Supplement 2: Analyisis of Mediation effect of LBW on newborn mortality

Let y_i represents the outcome of interest as a binary variable (i) that takes the probability of the presence of outcome's exposure as P and probability of absence of the outcome's exposure as 1-P. The bivariate regression model would be of the form as in Eq. 1

$$ln\left(\frac{P_j}{1-P_j}\right) = \alpha_i + \beta_i x_i \qquad (1)$$

Where j represents categories of perinatal, late neonatal mortality, and LBW, x_i covariates of choice for each of the outcome and β_i their respective coefficients.

To assess the moderation effect of health facility delivery on the effect LBW on perinatal mortality (*pm*), an interaction term between the LBW and institutional deliver (*hf*) was introduced as indicated in Eq. 2.

$$ln\left(\frac{P_{pm}}{1-P_{pm}}\right) = \alpha_i + \beta_{lbw}x_{lbw} + \beta_{hf}x_{hf} + \beta_{lbw*hf}(x_{lbw} * x_{hf}) \qquad (2)$$

Subsequently, a multivariable regression model controlling for other factors added on eq. 2 was run (Eq. 3). In this model, I also assessed how the intersection between birth order and maternal age would affect perinatal mortality as shown in Eq. 3.

$$\begin{aligned} ln\left(\frac{P_{pm}}{1-P_{pm}}\right) = {} & \alpha_i + \beta_{lbw}x_{lbw} + \beta_{hf}x_{hf} + \beta_{lbw*hf}(x_{lbw} * x_{hf}) + \beta_{Age}x_{Age} + \beta_{educ}x_{educ} \\ & + \beta_{birth\ order}x_{birth\ order} + (\beta_{birth\ order*Age}(x_{birth\ order} * x_{Age}) \\ & + \beta_{multiple\ birth}x_{multiple\ birth} + \beta_{wealth}x_{wealth} \\ & + \beta_{nm\ expreinced\ preiviously}x_{nm\ expreinced\ preiviously} + \beta_{sex}x_{sex} \\ & + \beta_{birth\ quarter}x_{birth\ quarter} + \beta_{marital\ status}x_{marital\ \ status} \end{aligned} \qquad (3)$$

The independent variables that were included under the multivariate regression model for the late neonatal mortality (*nm*) are as indicated in Eq. 4

$$\begin{aligned} ln\left(\frac{P_{nm}}{1-P_{nm}}\right) = {} & \alpha_i + \beta_{lbw}x_{lbw} + \beta_{Age}x_{Age} + \beta_{educ}x_{educ} + \beta_{birth\ order}x_{birth\ order} \\ & + \beta_{multiple\ birth}x_{multiple\ birth} + \beta_{wealth}x_{wealth} \\ & + \beta_{nm\ expreinced\ preiviously}x_{nm\ expreinced\ preiviously} + \beta_{sex}x_{sex} \\ & + \beta_{birth\ quarter}x_{birth\ quarter} + \beta_{marital\ status}x_{marital\ \ status} \end{aligned} \qquad (4)$$

The mediating variable was selected if the predetermined endogenous – in this case, LBW was strongly associated with the main outcome variable in the multivariate model. The effect of selected covariates on LBW was determined using a multivariate regression model as indicated in Eq. 5

$$ln\left(\frac{P_{lbw}}{1-P_{lbw}}\right) = \alpha_i + \beta_{age}x_{age} + \beta_{educ}x_{educ} + \beta_{birth\ order}x_{birth\ order} + \beta_{multiple\ birth}x_{multiple\ birth} + \beta_{wealth}x_{wealth} + \beta_{nm\ expreinced\ preiviously}x_{nm\ expreinced\ preiviously} + \beta_{sex}x_{sex} + \beta_{birth\ quarter}x_{birth\ quarter} + \beta_{marital\ status}x_{marital\ \ status} \quad (5)$$

The indirect effect for instance for perinatal mortality with their corresponding standard errors for the factors that were significant in the LBW model were calculated as indicated in Eq. 6.

$$indirect\ \ effect_i = \beta_{lbw\ i} * \beta_{pm\ i} \quad (6)$$

The indirect effect's standard errors were calculated based on Goodman's approach of the product of coefficients [1] as indicated in Eq. 7.

$$\sigma_{\beta lbw\ i*\beta pm\ i} = \sqrt{\sigma^2_{lbw\ i} * \beta^2_{pm\ i} + \sigma^2_{pm\ i} * \beta^2_{lbw\ i} - \sigma^2_{lbw\ i} * \sigma^2_{pm\ i}} \quad (7)$$

The corresponding z or t -value were calculated as in Eq. 8;

$$z_i = \frac{indirect\ \ effect_i}{\sigma_{\beta lbw\ i*\beta pm\ i}} \quad (8)$$

Eq. 8 was used to calculate the P-values (P_i) for each indirect variable's coefficient as recommend by [2,3] in Eq. 9;

$$P_i = e^{-0.717138*z_i - 0.415973*{z_i}^2} \quad (9)$$

Reference

1 MacKinnon DP, Lockwood CM, Hoffman JM, *et al.* A comparison of methods to test mediation and other intervening variable effects. *Psychol Methods* 2002;**7**:83–104. doi:10.1037/1082-989X.7.1.83

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