Smoking During Pregnancy and its Effect on Birth Weight

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1 Abstract

The average birth weight of babies with mothers who smoked during the pregnancy is lower than that of babies with non-smoking mothers, but not significantly. This does not totally support the theory that smoking during pregnancy may result in low birth weight.

2 Introduction and Background

Between 1960 and 1967 a study called the Child Health and Development Studies recorded, among other things, all of the pregnancies among the women included in the study. Some of the data included whether or not the mother smoked during the pregnancy, and the weight of the baby at birth. This information was used to examine the difference in the birth weights of babies born to smoking mothers versus those of non-smoking mothers, a difference which is important given that low birth weight can increase the risk of infant death. The data shows that the average weight of a baby born to a smoking mother was about 114 ounces, while that of a baby born to a non-smoking mother was about 123 ounces, supporting the theory that smoking may play a role in low birth weight. The difference here is statistically significant, and was determined by methods of statistical analysis.

3 Method

The data in this study was collected from women and their babies who were enrolled in the Kaiser Foundation Health Plan in Oakland, California. The base data that was analyzed noted two values: birth weight in ounces, and whether or not the mother smoked during the pregnancy. The latter value was marked with either a 0 for a non-smoking mother or a 1 for a smoking mother. After grouping the weights by the "smoker status" of the mother, several significant numbers were calculated from these data. Two measures of average, the mean and the

median, were taken. The quartiles of the data (essentially the median between the lowest value and the overall median, and between the overall median and the highest value) were collected for each group. The median, the quartiles, and the lowest and highest data values together can provide a useful numerical overview of data, known as a Five Number Summary.

For a deeper analysis, more statistical values must be calculated. These included the variance, the standard deviation, the skewness, and the kurtosis. The variance and standard deviation of a data set describe its spread; the former being a measure of the average "distance" between each individual data point and the mean, and the latter being the square root of the former, used to observe how far the data is spread as contained in as a standardized units of distance. Skewness measures to which side of the average most of the data lies (how the data skews, as the name would imply), compared to a normal distribution which has a skew of 0; it shows whether more of the data is above or below the average. Kurtosis[1] is a measure of the "heaviness" of the tails of the data relative to a normal distribution.

4 Results

Calculating the values previously mentioned gives both a broad view of the overall trend as well as a deeper understanding of the significance of the ostensible conclusion. What follows is an analysis of the data for each group, first the non-smoking, followed by the smoking.

4.1 Non-smokers' Babies

The babies born to non-smoking mothers had an average (mean) birth weight of 123.104 ounces, with a standard deviation of 17.462 ounces and a variance of 304.917. Table 1 shows the Five Number Summary of values for the non-smoking births.

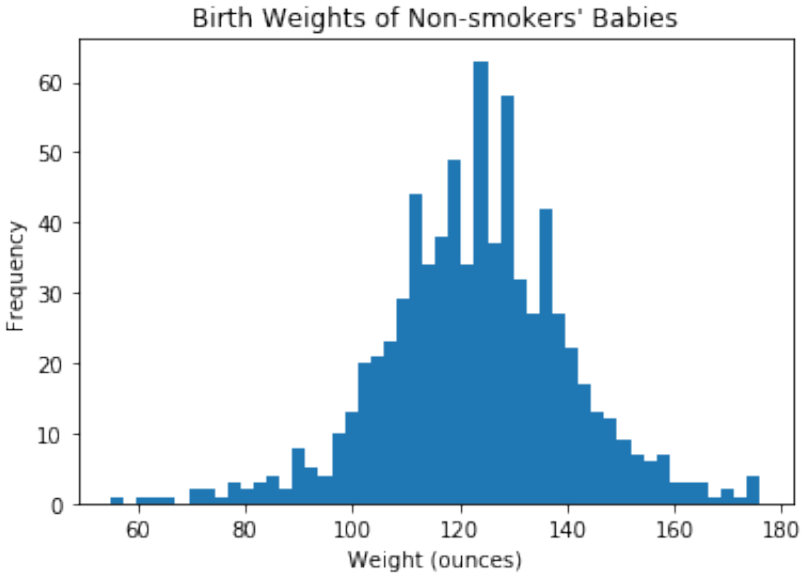
Median: 124.0	
Quartile 1: 113.0	Quartile 3: 134.0
Lower extreme: 55.0	Upper extreme: 176.0

Table 1: Five Number Summary for Non-smokers' Babies (in ounces)

There is not a lot of skew to this data, as is observable from the fact that the median is almost equidistant from both quartiles (9 oz from quartile 1 and 10 oz from quartile 3). As such, the skew is small, with a value of -0.18428. The negative value concurs with the observation that the median is closer to the first quartile than the third; the data has a minuscule left skew. This is further supported by the kurtosis value, 0.98616, which shows that the data is

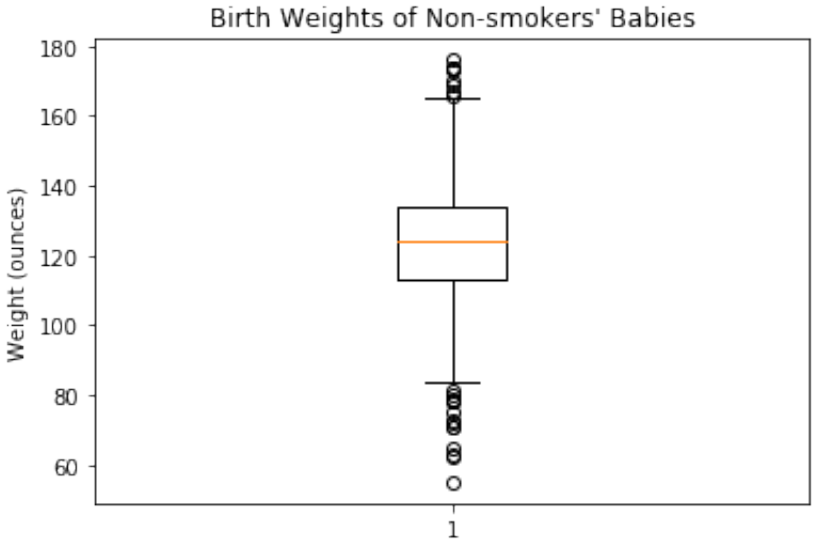
[1]For this paper I will use the Fisher definition which defines the kurtosis of the normal distribution to be 0

Figure 1: Histogram



not far off from a normal distribution (which, following Fisher's definition, has a kurtosis of 0.0). All of this is visually displayed in graphs of these data; here a histogram and a box-and-whiskers plot specifically.

Figure 2: Box-and-Whiskers Plot



4.2 Smokers' Babies

The babies born to smoking mothers had a mean birth weight of 114.11 ounces, with a standard deviation of 18.099 ounces and a variance of 327.572. Table 2 shows the Five Number Summary of values for the non-smoking births.

Median: 115.0	
Quartile 1: 102.0	Quartile 3: 126.0
Lower extreme: 58.0	Upper extreme: 163.0

Table 2: Five Number Summary for Smokers' Babies (in ounces)

As with the non-smokers' babies, there is not a lot of skew to in this data - the median is again almost equidistant from both quartiles, this time 13 oz from quartile 1 and 11 oz from quartile 3. The skew value of -0.03359 is a small negative value, supporting the observation that the median is slightly closer to the first quartile than the third and therefore the data has a left skew. We again have a kurtosis value close to that of the normal distribution's 0.0 (as defined by Fisher): -0.01197. The data is visually represented here in a histogram and a box-and-whiskers plot.

Figure 3: Histogram

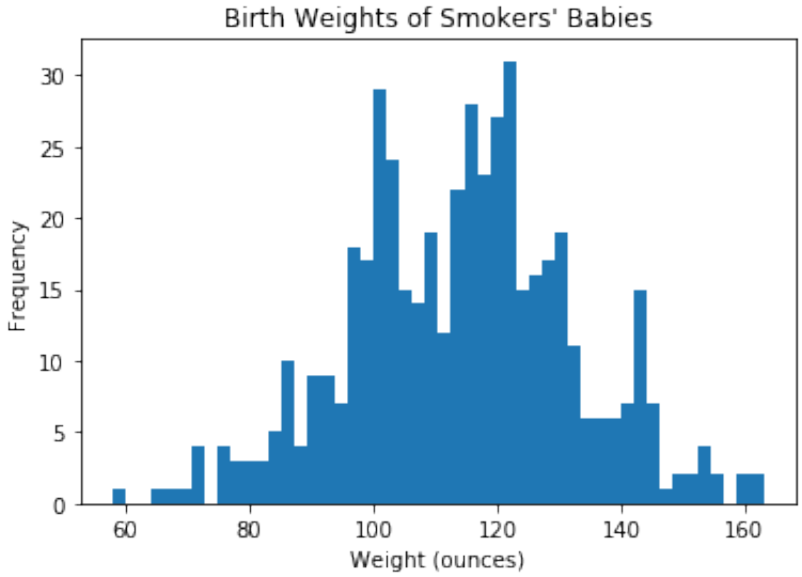
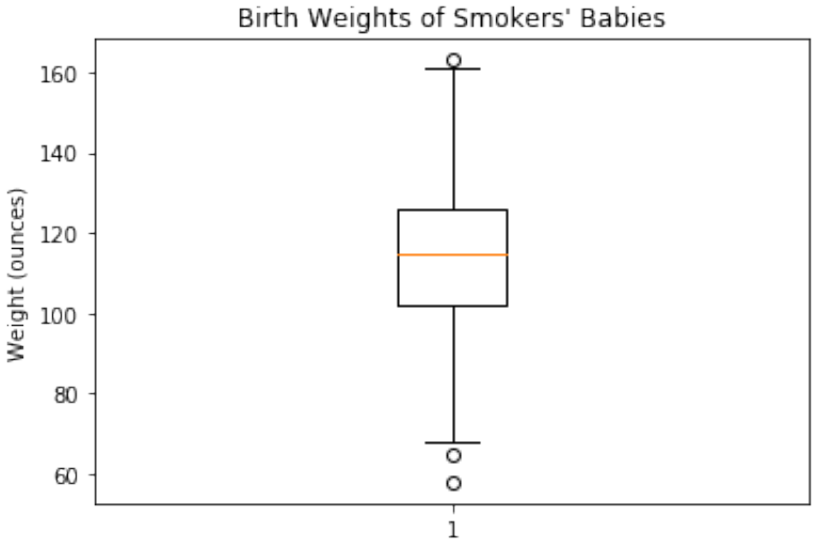


Figure 4: Box-and-Whiskers Plot



5 Conclusions and Discussion

Though it is clear that the babies of smokers generally have a lower birth weight, the differences in birth weight between smokers' babies and non-smokers' babies does not appear to be significant enough to support the Surgeon General's Warning. Though the median birth weight of the smokers' babies was lower than the non-smokers' babies' median by 9 ounces, it is also worth noting that all of the birth weights of smokers' babies are also seen in the birth weights of non-smokers' babies. In fact, the smokers' babies birth weights are more "clumped" together, as seen in the data range of 105 ounces versus the 121 ounce range non-smokers' babies. When looking at the extrema, while the upper extreme of the smokers' babies is 6 ounces lower than that of the non-smokers' babies, the lower extreme for the non-smokers' babies is lower than the smokers' babies, by 3 ounces. There are also less extreme values in the weights of the smokers' babies than in the non-smokers' babies, which can be seen in the kurtosis values as well - the kurtosis of the smokers' babies is negative, implying thinner tails on the data and less influence from extreme values; the non-smokers' babies' kurtosis positive, implying heavier tails, and also of note is that the absolute value of this kurtosis is far larger than that of the smokers' babies', which shows that the extreme values of the non-smokers' babies' weights very much affect the data. These observations seem to suggest that there are other factors at play beyond smoking during pregnancy that can lead to low birth weight.