Rate Of General Anesthesia Use For Cesarean Delivery Among Anesthesiologists With And Without Fellowship Training in Obstetric Anesthesia

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Dataset used: Pilot data.xlsx and Full data.xlsx

Latest data received on 03/06/2019

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This report presents a retrospective statistical analysis of cesarean delivery among attending anesthesiologists with and without fellowship training in obstetric anesthesia who were seen at the NYP between 2009 and 2014 and had their rate of general anesthesia use assessed. Demographic, training / service experience, and outcomes of anesthesia were summarized. Logistic regression model was used to identify whether the fellowship-trained anesthesiologists are more or less likely to provide general anesthesia for non-routine c-section as compared to non-fellowship trained anesthesiologists..

CONTENTS

OBJECTIVE

The objective of the study is to determine whether there is a significant difference in the rate of general anesthesia between attending anesthesiologists with obstetric anesthesia fellowship training and the attending anesthesiologists without fellowship training. The secondary aim is to explore other confounding factors.

INTRODUCTION

Many studies have proved that comparing to neuraxial anesthetics (spinal and epidural anesthesia), general anesthesia is associated with higher morbidity for cesarean delivery in pregnant women. Such that doctors will only utilize general anesthesia for emergency or exceptional condition such as failed neuraxial anesthesia, contraindication to neuraxial anesthesia. A retrospective cohort study suggested that cesarean sections hold during the night are associated with increased risk of morbidity for pregnant women, because there are less physician and nursing resources during the night. In this study, all the anesthesiologists are specified with fellowship-trained and non-fellowship trained based on the fact whether they have completed anesthesia residency training in the U.S. Since both fellowship-trained and non-fellowship trained doctors were staffed at Weill Cornell Medical College and New York-Presbyterian Hospital. The primary aim of this study is to identify do anesthesia fellowship-trained doctors will utilize general anesthesia less frequently than non-fellowship trained doctors. Based on the fact anesthesiologists prefer to apply neuraxial anesthesia rather than general anesthesia in the obstetric population, we hypothesize the fellowship-trained anesthesiologists are less likely to provide general anesthesia for non-routine cesarean sections as compared to non-fellowship trained doctors. Our secondary arm is exploring all possible confounding factors, including patients' age, race, BMI value, and doctor's ID number and years of training.

STUDY DESIGN

A retrospective, cohort, and cross-sectional study suggested that the patients receiving cesarean sections hold during non-routine operating hours are different from the patients receiving cesarean sections hold during the daytime. Hence, this study will only include the

information (participant ID and anesthesia type) of non-routine cesarean sections (Monday - Thursday: 17:00 - 06:59 and weekend hours: Friday 17:00 - Monday 6:59) between 2009 and 2014. All the anesthesiologists will be divided into two groups: obstetric anesthesia fellowship trained or non-obstetric anesthesia fellowship trained in this study. Moreover, each doctors' years of services will be involved in this study to clarify whether the rate of general anesthesia use is affected by this factor or fellowship training. To make sure research staff are blinded and prevent physician identification, each physician will be provided a unique ID during the data extraction phase. Only the Department of Anesthesiology Data Manager will have access to this information. By using a standardized data extraction tool, a medical record review will be conducted by the current obstetric anesthesia fellow on all cases revealed to utilize general anesthesia meeting study criteria. Patients' demographic characteristics of patients will also be collected.

Primary Objective

To identify whether the fellowship-trained anesthesiologists are more or less likely to provide general anesthesia for non-routine cesarean sections as compared to non-fellowship trained anesthesiologists.

Secondary Objective

To explore all possible confounding factors, including patients' age, race, BMI value, and doctor's ID number and years of training.

Inclusion Criteria:

All cesarean sections during non-routine operating hours (Monday - Thursday: 17:00 - 06:59 weekend hours: Friday 17:00 - Monday 6:59) between 2009 and 2014 with billing codes 01968 or 01961 with an 'anesthesia start time.'

Exclusion Criteria:

1. All non-cesarean sections

2. Cesarean sections taking place during routine operating hours

METHODS

1. Study endpoints

The primary endpoints are the anesthesia technique (General anesthesia vs. neuraxial anesthesia) applied and fellowship training (Yes vs. No) of anesthesiologists. The secondary endpoints are patients' age, BMI, Height, Weight as well as attending anesthesiologists' ID and years of service since residency.

2. Sample size calculation and data selection

The sample size determination was found on the hypothesis to test if obstetric anesthesia fellowship-trained attending anesthesiologists will utilize general anesthesia less frequently than non-fellowship trained attendings. We first used pilot data to calculate the sample size and then extract the exact number of participants from full data. The whole sample size calculation process was done using 'pwr' package in R Studio.

The number of participants required for 80% power two-sided test with $\alpha = 0.05$ was computed using pilot data. Since the proportions of using general anesthesia in fellowship training and non-fellowship training anesthesiologists were 2.14% and 0.95% respectively, the effective size equals to 0.098. Based on this effect size, 1,633 participants for each group were needed to meet the requirement, which is 3,266 participants in total. Since it was a retrospective study, we cannot make sure that we enrolled the same sample size from both fellowship-trained group and non-fellowship training group. Thus, we selected the top 3,266 participants from full data, and we removed all the missing values in the full data to make our results more accurate.

3. Statistical methods

Descriptive statistics were used to examine service year, fellowship training status, anesthesia fail status, race, height, weight, Body Mass Index (BMI), and age. Comparisons of categorical characteristics for the type of anesthesia and fellowship training experience were

performed using Pearson's chi-square test at the 0.05 significance level for a two-sided test. If more than 20% of the expected cell frequencies were less than 5 for the Pearson chi-square approximation, Fisher's exact test was used. Comparisons of continuous variables were performed using the Wilcoxon rank-sum test (or Mann-Whitney U test) or two-sample t-test.

Factors including Service Year, Fellowship Training, race, Body Mass Index (BMI) and age were analyzed by univariate analysis and were based on univariate logistics regression. Similarly, service year, Fellowship Training, race, Body Mass Index (BMI) and age were analyzed by multivariate analysis and were also based on multivariate logistics regression with Anesthesia type as an outcome variable. Height and weight were not included in both univariate and multivariate analysis since they are highly correlated with BMI. Also, BMI already possesses information on height and weight. Odds ratio and 95% confidence intervals of each variable were calculated based on coefficients of logistic regression. Any variable with Wald's test p-value of < 0.05 was considered to be significantly associated with outcome variable, while variable with p-value < 0.1 but p-value > 0.05 are considered to be possibly associated with outcome variable and need further analysis.

Statistical tests and logistic regression are applied for determining confounding variables. If p-value of the test is smaller than 0.05 was considered that significant association exists between factors. Then we could further identify whether they are confounding variables.

Data Summary

1. Summary of all Categorical Variables - Full Data (Figure 1)

There are four categorical variables in the dataset. The first one is Fellowship Trained: attending anesthesiologists are labeled as obstetric anesthesia fellowship trained (Yes) or non-obstetric anesthesia fellowship trained (No). The y-axis in the bar chart means the number of people in one group. Bar chart of the Fellowship Trained shows the number of fellowship-trained doctors is approximately the same as the amount of non-fellowship trained doctors. The second one is the anesthesia technique: there are two types of anesthesia techniques (General and Neuraxial) included in this study. The y-axis in the bar chart means the number of anesthesia techniques used. The second graph in [Figure 1] shows most anesthesiologists will utilize neuraxial anesthesia, just a few of them applied general anesthesia. The third one is anesthesia Failed: the results of anesthesia are failed or

successes. The NA in the graph shows that there was no failed anesthesia in the dataset. In other words, all the anesthesia were successful in this dataset. The last one is a race: attending participants are labeled as White, Asian, Black, and Others. The y-axis in the bar chart means the number of people in one group. [Figure 1] shows most of the participants are White.

2. Summary of all Continuous Variables - Full data (Figure 2 & 3)

There are seven continuous variables in this dataset. The participant ID is identical for all participants, so it was not included in the plots. Similarly, doctor ID was excluded from the variable analysis. The circles in the boxplots are the mean values, and the horizontal lines in the boxplots are the median values. Based on the boxplots, the mean values and median values are approximately the same for the variable Age, BMI, Height, and Weight. The density plots show the variable BMI, Height, and Weight has an approximately normal distribution. The variable Age, Service Year are skewed.

RESULTS

1. Demographics and clinical characteristics by anesthesia type (Table 1)

There were 3,266 patients selected from the full dataset following the criteria aforementioned. The selected data by anesthesia type showed the significant imbalance of sample sizes between the general anesthesia group (N=64, 1.95%) and neuraxial anesthesia group (N=3202, 98.04%). Zero cases were observed in anesthesia fail status in the general group. In the general anesthesia group, there were 42 fellowship-trained attendings and 22 non-fellowship-trained attendings. However, in the neuraxial group, the number of fellowship and non-fellowship trained anesthesiologists are relatively even: General (1516, 47.35%) vs. Neuraxial (1686, 52.65%). When it comes to the race, White patients (2304, 70.55%) are much more than Asian (131, 4.01%), Black (359, 10.99%), and other races (472, 14.45%) regardless of the type of anesthesia. According to the results of group comparisons by type of anesthesia, only fellowship training status showed the significant difference between general and neuraxial anesthesia group ($p = 0.01$).

2. Demographics and clinical characteristics by fellowship training (Table 2)

Of 3,266 samples, the selected data by fellowship training status indicated relatively balanced sample between the groups, attending group without fellowship training (N=1558, 47.7%) and the attending group with fellowship training (N=1708, 52.3%) as compared to the previous table by anesthesia type. For the group comparisons, four variables showed the significant differences between the trained and the non-trained attendings: service year ($p = 0.01$), type of anesthesia ($p = 0.01$), anesthesia result (0.02), and age (0.04). Service year was treated as a continuous variable.

3. Univariate vs. Multivariate Analysis for Anesthesia Type (Table 3)

Results from univariate logistic regression showed that Fellowship Training ($p < 0.01$) and Years of Service ($p = 0.072$) have an association with Anesthesia Type. Both factors showed a negative relationship with applying General Anesthesia. Note that the p-value of Years of Service is relatively high which is greater than 0.05 but less than 0.1. Thus, further analysis regarding service year will be in need.

Results from multivariate logistic regression showed that Fellowship Training ($p < 0.01$) and Years of Service ($p = 0.0965$) have an association with Anesthesia Type. Both factors showed a negative relationship with applying general anesthesia. Note that the p-value of Years of Service is relatively high which is greater than 0.05 but less than 0.1. Thus, further analysis regarding service year will be in need. The result is consistent with the univariate analysis.

4. Summary of the dataset used by Multivariable Logistic Regression (Table 4)

[Table 4] gave us a brief of the dataset used for the multivariable logistic regression. There are 10,367 observations (N1) in the full data, and the team selected first 3,266 observations (N2) following the sample size calculation. For the event, general anesthesia in this case, there were 64 counts in the selected data, while there were 3,202 cases of neuraxial anesthesia. Thus, the event rate was only 2.0%.

5. Univariate Analysis for Anesthesia Type (Figure 4)

The odds ratio plot showed that only the 95% confidence interval of odds ratio between Anesthesia Type and Fellowship Training covers 1. While the 95% confidence interval of odds ratio between Anesthesia Type and Service Year hardly covers 1. The result of the Plot is consistent with [Table 3] in univariate analysis.

6. Multivariate Analysis for Anesthesia Type (Figure 5)

The odds ratio plot showed that only the 95% confidence interval of the odds ratio between anesthesia type and fellowship training covers 1. While the 95% confidence interval of odds ratio between anesthesia type and service year hardly covers 1.

7. Confounding Variable Analysis: Association Between Fellowship Training and Service Year

Results from both Wilcoxon Rank-Sum test ($p = 0.011$) and Logistics regression ($p < 0.01$) between Fellowship Training and Years of Service showed the association between these two factors exist. It showed a positive relationship (OR = 2.731) that the longer the years of service the higher probability that certain doctor would have received fellowship training since service year has an association with the outcome variable, anesthesia type, and our primary variable of interest, fellowship training. The team considered service year a confounding variable in this analysis.

CONCLUSION

Based on the pilot data, 3,266 patients were in need in total to meet 80% power at the 0.05 significance level for a two-sided test. By applying the given information to 3,266 patients, the primary result is that fellowship training status showed a significant difference between general and neuraxial anesthesia. Moreover, comparing with non-fellowship training anesthesiologists, the odds of using general anesthesia is 0.471 times lower in attending fellowship training anesthesiologists. This result is also consistent with the primary result. Also, the analysis demonstrated that the service year is a confounder.

TABLES

Table 1: Demographics and clinical characteristics by anesthesia type (N=3266)

Anesthesis Type	General, N=64	neuraxial, N=3202	p-value
Service Year			0.09..
Mean +/- SD	1.47 +/- 0.82	1.7 +/- 1.01	
Median (min, max)	1 (1, 4)	1 (1, 4)	
Fellowship Training			0.01...
No	42 (65.62%)	1516 (47.35%)	
Yes	22 (34.38%)	1686 (52.65%)	
Anesthesis Failed			1....
No	64 (100%)	3191 (99.66%)	
Yes	0 (0%)	11 (0.34%)	
Patient Race			0.63....
Asian	3 (4.69%)	128 (4%)	
Black	8 (12.5%)	351 (10.96%)	
Others	6 (9.38%)	466 (14.55%)	
White	47 (73.44%)	2257 (70.49%)	
Height			0.26.
Mean +/- SD	1.6 +/- 0.1	1.62 +/- 0.1	
Median (min, max)	1.6 (1.32, 1.85)	1.62 (1.27, 1.99)	
Weight			0.74..
Mean +/- SD	51.87 +/- 12.96	52.63 +/- 13.58	
Median (min, max)	51.44 (20.15, 95.11)	51.77 (11.92, 115.8)	
BMI			0.57..
Mean +/- SD	20.21 +/- 4.73	20 +/- 4.47	
Median (min, max)	20.44 (7.43, 30.92)	19.93 (5.38, 36.03)	
Age			0.37..
Mean +/- SD	38.17 +/- 11.88	36.87 +/- 11.28	
Median (min, max)	39 (18, 56)	37 (18, 56)	

. Two-sample t-test was used to generate p-value.
.. Wilcoxon rank-sum test (or Mann-Whitney U test) was used to generate p-value.
… Pearson's chi-square test was used to generate p-value.
…. Fisher's exact test was used to generate p-value.

Table 2: Demographics and clinical characteristics by fellowship training status (N=3266)

Felloship Training	No, N=1558	Yes, N=1708	p-value
Service Year			0.01..
Mean +/- SD	1.47 +/- 0.82	1.7 +/- 1.01	
Median (min, max)	1 (1, 4)	1 (1, 4)	
Type of Anesthesis			0.01...
General	42 (2.7%)	22 (1.29%)	
neuraxial	1516 (97.3%)	1686 (98.71%)	
Anesthesis Failed			0.02...
No	1557 (99.94%)	1698 (99.41%)	
Yes	1 (0.06%)	10 (0.59%)	
Patient Race			0.39...
Asian	55 (3.53%)	76 (4.45%)	
Black	178 (11.42%)	181 (10.6%)	
Others	234 (15.02%)	238 (13.93%)	
White	1091 (70.03%)	1213 (71.02%)	
Height			0.21.
Mean +/- SD	1.62 +/- 0.1	1.62 +/- 0.1	
Median (min, max)	1.62 (1.3, 1.96)	1.62 (1.27, 1.99)	
Weight			0.47..
Mean +/- SD	52.45 +/- 13.73	52.76 +/- 13.41	
Median (min, max)	51.41 (12.01, 102.41)	51.98 (11.92, 115.8)	
BMI			0.93..
Mean +/- SD	20.01 +/- 4.62	20.01 +/- 4.34	
Median (min, max)	19.98 (5.48, 34.92)	19.91 (5.38, 36.03)	
Age			0.04..
Mean +/- SD	37.33 +/- 11.31	36.5 +/- 11.26	
Median (min, max)	37.5 (18, 56)	37 (18, 56)	

. Two-sample t-test was used to generate p-value.

.. Wilcoxon rank-sum test (or Mann-Whitney U test) was used to generate p-value.

… Pearson's chi-square test was used to generate p-value.

…. Fisher's exact test was used to generate p-value.

Table 3: Univariate Analysis vs. Multivariate for Anesthesia Type

	Univariate Analysis			Multivariate Analysis		
	OR	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Service Year	0.7621	(0.536, 1.004)	0.0723	0.7743	(0.5506, 1.0381)	0.1109
Fellow-training (Yes)	0.471	(0.24, 0.728)	0.0023	0.4536	(0.2552, 0.7792)	0.0052
Race (Black)	0.9725	(0.37, 10.049)	0.6094	1.4632	(0.3585, 9.8161)	0.6342
Race (Others)	0.5494	(0.193, 5.846)	0.8383	0.8295	(0.1874, 5.7288)	0.8208
Race (White)	0.8885	(0.365, 7.434)	0.8007	1.1892	(0.3584, 7.3678)	0.8128
BMI	1.0104	(0.958, 1.075)	0.6175	1.0077	(0.9511, 1.0674)	0.794
Age	1.0103	(0.993, 1.04)	0.1866	1.0117	(0.9886, 1.0357)	0.324

Table 4: Summary of the dataset used by Multivariable Logistic Regression

Observation N1	Observation N2	Event N	Non-event N	Event rate
1,558	**1,708**	**64**	**3,202**	**2.0%**

FIGURES

Figure 1: Bar Chart of Categorical Variables

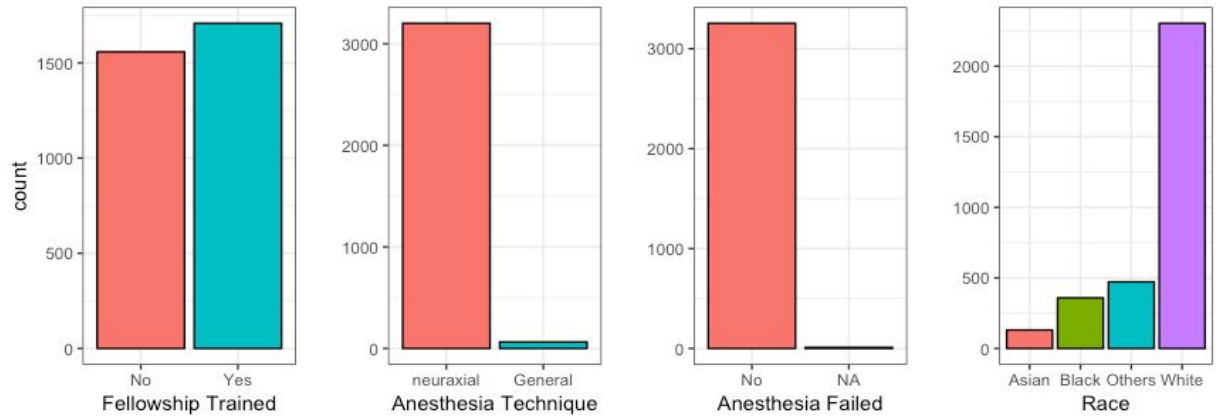


Figure 2: Boxplot of Continuous Variables

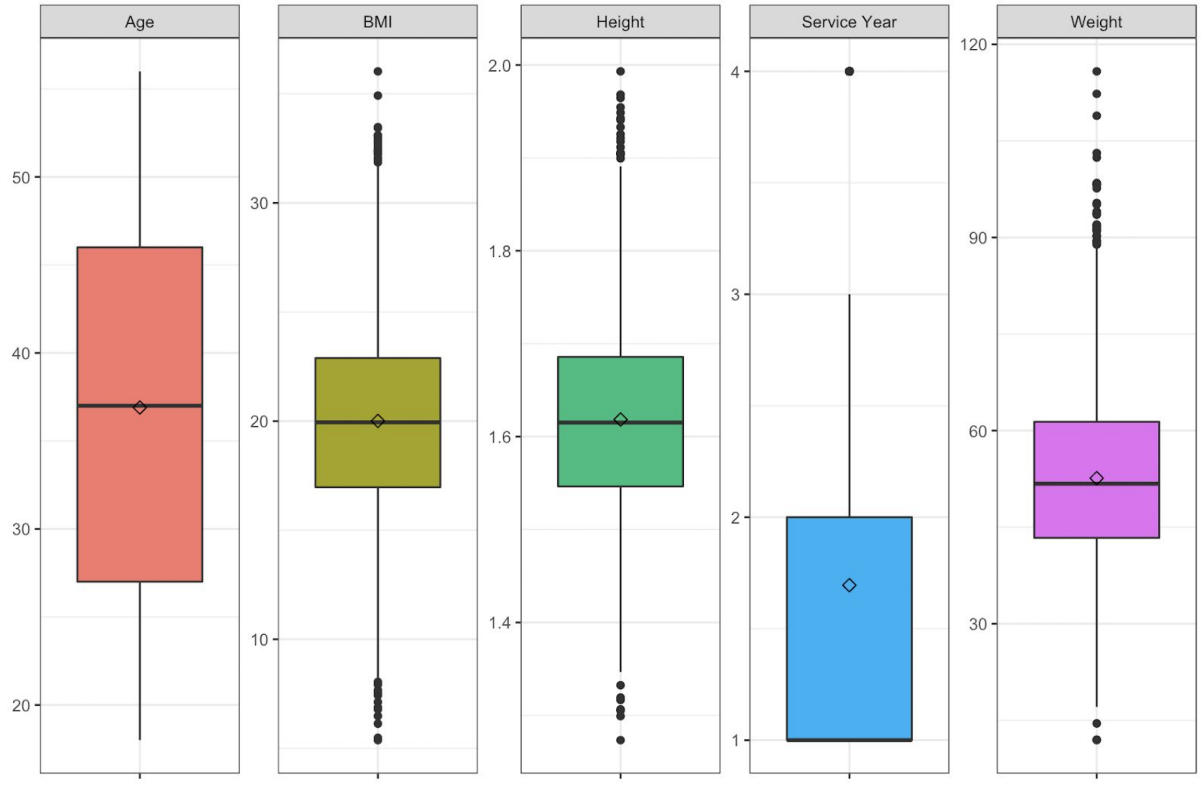


Figure 3: Density Plot of Continuous Variables

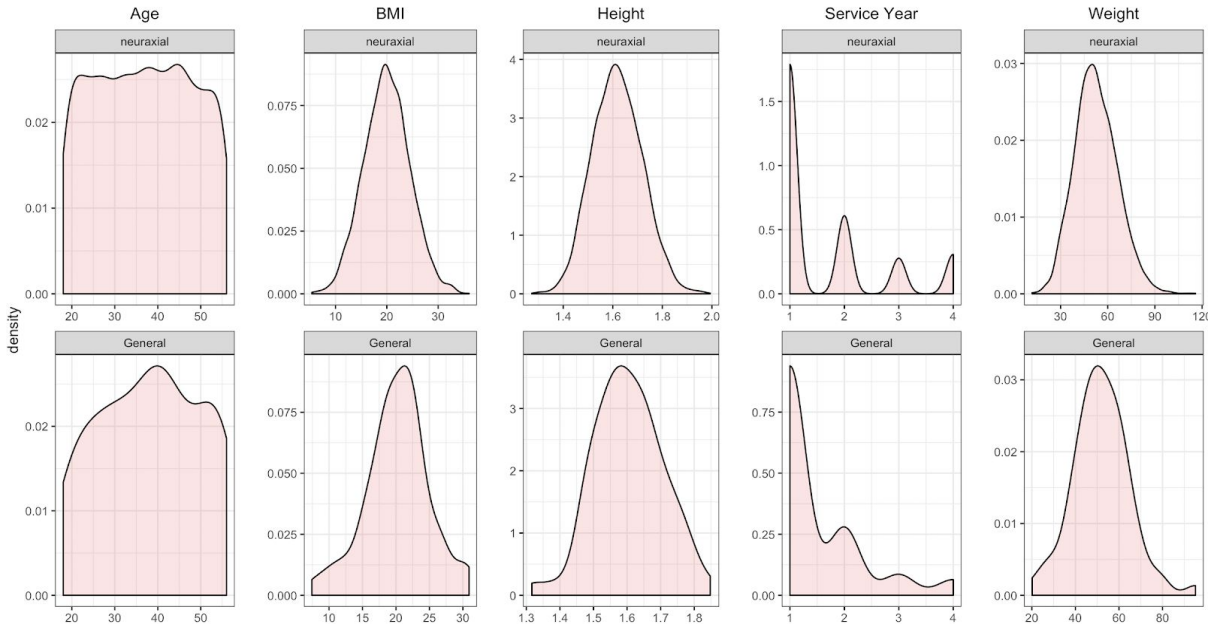
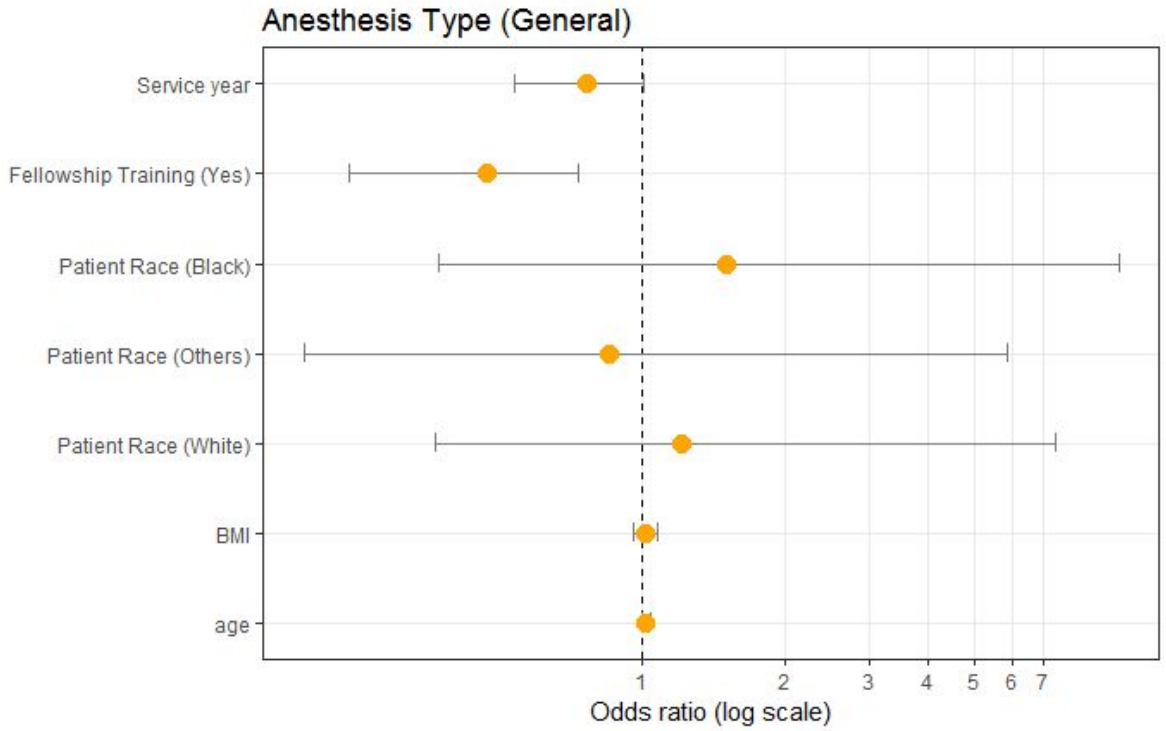


Figure 4: Univariate Analysis for Anesthesia Type



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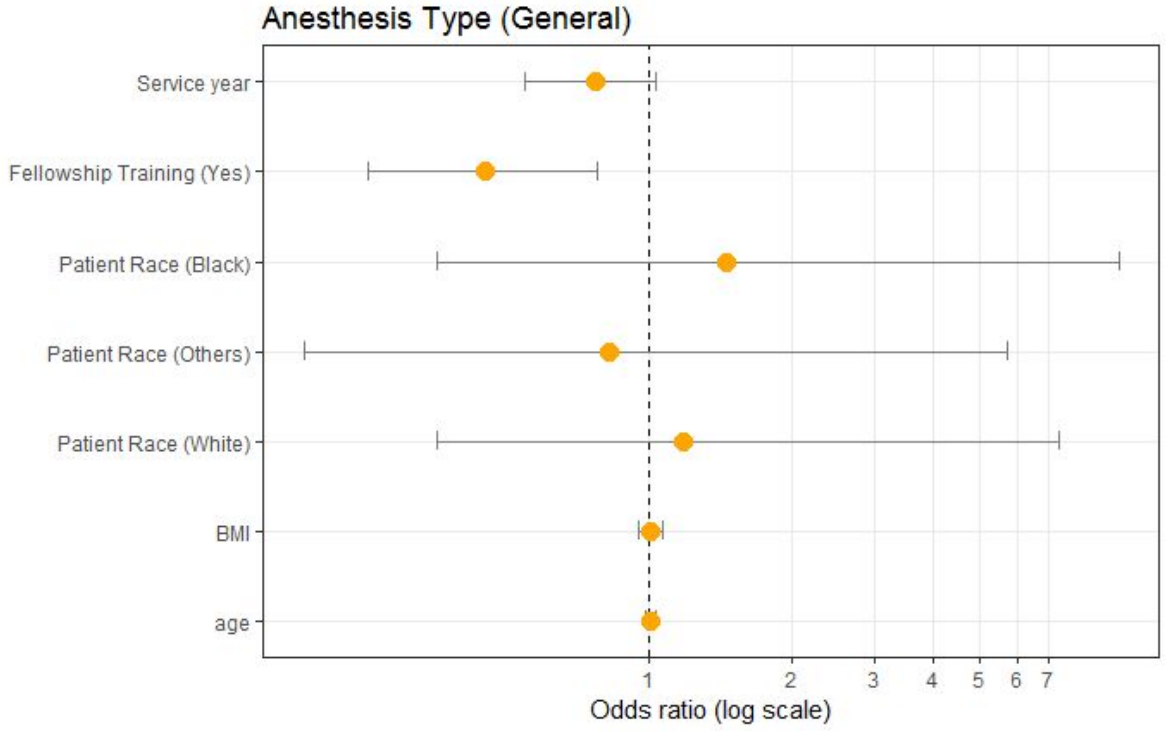


Figure 6: Graphical Summary of Pilot Data by Fellowship Training Status

Rate of general anesthesia in percentage by fellowship training status (Pilot Data)

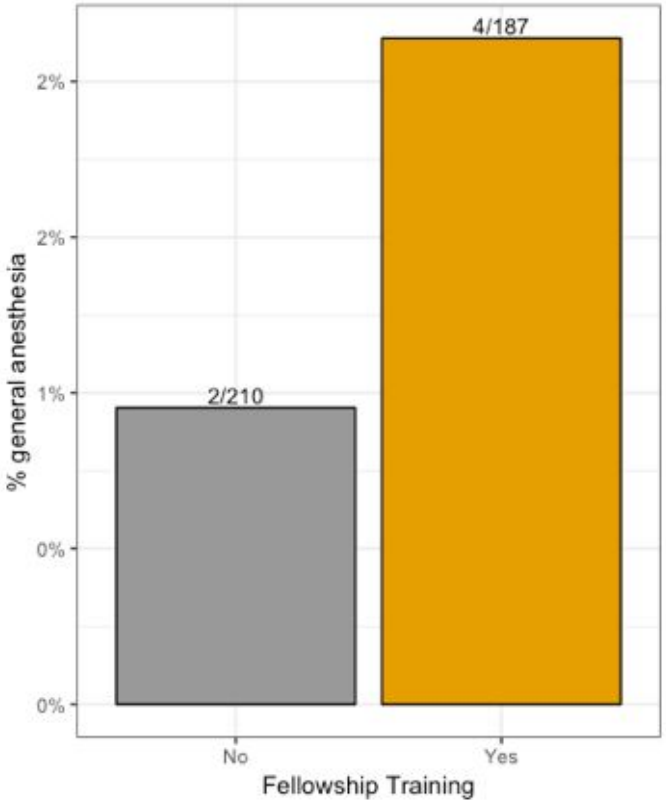
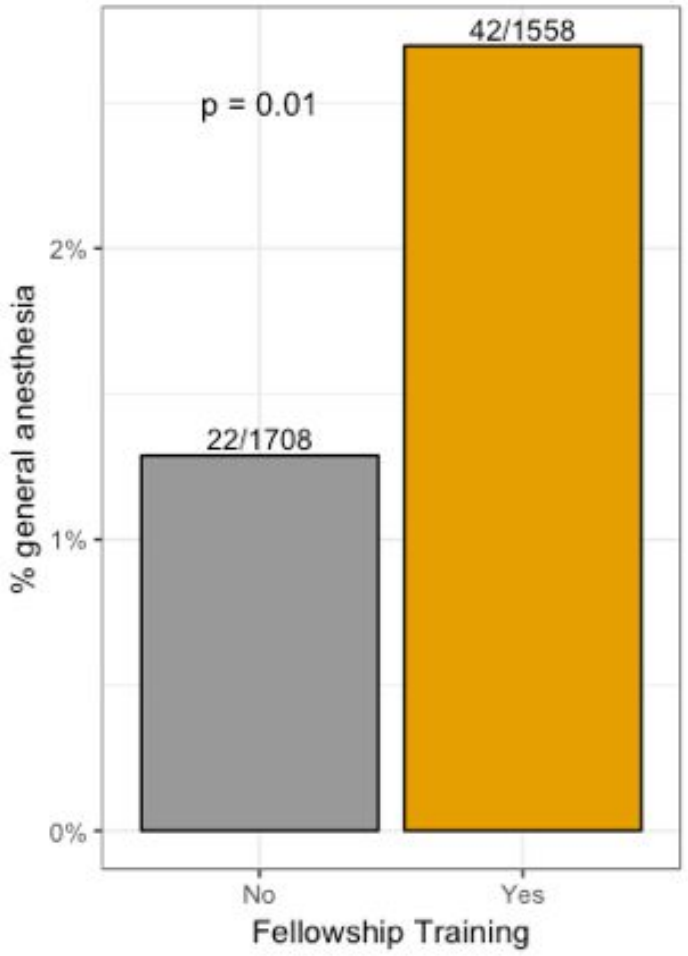


Figure 7: Graphical Summary of Full Data by Fellowship Training Status

Rate of general anesthesia in percentage by fellowship training status (Full Data)



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