

Obesity- Caused by a germ?

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Abstract- Obesity has reached epidemic proportions in India in the 21st century, affecting majority of the country's population both young and old. The pathophysiology of obesity has been attributed to various etiological factors such as hormones, diet, genetic and inflammatory nature. The microbiotas in the mouth have a significant impact on both the oral and general health. The salivary microbiota is a potential diagnostic indicator of several diseases. Recent research suggests that the composition of salivary bacteria changes in overweight subjects, and it is likely that *Selenomonas noxia* could serve as biological indicator of a developing overweight condition.^{1, 2} Culture –independent techniques are required to study the salivary microbial community since many of its members have not been cultivated³.

Recently an infectious nature of obesity is being explored and the role of single bacterial species (*Selenomonas noxia*) in saliva has been suggested in pathology that leads to obesity. *Selenomonas noxia* is a normal commensal of the oral cavity,⁴ however its count has been reported to have increased significantly in obese individuals, suggesting its direct or indirect role in the etiology of obesity.

Hence, the present study was conducted to evaluate the salivary populations of *Selenomonas noxia* in obese individuals, in order to explore their reliability as a biological indicator of obesity. Quantitative bacterial population were measured by Real-time PCR based on SYBR-Green I fluorescence in the saliva of obese and non-obese individuals.

Index Terms- Obesity, *Selenomonas noxia*, Real time PCR based on SYBR Green I fluorescence four.

I. INTRODUCTION

Obesity is one of the greatest health challenges of our time affecting a vast majority of the population of all age groups and is increasing at an alarming rate. Obesity rates have doubled in adults and tripled in children and adolescents over the last two decades⁵. It is a growing epidemic in many developed countries, and is arousing concern in developing countries.⁵

Obesity results from alterations in the body's regulation of energy intake, expenditure, and storage. Obesity is also caused by excessive calorie intake combined with inadequate amounts of physical activity. Obesity can also be caused by metabolic disorders.⁶

Recent evidence, primarily from investigations in animal models, suggests that the oral microbiota affects nutrient acquisition and energy regulation^{6, 7}. Obesity has also been shown repeatedly to be associated with an increased risk of mortality. Though a

number of treatment modalities have been suggested but none of them guarantees a permanent relief. Obesity is characterized by the abnormal or excessive deposition of fat in the body. It not only has adverse metabolic effects on health but also enhances oxidative stress.

The microbiota in the mouth has a significant impact on both the oral and general health. The bacteria of the oral cavity can be altered in disease conditions such as oral cancer and dental caries. These associations can be useful in diagnosis and potentially reflect an underlying etiology.¹ The salivary level of the bacterium *Selenomonas noxia* which is a motile, crescent-shaped, nonspore-forming, Gram-negative bacteria correlates with obesity^{1, 3}.

With the recognition of *Selenomonas noxia* as a potential contributor to obesity, quantitative bacterial population was measured by Real-time PCR based on SYBR-Green I fluorescence in the saliva of obese individuals and was compared with the levels of the same in the saliva of the non obese individuals.

II. MATERIALS AND METHODS

The present study was conducted on 21 obese subjects between the ages of 20 and 45 yrs. Age and sex matched individuals served as controls. All the subjects were recruited from the outpatient department of our institute. Individuals with chronic illness and long term medication were not included in the study.

Ethical clearance for undergoing the study was obtained from the Institutional Ethical Clearance Committee.

The obese group constituted of 21 individuals with body mass index (BMI) ranging from 27 and 32. Whereas 23 individuals with BMI < 27, with no known systemic diseases were recruited as controls.

2 to 3ml of unstimulated saliva was obtained from each subject in a sterile bottle by expectoration. Quantitative salivary bacterial population of overweight and control subjects was measured by Real-time PCR based on SYBR-Green I fluorescence. It is an assay based on SYBR-Green I binding that is quick, reliable, easily optimized and demonstrates its general applicability by measuring copy number in different genetic contexts⁹

III. STATISTICS

Data analysis was carried out using the statistical software package. The level of significance was accepted at *P* values <0.001(Table 1). For statistical analysis ANOVA, and χ^2 test were used.

IV. RESULTS

As part of the study, salivary bacterial populations in 21 obese and 23 control individuals were measured targeting *Selenomonas noxia* by Real-time PCR based on SYBR-Green I fluorescence assay. It was observed that (*Selenomonas noxia*) microbial profiles differed markedly between obese individuals and controls and this difference was statistically significant. ($P<0.001$)(Table 1)

Table 1: Characteristics of the subjects

Variables	Obesity (n=21) Mean (s.d.)	Controls (n=23) Mean (s.d.)	p value
Male/female	12/9	13/10	1.000*
Age (years)	34.71 (1.31)	34.13 (1.33)	0.378+
Weight (kg)	86.28 (10.28)	60.69 (4.23)	<0.001+
Height (m)	1.66 (0.10)	1.64 (0.11)	0.345+
BMI (kg/m²)	31.04 (2.10)	18.21 (1.9)	<0.001+
<i>Selenomonas noxia</i>	27.72 (2.56)	19.6 (1.61)	<0.001+

* Chi square test χ^2 as statistical method

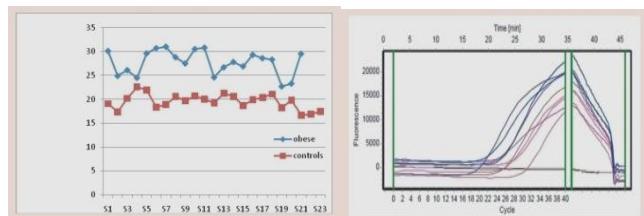
+ ANNOVA as statistical method

This study reveals that specific bacteria (*Selenomonas noxia*) levels in the human mouth are higher in obese individuals when compared to that of non obese. (Table 2) Thus, *selenomonas noxia* species of bacteria may have some role, direct or indirect in the etiology of obesity.

Our results are in accordance with the observations made by **Goodson et al 2009**, who concluded that *Selenomonas noxia* levels in saliva may serve as biological indicator of obesity.¹

Cecilia et al 2012, studied association between obesity and sum of bacterial cells in the oral subgingival biofilm indicates a possible link between oral microbiota and obesity in adolescents.⁸

Table 2: *Selenomonas noxia* levels in obese and non obese group.



V. DISCUSSION

Analysis of the salivary microbiome may have implications in diagnostics e.g. in detection of microorganisms and viruses without designing specific tests for each pathogen². Bacteria that live in the human mouth may act as biological indicators of gaining excess weight, and may even participate in the disease process that leads to obesity.

The results of this study suggest that *Selenomonas noxia* profiles differed in saliva of overweight individuals when compared to

with the levels in the saliva of healthy individuals and were statistically significant.

Selenomonas noxia could be considered a disease candidate. The genus *Selenomonas* in general, are motile, crescent-shaped, non-spore-forming, Gram-negative bacteria which actively ferment glucose to produce propionic acid, and are obligate anaerobes found in both the mouth and the gastro-intestinal tract.¹

As reported by **Di Baise et al 2008**, several findings indirectly support the hypothesis that oral bacteria could be related to obesity.⁶

Studies conducted on animals demonstrated that gut microbiota promoted absorption of monosaccharides in mice, which resulted in lipogenesis. The authors hypothesized that individuals predisposed to obesity may have gut levels of Firmicutes that promote more efficient extraction and/or storage of energy from a given diet, compared with lean individuals, and that intentional manipulation of gut microbiology may be useful for controlling weight in overweight individuals^{1,6}.

Although these studies focused on gut bacteria, all gastrointestinal bacteria pass through the oral cavity at some time, and some of those transients might be located in, if not seeded from the oral cavity.^{1,6}

Selenomonas noxia were significantly higher in tissue surfaces other than saliva, lateral and dorsal surface of tongue (**Mager DL et al. 2003**)⁴.

In a different context, investigators suggested that obesity may spread in social networks in a quantifiable and discernable pattern that depends on the nature of social ties. They studied the social interactions between overweight and non-overweight humans (**Nicholas and Christakis, 2007**) and found that obesity appears to spread through social associations. This was true of siblings and spouses, but not of neighbours.^{1,9}

Researchers from Forsyth Institute, Boston, and Piracicaba Dental School, State University of Campinas, Piracicaba, São Paulo, Brazil conclude that it seems likely that these bacterial species could serve as biological indicators of a developing overweight condition.^{1,2} Future research will investigate the role oral bacteria plays in the pathology that leads to obesity^{1,5}

Tumor necrosis factor- α (TNF α) is one of many pro-inflammatory cytokines produced by diseased periodontal tissues that could be a pivotal inflammatory cytokine encouraging obesity. TNF α increases insulin resistance, induces C-reactive peptide production, and inhibits adiponectin, an important anti-inflammatory adipokine.¹ TLRs and adapter proteins were overexpressed in peripheral blood mononuclear cells (PBMCs) from obese subjects, which correlated with increased expression of TNF- α and IL-6. This association may explain a potential pathophysiological link between obesity and inflammation leading to insulin resistance. (**Rasheed Ahmed et al 2012**)¹⁰

Periodontal treatment is effective in reducing blood levels of TNF- α and C-reactive protein. By this mechanism, periodontal bacteria would be seen to stimulate the formation of

inflammatory cytokines such as TNF α that divert energy metabolism to lipid synthesis may contribute to obesity.^{1,11}

The scientists (**Goodson et al 2009**)¹ suggests three possibilities: first oral bacteria may increase metabolic efficiency, reducing the amount of food the body burns – a speculative process called “infectobesity”.

Another possibility is that the oral bacteria can increase weight gain by increasing appetite – by stimulating your desire to chow down, the bacteria get more to eat, too.

A third hypothesis is that oral bacteria facilitate insulin resistance, screwing with your cellular metabolism so your body stores food as fat instead of burning it off.

Any small excess in calorie consumption with no change in diet or exercise could result in unacceptable weight gain by any of these mechanisms.¹ *Selenomonas noxia* represented a large percentage of the oral bacterial population and were significantly higher in tissue surfaces other than saliva, lateral and dorsal surface of tongue (**Mager et al., 2003**)^{1,4}.

As suggested by **Goodson et al 2009** it is not justified to suggest that *S. noxia* infections have an etiologic role in obesity.^{1,2} However, based on the data obtained in our study and several other similar studies, it is reasonable to suggest that *S. noxia* may be an indicator of change in oral microbial ecology.

The reasons for a relationship between obesity and oral bacteria are undoubtedly complex and varied. The relationship may be circumstantial, as being related to diet. It could be opportunistic, such as proliferation driven by metabolic changes that have occurred in the host. It could also be causal, as participating in initiation or propagation of the disease. Whatever the reason, it is clear that the parallel microbiological universe that travels with man changes, as man changes, and appears to be affected by a tendency to gain weight.^{1,2}

VI CONCLUSION

Thus, from our study it may be concluded that even in Indian population, there is a definite increase in levels of *Selenomonas noxia* in saliva of obese people when compared to those of non obese. This implies that, these bacteria may have some role, either direct or indirect in the etiology of obesity. However, further studies on larger sample size and individuals with different socioeconomic status may be required to clarify this

relationship between oral bacteria (*Selenomonas noxia*) and obesity.

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