Original Article

Correlation and comparison of body mass index and oral health status among urban South Indian population: A pilot study

Abstract

Introduction: The prevalence of obesity has increased internationally over the last decades, and it was in the 1990s the World Health Organization considered it as a global epidemic. The link between obesity and a series of diseases has been confirmed, particularly cardiovascular diseases and diabetes. The main cause of obesity is unhealthy or unbalanced diet combined with the lack of exercise. Obesity is also associated with periodontal disease, tooth loss, overall poor oral and general health. Obesity can be measured by measuring the body mass index (BMI). Prpić *et al*. stated that persons with an increased BMI had slightly worse dental health, as represented by higher dental index (caries, periodontitis, periapical lesions, and missing teeth) regardless of their tooth brushing routines. **Aim:** To correlate the association between obesity and oral health in Indian population. **Study Design:** A total of 100 subjects were equally divided into two groups (50 study and 50 control group). The study group comprised of individuals with BMI 25-29.99 (overweight), BMI >30 (obese) and the control group comprises of individuals with BMI 18.5-24.99 (normal). Individuals with any systemic disease and any kind of deleterious habits were excluded from the study. Oral examination was performed on the subjects, which included plaque index (PI), gingival index, periodontal index, decayed missing filled teeth index and the overall oral health. A food frequency questionnaire validated with a monthly dietary record was conducted for each patient. Tooth brushing habits were also recorded. **Statistical Analysis Used:** Statistical analysis was performed by Chi-square test and student (unpaired) *t*-test. **Results and Conclusion:** There was a significant correlation between the BMI and oral health of obese individuals. The oral hygiene of obese patients was poor when compared to normal individuals.

Key words: Body mass index, decayed missing filled teeth, obesity, oral health, periodontitis

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INTRODUCTION

Obesity is a part of the first wave of defined cluster of noncommunicable diseases called New World syndrome creating an enormous socioeconomic and public health burden. The World Health Organization (WHO) has described obesity as one of today's most neglected public health problem, affecting every region of the globe.[1] Obesity is derived from the French word "*obésité*" and *Latin word "obesitas"* which means fatness or corpulence. Obesity is an unhealthy accumulation of body fat with an excessively high amount of adipose tissue in relation to lean body mass. It is the end result of an imbalance between food eaten, and energy expended.[2] An individual's risk for obesity depends approximately 70% on lifestyle and remaining 30% accounts for the genetics.[3] The impact of obesity on health status has the same outcome as 20 years of aging and exceeds the impact of smoking or alcohol abuse.[4] It is a risk factor for several chronic health conditions as well as being associated with increased mortality. A few negative health effects of obesity include hypertension, high cholesterol, heart disease, type 2 diabetes, stroke, certain cancers and periodontal disease (PD).[5]

Indians, traditionally known for malnutrition, are now reporting more frequently with cases of obesity. Undernutrition is more prevalent in rural areas whereas obesity is 3 times more common in urban population.[1] However, the scenario in the rural population is fast changing. According to a study

by Ramachandran and Snehalatha the prevalence of obesity has increased 1.7-fold in a decade, both in urban and rural population South India. The rural population showed an 8.6-fold increase in 14 years. The changing lifestyle of the rural dwellers, transport facilities, medical care, educational status and socioeconomic status were found to be contributory factors for conditions such as obesity and metabolic diseases like diabetes.[6] Obesity as well as undernutrition is more common in females when compared to males in urban and rural population. This may have an endocrine basis as well as the fact that society and cultural norms which prevent women from leading a healthy lifestyle. Though Indians mostly are normal weight individuals, they fit into the category of metabolically obese and despite having a lean body mass index (BMI), they have more chances of abdominal obesity. According to Jaipur Heart Watch obesity strongly correlates with cardiovascular risk factors, hypertension, dyslipidemia and diabetes.[1] However, there is not much data available between the correlation of obesity and oral status in Indian population.

The most common way of measuring obesity is the BMI. The BMI represent the weight levels associated with the lowest overall risk to health and is an indicator of overall adiposity. Other ways to measure obesity include waist circumference, waist to hip ratio and total body fat.[2] Studies have pointed out an association between oral conditions and BMI.[1,2,7] Prpić *et al.* stated that persons with an increased BMI had slightly worse dental health, as represented by higher dental index with respect to caries, periodontitis, periapical lesions, and missing teeth.[7] Literature search reveals only few studies comparing the relation of BMI and oral health while no such study has been carried out in the Indian population. Thus, a pilot study was carried out to correlate the association between obesity and oral health among urban South Indian adult population.

MATERIALS AND METHODS

The study included 100 subjects divided into study and control groups of 50 each. The study was commenced after obtaining ethical clearance from the Institutional Ethical review board. Individuals were selected based on their BMI as study and control groups.

BMI was computed by the formula : $\frac{\text{Weight (kg)}}{\text{Height}^2\ (\text{m}^2)}$

Later individuals were categorized into normal, overweight and obese based on the WHO criteria. Study group comprised of individuals with BMI >30 (obese) and BMI of 25-29.99 (overweight), whereas control group included individuals with BMI from 18.5 to 24.99 (normal).[8] Exclusion criteria for both study and control groups included subjects with any systemic diseases and deleterious habits. Written informed consent was obtained from the subjects prior to conducting the study.

Oral examination was performed on the subjects, which included missing teeth, caries index (decayed missing filled teeth [DMFT] index), periodontitis (Russel's periodontal index), gingival index (GI) (Loe and Silness), caries index, PI (Silness and Loe) and the overall oral health. A food frequency questionnaire validated with a 3 days dietary record was conducted for each patient. The questionnaire was adapted from Pandey *et al.* and modified according to our study population wherever necessary[9] [Table 1].

Mean and standard deviation for scores of individuals were determined and compared between study and control group. Statistical analysis was performed by Chi-square test and student (unpaired) *t*-test. The values were considered statistically significant when $P < 0.05$.

RESULTS

Of 100 subjects, 56 were males and 44 were females aged between 22 and 38 years. This young age group was considered because systemic diseases are much more common with the older age group and the dental indices would be affected by aging in older individuals. In the present study, when we compared the age and gender of the study and control group, no statistically significant correlation was observed [Tables 2 and 3]. A significant correlation was seen on a comparison of BMI and basal metabolic rate (BMR) between the study and control group. A significant correlation was seen on comparison of the dental indices between the study and control group that is, gingival, plaque, periodontal and DMFT indices which were higher in the study group [Table 4]. A significant correlation was seen in the frequency of consumption of high-calorie foods ($P \leq 0.01$) between the study and control group [Table 5]. Study group consumed the high-calorie foods on a daily and weekly basis (60%) as compared to the control group (6%). High-calorie foods included food items apart from the daily consumption of sugars and other calorific foods consumed on a daily basis (cheese, butter, junk food).

DISCUSSION

Adipose tissue is loose connective tissue composed of cells called adipocytes, which stores energy, insulates and cushions the body and functions as a reserve of nutrients. Adipose tissue is located beneath the skin and around the internal organs, providing insulation and protection.[1] Adipose tissue is an active endocrine organ secreting cytokines and protein mediators collectively called as adipokines. Adipokines secreted include tumor necrosis factor alpha (TNF-α), interleukin 6 (IL-6), IL-8, and plasminogen activator inhibitor-1 (PAI-1). These cytokines are secreted in proportion of adipose tissue present in the body. Several of these adipokines are enhanced in obese patients with a large amount of adipose tissue.[10]

The prevalence of obesity has increased internationally over the last decades, and was in the 1990s considered by the WHO as a global epidemic.[11] A first simple explanation for the cause of obesity is poor health conditions that would lead to unbalanced food choices, thus promoting obesity. Second recent reviews have suggested that the potential impact of infectious agents and a new concept called infectobesity' has been developed, referring to obesity from infectious origin. Accordingly, high levels of firmicutes in gut microflora have been associated with obesity and similar

Table 1: Food frequency questionnaire

Date: __/__/13
Personal details
Name: _____
Age: _____years
Gender: Male/female
Occupation: _____
Address: _____
Height: _____m
Weight: _____kg
Body mass index: _____
Items in food frequency questionnaire

Food items	Daily	Weekly	Fortnightly	Monthly
Snacks				
Cake/pastry				
Chocolate				
Ice cream				
Custard/pudding				
Biscuits				
Samosa				
Potato chips				
Burgers				
Pizza				
Chaat				
Pakoda				
Dry fruits				
Pav bhaji				
Milk and milk products				
Milk				
Yoghurt				
Buttermilk				
Fats and oils				
Cream				
Butter				
Vegetable oils				
Ghee				
Cheese				
Egg and meat				
Egg				
Mutton				
Fish				
Chicken				
Cereals				
Cornflakes				
Bread				
Roti				
Puri/paratha				
Rice				
Noodles				
Pulses				
Beverages				
Carbonated drinks				
Fruit juices				
Tea				
Coffee				
Fruits				
Vegetables				
Sugars				
Jaggery				
Jam				
Honey				

Breakfast: _____
Lunch: _____
Dinner: _____
Plaque index (silness and loe): _____
Gingival index (loe and silness): _____
DMFT index: _____
Decayed: _____
Missing: _____
Filled: _____
Periodontal index (russel): _____
Other oral findings: _____
Patients signature: _____

Table 2: Gender distribution between two groups

Group	Gender		Total	*P*
	Female	Male		
Study (%)	23 (46)	27 (54)	50	0.687
Control (%)	21 (42)	29 (56)	50	

Table 3: Age distribution between two groups

Group	Age (years)	*P*
Study	29.4±7.63	0.81
Control	27.1±4.61	

Table 4: Comparison of various dental indices between study and control group

Group	PI	GI	DMFT	Perio index
Study	1.25±0.24	1.19±0.26	3.78±3.16	1.12±0.29
Control	0.91±0.19	0.94±0.14	2.02±2.18	0.94±0.11
P	<0.01	<0.01	<0.04	<0.01

PI = Plaque index, GI = Gingival index, DMFT = Decayed missing filled teeth

Table 5: Comparison of food frequency of high calorie foods in the study and control group

Group	Daily	Weekly	Fortnightly	Monthly	Total	*P*
Study (%)	6 (12)	24 (48)	20 (40)	0	50	<0.01
Control (%)	0	3 (6)	18 (36)	29 (58)	50	

bacteria species have been found in the gut and dental microflora. Inflammation and insulin resistance have also been associated with obesity.[12]

The link between obesity and a series of diseases has been confirmed, particularly cardiovascular diseases and diabetes. General health and oral health share similar causal and behavior mechanisms and the self-perceived oral health of an individual has been related to general health.[11] Previous studies have pointed out an association between oral conditions and BMI although the nature of this association remains poorly understood.[12]

Benguigui *et al.* did a study correlating BMI and oral health, including the systemic diseases such as hypertension, diabetes as well as patients with habits (smoking, alcohol consumption). The study also included molecular markers such as triglycerides, cholesterol, etc.[12] As cardiovascular disease and systemic conditions like diabetes are known to have a negative effect on periodontal health, we intended to study whether obesity has any effect on the oral health status excluding the systemic diseases and habits.

The aim of the present study was to correlate the BMI to oral health of the individuals as determined by food habits, plaque index (PI), GI, DMFT score and periodontal index. It was found that no significant correlation was seen in the age and gender of the study and control group. A significant correlation was noted between BMI and BMR of the study and control group.

It was observed that the index score was higher in the study group as compared to the control group. The study group subjects had a greater proportion of PD as compared to the control group. Obesity may have the potential for transforming the hosts immunity and inflammatory system causing the patient to be more at risk to the effects of microbial plaque. Furthermore, obesity contributes by producing pro-inflammatory cytokines (TNF-α and IL-8). TNF-α plays a significant role in the pathogenesis and development of periodontitis. TNF-α negatively affects the host immunity in periodontal tissue causing obesity to function as a risk factor for PD. Thickening of periodontal blood vessels is observed in obese patients who are caused by the adipokine PAI-1, and this diminished blood flow may promote the development of periodontitis. Increased TNF-α serum levels may initiate or intensify preexisting PD in several ways. TNF-α may stimulate fibroblasts to synthesize matrix-degrading enzymes. It may also stimulate osteoclasts leading to bone loss.[2]

Benguigui *et al.* studied the link between BMI and several oral health markers, after adjustment for dietary patterns and plasma insulin on 186 French subjects. BMI was statistically associated with missing teeth, pocket depth and PI, but not with clinical attachment level (CAL), GI or periodontitis. The authors explained this association based on that PI reflects the level of clinical dental plaque at tooth surface and PD reflects the periodontal inflammation associated with specific pathogens involved in PD, both are associated with current inflammatory and infectious processes. On the other hand, CAL, which is rather linked with bone loss than to current inflammatory or infectious processes, was not significantly associated with BMI.[12]

Prpić *et al.* conducted a research to determine whether oral health was related to BMI using a cross-sectional design for 292 subjects. Measurements of weight and height, education level and frequency of tooth brushing were also recorded. The various dental factors associated with obesity include caries, periodontitis, periapical lesions, infections and missing teeth. BMI was most dependent upon the number of missing teeth (88.6%), followed by the number of carious lesions (8.3%).[7] Missing teeth appear to be only a surrogate variable for dietary pattern or metabolic disturbances.[11] People with fewer teeth have difficulty in chewing food and as a result increase amount of fat reached the gut, where the firmicute bacteria develop more energy from such food types leading to obesity.[13]

In our study, BMI was most dependent on the number of decayed teeth followed by the missing teeth. The subjects with high calorific intake had a higher caries incidence when compared to others. Several other studies have established a correlation between BMI and dental caries depending upon the food habits.[14-16]

Oikarinen *et al.* did a study correlating BMI and periodontal index in nonsmoking older individuals. The main finding was that 75-year-old or older persons with elevated body weight were not more likely to have signs of periodontal infection. However, the relative risk of deepened periodontal pockets was higher in subjects having BMI between 25 and 29.99 and BMI >30 when compared to subjects with BMI <25.[17]

The limitations of our study are not including the patients with systemic disease, some of which may affect the BMI and periodontal status of an individual. Furthermore, patients with habits were excluded from the study. We did not include the individual markers and confounding factors at a molecular level which may lead to obesity. Furthermore, subjects self-reported their dietary intake which may be a source of bias.

CONCLUSION

Thus, we conclude that there is a definite correlation between BMI and oral health status of the individual. Although our study has certain limitations, it identifies dental indices as a major independent factor related to obesity. Obesity has a negative effect on the person's overall health. Promotion of healthy nutrition and adequate physical activity may help prevent or slow progression of obesity.

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