body composition and

***Corresponding author:**
Dr. Amit Kumar
N & D Square, Hanuman Chowk, Opp-Chanakya City Appartment Gola Road, Patna, India
Email: docamitkr@yahoo.in

and muscle performance. [10] Consequently, physical fitness is directly affected by body fat accumulation and muscle metabolism. Damage to the muscles, which may lead to decreased physical fitness, induces a chain of events involving leukocytes and increased serum levels of proinflammatory cytokines, such as interleukin (IL)- 1ß, IL-6, and tumor necrosis factor (TNF)-α.[11] This inflammatory response in the muscle may lead to secondary damage to the healthy muscle structures, thereby lengthening the muscle repair process, increasing muscle soreness, and making the individual more reluctant to contract his or her skeletal muscles. [12,13] Considering that the same proinflammatory biomarkers are involved in both periodontal diseases and muscle metabolism, [14] it is plausible that the systemic challenge generated by periodontal disease could also influence physical fitness.

As there is limited evidence suggesting an association between poor oral health and decreased physical fitness, there is a need for more research to establish the relationship between periodontal disease and poor physical fitness. Therefore, the objective of the present study was to compare periodontal clinical parameters between unfit and fit individuals to find an association between periodontal disease and poor physical fitness.

MATERIALS AND METHODS

Study sample

Prior to the start of the study ethical clearance of the protocol was obtained from Ethical Committee of the Institutional Review Board (Navodaya Dental College and Hospital). This study was conducted on 125 subjects in the Navodaya Dental College Gymnasium, Raichur. All subjects signed an informed consent before taking part in the study and were assured that all information gathered in the course of study will be kept confidential. The inclusion criteria required study subjects to be in the age group of 20 to 40 years, minimum of 20 scorable teeth, no history of periodontal therapy and not on antibiotics or anti-inflammatory medication within the preceding six months. Exclusion criteria included subjects who were current or former smokers, obese individuals having BMI ≥ 30 kg/m^2, having hematological disorders or other systemic illness and pregnant women or women on oral contraceptives.

Questionnaire

Participants answered a structured, self-administered questionnaire before the commencement of physical fitness test. The questionnaire included information about age, sex, medical history, dental history, smoking habit and oral hygiene practice. Oral hygiene practice included the frequencies of tooth brushing which was categorized into once per day and twice per day. Individuals were divided into age groups of 20 to 29 years and ≥ 30 years.

BMI and Percentage Body Fat

BMI was obtained by dividing the weight (in kilograms) by the square of the height (in meters). Individual's weight and height were assessed in the Gymnasium itself. Individuals were classified into ''normal weight'' and ''overweight'' categories by using the World Health Organization cutoff points for BMI (18.5 to 24.9 kg/m^2 for normal weight and 25 to 29.9 kg/m^2 for overweight). Obese (BMI ≥30 kg/m^2) individuals were not observed in the study. The percentage of body fat (% BF) was obtained by a portable bioimpedance monitor (Omron, HBF 306), according to the specifications of the manufacturer. After entering the individual's age, height, weight, and sex into the monitor, measurements were taken with the person standing, holding the metallic sensors, with elbows extended and the arms at 90 degree relative to the body. The % BF range registered by the monitor was 4% to 50%. Individuals were classified into low and high % BF, according to the bioimpedance cutoff points and age. [15]

Physical Fitness Test (PFT)

The PFT [16] comprises of three physical performance exercises 1.Sit-ups, 2.Push-ups and 3.Two-Mile run. A minimum score of 60 in each event (i.e. total score 180 out of 300) was required to be considered as physically fit or else unfit. 1) Sit-ups:- To do this, subjects were asked to lie down on the floor with his or her back. The participants lift his/her upper and lower vertebrae from the floor until his/her upper body (above the buttocks) does not touch the ground. 2) Push-ups:- To do this, subjects were asked to kneel on the floor, hands on either side of the chest and keep the back straight. Lower the chest down towards the floor, either till the elbows are at right angles or the chest touches the ground. 3) Two-Mile run :- This was a timed exercise. To do this, subjects were asked to run 2 mile distance on a treadmill in the shortest time possible. Although walking was allowed, it was strongly discouraged.

Procedure

The periodontal clinical examinations were carried out using a sterile dental mouth mirror and manual periodontal probe (HuFriedy, Chicago, IL, USA). The gingival condition was assessed using the gingival index (GI). [17] The Clinical Attachment Loss (AL) and the probing depth (PD) were measured at six sites per tooth. PD was defined as the distance from the free gingival margin to the bottom of the pocket/sulcus. AL was defined as the distance from the cement-enamel junction to the bottom of the pocket/sulcus. Measurements were made in millimeters and were rounded to the nearest millimeter. All clinical data were collected by a single examiner, who had been calibrated prior to the commencement of the study until the examiner could maintain > 90% agreement on repeated measures of all examination protocols. The intra examiner agreements were evaluated by means of repeated measurements with a 7-day interval from the first examination.

Statistical analysis

Means of GI, AL, and PD were calculated for each individual. Participants were categorized according to the number of teeth with PD ≥5 mm and AL ≥4mm (no teeth and at least one tooth). Non parametric test (Mann-Whitney U test) was used to compare the PFT results across categories of the independent periodontal variables. All levels of significance were set as p<0.05. Data were stored in a database and was or were analyzed using Statistical Package for Social sciences (SPSS windows version 16th Chicago, Illinois).

RESULTS

Initially, 190 subjects attending gymnasium were targeted for this study [Figure 1]. About 166 subjects agreed to take part in the study and were asked to answer self – administered questionnaire. 41 subjects were excluded from the study following the exclusion criteria's. The final sample size was comprised of 125 subjects. Physical fitness test and periodontal assessments were done for these subjects.

Table 1 shows the characteristics of study samples. The mean age of the study group was 26.65(±4.07SD). Most of the subjects were in the age group of 20 to 29. The percentage of males and females were 76% and 24%, respectively. About 52.8% subjects used to brush their teeth twice daily. 57 % subjects were in overweight category, with a mean % BF of 21.26(±5.89). Mean GI, PD, AL were 1.30(±0.87SD), 3.48(±1.69) mm and 2.42(±1.33) mm, respectively. Around 35.2 % subjects had PD ≥ 5mm in ≥ 1 tooth and 49.6 % subjects had AL ≥ 4mm in 1 tooth.

Figure 2 shows the frequency of PFT scores. About 63 % subjects were physically fit and maximum subjects scored 180. Figure 3 shows the percentage of physically fit and unfit males and females. [Table 2] Overweight and high % BF individuals showed significantly lower PFT scores compared to normal weight individuals. Significantly higher GI was present in individuals having lower PFT scores (p=0.003). Individuals presenting at least one tooth with PD ≥ 5mm had significantly lower

mean PFT scores than individuals without that condition (p=0.006). Similarly, individuals presenting at least one tooth with AL ≥4mm had significantly lower mean PFT scores (p<0.001). Periodontal status of both the physically fit and unfit individuals is depicted in Table 3, Figure 4. It was found that periodontal status was statistically significant among physically fit and unfit males and females (p<0.05).

Table 1: Characteristics of the Study Samples (N =125)

Variables	Results
Age (Years)	26.65 ± 4.07
20 to 29	87 (69.6)
≥30	38 (30.4)
Sex	
Male	95(76)
Female	30(24)
Tooth brushing	
Once/day	59(47.2)
Twice/day	66(52.8)
Bioimpedance	21.26 ± 5.89
BMI(kg/m^2)	24.58 ± 2.84
Normal	68(54.4)
Overweight	57(45.6)
GI	1.30 ± 0.87
PD(mm)	3.48 ± 1.69
AL(mm)	2.42 ± 1.33
PD ≥ 5 mm in ≥ 1 tooth	44(35.2)
AL ≥ 4 mm in ≥ 1 tooth	62(49.6)

The results are presented as mean ± SD or n (%). BMI- Body Mass Index ; GI- Gingival Index; PD- Probing Depth; AL- Attachment Loss.

Table 2: Mean PFT Scores According to Demographic, Behavioral, and Clinical Characteristics

Characteristics	PFT Score (mean ± SD)	*p*
Male (Age)[c]		
20 yrs to 29 yrs	172.64 ± 27.75	
≥ 30 yrs	170.59 ± 28.96	0.73
Female (Age)[c]		
20 yrs to 29 yrs	173.10 ± 27.77	
≥ 30 yrs	169.33 ± 20.82	0.48
Toothbrushing[c]		
Once/day	173.91 ± 27.49	
Twice/day	168.60 ± 27.72	0.18
Bioimpedance[c]		
Low % BF	188.73 ± 21.10	
High % BF	152.31 ± 24.50	<0.001*
BMI[c]		
Normal	187.74 ± 20.57	
Overweight	153.67 ± 23.73	0.001*
Gingival index (GI)[c]		
0.1 to 1.0	186.16 ± 21.09	
1.1 to 2.0	156.91 ± 26.29	
2.1 to 3.0	149.1 ± 22.80	0.003*
PD ≥ 5 mm[c]		
0 teeth	183.09 ± 24.02	
≥ 1 tooth	152.14 ± 22.80	0.006*
AL ≥ 4mm[c]		
0 teeth	189.44 ± 18.69	
≥ 1 tooth	154.67 ± 24.43	<0.001*

[c] Mann-Whitney U test. *Statistically significant. BF- Body Fat ; PD – Probing Depth; AL – Attachment Loss.

Table 3: Clinical parameters in Fit and Unfit groups (mean ± standard deviation)

Clinical measurements	Fit (N=79) (PFT score ≥ 180)	Unfit (N=46) (PFT score < 180)	*p value*
Mean GI[C]	0.96 ± 0.78	1.89 ± 0.67	0.03*
Mean PD (mm)[c]	2.87 ± 1.39	4.89 ± 1.89	<0.001*
Mean AL (mm)[c]	1.33 ± 1.88	4.28 ± 1.47	<0.001*
Number of teeth with PD ≥ 5 mm[c]	0.15 ± 0.36	1.69 ± 1.47	0.002*
Number of teeth with AL ≥ 4 mm[C]	1.27 ± 1.44	2.89 ± 4.43	0.04*

[c]Mann-Whitney U test. *Statistically significant. GI – Gingival Index ; PD – Probing Depth ; AL- Attachment Loss.

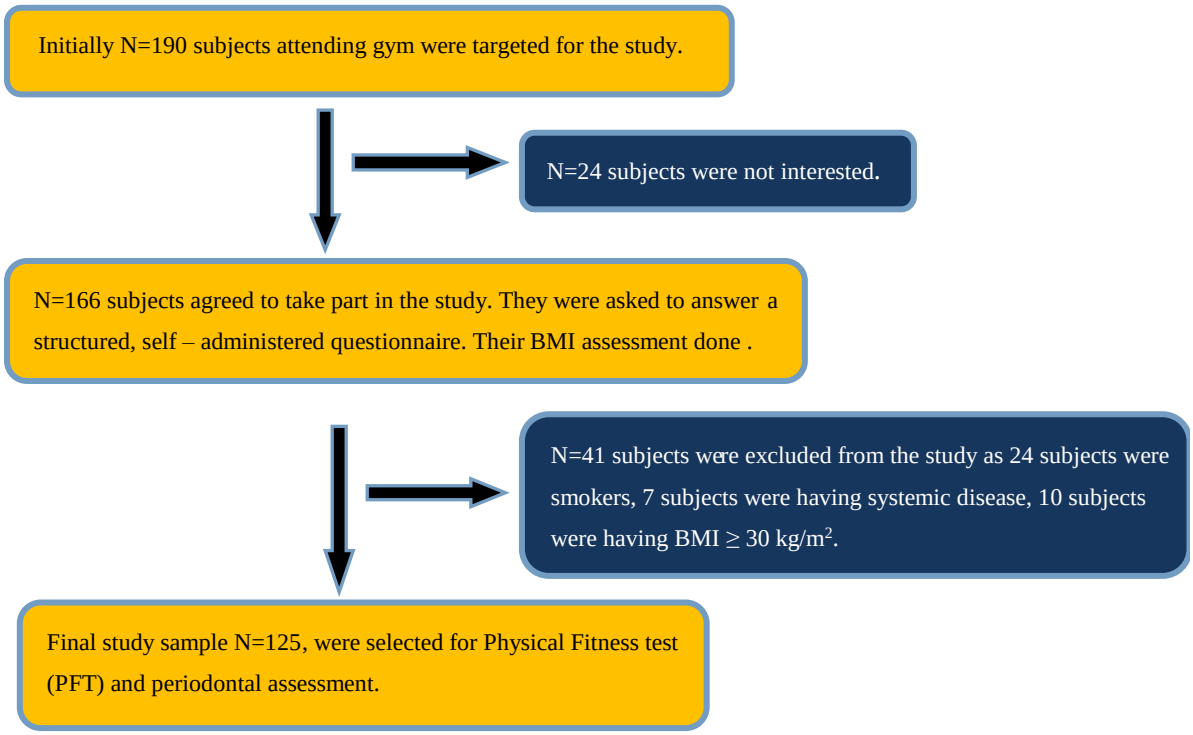

Figure 1: Flowchart of the targeted study sample

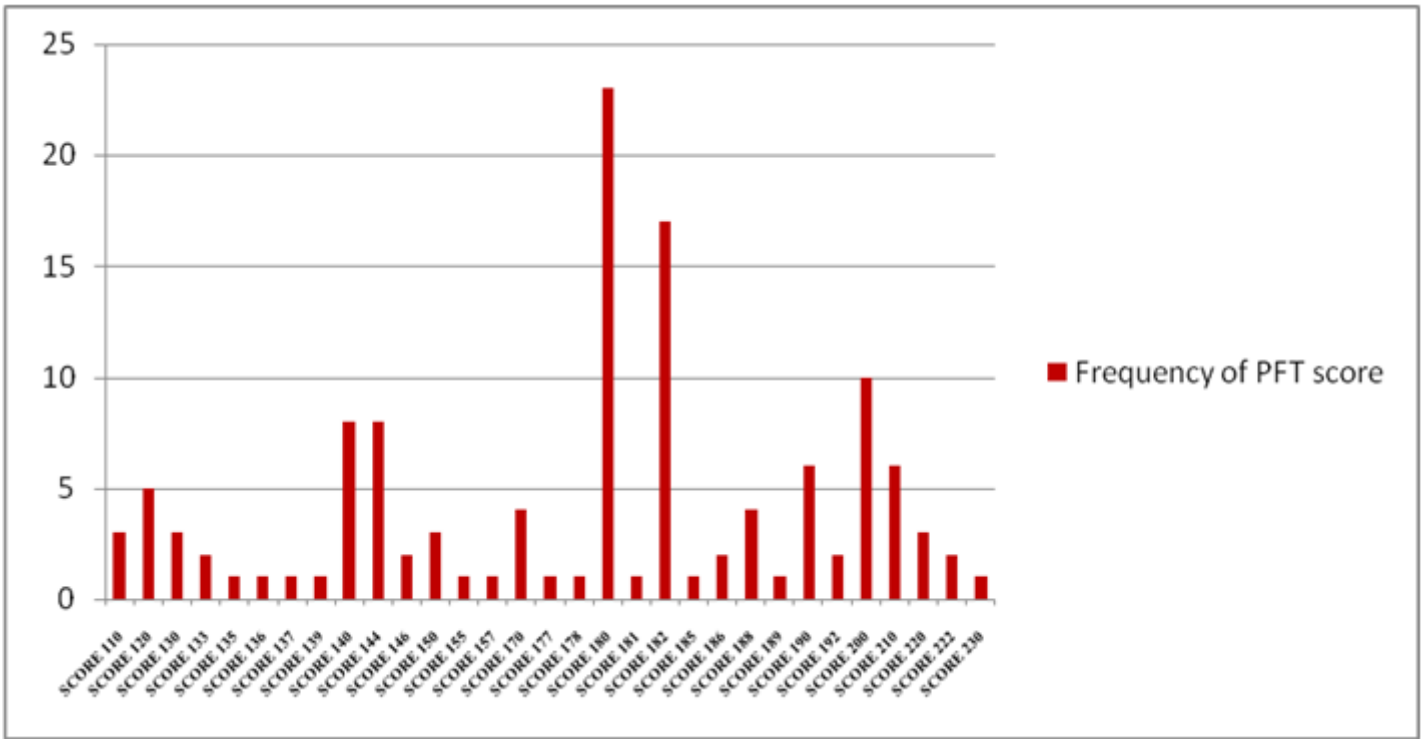

Figure 2: Frequency of PFT scores for study participants

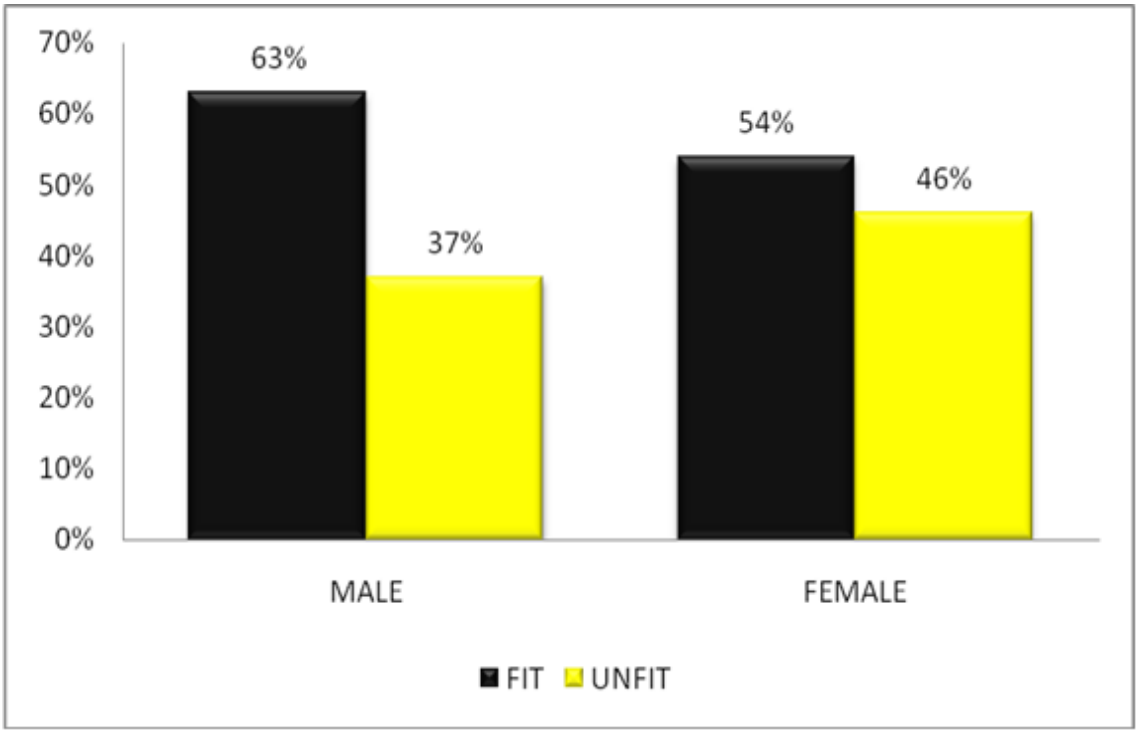

Figure 3: Weighted Percentage of physical fitness of males and females

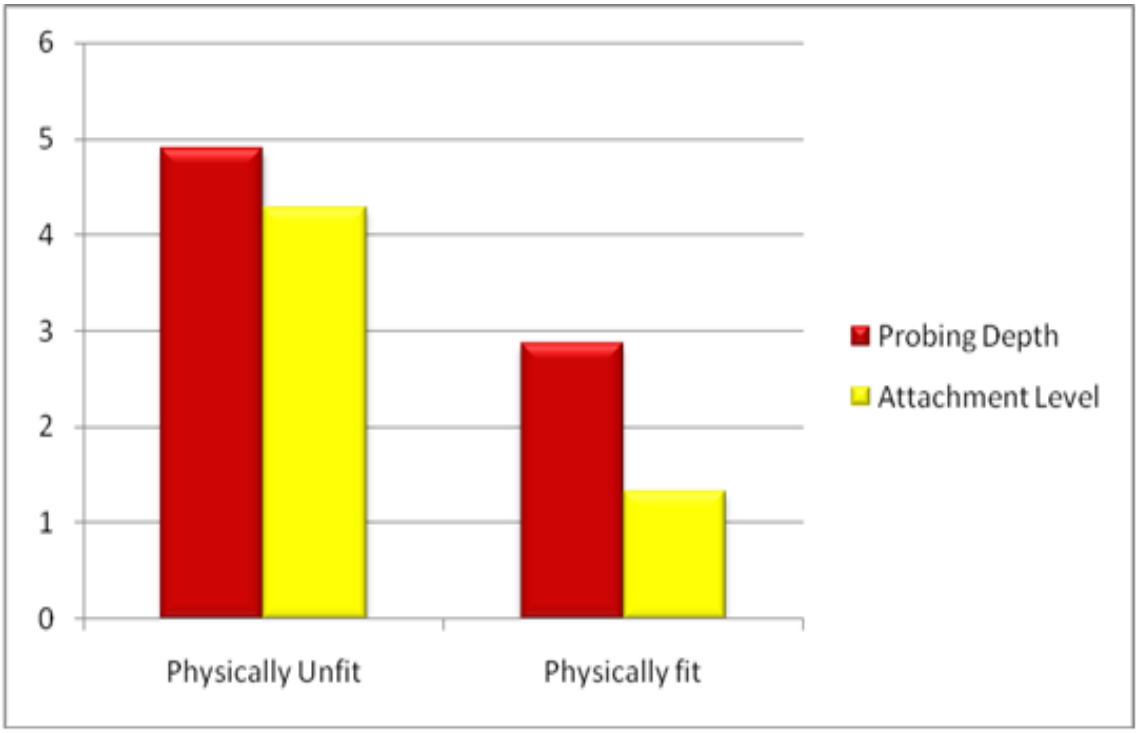

Figure 4: Amount of attachment loss and probing depth among physically fit and unfit subjects

DISCUSSION

It is well documented that systemic conditions may affect the oral cavity; in contrast to the oral conditions affecting the systemic health remains speculative. Since oral health is intimately related to systemic health, as mouth is truly connected to the rest of the body, the directionality of special relationships has to be clarified. The purpose of this cross sectional study was to assess the relationship between periodontal disease and poor physical fitness among the individuals attending gymnasium. Periodontal disease, as assessed using various clinical parameters, was determined to be significantly associated to poor physical fitness. This study raises the possibility that the systemic challenges resulting from periodontal disease may contribute to poor physical fitness. But at the same time we have to keep in mind that there is limited literatures available showing this inverse association as this is amongst the latest research field in periodontology.

Our findings showed a strong association of increased BMI with poor physical fitness. The overweight individuals showed statistically significant lower PFT scores compared with normal-weight individuals.

This finding has also been observed in the literature. [18] It has been suggested that the secretion of inflammatory cytokines by adipose tissue could be triggered by lipopolysacchride (LPS) of gram-negative periodontal bacteria, might leads to reduction in insulin sensitivity and hepatic dyslipidemia. These features would be enhanced in individuals with increased level of adipose tissue and would aggravate the systemic inflammatory condition which might predisposing to aggrevation or establishment of inflammatory conditions such as peridontal diseases. [19]

There is evidence supporting the idea that physical fitness is influenced by behavioral habits. In this regard, diet, BMI, physical activity, and periodontitis seem to be linked, [20] comprising a behavioral axis. It could be argued that the inverse association between periodontal status and physical fitness found in this study is related to this axis. Contrarily, it would be expected that better oral hygiene habits should be associated with better physical fitness. In the present study, higher self-reported frequencies of tooth brushing are not associated with physical fitness. Nevertheless, it has to be acknowledged that self - reported oral hygiene may not necessarily reflect the real clinical condition of supragingival biofilm control. [21]

Our study showed increased GI, PD and AL in physically unfit individuals. This is in accordance to the cross sectional observational study recently conducted in male police officers. It has been demonstrated that elevated PD and AL are associated with increased serum levels of proinflammatory cytokines. [22]

This low-grade systemic inflammatory challenge resulting from periodontal disease may explain, in part, the findings of the present study. This is plausible once there is evidence for the accumulation of in situ neutrophils, macrophages, and proinflammatory cytokines at the time of muscle injury. [11, 23] Consequently, the elevation of systemic proinflammatory cytokines observed in periodontal disease may modify the muscle metabolism locally and lead to poorer physical fitness. Additionally, periodontal disease could be linked to physical fitness by acting on sensations of fatigue, which arise from a central mechanism or from local factors at the muscle–tissue level (e.g., changes in serum levels of IL-6, IL-1ß, and TNF-α). [24] During exercise, the workload may create such an intense sensation that one reduces or even stops the exercise. Physiologically, these sensations serve to protect the body from damage and to maintain homeostasis and physical integrity. [25, 26] This defence system could be magnified by cytokines originating from the systemic response of periodontal disease, which may serve to decrease fatigue thresholds.

In this study cardiorespiratory fitness was also assessed by two mile run on a treadmill in the shortest time possible and we found an association between periodontal disease and low cardiorespiratory capacity suggesting that periodontal disease also negatively affected the cardiorespiratory fitness. This is in accordance to a study that reported periodontal disease to be associated with low level of cardiorespiratory fitness, as measured by peak oxygen uptake during exercise in a cycle ergometer. Cardiorespiratory fitness is the ability to carry out large muscle, moderate to high intensity exercise over a prolonged period of time and is measured as maximal oxygen consumption (VO_2 max), during physical exertion. [27]

It is noteworthy that regular physical activity has a protective effect and may reduce the risks of several chronic diseases associated with low-grade systemic inflammation (e.g., cardiovascular disease, type 2 diabetes, and cancer). [28] Observational studies have revealed that lower concentrations of inflammatory biomarkers are encountered in individuals who report more intense and frequent physical activity. [29] This protection is likely also found for periodontitis, [30] given the evidence associating a lack of regular physical activity with periodontitis. [31, 32] These results, along with those presented in this study, point to a possible bidirectional association between periodontitis and physical fitness/activity.

However, the findings of this study should be interpreted in light of the possible limitations of the design and methodology. We have not done the biochemical and radiographic assessment of the subjects which would have made this study more convincing and the meaningful.

CONCLUSION

Oral health has a direct and or indirect impact on the overall general health. The results of our study suggest that periodontal diseases may influence the physical fitness and affects the body's ability to function efficiently. If periodontal health and physical fitness are truly connected, the prevention and treatment of periodontal diseases should be considered at the population level inorder to ensure proper physical fitness. Dentist must recognize the emerging and increasing significance of this fact in comprehensive health care. As an explorative research field, the present study raises new questions and encourages other investigations about the same subject.

Conflict of Interest

None.

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