Body Mass Index (BMI) and Dental Caries: Analysis of the Dental, Oral, Medical Epidemiological (DOME) Nationwide Big Data Study Using Machine Learning and Statistical Models

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Introduction

The evidence in the literature of an association between BMI and caries was inconsistent , with some studies showing that increased BMI is associated with a higher burden of dental caries..

Aims

To analyze the association between BMI and dental caries using novel approaches of both statistical and machine learning models while adjusting for cardiovascular risk factors and metabolic syndrome components, consequences, and related conditions.

Materials and Methods

DOME repository

Central demographic database
- Age and sex
- Education
- IQ
- Socio- economic status
- Origin and
- birth countries.

Medical record – CPR
- Medical diagnoses
- Blood test results
- General physical test
- Health related habits
- Medical visits

Dental Patient Record
- Dental diagnoses.
- Planned anddelivered dental procedures.
- Dental health related habits
- Dental visits

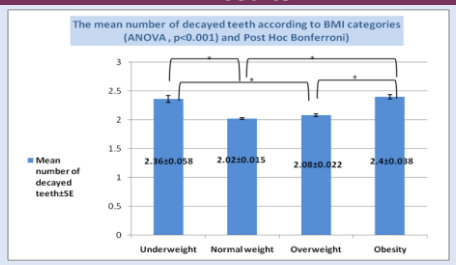
Operational source systems

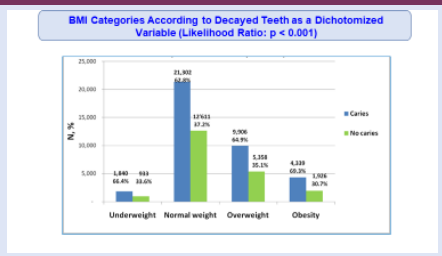
Flow chart of data analyses approach

Step 1. Statistical model-univariat analysis of different variables according to BMI categories → Step 2. Statistical models-carious teeth according to BMI categories in different multivariate models → Step 3. Machine Learning mod with the dichotomous target variable of decayed teeth → Step 4. Machine Learning model with obesity set as a target variable

Results

WHO CLASSIFICATION OF WEIGHT STATUS		
WEIGHT STATUS	BODY MASS INDEX (BMI), kg/m^2	N=66,790
Underweight	<18.5	3113, 4.7%
Normal range	18.5 – 24.9	38924, 59.2%
Overweight	25.0 – 29.9	16966, 25.8%
Obese	≥ 30	6736, 10.2%
Obese class I	30.0 – 34.9	5137 (76.2)
Obese class II	35.0 – 39.9	1273 (18.9)
Obese class III	≥ 40	326 (4.8)



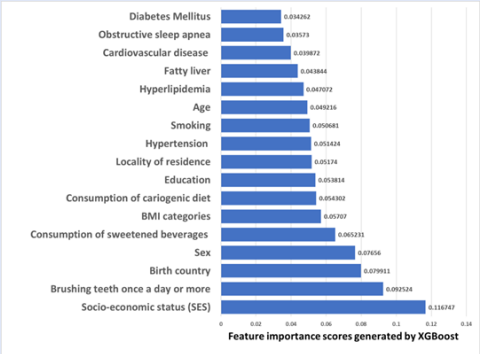


Compared to normal weight (2.02±2.79), the number of decayed teeth was statistically significantly higher in subjects with obesity [2.40±3.00; OR=1.46 (1.35-1.57)], underweight [2.36±3.04; OR= 1.40 (1.26-1.56)] and overweight [2.08±2.76, OR=1.05 (1.01-1.11)].

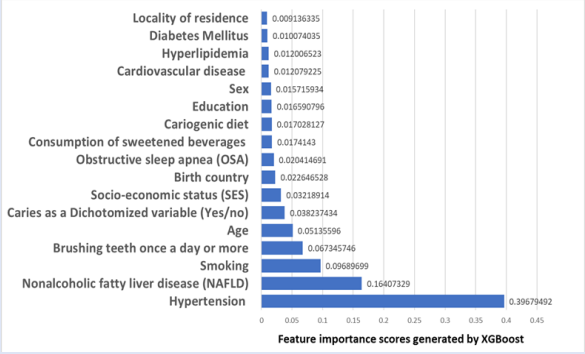
Following multivariate analysis, the associations persisted for obesity [OR=1.56 (1.39 -1.76)] and underweight [OR=1.29 (1.16-1.45)], but not for overweight [OR=1.11 (1.05-1.17)].

Variable	BMI categories			
	Normal	Underweight	Overweight	Obesity
Model 1 -unadjusted decayed teeth vs. BMI categories				
OR and 95%CI	1	1.40 (1.26-1.56)	1.05 (1.00-1.11)	1.46 (1.35-1.57)
Model 16-adjusted for age, sex, education, SES and locality, birth country, hypertension, diabetes, hyperlipidemia, NAFLD, OSA, cardiovascular disease, smoking , brushing teeth , cariogenic diet and sweetened beverages				
OR and 95%CI	1	1.18 (1.004 -1.39)	1.04 (0.96-1.13)	1.56 (1.39 -1.76)

Features Importance for Caries as a dependent Variable according to XG Boost Machine Learning Algorithm. BMI categories ranked fifth in features importance after well-known risk factors of caries (AUC=0.60, Accuracy 0.66)



Features Importance for Obesity According to XG Boost Machine Learning Algorithm, with teeth brushing ranked fourth and dental caries ranked sixth in features importance. (AUC=0.702, Accuracy=0.896)



Conclusions

***The study demonstrates a positive association between underweight and obesity BMI categories and caries, independent of the socio-demographic, health-related practices, and other systemic conditions related to Metabolic Syndrome that were studied.**
*** Better allocation of resources is recommended, focusing on populations underweight and obese in need of dental care. .**