Birth weight for gestational age of infants, by year of mothers' age;

A Life History study

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Introduction

Life History Theory (1) predicts offspring of youngest maternal organisms will be small and in poor condition, as result of a physiological trade-off between final maternal and initial offspring development, as demonstrated in all species tested up to now, including fish, barnacles, sheep, rats, trees, and grasses.

In humans the uterus develops (Fig 1) to age 20 (2) and at least one dimension of growth (knee height) continues through adolescent pregnancy and post partum (3).

However, some (4,5) have denied infant outcome is affected by developmental characteristics of adolescent gravidas, agreeing that "a biological explanation seems warranted" (5).

Biological characteristics of African-American (AA) pregnancies are especially suited to an investigation of a developmental trade-off. They:

- share a relatively common ethnic heritage and socio-demographic ecology (7),
- may achieve menarche (8), and have first intercourse (9), early, and conceive before completing physical development (3),
- experience an abnormal biochemical gestational milieu (10), preterm birth (11) and/or depressed birth weight (12).

Figure 1. Uterine volume (ml) by Tanner Stage (2)

Hypotheses

- Maternal biological maturity and birth weight for gestational age are related.
- The hypothesized relationship is suggestive of a trade-off between growth of the mother and growth of the offspring.

Methods

Design: retrospective cross-sectional analysis of a population cohort. Population: from the 1999 NCHS Perinatal Mortality Data File (13) all (169,600) live singleton 1st born infants of 15-29 y old AA delivering from the 34 to 41 wk in the US.

Analysis:

- calculation of mean birth wt at gestational wk by y of maternal age, (y of maternal age a proxy for maturation; birth wt and gestational age for offspring size and condition).
- mean wt of births at each gestational wk stratified by mothers' y of age.
- relationships were tested by Linear Regression and ANCOVA, adjusted for prenatal care initiation, marital status, and appropriateness of educational attainment.
- differences found were significant for this finite population, there was no sampling error in the File and inferential analyses were not required.
- confidence intervals were developed, for comparison of results with populations in other years.

Results

Mean infant birth wt by gestational wk (Fig 2 and Table 1) was:

- inversely related to mothers' y of age15-21 at each gestational wk <37, 34 th wk mean wt of births to mothers, for example: 15 y - 2650 g 21 y - 2543 g
- positively related to mothers' y of age 15-21 at each gestational wk >37, 41st wk mean wt of births to mothers, for example: 15 y - 3281 g 21 y - 3410 g
- unrelated to adult (22) mothers' y of age

Relationships were confirmed by Linear Regression and ANCOVA, adjusting for: prenatal care initiation, marital status, appropriateness of educational attainment.

Conclusion

As predicted by life history theory (1) gravidas delivered infants whose birth weight for gestational age was related to the maternal state of biological maturity:

- in negative association with mothers' y of age 15-21 y, preterm,
- in positive association with mothers' y of age 15-21 y, term births.
- unrelated to adult mothers' y of age

Consistency of interrelationships across adolescence when adjusted for available socioeconomic factors indicates the stage of physical development was partially responsible for birth wt for gestational age of adolescents' infants.

A potential explanation for the pattern of relationships is:

- least mature gravidas were likely to espel infants which reached a relatively large size in early gestation,
- more mature adolescent gravidas could carry infants of that size to a longer gestation,
- an immature uterus (among other body components) contributes to preterm birth of infants who would have had the opportunity to develop more fully in the womb of more mature adolescent gravidas.

Implications

This trade-off leading to small, less fit infants is one of the biological processes in gestation with ill effects that are predictive of adult diseases (14) and poor outcome in intergenerational reproduction patterns (15), and thus is important though it does not give rise to a large overall number of preterm or small infants in a particular year.

Child bearing among mothers 15 – 21 y producing infants affected by a trade-off between their mother’s final development and their initial development should be a focus of biological as well as socio-economic concern.

The trade-off likely affects adolescent child bearing in other US ethnicities, though perhaps to a lesser degree because of dissimilar growth and reproductive patterns (later menarche, greater contraception and later childbearing among the dominant European American population).

Table 1. Mean birth weight by gestational week, and age of mother.

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* Deviation

Figure 2. Mean birth weight by gestational age, and age of mother: U.S. AA 1999, singleton live births (N=107,997)

References: