Article Analysis

CCHS 315

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Title of Article: Smoking cessation in pregnancy and the risk of child behavioural problems: a longitudinal prospective cohort study. Robinson, M., McLean, N. J., Oddy, W. H., Mattes, E., Bulsara, M., Li, J., Zubrick, S.R., Newnhan, J. P. (2010). *Journal* of *Epidemiology and Community Health, 64*(7), 622-629. doi: 10.1136/jech.2009.088658 Retrieved from http://illiad.ferris.edu/illiad/illiad.dll?SessionID=B093921232M&Action=10&Form=75&Value=70130

Summary:

In a literature review prior to their research, authors' Mclean et al. found many studies associating physical health risks with smoking during pregnancy. Previous studies have also linked smoking during pregnancy with behavioral problems in children. The findings of these studies have been controversial because of the many variables, such as socioeconomic disadvantages and maternal stressors, which could have affected the results. This research, the Western Australian Pregnancy Cohort Study, was the first study to look at the "influence of smoking cessation in pregnancy on long term behavioral outcomes" (McLean et al., 2010, p. 622) while controlling the variables that might influence these results. The study was a longitudinal prospective cohort study following 2868 children from birth through 14 years of age.

The study was divided into four sets of variables that were then compared. The first set of variables, Outcome Variables, used the Child Behaviour Checklist (CBCL) as a tool to measure behavior in children by parental reporting. The CBCL is divided into two tests, for young ages 2-

3 years and older children, ages 4-18. This test was shown to be reliable and valid for use in Western Australia, although it was developed in the United States. To assess smoking (Predictor Variables), mothers were divided into four categories: A. never smoked, B. light smokers that quit in the first 18 weeks of pregnancy, C. heavy smokers that quit in the first 18 wks of pregnancy, and D. smokers that continued to smoke past 18 weeks of pregnancy. Additional data demonstrated no significant difference in number of cigarettes smoked at 18 weeks and 34 weeks gestation so there was no need for further categories.

The third and fourth variables were the confounding variables that the study sought to control. Labeled as Control Variables, the study defined the third set of variables as the maternal experience of stressful events and other factors such as birth weight, gestational age, and breast-feeding duration that could affect results. Additionally, maternal self-efficacy, the fourth variable (Other Variables), was measured using an assessment tool called the modified Cowen Perceived Self-Efficacy Scale.

The aim of the study was to compare the behavioral outcomes for the children over a 14 year timeframe, produced by mothers who continued to smoke or quit smoking with those who never smoked during pregnancy. Previous studies had supported the probability that smoking in pregnancy leads to behavioral problems. Mclean et al. wanted to look at the results while controlling the variables over a longer period of time. In this longitudinal study, the authors took the behavioral scores of the children and subtracted the influence of the confounding variables to find that the children of the mothers that continued to smoke had significantly higher CBCL scores (i.e. behavior problems) than the non-smoking and cessation of smoking mothers. In a surprising outcome of the research, it was found that the light smokers who quit at < 18weeks gestation had significantly lower CBCL scores and therefore less behavioral problems than all

other categories, including the non-smoking mothers. This unexpected result was also evaluated and the light smokers that quit were shown to have a significantly higher self-efficacy score than the other three categories. Other literature review shows that "high self-efficacy is a strong predictor of positive parenting practices" (McLean et al., 20010, p. 626).

In summary, the study demonstrated a correlation between smoking throughout pregnancy and behavioral problems throughout childhood. The unexpected discovery of support for cessation of smoking before 18 weeks based on the lower behavioral morbidity (CBCL) scores and increased self-efficacy scores has implications for further study. There is a need for additional knowledge on how pre-natal healthcare workers can best assist mothers to stop smoking by addressing the "maternal characteristics that strengthen a mother's capacity to quit" (McLean et al., 2010, p. 628) while giving her additional supportive tools to raise her family.

Statistics used in the Article:

1. Name of statistic: **Z-Score**
2. Was this statistic covered during class? **Yes**

Number of times used in article: **1 (although this score was referenced many times)**

Why do you think this statistic was used? **Z-scores take the raw data and turn it into a measurement (score) that can be used in a normal distribution curve. That way the researcher can tell how the measurement relates to the mean. In other words, how close or far away the score is from the norm.**

In this study, researchers calculated three Z-scores based on scores provided by a parental reported behavioral tool, the Child Behavior Checklist (CBCL), for every child at ages 2, 5, 8, 10, and 14. The three categories of Z-score were based on total behavior and then subdivided into internalizing behavior (withdrawal, anxiety,

depression, etc.) and externalizing behavior (acting out). Means of each category were calibrated and the Z-scores of each child where compared.

What did this statistic show or prove? **Higher Z-scores (further from the norm) represented more disturbed emotions and behaviors. When compared later to the predictor variables (smoking habits of mothers), the children of mothers that continued to smoke heavily throughout their pregnancies had higher Z-scores demonstrating a higher value away from the norm or more deviant behavior. Children of light smoking mothers that had the ability to quit smoking had lower z-scores, therefore less behavior problems.**

Was there an associated P value? **No**

If yes, what did the P value show? **N/A**

3. Name of Statistic: **T score**

Was this statistic covered during class? **Yes**

Number of times used in article: **1**

Why do you think this statistic was used? **T scores are used when there is more variability in the data. The bell curve is a little wider and flatter (longer tails).**

The researchers appeared to use this score to compare their sample of Australian children with the United States children upon which the CBCL test was developed. They wanted to make sure that the test was a good indicator of behavior of children in Western Australia (C. Nichols PhD., Munson Medical Center, personal communication, November 18, 2010). The standard T score values for the CBCL in the United States is a mean of 50 and a SD of 10. This was presented in the article as T is equal or greater than 60.

What did this statistic show or prove? **The comparison showed good reliability, sensitivity, and specificity for behavior in children of Western Australia. This made the researchers confident that the CBCL was a good was to evaluate the behavior of these children for the study.**

Was there an associated P value? **No**

If yes, what did the P value show? **N/A**

4. Name of statistic: **Pearson r**

Was this statistic covered during class? **No, although similar to a line graph.**

Number of times used in article: **1**

Why do you think this statistic was used? **The Pearson r is also called a linear correlation coefficient. This describes comparing two values, on an x-axis and y-axis on a one to one basis.**

The value given in this article was r = .866 The Pearson r was used in this research to show that the mothers that were still smoking at 18 weeks gestations were going to be still smoking the same amount at 34 weeks gestation. Comparing the mothers at 18 weeks to the mothers at 34 weeks, the value was close to 1 which is highly significant. The closer to 1, the closer every value for x is equal to every value for y. (C. Nichols PhD., Munson Medical Center, personal communication. November 18, 2010).

What did this statistic show or prove? **There was no need to include the data of mothers still smoking past 18 weeks gestation in the study. Adding the data of women of 34 weeks gestation would have added no additional information to the study as it was nearly the same as the data for 18 weeks gestation.**

Was there an associated P value? **Yes, $p < 0.001$.**

If yes, what did the P value show? **This shows a highly significant probability that the r value was correct and the researchers can reject the possibility that there was a large difference between mother's smoking habits at 18 weeks gestation and 34 weeks gestation. They can also reject that mother's smoking habits at 34 weeks gestation should have been included in the study.**

5. Name of statistic: **Cronbach's α coefficient**.

Was this statistic covered during class? **No**

Number of times used in article: **1**

Why do you think this statistic was used? **Used to evaluate the consistency of a test (C. Nichols PhD., Munson Medical Center, personal communication, November 18, 2010). The Cronbach's alpha "provides an estimate of the reliability of all possible ways of dividing an instrument into two halves" (Nieswiadomy, 2008, p.220). Therefore, it measures that all questions on the test measure or look at the same thing (internal consistency reliability).**

In the determination of the "other" variables in the study, the modified Cowen Perceived Self- Efficacy Scale was used. This consisted of a 22 item test administered to the mothers during pregnancy and then 3 years later to measure the coping skills (self-efficacy) available when faced with everyday situations. The Cronbach's α coefficient demonstrates what percentage of the questions on the self-efficacy test are specific to self-efficacy.

What did this statistic show or prove? **The results were 0.91 and could be read as 91%. This shows that 91% of the test was specific enough to produce the best answer related to self-efficacy for that person. This would be very important for the test because it was**

repeated three years later. Consistent questions would be more likely to produce similarly significant answers in repeated testing.

Was there an associated P value? **No**

If yes, what did the P value show? **N/A**

6. Name of statistic: **Linear Regression Model**

Was this statistic covered during class? **No**

Number of times used in article: **1**

Why do you think this statistic was used? **Linear Regression is a way to compare variables one to one similarly to the Pearson r discussed in #2.**
This linear regression compared the variables of the results of the CBCL (behavior scores) with the predictor variable (mother's smoking history). It was used to show there was a difference on which to base the studies to control the confounding variables. Basically, it was used as a control value. If there had been no difference in the first place in the behaviors amongst the children, researchers would not have needed to continue the study and look at the variables.

What did this statistic show or prove? **It shows a correlation between a history of smoking throughout pregnancy and poor behavior outcomes in children. It did not allow for the influence of the confounding variables.**

Was there an associated P value? **No. I am sure there was a p-value that was not provided as this test does not speak to the aim of the study. The researchers were more interested in the statistical significance of the confounders.**

If yes, what did the P value show? **N/A**

7. Name of statistic: **Frequency characteristics (similar to Prevalence rates and percentages)**

Was this statistic covered during class? **Yes**

Number of times used in article: **1**

Why do you think this statistic was used? **This is a descriptive statistic used to describe the frequency of new and existing characteristics in the given population.**

In the article, Smoking cessation in pregnancy and the risk of child behavioural (sic) problems: a longitudinal prospective cohort study, Table 1 provides the number and percentage of the population of predictor, outcome and control variables by variables opposite the category of smoking history. The table demonstrated gender, maternal age (5 class intervals; from <20years - 35+ years), maternal education (3 class intervals; <10+10, 11, 12+), Father living with family, family income (2 interval above and including and below 24,000 per annum), number of stress events in pregnancy (0,1-2, 3+) and finally, alcohol intake (0, 1, 2-6, daily, per week) in numbers and percentages. The percentages were also summarized in the body of the article.

What did this statistic show or prove? **It was simply a description of how many and what percentage of children were in each category.**

Was there an associated P value? **Yes.**

If yes, what did the P value show? **All p values were < 0.001 assuring that each child only fit in one class interval of each category. An exception to this was for gender (p=0.062) which was not a confounder and in this study was homogenous (because gender made no difference). Therefore, it made no difference what the p-value was.**

8. Name of statistic: **Odds Ratio**

Was this statistic covered during class? **Yes**

Number of times used in article: **1**

Why do you think this statistic was used? **Ratio is used to determine if a certain exposure caused the problem.**

In this study, both the univariate(comparing one variable at a time) and multivariate (comparing more than one variable) analyses over all 14 years showed a significant relationship between mothers that continued to smoke during pregnancy and all three categories of behavioral morbidity (total, internalizing, and externalizing). Even after adjusting for the confounding variables, "the OR's remained high". This data was shown in Table 4 with the OR being over twice as high for CBCL morbidity in children with mothers that smoked before and during pregnancy. An example of the actual numbers given is the OR of children whose mothers smoked 1-10 cigarettes before pregnancy is 0.94 for total behavior disturbances (less than the significant > 1) as compared to the OR ratio of the continued smoking group of 2.19(well greater than 1 and therefore significant).

What did this statistic show or prove? **This statistic shows the odds of having disturbed behavior is higher if mothers of these children continue to smoke during pregnancy even after adjusting for the confounding variables. The numbers provided show a more than 2 times probability for behavioral morbidity in children of mothers that continued to smoke during pregnancy than light smokers that stopped. .**

Was there an associated P value? **Yes**

If yes, what did the P value show? **The p value was <0.001. If the OR is >1 the p value must be <0.05 for the result to be significant. This shows this difference is not by chance.**

9. Name of statistic: **Generalised Estimating Equations (GEE)**

Was this statistic covered during class? **No**

Number of times used in article: **1**

Why do you think this statistic was used? **The article describes the GEE as a random effect logistic model. Wikipedia describes it as a semi-parametric regression technique. They state "GEE is used to fit the parameters of a generalized linear model where unknown correlation is present" (accessed 11-18-10). Wikipedia continues with their description of GEE as suitable when random effects and variances are not of direct interest. They also state it is good for use in longitudinal studies.**

In looking at this research study, it states researchers first cross tabulated the outcome and predictor variables (See #4 linear regression). The predictor values (prenatal smoking) were then placed in a univariate random effects model which compared the smoking variables to the results of the CBCL test. They then formed a matrix to look at all the variables (multivariable analysis of the confounders such as maternal stressors and self-efficacy) usually referred to as a "Square Corr Matrix" (C. Nichols PhD., Munson Medical Center, personal communication. November 18, 2010). (My thought is it is similar to a large football pool or large contingency table). The predictor data was then placed in the GEE which is a logistical way of looking at the data or a way of comparing data by way of significance. C. Nichols PhD explains it is a method of using multiple statistical tests at once (C. Nichols PhD., Munson Medical

Center, personal communication. November 18, 2010). Since GEE is a semi-parametric regression technique, it is possible that the researchers needed to use this data because the data was not quite a normal distribution.

What did this statistic show or prove? **This combination of tests allowed the researchers to discount the other confounding variables and support the predictor variable (continuous smoking 11+ cigarettes/day) as a strong correlation to poor childhood behavior.**

Was there an associated P value? **Yes.**

If yes, what did the P value show? **p= < 0.001 for all behaviors associated with heavy smoking throughout pregnancy with the exception of one category. The adjusted analysis (removing the confounders) of internalizing behavior was p= 0.006 which is still well below 0.05 and statistically significant.**

10. Name of statistic: **ANOVA (Analysis of Variance)**

Was this statistic covered during class? **Yes**

Number of times used in article: **1**

Why do you think this statistic was used? **ANOVA compares 3 of more groups in an experiment to look for differences.**

These researchers used ANOVA to compare the smoking habits of the 4 groups of mothers to their scores on the modified Cowen Perceived Efficacy Scale. After the unexpected results of having the children of light smokers that quit smoking by 18 weeks gestation show less behavioral problems, this was an explanation. However, ANOVA only demonstrates a difference is present and an additional test was needed to show which group was different (See # 11).

What did this statistic show or prove? **That there was a difference in smoking groups and self- efficacy. No F ratio was included in the article.**

Was there an associated P value? **No**

If yes, what did the P value show? **N/A**

11. Name of statistic: **Tukey's Honestly Significant Difference Test**

Was this statistic covered during class? **Yes**

Number of times used in article: **1**

Why do you think this statistic was used? **This is a multiple comparison method used to look at the difference found in an ANOVA to determine which category was different (see ANOVA, #8).**

This method was used to determine which of the 4 smoking categories scored statistically differently on the self-efficacy test. An HSD value was not provided. A bar graph was provided, demonstrating the largest self-efficacy score belonging to the group that smoked lightly before 18weeks gestation and was able to cease by then.

What did this statistic show or prove? **See above. This research supports that mothers that have better self-efficacy may have a better ability to control their smoking and better coping skills to deal with stressors. Further literature review in the article supports stronger parenting skills with stronger self-efficacy.**

Was there an associated P value? **Yes. p = 0.013.**

If yes, what did the P value show? **This tells us that the groups were statistically different and the results were significant. P is almost < .01 making it highly significant that the researchers were correct in determining that the cessation of light smoking group has a higher self-efficacy.**

12. Name of statistic: **Confidence Interval**

Was this statistic covered during class? **Yes**

Number of times used in article: **2**

Why do you think this statistic was used? **Confidence intervals capture the true value of the mean population within a certain percent. They assure that any sample mean of the population is going to fall within that interval a certain percentage of the time.**

In table 3 of the study, the relationship between smoking and smoking cessation and the CBCL mean z-scores for this population are presented. This table has a confidence interval of 95%. The researchers set their confidence interval at 95% ensuring that the mean of any sample population in their study would fall within the range determined. The Z-score is given and a range of 2 numbers (margins of error subtracted and added to the mean) is given below that. Researchers can be 95% confident that within the range given lies the true value of the CBCL mu (mean of all values in a population probably based in Western Australia).

Again in table 4, a confidence interval of 95% is used to say using the OR between smoking and smoking cessation and CBCL morbidity, researchers can be 95% confident that within the range given lies the true value of the CBCL morbidity mu(mean of all values in a population the same as above).

What did this statistic show or prove**? The researchers are 95% confident that the mean for the true population is going to fall between those two numbers.**

Was there an associated P value? **No**

If yes, what did the P value show? **N/A**

References

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