Canonical Correlation Analysis Of Neonatal Anthropometric Indicators And Maternal Socio - Demographic Factors

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Abstract: The main objective of this study was to examine the relationship between neonatal anthropometric indicators (Baby head circumference, Baby full length and Baby weight) and maternal socio-demographic factors (Gravidity, Parity, Educational level, Age, occupation of mother and number of ANC visit) using canonical correlation analysis. The neonatal anthropometric indicators were considered as depended (Y) variables whiles maternal socio-demographic factors were considered as independent variables (X). The outcome of the canonical correlation analysis showed that, there exists a significant relationship between neonatal anthropometric indicators (Baby head circumference, Baby full length and Baby weight) and maternal socio-demographic factors (Gravidity, Parity, Educational level, Age, occupation of mother and number of ANC visit). The total shared variance between the two set of variables was 69.8%. The study also showed that Baby head circumference has a positive relationship with maternal Age and also negative relationship with the remaining of the maternal socio-demographic factors whiles Baby full length and Baby weight also has a positive relationship with all the maternal socio-demographic factors used in the study except maternal Age.

Index Terms: Canonical correlation, Neonate, Anthropometric indicators, Maternal Socio-Demographic factors

1 INTRODUCTION

Several studies by researchers have indicated the significant effects of maternal factors on the anthropometric indicators of newborns [1- 4]. This is so because of the growing interest by researchers to fill the gap of the relationship between the anthropometric indicators of newborns and maternal factors. Some of the lot studies done were on the relationship between maternal anthropometric and neonatal anthropometric indicators. It was revealed that that maternal age and parity plays important role in foetal growth and development [5]. Other study was also on the effect of maternal nutritional statues on the anthropometric indicators of infant. It was reported that maternal nutritional statues is also a key factor on the body dimension (birth weight and length) of neonate [6]. The common anthropometric measurements used as growth and development indicators in several studies by researchers were height, weight and body circumference [7]. In the study by [8] who considered the above list in their study [7] as growth and development indicators showed that several maternal factors such as age, parity, social class and ethnicity influenced growth of neonate. Mother's height was also revealed to be associated with the birth size and height of neonate [9-12]. Maternal factors such as body weight, age, height, parity, smoking during pregnancy, ethnicity and many more also affect growth and development of neonate [13].

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The neonatal anthropometric indicator such as birth weight is a tool used to assess the neonatal nutritional statues, gestational maturity and prediction of early neonatal death. It is also used as a guide to provide appropriate drug and fluid doses and many more [14]. As a result of the usefulness of the anthropometric indicators any factor that has effect on the neonatal anthropometric indicators should be investigate into. But the literature of the factors that influence the neonatal anthropometric indicators has been investigated in several ways with the exception of maternal socio-demographic factors. Hence this paper seeks to use canonical correlation analysis to investigate into the relationship between neonatal anthropometric indicators (Baby head circumference Baby full lenght and Baby weight) and maternal socio-demographic factors (gravid, parity, educational level, age, occupation and finally number of ANC visit).

2 METHODOLOGY

The objective of this research work is to investigate the relationship between neonatal anthropometric indicators and maternal socio-demographic factors. This research work made use of secondary data from 2015 to 2017 compiled by St. Michael Hospital Jachie Pramso. A total of 600 neonatal anthropometric information with their corresponding maternal socio-demographic information was analysed. SPSS version 20.0 was used in analyzing the data. A canonical correlation analysis was employed to investigated the association between the two set of variables (neonatal anthropometric indicators and maternal socio-demographic factors) using SPSS. The analysis was conducted by taking the set of variables: anthropometric indicators (Baby head circumference, Baby full lenght and Baby weight) as dependent set of variables (Y) and corresponding maternal socio-demographic factors (Gravidity, Parity, Educational level, Age, occupation of mother and number of ANC visit) as the set of independent variables (X). The canonical correlation analysis was performed to investigate the extent of the association between the two set of variables and to identify the most favorable linear combinations of the variable sets.

2.1 Canonical Correlation Analysis

The relationship between neonatal anthropometric indicators (Baby head circumference, Baby full length and Baby weight) and maternal socio-demographic factors (Gravidity, Parity, Educational level, Age, occupation of mother and number of ANC visit) was examined with canonical correlation analysis by using the SYNTAX COMMAND procedure of SPSS. Canonical correlation analysis main aim is to find the relationship between synthetic variables (linear combination of the variables in one set and a linear combination in another set) [15]. The canonical covariates (the linear combination of dependent and the linear combination of independent variables) and the relationship between the covariates are the results of interest [16]. Defining B_n and Z_m as canonical variates obtained from neonatal anthropometric indicators and maternal socio-demographic factors respectively.

$$B_n = b_{n1}Y_1 + b_{n2}Y_2 + ... + b_{np}Y_p \quad (1)$$

$$Z_m = z_{m1}X_1 + z_{m2}X_2 + ... + z_{mq}X_q \quad (2)$$

The correlation between B_n and Z_m is termed canonical correlation(C_{nm}). The amount of variance explained by the canonical variates is the squared canonical correlation (canonical roots) [16]. The standardized regression coefficients in the multiple regressions which is of relative importance to the explanatory variable in determining the value of the dependent variable is similar to the standardized regression coefficients in the canonical correlation analysis. As a result of this correlation analysis seeks to estimate the canonical coefficients:

$b_{n1}, b_{n2}, ..., \quad b_{np}$ and $z_{m1}, z_{m2}, ..., \quad z_{mq}$

when there exist a maximum canonical correlation. The maximization of the canonical correlation is illustrated below: represent the first set of p variates by random vector, $Y_{p\times1}$ and the second set of q variates by random vector $X_{q\times1}$. Hence the population mean and (co)variance are as follows:

$$E(X) = \mu, \qquad E(Y) = \mu$$

$$Cov(X) = \Sigma_{11}, \qquad Cov(Y) = \Sigma_{22}$$

$$Cov(X,Y) = \Sigma_{12} = \Sigma_{21}$$

The random vector and (co)variance can be expressed as:

$$\begin{pmatrix} Y_{p\times1} \\ X_{q\times1} \end{pmatrix} = \begin{pmatrix} Y_1 \\ Y_2 \\ Y_3 \\ X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{pmatrix} \qquad \Sigma = \begin{pmatrix} \Sigma_{11_{p\times q}} & \Sigma_{12_{p\times q}} \\ \Sigma_{21_{q\times p}} & \Sigma_{22_{q\times p}} \end{pmatrix}$$

The linear combination of the component of X and Y will be:

$$Var\ (B) = bCov\ (Y)b = b\Sigma_{11}b$$

$$Var\ (Z) = zCov\ (X)z = z\Sigma_{22}z$$

$$Cov\ (B, Z) = bCov\ (Y, X)z = b\Sigma_{12}z$$

The correlation between the canonical variates B and Z is developed as:

$$C = \frac{b\Sigma_{12}z}{(b\Sigma_{11}b)(z\Sigma_{22}z)}$$

2.2 Statistical significance of the canonical correlation

Hypothesis:

$$H_0 : C_1 = C_2 ..... = C_m = 0$$

$$H_1 : C_1 \neq C_2 ..... \neq C_m = 0$$

Testing for the significance of the hypothesis above the wilki's Lamda statistics is used. This is given by:

$$\wedge = \prod_{i=n}^{m} (1 - C_i^2)$$

3. RESULTS

This section of the study presents the outcome of the canonical correlation analysis between neonatal anthropometric indicators (Baby head circumference, Baby full length and Baby weight) and maternal socio- demographic factors (Gravidity, Parity, Educational level, Age, occupation of mother and number of ANC visit).

3.1 Statistical Test of Significance

In fitting a canonical correlation analysis, the initial step to take is to study the outcome from the multivariate senses that is multivariate test of significance. This test shows whether the canonical correlation analysis fit well for the data obtained that is to say if the canonical model obtained is statistically significant or not. The table 1 below indicates the various test statistics which is used when performing the multivariate test of significance: Wilki's Lamda, Pillais trace, Hotelling trace and Roy's largest root but according to Henson and Sherry, several authors interpret or perform this test using the wilki's Lamda statistic due to it higher level of practicality[15]. The multivariate test of significance table below shows that the full model across all functions is statistically significant using wilki's λ = 0.27746 criterion, where F = (18, 1779.00) with P= 0.000<0.05. But wilki's λ statistic gives the amount of the unexplained variance by the model hence 1- λ presents the amount of variance shared by the canonical variables. The full canonical model explained approximately 72% of the variance shared between the two variable sets (neonatal anthropometric indicators and maternal socio – demographic factors).

Table 1
Multivariate Test of Significance

Test name	Value	Approx F	Hypoth df	Error df	Sig of F
Pillais	0.1256	50.320	18.00	1779.00	0.000
Hotellings	1.9361	120.459	18.00	1779.00	0.000
Wilk's	0.2774	110.394	18.00	1779.00	0.000
Roys	0.7946				

3.2 Eigenvalues and Canonical Correlation

Table 2
Eigenvalues and Canonical correlations

Root No.	Eigenvalue	Percent	Cum. Percent	Can. Correlation	Can. Correlation Squared
1	2.10454	99.734	99.734	0.83348	0.69779
2	0.00276	0.244	99.978	0.07446	0.01667
3	0.0008	0.022	100.00	0.02241	0.00554

From Table 2 above the eigenvalues of the canonical functions and their corresponding correlation values are shown. The eigenvalues of the canonical functions and their correlation presents which canonical function has the highest correlation and also significant [16]. From the Table above we observed that Root No. has three rows meaning three canonical functions were obtained from the analysis. The first canonical function has a canonical correlation of 0.83348 and the amount of shared variance between the neonatal anthropometric indicators and maternal socio – demographic factors is 69.779% out of the 72% of the full model. The second function also has a canonical correlation value of 0.07446 and 1.667% of the shared variance between the neonatal anthropometric indicators and maternal socio – demographic factors out of the 72% of the full model. Finally, the third function has a canonical correlation value of 0.02241 and 0.554% of the shared variance between the neonatal anthropometric indicators and maternal socio – demographic factors in the third function out of the total shared variance of 72%. This indicates that the first canonical function has the highest correlation value and also explains the largest amount of the shared variance between the neonatal anthropometric indicators and maternal socio – demographic factors (the two data sets).

3.3 Dimension Reduction Analysis

This analysis which forms part of the canonical correlation analysis is responsible for helping the researcher to find out the amount of the shared variance explained by the full model that each canonical function accounted for and then test for the significance of each of the canonical functions. From the Table 3 below, we observed that only the function 1 to 3 is statistically significant with F(18.00, 233.66), P=0.000<0.05. The remaining functions from the Table 3 that is 2 to 3 and 3 did not accounted for larger portion of the shared variance and hence insignificant with P – values greater than 0.05 which is the level of significance.

Table 3
Dimension Reduction Analysis

Roots	Wilk's λ	F	Hypoth df	Error df	Sig. of F
1 to 3	0.2774	110.394	18.00	223.66	0.000
2 to 3	0.96919	0.85411	10.00	1688.00	0.523
3 to 3	0.99125	0.21224	4.00	845.00	0.807

3.4 Canonical Analysis for the First Canonical Function Regarding the Correlation between the two sets of data (neonatal anthropometric indicators and maternal socio – demographic factors)

With the help of the canonical correlation square we observed that only the first canonical function was found to be statistically significant since it accounted for a larger amount of the shared variance that is 69.8%. The other two functions that is 2 to 3 and 3 only accounted for 1.7% and 0.55% respectively from Table 2. To determine the extent to which the variables included in the data contributes to the correlation between the canonical variables, the structural coefficients and the standardized coefficients concerning the canonical functions are used. For the neonatal anthropometric indicators (Baby head circumference, Baby full length, Baby weight), Baby weight is the primarily indicator with baby full length secondary indicator. Baby full length and Baby weight has positive relationship with all the significant predictor variables (maternal socio – demographic factors) with the exception of the mother's age which in turn also has a positive relationship with the Baby head circumference. Concerning the predictor variables we observed that the significant variables so far as the maternal socio – demographic factors are concern are primarily Age of the mother, Gravidity and the number of ANC visit whiles Parity is the secondary factor to the neonatal anthropometric indicators. This was supported by the squared structure coefficients.

Table 4

Canonical Analysis for the First Canonical Function concerning the Correlation between neonatal anthropometric indicators and maternal socio – demographic factors

Variable	First Canonical Function			
	Coef.	r_s	r_s^2 %	h^2 %
Baby head circumference	0.015	- 0.044	0.195	0.195
Baby full length	0.045	0.456	20.79	20.79
Baby weight	2.655	0.869	75.46	75.46
R_c^2	69.8			
Age of mother	-0.0792	-0.686	47.06	47.06
Gravidity	0.295	0.852	72.59	72.59
Parity	0.355	0.583	33.99	33.99
Educational level	0.1699	0.199	3.96	3.96
Occupation	0.0469	0.0949	0.90	0.90
Number of ANC	0.2554	0.672	45.16	45.16

4. CONCLUSIONS

The study was about finding out the relationship between neonatal anthropometric indicators and maternal socio – demographic factors using canonical correlation analysis. The canonical correlation analysis was carried out using neonatal anthropometric indicators as depended variables and maternal socio – demographic factors as independed variables. The outcome of the analysis has revealed that there is a significant relationship between the two sets of data that is neonatal anthropometric indicators and maternal socio – demographic factors. The analysis yielded three canonical functions with squared canonical correlation (R_c^2) of 0.69779, 0.01667 and 0.00554 for the functions 1 to 3, 2 to 3 and 3 respectively. The full model across all the functions was statistically significant using the wilki's λ=0.2774 and a P=0.000<0.05. This value of the wilki's λ statistic resulted in the full model accounting for about 72.2% of the shared variance between the two variables. The dimension reduction analysis also revealed that out of the three canonical functions only one of them was significant that is it accounted for the larger portion of the shared variance that is function 1 to 3 which accounted for about 69.8% of the total 72.2% of the shared variance of the full model. From Table 4 we observed that maternal Age, Gravidity and number of ANC visit are the primarily predictors that has high impact on the neonatal anthropometric indicators. Parity on the other hand is the secondary factor. Maternal Age was found to have a positive relationship with Baby head circumference whiles the rest of the independent variables also has positive relationship with the remaining neonatal anthropometric indicators.

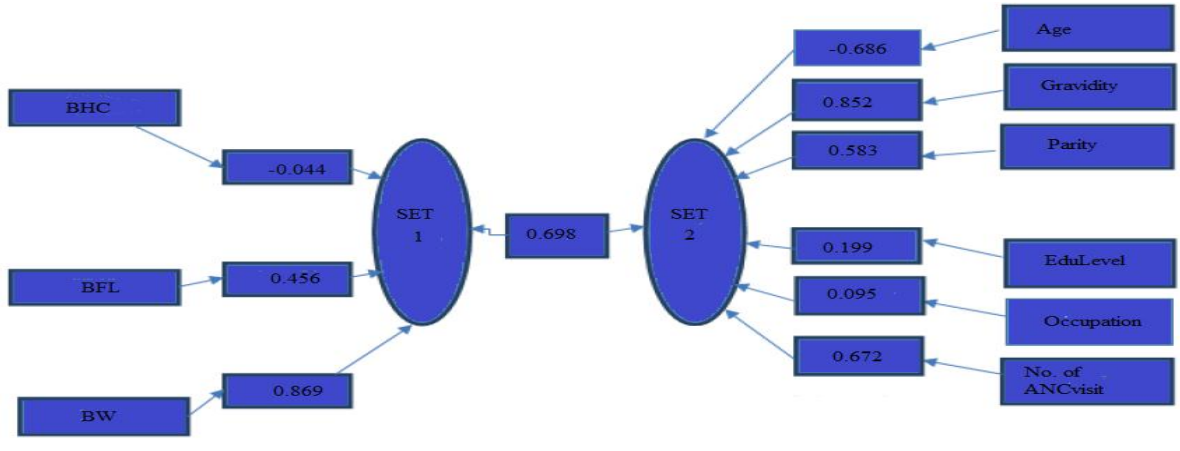

Figure 1: *Structure Coefficients and Canonical Correlation Value for the First Canonical Function concerning the correlation between neonatal anthropometric indicators and maternal socio – demographic factors.*

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