Correlation between Infants' Cortisol Level and Mothers' Cortisol Level

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Overview

The main goal of this research is that to investigate whether there is a correlation between cortisol levels between infants and mothers. The reason why this research needs to be done is that cortisol is an adrenal, steroid hormone that effects on people like immune system, water retention in the kidney, and adjusting blood glucose, etc. Especially in the early years of life, the variations in cortisol level would impact early physiologic and cognitive development. To clarify, this research was studied. Mothers and infants are randomly selected from each island in East, West, South, and North. Based on this, I designed a model with assuming factors affecting cortisol. The data collected in designing the model are that the location of island, mothers' cortisol, infant's cortisol, sibling cortisol, mothers' stress ranking, and whether breastfeed. This research is designed a linear model to compare the relationship between the variables and the response and conducted a correlation test to determine the final correlation. As a result, it was concluded that the correlations between cortisol levels of infants and mothers were lower than 0.5, indicating a low correlation.

Data Exploration

	Mothers	**Infants**	**Siblings**
Sample Size	43	43	43
Cortisol Level mean	6.712	4.189	5.507
Location (S: N: E)	23: 8: 12		
Breastfeed (Yes: No)	10:34		

Table1. Baseline Demographics of Variables

This research focuses on the correlation of cortisol levels between infants and mothers. The researchers randomly surveyed 43 homes in the south, north, and east of the island and

confirmed whether they were breastfeeding. In addition, this research studies to investigate deeper results by comparing the correlation between mother and siblings' cortisol levels. If mother's cortisol level affects your child's cortisol levels, you should also identify the variables that affect your mother's cortisol level. As shown in Table 1, correlations by modeling not only the cortisol levels of infants, mothers, and siblings, but also the location on the island and the mother's stress level lead more accurate results.

Data Analysis Methods

This study used a correlation test method to find out the correlation between cortisol levels in infants and mothers. Before testing correlation between cortisol levels in infants and mothers, I examined which variables affect infant cortisol levels, mother cortisol levels, and sibling's cortisol levels with linear model.

Linear model equation below is modeling that the linear correlation between the dependent variable y and one or more independent variables x.

$$Y_i = \beta_0 + \sum_{j=1}^{p} x_{ij}\,\beta_j + \epsilon_i \qquad \text{(Eq.1)}$$

To find out which variables have the greatest effect on the response, Y value is modeled with the cortisol level of the infant, the cortisol level of the mother, and the cortisol level of the siblings. Depending on the result, whether the mother's cortisol level or whatever has the greatest effect on the cortisol level and look at the relationship between it and the infant as using correlation test.

Correlation test model equation below measures a linear dependence between two variables. This research is designed correlation t test which is test for correlation between paired

samples and it shows that the correlation coefficients and the significance level, which is p-values.

$$r = \frac{\sum(x - m_x)(y - m_y)}{\sqrt{\sum(x - m_x)^2 \sum(y - m_y)^2}} \qquad \text{(Eq.2)}$$

The following hypotheses were tested using t-test

$$H_0 = r < |0.5|$$

$$H_a = r > |0.5| \qquad \text{(Eq.3)}$$

Correlation testing is a test to understand the relationship by quantifying the correlation of two variables. Correlation range is between -1 and 1. A negative correlation is close to -1, and a positive correlation is close to 1. If it is close to 0, it means that there is no correlation. The correlation value is determined to be high and low based on the absolute value of 0.5. The significance, which is p-values, of the correlation can be determined by calculating t-values. In other words, if p is lower than significance level at 0.05, H_0 reject and there is no correlation.

Summarize Results

The linear model results of equations (Eq.1) are given in Table 2, Table3, and Table4 below.

	Intercept	Mother	Siblings	Mothers' Stress	Breastfeed	Location (S: N: E)
p-values	0.2336	0.1388	0.0841	0.6882	0.0101*	0.6366: 0.3182: 0.7266

Table2. Model1: Infant ~ Mother+ Sibling + Mothers' Stress + Breastfeed + Location

Using Linear model result from Table 2, Mothers' Breastfeed p-values is 0.0101 which is low p-value, it means that it is significant level at 0.05. Only mothers breastfeed effects on infants' cortisol level.

	Intercept	Mother	Mothers' Stress	Breastfeed
p-values	1.13e-07	0.00308*	0.46849	0.72043

Table3. Model2: Siblings ~ Mother+ Mothers' Stress + Breastfeed

Using Linear model result from Table 3, Mothers' cortisol level p-values is 0.00308 which is low p-value, it means that it is significant level at 0.05. Only mother's cortisol level effects on siblings' cortisol level.

	Intercept	Mothers' Stress	Breastfeed	Location (S: N: E)
p-values	1.13e-07	0.00308*	0.46849	0.72043

Table4. Model3: Mother ~ Mothers' Stress Rank + Breastfeed + Location

Using Linear model result from Table 4, Mothers' Stress rank p-values is 0.00308 which is low p-value, it means that it is significant level at 0.05. Only mothers stress effects on mothers' cortisol level.

The correlation test results for equations (Eq.2) are given in Table 5.

Infants and Mother correlation	Siblings and Mother correlation
0.4274101	0.4483487

Table5. Infants and Mother correlation vs. Siblings and Mother correlation

Using the correlation test result from Table 5, both infants and mother cortisol level correlation and between siblings and mother cortisol level correlation are less than 0.5 meant that H_0 fail to reject. This result shows that there is no correlation between infant and mother and siblings and mother.

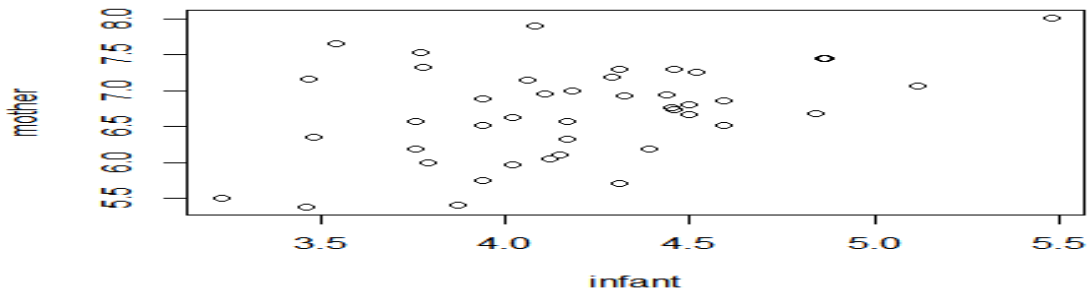

Figure 1. Correlation between Infants' cortisol level and Mothers' cortisol level

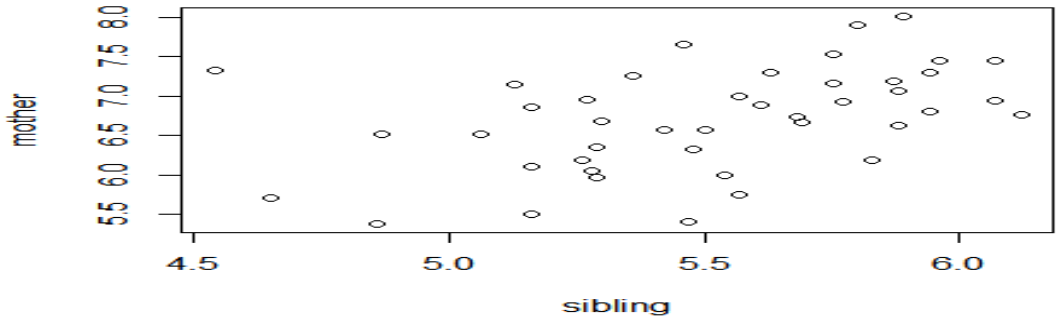

Figure 2. Correlation between Siblings' cortisol level and Mothers' cortisol level

Compare between Figure 1 and Figure 2, cortisol level in mothers and infants is lower than mothers and sibling. And, both plots appear that if mother's cortisol level is high, infants and sibling's cortisol level seem high, but the patterns are not constant. This can be confirmed by the plot that between two relation has low correlation.

Result Discuss

It was assumed that there was a correlation between the cortisol level of the mother and the cortisol level of the infant, but the results were not correlated. Table 1 shows that the p-value of breastfeeding is lower than 0.05. This shows that breast-feeding is the most influential factor in infant cortisol levels. But the data collected showed that only 10 out of 43 women

breast-fed. In other words, the overall data suggests that cortisol correlations between infants and mothers are low because data from mothers and infants who have not breastfed have been collected.

References

Learning Objectives. (n.d.). Retrieved from http://sphweb.bumc.bu.edu/otlt/MPH Modules /BS/R/R5_Correlation-Regression/R5_Correlation-Regression_print.html

Appendix

```
idata = read.csv("C:/Users/brism/Downloads/infants.csv",header=TRUE)

infant= idata$Infant.s.Cortiso[1:43]
mother= idata$Mother.s.Cortisol[1:43]
sibling= idata$Sibling.s.Cortisol[1:43]
rank= idata$Mother.s.Stress.Ranking[1:43]
breastf= idata$Mother.Breastfeeding..Y.N.[1:43]
location= idata$Island..North..South..East.[1:43]
model1= lm(infant ~ mother+ sibling + rank + breastf + location, data= idata)
summary(model1)
## Call:
## lm(formula = infant ~ mother + sibling + rank + breastf + location,
##     data = idata)
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.95049 -0.17434 -0.04046  0.06311  0.79952
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    1.17751    0.97105   1.213   0.2336
## mother         0.18038    0.11898   1.516   0.1388
## sibling        0.31142    0.17500   1.780   0.0841 .
## rank           0.03154    0.07793   0.405   0.6882
## breastf       -0.48684    0.17860  -2.726   0.0101 *
## locationEast   0.12021    0.25218   0.477   0.6366
## locationNorth  0.20195    0.19934   1.013   0.3182
## locationNorth  0.35373    0.43202   0.819   0.4186
## locationSouth  0.06618    0.18771   0.353   0.7266
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 0.3744 on 34 degrees of freedom
## Multiple R-squared:  0.4715, Adjusted R-squared:  0.3472
## F-statistic: 3.792 on 8 and 34 DF,  p-value: 0.00283

model2= lm(sibling ~ mother + rank + breastf, data= idata)
summary(model2)
## Call:
## lm(formula = sibling ~ mother + rank + breastf, data = idata)
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -1.17012 -0.16192  0.01608  0.21332  0.58234
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  3.88482    0.59974   6.478 1.13e-07 ***
## mother       0.26557    0.08414   3.156  0.00308 **
## rank        -0.04748    0.06485  -0.732  0.46849
## breastf     -0.05112    0.14180  -0.360  0.72043
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 0.3527 on 39 degrees of freedom
## Multiple R-squared:  0.2121, Adjusted R-squared:  0.1515
## F-statistic:   3.5 on 3 and 39 DF,  p-value: 0.02428
```

```
model3= lm(mother ~ rank + breastf + location, data= idata)
summary(model3)
## Call:
## lm(formula = mother ~ rank + breastf + location, data = idata)
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.01498 -0.21049  0.03204  0.31200  1.14112
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)      5.6942     0.4256  13.380 1.54e-15 ***
## rank             0.1763     0.1136   1.553  0.12926
## breastf          0.3739     0.2632   1.421  0.16405
## locationEast    -0.4280     0.3738  -1.145  0.25980
## locationNorth    0.0648     0.3003   0.216  0.83035
## locationNorth    1.2268     0.6139   1.998  0.05326 .
## locationSouth    0.7155     0.2581   2.772  0.00876 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 0.5671 on 36 degrees of freedom
## Multiple R-squared:  0.3512, Adjusted R-squared:  0.243
## F-statistic: 3.247 on 6 and 36 DF,  p-value: 0.0118
```

```
res1= cor.test(infant, mother, method = "pearson", conf.level = 0.8)
res1
##  Pearson's product-moment correlation
## data:  infant and mother
## t = 3.0272, df = 41, p-value = 0.004254
## alternative hypothesis: true correlation is not equal to 0
```

```
## 80 percent confidence interval:
##  0.2487619 0.5779338
## sample estimates:
##       cor
## 0.4274101

res2= cor.test(sibling,mother, method = "pearson", conf.level = 0.8)
res2
##  Pearson's product-moment correlation
## data:  sibling and mother
## t = 3.2117, df = 41, p-value = 0.002568
## alternative hypothesis: true correlation is not equal to 0
## 80 percent confidence interval:
##  0.2729055 0.5949300
## sample estimates:
##       cor
## 0.4483487
```