

Relationship Between the Body Mass Index and Oral Health

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ABSTRACT

The Body Mass Index (BMI) is a measure which relates patient weight and height. A higher BMI score indicates greater risk for developing serious health problems, such as heart disease, stroke and diabetes. **Objective:** To examine the relationship between BMI and oral health in both a cross-sectional and longitudinal survey of adults. **Methods:** Five hundred five subjects were enrolled and clinical measures, including gingivitis (GI), gingival bleeding and pocket depth (PD) were collected at two visits separated by two years. At the second visit, blood samples were collected and analyzed for whole blood and serum biomarkers which are considered potential correlates to periodontal disease severity/activity. All subjects were weighed and measured and BMI was calculated. Relationships between biomarkers and BMI were computed using a Pearson correlation. Analyses relating clinical parameters and BMI were computed using an F-test. **Results:** Significant positive relationships were identified between BMI and Apolipoprotein B; C-reactive Protein, uric acid, white blood cells, eosinophils, lymphocytes and red blood cells ($p < 0.05$). There was a negative relationship between BMI and Apolipoprotein A-1 and folic acid ($p < 0.001$). For overall GI severity and total bleeding, subjects with higher BMI scores had significantly more gingival inflammation and bleeding, ($p < 0.01$). Subjects with higher (and very low) BMI scores had significantly deeper mean PD, ($p < 0.001$). In addition, the percent of subjects who had at least 1 site progress was significantly greater with higher BMI ($p < 0.01$) and those that had higher BMI scores had fewer sites which improved over 2 years ($p < 0.05$). When the data were corrected for dental care habits, the same relationship exists indicating an underlying impact of BMI on oral health. **Conclusions:** In general, BMI has a positive relationship with pro-inflammatory markers and inverse relationship with antioxidants. BMI scores are related to oral health and may be a confounder of disease status.

INTRODUCTION

The Body Mass Index (BMI) is a method which relates weight to height in order to establish a level of risk for certain weight-related diseases.

Typically, a high BMI score indicates a high level of body fat and a higher risk of developing diseases, such as heart disease, stroke and diabetes. Further understanding of the biological mediators that may be involved in the development of such diseases has demonstrated that excess body weight may be associated with chronic low-grade inflammation, presumably related to adipocytes which are catalysts for these mediators. Given the chronic nature of periodontitis, several groups have examined and reported the existence of a relationship between BMI and periodontitis (Saito et al., 1998, 1999; Grossi and Ho, 2000; Elter et al., 2000). The purpose of this study was to better understand the relationship between BMI and oral health in both a longitudinal and cross-sectional survey of a North American adult population.

MATERIALS AND METHODS

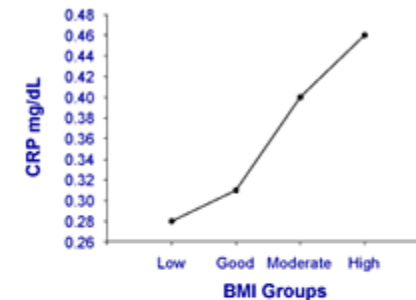
Five hundred five subjects were enrolled in this two year, longitudinal trial to examine relationships among clinical measures with self-reported personal and family medical/dental histories and personal oral care habits/practices. Participants completed a questionnaire consisting of a series of questions regarding personal and family medical/dental histories, along with personal habits and attitudes regarding oral health. Blood was collected via venipuncture for analysis of complete blood count (CBC) with differential cell count, C-reactive protein (CRP), folate (both serum and red blood cell) and uric acid. Clinical evaluations were comprised of examinations for gingivitis/bleeding using the Löe-Silness Gingival Index and pocket depth using a manual periodontal probe. A subset of subjects returned to the clinic for fasting blood collection for Apolipoproteins A1 and B (N=226). All subjects were weighed and measured and BMI was calculated using the following formula:

| | |
|--|--|
| Weight (lbs.)* 700/height (in.) ² | BMI < 19 = Health risk ("Low") BMI of 19-25 = Healthy ("Good") BMI of 26-27 = Moderate health risk ("Moderate") BMI > 27 = Significant health risk ("High") |
|--|--|

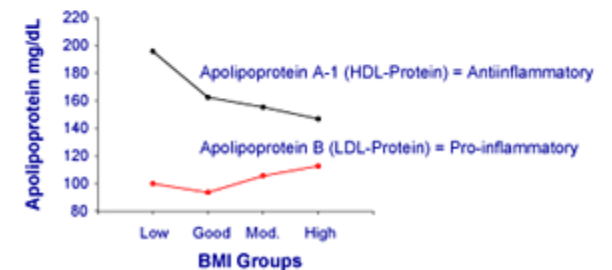
Relationships between biomarkers and BMI were computed using a Pearson correlation. Analyses relating clinical parameters and BMI were computed using an F-test.

RESULTS

C-Reactive Protein vs. BMI Group



Apolipoproteins vs. BMI Group



RESULTS (cont.)

Table 1. Summary of BMI and Biomarkers

| Biomarker | BMI Relationship | P-value |
|--------------------|------------------|----------|
| Apolipoprotein A-1 | Negative | 0.00003 |
| Apolipoprotein B | Positive | 0.0001 |
| C-Reactive Protein | Positive | 0.009 |
| Folic Acid | Negative | 0.0009 |
| Uric Acid | Positive | <0.00001 |
| White Blood Cells | Positive | 0.008 |
| PMNs | Negative | 0.07 |
| Lymphocytes | Positive | 0.04 |
| Eosinophils | Positive | 0.05 |
| RBCs | Positive | 0.0002 |

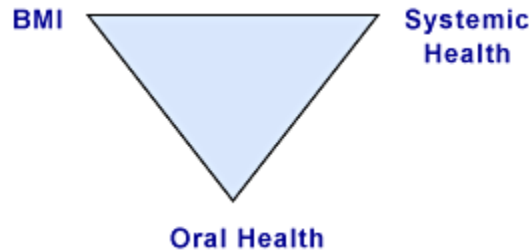
Table 2. BMI and Clinical Parameters

| X-Sectional Measurement | BMI | Mean | P-value |
|-------------------------|--------------------|------|---------|
| GI | 15.1-29.1 N=604 | 0.56 | 0.002 |
| | 29.1-61.4 N=362 | 0.66 | |
| PD | 15.1-24.2 N=300 | 2.26 | 0.0008 |
| | 24.2-61.4 N=669 | 2.33 | |
| LONGITUDINAL DATA | | | |
| PD change (≥2mm) | <19 N=9 | 8.44 | 0.0002 |
| | 19-25 N=168 | 2.45 | |
| | >26 N=311 | 4.29 | |

Significant positive relationships were identified between BMI and Apolipoprotein B; C-reactive Protein, uric acid, white blood cells, eosinophils, lymphocytes and red blood cells (p<0.05). There was a negative relationship between BMI and Apolipoprotein A-1 and serum folic acid (p<0.001).

For overall GI severity and total bleeding, subjects with higher BMI scores had significantly more gingival inflammation and bleeding, (p<0.01). Subjects with higher (and very low) BMI scores had significantly deeper mean PD, (p<0.001). In addition, the percent of subjects who had at least 1 site progress was significantly greater with higher BMI (p<0.01) and those that had higher BMI scores had fewer sites which improved over 2 years (p<0.05). The relationship between BMI and gingival bleeding and PD did not change when gender was also considered.

The cross-sectional data demonstrated that there were significant differences in periodontal health when stratified by BMI. One possible explanation for this relationship is that subjects with similar BMI scores had similar dental care habits. The data were corrected for dental care habits including: toothbrushing frequency, frequency of dental visits, flossing frequency and smoking history. There was little change in the relationship between BMI and the clinical variables, indicating an underlying impact of BMI on oral health.



CONCLUSION

In general, BMI had a positive relationship with pro-inflammatory markers and an inverse relationship with antioxidants in this study. These inflammatory changes were evident in the oral cavity as well, with higher BMI scores associated with higher levels of periodontal disease. Interestingly, subjects with higher BMI scores also had significantly more progression of periodontal pockets over 2 years.

BMI may be a confounder of disease status, both systemically and specifically in the oral cavity. This relationship appears to be independent of oral care habits.