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Basic Statistics for Medical Sciences

Cover Sheet

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| CANDIDATE NUMBER:  JCZZ8 |
| SUMMATIVE ASSESSMENT TITLE:  Statistical analysis of the association between hypertension and gender and between Body Mass Index (BMI) and gender. |

**INTRODUCTION**

Between 1988 and 1994 data from 7,012 men and women across the US was collected for the Third National Health and Nutrition Examination Survey (NHANES III). Data obtained included demographic, socioeconomic and health-related variables, together with medical and dental examinations, in order to assess the health status of the US population. From this data it has been hypothesized that women have a lower risk of hypertension compared to men, and also that women have a higher BMI than men. In this report, both relationships will be assessed, using Mantel-Heanszel analysis and linear regression respectively.

**METHODOLOGY**

***Variables***

This sample included demographic (Age, Ethnicity, Gender and Education Years), socioeconomic (Poverty Quartile and Dental Insurance) and health-related variables (History of Diabetes, Metabolic Syndrome, BMI, History of Heart Attack, Perceived Oral Health, Perceived General Health and Hypertension). Both Age and Education were presented as continuous and categorical variables, continuous variable was used for the descriptive analysis and categorical for the association analysis. Continuous BMI was categorized into 4 groups: Underweight (<18.5), Normal (18.5-<25) Overweight (25-<30) and Obese (>30). However, association analysis could not be run on the underweight category as it contained very few individuals, therefore underweight and normal individuals were merged into one group. Smoking was categorized into 3 different groups: Non-Smokers (0 cigarettes per day), Mild Smokers (1-19 CPD) and Heavy Smokers (20+ CPD).

***Summary of the Sample***

Table1 summarizes collected data by gender. The sample included more females than males, but mean age was similar for both categories. A higher proportion of men suffered from metabolic syndrome or periodontal disease or had had a heart attack. In terms of BMI more women were classified as obese in comparison to men (34.44% vs. 19.04%) which resulted in women’s BMI average being higher than men’s (27.45 vs. 26.45). Men also smoked more, both mild and heavy smokers and suffered from hypertension at a higher proportion than women (19.86% vs. 15.45%).

Age, BMI and Smoking were checked for normality. Neither age or smoking are normally distributed, as the population is rather young on the study and most of the participants are non-smokers (73,65%). BMI is almost normally distributed but slightly positively skewed and heavy-tailed.

***Missing data***

Missing data was high for Metabolic Syndrome (11,27% of non-responders), Dental Insurance (24,16%) and Poverty Quartile (9,24%) but minimal in the other variables (below 1,5%). To avoid variability in the sample size, only the 4,196 individuals with complete data were assessed during the association study. Despite 2,816 individuals not being considered, the power of the study remained above 95% and was not compromised.

**MANTEL-HEANSZEL ANALYSIS FOR THE ASSOCIATION BETWEEN GENDER AND HYPERTENSION**

The descriptive study showed women suffered hypertension at a lower proportion than men, with 15.73% of women being hypertense compared to 19.04% of men. Crude odds for having hypertension were 0.709 lower for women than men (p<0.001) suggesting a protective effect for women in hypertension.

To confirm this hypothesis, this association was checked for effect modifiers and confounders. First, each variable or risk factor was checked for association with both the exposure (Gender) and the outcome of interest (Hypertension) using Chi Squared test (Table 2). A p-value<0.05 was considered significant, and variables with such p-values were presumed associated with either Gender, Hypertension or both. While confounders must be associated with both the outcome and the exposure, effect modifiers do not need to be related to both. Variables considered are pointed in Table 2. Both Perceived General Health and Perceived Oral Health did not meet the p-value threshold for association with Gender, however the difference is minimal, therefore were considered potential confounders and effect modifiers as well. None of these variables were believed to be the causal path between Gender and Hypertension.

Second, to confirm effect modifiers and confounders, test of homogeneity of stratum-specific odds ratio (OR) was carried out and change in adjusted OR was calculated (Table 3). P-value for homogeneity was checked to be greater than 0.05 for potential confounders and Ethnicity, Educational Years, Smoking, Heart Attack, Perceived General Health and Perceived Oral Health met this criterion. However, when next assessing the change in OR for those variables, only Smoking, Heart Attack and Perceived General Health had a significant change (10.00%, 8.62% and 7.24%, respectively) and therefore were considered significant confounders.

For effect modifiers the p-value for homogeneity was checked to be below 0.05 to verity different that stratum-specific OR differed between categories. Four variables met this criterion: Age, BMI, Dental Insurance and Periodontal Disease. To further validate, homogeneity tests were run again controlling for the confounders (Data not shown) and Periodontal Disease did not meet the threshold (homogeneity p-value = 0.160) and therefore was not considered an effect modifier. Still the interpretation of results with three effect modifiers is almost impossible. Therefore, only Age was considered as it showed the most significant p-value for homogeneity (p<0.001). Besides, Dental Insurance had 25% missing data that were dropped and this could have biased the results, and BMI results depended highly on how the data was categorized, as when it was tested as a binary variable (Underweight & Normal and Overweight & Obese) it did not come out as an effect modifier (Data not shown).

The results show that when adjusting for Smoking, Heart Attack and Perceived General Health, there is significant relationship between Gender and Hypertension in individuals aged between 17-30 and 31-44. It is especially significant among 17-30 individuals, where the odds of women having hypertension is 0.116 times lower than the odds for men. For 31-44 individuals being a woman still has a protective effect though the magnitude is reduced and odds of hypertension in women are 0.325 times lower compared to men. For 45-65 individuals there could be a possible association (p-value=0.052) however it is weaker compared to younger categories (0.740 OR) and this protective relationship is inexistent for 66+ individuals.

**LINEAR REGRESSION ANALYSIS FOR THE ASSOCIATION BETWEEN GENDER AND BMI**

Descriptive study showed women’s mean for BMI was higher than men’s (27.45 vs. 26.41). A linear regression analysis was carried out to assess whether BMI is indeed higher for women than for men.

First, all variables were individually checked for association with BMI. P-value of 0.05 was considered significant and all variables below it were not considered for the multivariable model. Only Metabolic Syndrome and Age had a significant power explaining the variability in BMI (R2:17.82% and 5,48%). The other variables had a low R2 (ranging between 0.19% and 2.35%) but they were still considered for the multivariable model. Next, interactions between variables and gender were assessed (Table 4) and interactions with a Wald’s test p-value below 0.05 were considered significant and considered for the final multivariable model.

All significant variables and interactions were joined in a multivariable regression model (Table 5). Periodontal Disease and Heart Attack were not significant and therefore were no longer considered in the final model. Neither were the interactions between Gender and Educational Years, Perceived General Health and Perceived Oral Health and were also not included. Overall, the final multivariable model shows that the chosen variables and interactions are able to predict only 24.43% of the variability in BMI, with Gender (β=-0.16) and Metabolic Syndrome (β=0.39) being the most significant predictors.

Finally, to assess the validity of this model the residual distribution was checked for normality using a two-way scatter plot and a Kernel density plot. Two-way scatter plot showed no heteroskedasticy and Kernel density plot showed minimal kurtosis and positive skewness. This variance was not considered significant and therefore the model could be considered valid.

This model showed that when taking into account Ethnicity, Age, Smoking, Metabolic Syndrome, Education Years, Perceived General Health, Hypertension and the interactions between Gender and Age, Ethnicity and Poverty, women did not have a higher BMI than men, in fact women’s average BMI would be 22.37 and men’s 24.24 (-1.88 difference). Interactions with gender seem to play a very important role, as without taking them into account, the model shows higher BMI for women than men (+0.40 difference), further study needs to be done with interactions with gender and with interaction within other variables, as they could provide a better model.

**CONCLUSIONS**

It is important to mention that several factors could have biased our data. Both Perceived General Health and Perceived Oral Health were self-reported, and individuals could have introduced non-representative variability in the responses. Also, data dropped accounted for 30% of records and it is possible that bias were introduced when doing so, as the individuals with missing data could have been a different group from those that were accounted for.

In conclusion, this study shows that women aged between 17 and 44 have lower risk of hypertension than men and potentially women between the age 45 to 65, but at a milder degree. It also rejects the hypothesis that states women have higher BMI than men and provides evidence that when controlling for significant variables and interactions, women have a BMI 1.88 times lower than men.

**REFERENCE**

NHANES III: Wwwn.cdc.gov. (2020). *NHANES III (1988-1994)*. [online] Available at: https://wwwn.cdc.gov/nchs/nhanes/nhanes3/Default.aspx [Accessed 11 Jan. 2020].

**Word Count: 2977**

**Table 1** – Descriptive summary of the sample

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Category** | **Male (N=3,249)** | **Female (N=3,763)** | **Total (N=7,012)** |
| **Ethnicity** | White | 1,143 (35.18%) | 1,398 (37.15%) | 2,541 (36.24%) |
| Black | 904 (27.82%) | 1,124 (29.87%) | 2,028 (28.92%) |
| Mexican | 1,084 (33.36%) | 1,075 (28.57%) | 2,159 (30.79%) |
| Other | 118 (3.36%) | 166 (4.41%) | 284 (4.05%) |
| **Age** | *Mean (95%CI)*  *SD* | *41.92 (41.28-42.55)*  *18.39* | *41.87 (41.29-42.45)*  *18.06* | *41.89 (41.47-42.31)*  *18.21* |
| 17 - 30 | 1,098 (33.80%) | 1,229 (32.66%) | 2,327 (33.19%) |
| 31 - 44 | 918 (28.25%) | 1,157 (30.75%) | 2,075 (29.59%) |
| 45 - 65 | 759 (23.36%) | 866 (23.01%) | 1,625 (23.17%) |
| 66+ | 474 (14.59%) | 511 (13.58%) | 985 (14.05%) |
| **Educational Years** | *Mean (95%CI)*  *SD* | *10.99 (10.86-11.13)*  *3.93* | *11.21 (11.10-11.34)*  *3.65* | *11.12 (11.03-11.20)*  *3.78* |
| <12 years | 946 (29.36%) | 1,091 (29.22%) | 2,037 (29.28%) |
| 12 years | 952 (29.55%) | 1,289 (34.52%) | 2,241 (32.22%) |
| >12 years | 1,324 (41.09%) | 1,354 (36.26%) | 2,678 (38.5%) |
| **BMI** | *Mean (95%CI)*  *SD* | *26.41 (26.25-26.65)*  *4.95* | *27.45 (27.24-27.66)*  *6.57* | *26.97 (26.83-27.10)*  *5.90* |
| Underweight | 59 (1.82%) | 103 (2.74%) | 162 (2.31%) |
| Normal | 1,290 (39.74%) | 1,452 (38.67%) | 2,742 (39.17%) |
| Overweight | 1,279 (39.40%) | 1,057 (28.15%) | 2,336 (33.37%) |
| Obese | 618 (19.04%) | 1,143 (34.44%) | 1,761 (25.15%) |
| **History of diabetes** | Yes | 172 (5.30%) | 249 (6.63%) | 421 (6.01%) |
| No | 3,074 (94.70%) | 3,509 (93.37%) | 6,583 (93.99%) |
| **Smoking** | *Mean (95%CI)*  *SD* | *4.55 (4.23-4.87)*  *9.22* | *2.84 (2.60-3.06)*  *7.23* | *3.63 (3.43-3.81)*  *8.25* |
| Non-smoker | 2,178 (67.04%) | 2,986 (79.35%) | 5,164 (73.65%) |
| Mild smoker | 673 (20.71%) | 501 (13.31%) | 1,174 (16.74%) |
| Heavy smoker | 398 (12.25%) | 276 (7.33%) | 674 (9.61%) |
| **Metabolic Syndrome** | Yes | 2,265 (78.48%) | 2,531 (75.87%) | 4,796 (77.08%) |
| No | 621 (21.52%) | 805 (24.13%) | 1,426 (22.92%) |
| **Dental Insurance** | Yes | 1,288 (51.36%) | 1,384 (49.25%) | 2,672 (50.23%) |
| No | 1,220 (48.64%) | 1,428 (50.75%) | 2,648 (49.77%) |
| **Poverty Quartile** | 1 | 819 (27.75%) | 862 (25.26%) | 1,681 (26.41%) |
| 2 | 766 (25.96%) | 842 (24.67%) | 1,608 (25.27%) |
| 3 | 697 (23.62%) | 801 (23.47%) | 1,498 (23.54%) |
| 4 | 669 (22.67%) | 908 (26.60%) | 1,577 (24.78%) |
| **Periodontal Disease** | Mild or none | 2,669 (82.33%) | 3,367 (89.71%) | 6,036 (86.29%) |
| Moderate | 460 (14.19%) | 337 (8.98%) | 797 (11.39%) |
| Severe | 113 (3.49%) | 49 (1.31%) | 162 (2.32%) |
| **Heart Attack** | Yes | 106 (3.30%) | 67 (1.80%) | 173 (2.5%) |
| No | 3,102 (96.70%) | 3,652 (98.20%) | 6,754 (97.5%) |
| **Perceived General Health** | Excellent | 617 (19.00%) | 564 (14.99%) | 1,181 (16.84%) |
| Very good | 837 (25.77%) | 957 (25.43%) | 1,794 (25.59%) |
| Good | 1,169 (35.99%) | 1,385 (36.43%) | 2,554 (36.43%) |
| Fair | 529 (16.29%) | 727 (19.32%) | 1,256 (17.91%) |
| Poor | 96 (2.96%) | 130 (3.45%) | 226 (3.22%) |
| **Perceived Oral Health** | Excellent | 285 (8.86%) | 338 (9.06%) | 623 (8.97%) |
| Very good | 458 (14.25%) | 544 (14.58%) | 1,002 (14.43%) |
| Good | 1,007 (31.32%) | 1,247 (33.43%) | 2,254 (32.46%) |
| Fair | 945 (29.39%) | 999 (26.78%) | 1,944 (27.99%) |
| Poor | 520 (16.17%) | 602 (16.14%) | 1,122 (16.16%) |
| **Hypertension** | Normotensive | 2,598 (80.14%) | 3,161 (84.27%) | 5,759 (82.35%) |
| Hypertensive | 644 (19.86%) | 590 (15.73%) | 1,234 (17.65%) |

**Table 2** – Association analysis of the risk factors and the exposure and outcome of interest (Gender and Hypertension)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Gender** | | | **Hypertension** | | |
| **Variable** | **Category** | **D.F.** | **N female (%)** | **χ2** | **χ2 p-value** | **N hypertense (%)** | **χ2** | **χ2 p-value** |
| **Ethnicity** | White | 3 | 1,023 (53.73%) | 15.94 | 0.001 | 382 (20.06%) | 26.20 | <0.001\* |
| Black | 613 (55.73%) | 167 (15.18%) |
| Mexican | 507 (47.61%) | 142 (13.33%) |
| Other | 67 (52.76%) | 18 (14.17%) |
| **Age** | 17 - 30 | 3 | 683 (52.54%) | 2.44 | 0.485 | 23 (1.77%) | 775.43 | <0.001\*\* |
| 31 - 44 | 693 (54.35%) | 127 (9.96%) |
| 45 - 65 | 540 (51.58%) | 269 (25.69%) |
| 66+ | 294 (51.22%) | 290 (50.52%) |
| **Educational Years** | <12 years | 2 | 806 (53.55%) | 29.08 | <0.001 | 210 (13.95%) | 16.08 | <0.001\* |
| 12 years | 818 (56.96%) | 254 (17.69%) |
| >12 years | 586 (46.69%) | 245 (19.52%) |
| **BMI** | Underweight & Normal | 2 | 997 (55.45%) | 100.60 | <0.001 | 184 (10.23%) | 106.76 | <0.001\* |
| Overweight | 586 (42.28%) | 279 (20.13%) |
| Obese | 627 (61.96%) | 246 (24.31%) |
| **History of diabetes** | Yes | 1 | 101 (51.53%) | 0.11 | 0.744 | 64 (32.65%) | 36.34 | <0.001\*\* |
| No | 2,109 (52.73%) | 645 (16.13%) |
| **Smoking** | Non-smoker | 2 | 1,791 (56.84%) | 90.18 | <0.001 | 560 (17.77%) | 7.82 | 0.020\* |
| Mild smoker | 266 (41.82%) | 85 (13.36%) |
| Heavy smoker | 153 (37.41%) | 64 (15.65%) |
| **Metabolic Syndrome** | Yes | 1 | 479 (53.05%) | 0.07 | 0.798 | 342 (37.87%) | 360.56 | <0.001\* |
| No | 1,731 (52.57%) | 367 (11.14%) |
| **Dental Insurance** | Yes | 1 | 1,170 (53.87%) | 2.59 | 0.107 | 288 (13.26%) | 42.43 | <0.001\*\* |
| No | 1,040 (51.38%) | 421 (20.80%) |
| **Poverty Quartile** | 1 | 3 | 724 (52.05%) | 1.89 | 0.597 | 253 (18.19%) | 8.95 | 0.03\*\* |
| 2 | 650 (51.67%) | 205 (16.30%) |
| 3 | 488 (54.04%) | 165 (18.27%) |
| 4 | 348 (54.04%) | 86 (13.35%) |
| **Periodontal Disease** | Mild or none | 2 | 2,021 (54.89%) | 61.15 | <0.001 | 535 (14.53%) | 123.48 | <0.001\* |
| Moderate | 164 (38.05%) | 140 (32.48%) |
| Severe | 25 (30.12%) | 34 (40.96%) |
| **Heart Attack** | Yes | 1 | 35 (33.65%) | 15.47 | <0.001 | 49 (47.12%) | 69.35 | <0.001\* |
| No | 2,175 (53.15%) | 660 (16.13%) |
| **Perceived General Health** | Excellent | 4 | 392 (48.28%) | 8.18 | 0.085 | 90 (11.08%) | 83.07 | <0.001\*\*\* |
| Very good | 654 (53.13%) | 179 (14.54%) |
| Good | 796 (53.93%) | 262 (17.75%) |
| Fair | 323 (54.56%) | 143 (24.16%) |
| Poor | 45 (52.94%) | 35 (41.18%) |
| **Perceived Oral Health** | Excellent | 4 | 225 (51.61%) | 8.15 | 0.086 | 64 (14.68%) | 34.86 | <0.001\*\*\* |
| Very good | 381 (54.12%) | 104 (14.77%) |
| Good | 783 (55.10%) | 222 (15.62%) |
| Fair | 537 (50.05%) | 176 (16.40%) |
| Poor | 284 (50.53%) | 143 (25.44%) |

\* Association with both gender and outcome, potential effect modifier and confounder.

\*\* Association with only gender or outcome, potential effect modifier.

\*\*\* p-value for association not significant, but still considered potential effect modifier and confounder

**Table 3** – Confirmation of possible confounders and effect modifiers in the association between gender and hypertension through Mantel-Haenszel analysis. Adjusted OR is shown for confounders, stratum specific ORs are shown for effect modifiers.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Adjusted variable** | **Odds Ratio (95% CI)** | | **P-value** | | | **P-value for homogeneity** | | **Change in Odds Ratio** | |
| Gender (crude) | 0.709 (0.603-0.835) | | <0.001 | | |  | |  | |
| Ethnicity | 0.698 (0.593-0.822) | | <0.001 | | | 0.343 | | 4.14% | |
| Age |  | |  | | | <0.001 | |  | |
| 17 to 30 | 0.131 (0.038-0.449) | | <0.001 | | |  | |  | |
| 31 to 44 | 0.377 (0.255-0.558) | | <0.001 | | |  | |  | |
| 45 to 65 | 0.715 (0.541-0.945) | | 0.018 | | |  | |  | |
| 66+ | 1.232 (0.887-1.711) | | 0.213 | | |  | |  | |
| Educational Years | 0.716 (0.608-0.843) | | <0.001 | | | 0.511 | | 2.07% | |
| BMI |  | |  | | | 0.006 | |  | |
| Underweight & Normal | 0.661 (0.486-0.898) | | 0.008 | | |  | |  | |
| Overweight | 0.965 (0.739-1.259) | | 0.790 | | |  | |  | |
| Obese | 0.508 (0.379-0.683) | | <0.001 | | |  | |  | |
| Diabetes | 0.709 (0.603-0.835) | | <0.001 | | | 0.238 | |  | |
| Smoking | 0.682 (0.578-0.804) | | <0.001 | | | 0.549 | | 10.00% | |
| Metabolic Syndrome | 0.682 (0.575-0.809) | | <0.001 | | | 0.1 66 | |  | |
| Dental Insurance |  | |  | | | <0.001 | |  | |
| Yes | 0.927 (0.748-1.149) | | 0.372 | | |  | |  | |
| No | 0.505 (0.391-0.652) | | <0.001 | | |  | |  | |
| Poverty Quartile | 0.709 (0.603-0.835) | | <0.001 | | | 0.155 | |  | |
| Periodontal Disease |  | |  | | | 0.029 | |  | |
| None or mild | 0.706 (0.587-0.849) | | <0.001 | | |  | |  | |
| Moderate | 1.290 (0.853-1.951) | | 0.225 | | |  | |  | |
| Severe | 0.944 (0.361-2.470) | | 0.907 | | |  | |  | |
| Heart Attack | 0.735 (0.624-0.866) | | <0.001 | | | 0.066 | | 8.62% | |
| Yes | 1.544 (0.676-3.527) | | 0.299 | | |  | |  | |
| No | 0.712 (0.603-0.842) | | <0.001 | | |  | |  | |
| Perceived Oral Health | 0.714 (0.606-0.841) | | <0.001 | | | 0.190 | | 1.03% | |
| Perceived General Health | 0.690 (0.585-0.813) | | <0.001 | | | 0.300 | | 7.24% | |
| Controlling for Smoking, Heart Attack and Perceived General Health | | | | | | <0.001 | |  | |
| 17-30 | | 0.116 (0.030-0.442) | | 0.001 |  | |  | |
| 31-44 | | 0.325 (0.211-0.500) | | <0.001 |  | |  | |
| 45-65 | | 0.740 (0.546-1.003) | | 0.052 |  | |  | |
| 66+ | | 1.137 (0.795-1.626) | | 0.482 |  | |  | |

**Table 4** – Linear Regression test for individual variable association with BMI and summary of the significant interactions between individual variables and Gender.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **B0 (95% CI)** | **B1 (95% CI)** | **F** | **Model p-value** | **R2** |
| Gender | 0.62 (0.27/0.97) | 25.89 (25.32/26.45) | 11.95 | 0.001 | 0.28% |
| Ethnicity (Ref: White) | 26.27 (26.01/26.53) |  | 15.54 | <0.001 | 1.10% |
| Black | 1.34 (0.91/1.77) |
| Mexican | 0.89 (0.46/1.32) |
| Other | -0.56 (-1.59/0.47) |
| Age Group (Ref: 17-30) | 24.89 (24.58/25.19) |  | 80.96 | <0.001 | 5.48% |
| 31-44 | 2.81 (2.37/3.24) |
| 44-65 | 3.26 (2.80/3.72) |
| 66+ | 2.00 (1.45/2.55) |
| Smoking (Ref: Non-smokers) | 27.05 (26.85/27.25) |  | 9.49 | <0.001 | 0.45% |
| Light Smokers | -0.77 (-1.26/-0.27) |
| Heavy Smokers | -1.06 (-1.66/-0.47) |
| Metabolic Syndrome | 25.55 (25.37/25.73) | 5.94 (5.55/6.32) | 909.58 | <0.001 | 17.82% |
| Dental Insurance | 26.76 (26.51/27.01) | 0.13 (-0.22/0.48) | 0.56 | 0.455 | 0.00% |
| Educational Years (Ref:<12) | 26.34 (26.05/26.63) |  | 9.10 | <0.001 | 0.43% |
| 12 years | 0.88 (0.46/1.30) |
| > 12 years | 0.64 (0.20/1.06) |
| Poverty Quartile (Ref: 1) | 26.50 (26.20/26.81) |  | 2.34 | 0.071 | 0.00% |
| 2 | 0.56 (0.12/1.00) |
| 3 | 0.45 (-0.03/0.94) |
| 4 | 0.37 (0.17/0.91) |
| Periodontal Disease (Ref: None or Mild) | 26.74 (26.56/26.93) |  | 3.98 | 0.018 | 0.19% |
| Moderate | 0.56 (-0.01/1.14) |
| Severe | 1.39 (0.13/2.64) |
| Heart Attack | 29.77 (27.54/31.99) | -1.49 (-2.61/-0.36) | 6.73 | 0.010 | 0.16% |
| Perceived General Health (Ref: Excellent) | 25.51 (25.12/25.91) |  | 25.19 | <0.001 | 2.35% |
| Very Good | 0.83 (0.32/1.33) |
| Good | 1.85 (1.36/2.34) |
| Fair | 2.55 (1.95/3.16) |
| Poor | 3.09 (1.81/4.37) |
| Perceived General Health (Ref: Excellent) | 26.80 (26.26/27.34) |  | 5.13 | <0.001 | 0.49% |
| Very Good | -0.66 (-1.35/0.03) |
| Good | 0.18 (-0.44/0.80) |
| Fair | -0.09 (-0.73/0.55) |
| Poor | 0.76 (0.03/1.48) |
| Hypertension | 26.45 (26.26/26.64) | 2.26 (1.80/2.72) | 92.07 | <0.001 | 2.15% |
| **Interaction** |  |  | **F** | **P-value Wald's Test (testparm)** | **R2** |
| Gender\*Age |  |  | 59.87 | 0.003 | 5.65% |
| Gender\*Ethnicity |  |  | 32.18 | <0.001 | 3.12% |
| Gender\*Poverty |  |  | 18.26 | <0.001 | 1.97% |
| Gender\*Education Years |  |  | 25.57 | <0.001 | 1.81% |
| Gender\*Perceived General Health |  |  | 28.77 | <0.001 | 3.57% |
| Gender\*Perceived Oral Health |  |  | 13.20 | <0.001 | 1.69% |

**Table 5** – Multivariable linear regression model for BMI.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **β1 Coefficient (95% CI)** | **P-value** | **Standardized β coefficient** | **Model p-value (F)** | **R2(Adjusted R2)** |
| Gender | -1.88 (-2.68/-1.07) | <0.001 | -0.16 | <0.001 (46.44) | 24.43 (23.91) |
| Ethnic (Ref: White) |  | <0.001\* |  |
| Black | 0.61 (0.02/121) |  | 0.05 |
| Mexican | 0.40 (-0.20/1.00) |  | 0.03 |
| Other | -0.60 (-1.93/0.73) |  | -0.02 |
| Age Group  (Ref: 17-30) |  | <0.001\* |  |
| 31-44 | 1.40 (0.81/1.99) |  | 0.11 |
| 45-65 | 0.96 (0.33-1.59) |  | 0.07 |
| 66+ | -0.24 (-1.02/1.59) |  | -0.01 |
| Smoking  (Ref: Non-Smoker) |  | <0.001\* |  |
| Mild Smoker | -0.79 (-1.23/-0.35) |  | -0.05 |
| Heavy Smoker | -1.19 (-1.73/-0.64) |  | -0.06 |
| Metabolic Syndrome | 5.42 (5.01/5.82) | <0.001 | 0.39 |
| Education Years  (Ref: <12 years) |  | 0.008\* |  |
| 12 years | 0.54 (0.16/0.92) |  | 0.04 |
| >12 years | 0.04 (-0.41/0.49) |  | 0.00 |
| Perceived General Health (Ref: Excellent) |  | <0.001\* |  |
| Very Good | 0.47 (0.02/0.92) |  | 0.04 |
| Good | 0.99 (0.55/1.44) |  | 0.08 |
| Fair | 1.21 (0.64/1.79) |  | 0.07 |
| Poor | 1.42 (0.25/2.59) |  | 0.03 |
| Hypertension | 0.54 (0.08/1.00) | 0.022 | 0.04 |
| Interaction1 (Gender\*Ethnicity, Ref: White) |  | 0.006\* |  |
| Black | 1.43 (0.63/2.24) |  | 0.08 |
| Mexican | -0.76 (-1.43/-0.09) |  | 0.07 |
| Other | -0.81 (-1.59/-0.4) |  | 0.02 |
| Interaction2 (Gender\*Age Group, Ref: 17-30) |  | 0.006\* |  |
| 31-44 | 1.21 (0.41/2.00) |  | 0.09 |
| 45-65 | 1.25 (0.41/2.09) |  | 0.04 |
| 66+ | 0.39 (-0.64/1.42) |  | 0.00 |
| Interaction3 (Gender\*Poverty, Ref:1) |  |  |  |
| 2 | 1.36 (0.57/2.14) | 0.001\* | 0.08 |
| 3 | 1.45 (0.56/2.35) |  | 0.08 |
| 4 | 1.77 (0.75/2.78) |  | 0.08 |
| Constant | 26.11 (24.78/27.44) | <0.001 |  |

\* Wald’s test p-value (testparm)