**Maternal birth weight predicts the birth weight of the first live born child**

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## Introduction

Birth weight is one of the measures or a key indicator of the health of newborns other than the height at birth. It is not merely a measure of health of an infant but is also a strong indicator of a newborn's chances for survival, growth, long-term health and psychosocial development [(1)]. The baby's weight at birth is influenced by intrauterine environmental factors and genetic factors [(2)]. Environmental influences were estimated to account for about 25% on birth weight variance and genetic influences accounted for 38-80% [(3)]. The consequences of poor nutritional status and inadequate nutritional intake for women during pregnancy, not only directly affects women's health status, but may also have a negative impact on birth weight and early development.

Familial trends in birth weight have been observed where there is a significant correlation between parental birth weights and their child's birth weight [(4)]. Specifically, this correlation was observed between mother's birth weight and the weight of her child's first birth [(2)]. Furthermore, maternal birth size was a significant predictor of child's birth size after adjusting for gestational age, race and sex of the child, and other potential confounders [(5, 6, 7)].

The probability that a child is low birth weight is almost 50% higher if her mother is low birth weight [(8)]. Low birth weight (<2500 g) is a major determinant of mortality, morbidity and disability in infancy and childhood and also has a long-term impact on health outcomes in adult life. From 2003 to 2008, the percentage of infants weighing less than 2,500 grams at birth in the Philippines is 4 percentage points higher than other developing countries in general (20% vs. 16%) [(9)].

Few studies have been conducted that examine the association of maternal birth weight on the child's birth weight because of the rarity of intergenerational data on mother and their children. The availability of the Cebu Longitudinal Health and Nutrition Survey (CLHNS) data from 1983 to 2009, made this study possible. The objective of our study is to determine whether the birth weights of female cohorts who were born in May 1983 to April1984 predict the birth weights of their first live births.

## Data and Methods

*Source.* Data from the 1983 and 2009 CLHNS surveys were used – (see more detailed description of this survey in [10, 11]). The CLHNS since 1983 and up to 2009 has covered three generations already. It started in 1983 with the recruitment of women who were pregnant in their last trimester and followed up when these women were grandmothers. Subsequent follow-up surveys were conducted in 1991, 1994, 1998, 2002, 2005, 2007 and 2009. Our analysis sample was from the 3,080 singleton live births born between May 1983 and April 1984. Of the 3,080

live births, 47% were females. Owing to the nature of our study, our sample is limited to females only and their first single live births. As of 2009 CLHNS survey, there were 433 cases with complete data on all key variables of interest.

*Outcome variable.* Birth weight (in grams) of the female's first single live born child taken from the 2009 CLHNS survey and treated as a continuous variable. These birth weights were from records and if no record available, female's recall of her child's birth weight was considered.

*Exposure variable*. The main exposure variable was the weight at birth (in grams - continuous variable) of the females in the 1983 CLHNS survey. The information on their birth weights was from hospital records and from health practitioners who helped the home deliveries.

*Other variables.* The female's background characteristics before and during her first single live birth include: number of sibling, educational attainment, age at first live birth, marital status and immunization status when pregnant with the first live birth. Moreover, indices of urbanicity and asset, current smoking status, sex and gestational age of the female's first live birth were also considered as covariates.

To identify whether there are long-lasting effects of conditions experienced during female's birth or, there is an effect of the current conditions [8], measures of assets and urbanicity between the two time periods – i.e. 1983 and 2009, were included in the preliminary analysis. However, the measures in the two conditions were highly correlated, thus indices of asset and urbanicity at the time of the female's first live birth were dropped in the final model.

The type of residence where the females resided in 1983 was a 7-component urbanicity index. The components include communication, education (school types), transportation, health services, markets, population and population density of the community [12]. Those who lived in a more urban community had a higher score. The asset index was used as a proxy for maternal/household economic status and ranged from 0 to 10 where a higher score denotes better economic status. This index includes the type of lighting used, house ownership, material used for housing, and ownership of selected assets including television, air conditioner, tape recorder, refrigerator, or motor vehicle. Maternal education was categorized into (1) with elementary (2) had 1 to 3 years of high school (3) graduated from high school and, (4) had college. Smoking status had two categories: never and ever smoke and, marital status at the time of pregnancy was categorized into: (1) never married/cohabited (2) cohabiting and (3) legally married. Mother's immunization status was without immunization and had immunization.

*Statistical analysis.* The background characteristics were presented as percentages and means. Linear regressions were performed to determine the association of maternal birth weight in 1983 and the weight at birth of first live born child. With a large percentage (from the 1,448 female cohorts in 1983, only 433 comprised the analysis sample) who dropped out from our study, a possibility of attrition bias may be observed. Further procedure will be taken into consideration to address this issue. All analyses were done using STATA 11 (Copyright 1984-2009. StataCorp., 4905 Lakeway Drive College Station, Texas 77845 USA).

## Results

In **Table 1**, birth weights of females and their first live born child were in the above normal range (>2,500g).

The mean number of siblings they have had was two. They lived in a more urban residence and were in the lower economic status of the community. Almost 30 per cent had college education and delivered their first single live birth when they were at 20 years old. A third of them ever smoke, with almost 2 out of 10 never married nor cohabited and less than 10 per cent did not have immunization during pregnancy. The sex ratio at birth of the first single live born was 103 and gestational age in weeks was within normal duration.

**Table 2** shows regression results unadjusted, adjusted for covariates and with weighting. Estimates show that the female's birth weight was positively associated with the weight at birth of the first live born child. For every gram increase in the birth weight of the mother, the weight at birth of her first live born was predicted to increase by almost 30 per cent. The association, however, slightly attenuated (0.0159) when adjusted for gestational age and other covariates but remained significant. In addition, gestational age that was expressed in weeks was found to be highly significantly associated.

## Conclusion

The estimates showed a positive association of maternal birth weight and the weight at birth of the first live born child. The heavier the mother's weight at birth, the bigger her first live offspring also. The association remained significantly higher even after adjusting for covariates and by weighting. However, an abrupt increase in the reliability of the relationships (an increase in R-squared of 8%) was observed when adjusted for gestational age and other covariates. This implies that other than maternal birth weight, the length of gestation also influences the weight at birth of first live born child. In our study, for every week increase in the duration of gestation, the birth weight of the first live born child will increase by 136.5 grams.

Our study is limited to females only because the CLHNS 2009 survey did not gather information on the reproductive history of males. Furthermore, data on birth weights of first live born children were from mother's self report. The result may be biased, thus weighting may be applied [13]. Moreover, our study may be an important contribution particularly on studies about child health where longitudinal data are very rare especially in the context of developing countries. Information on child health at birth is necessary especially for the Philippines where the total fertility rate remained relatively high and stable at 3.3 in the last decade [14]. Birth weight is influenced by both maternal nutrition and environmental condition. Maternal and child undernutrition were related to health outcomes such as glucose concentrations and blood pressure and are associated with lower human capital in adult life [15]. The consequences of undernutrition such as low birth weight on human capital and labor force participation in adulthood has negative impact on the country's economic development.

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**Table 1.** Background characteristics of the analysis sample (N=433)

| Characteristics | |
|---|---|
| Birth weight of females in g, mean (SD) | 2973.91 (± 412.36) |
| Birth weight of first live birth in g, mean (SD) | 2907.09 (± 611.47) |
| Female's number of sibling, mean (SD) | 2.38 (± 2.32) |
| Urbanicity score, mean (SD) | 28.26 (± 13.27) |
| Asset score, mean (SD) | 2.25 (± 1.77) |
| Educational level, % | |
| with elementary | 12.1 |
| 1-3 yrs high school | 15.9 |
| 4 yrs high school | 42.5 |
| with college | 29.5 |
| Age of females at first live birth in y, mean (SD) | 20.51 (± 2.37) |
| Smoking status, % | |
| ever smoke | 32.6 |
| Marital status at first live birth, % | |
| not married | 16.4 |
| cohabiting | 56.1 |
| legally married | 27.5 |
| Immunization status at pregnancy, % | |
| not immunized | 9.9 |
| Sex of first live birth, % | |
| female | 42.3 |
| Gestational age of first live birth in wks, mean (SD) | 38.42 (±1.06) |

**Table 2.** Regression results of female's birth weight and weight of her first single live born child (N=433)

| Unadjusted ($r^2$ = 0.0381) | | | Adjusted ($r^2$= 0.1129) | | |
|---|---|---|---|---|---|
| $\beta$ | (95% CI) | P>\|t\| | $\beta$ | (95% CI) | P>\|t\| |
| 0.2893 | (0.15 - 0.43) | 0.000 | 0.2734 | (0.14 – 0.41) | 0.000 |