

The effects of age and aboriginality on the incidence of low birth weight in mountain townships of Taiwan

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ABSTRACT

Background This study aimed to examine the associations between aboriginality, age, demographic and socioeconomic factors of the mother and the risk of low birth weight (LBW) in mountain townships of Taiwan.

Methods We analyzed the LBW proportion of single live babies born to 2032 first-time mothers between 2004 and 2005. Data were analyzed using the chi-square test, analysis of variance, the Scheffe test and logistic regression.

Results About 14.8% of Aboriginal mothers and 18.7% of Aboriginal teen mothers gave birth to infants of LBW. Aboriginal mothers were found to be at higher risk of delivering LBW infants; however, after controlling for marital status and education, the influence of aboriginality and age was no longer significant.

Conclusions Marital status and education are more important determinants of LBW than aboriginality and age in mountain townships of Taiwan.

Keywords epidemiology, ethnicity

Background

Low birth weight (LBW) is a major cause of infant mortality and is strongly associated with subsequent childhood morbidity and mortality,^{1–3} making it a significant public health concern. An infant weighing <2500 g is defined by the World Health Organization (WHO) as being of LBW.⁴ According to the WHO, the LBW rate for 2000 was 15.5% globally, 5.9% for eastern Asia, 8.0% for Japan and 6.0% for China;⁴ the proportion of LBW infants born to all mothers and teenage mothers in Taiwan was about 5.0% and 7.7% in 1997, respectively.⁵

Studies have found that LBW can be predicted by many maternal characteristics, including age and ethnicity.^{6–13} However, the effect of the mother's age on birth weight has been a matter of debate, with some studies reporting that teenage mothers are more likely to give birth to preterm babies and babies of LBW, and others suggesting that other factors such as racial and socioeconomic differences may confound such results and weaken any conclusions regarding the effect of age.^{7–8,14–21}

The fertility rate for women of childbearing age (15–49 years) was reported to be 33 per 1000 for the entire population of Taiwan in 2005 and 8 per 1000 for teens (15–19 years).²² However, in Taiwan's 30 mountain townships, the fertility rate is 56 per 1000 for women of childbearing age and 52 per 1000 for teens.²²

Clearly, there is a greater prevalence of teenage pregnancy in rural areas,^{12,23,24} which would increase the number of first-time births for this age group. Age has been suspected of being an important factor in determining birth weight. One hospital-based study in eastern Taiwan, for example, reported that teenage mothers gave birth to babies of significantly lower birth weight than adult mothers (19 versus 9%, respectively).¹² Other studies in Taiwan question the

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impact of maternal age on poor birth outcomes, suggesting that adverse reproductive outcomes may be explained by other variables including socioeconomic factors, access to care and resources,²⁵ and others have found an association between LBW and other risk factors including aboriginality, multiple deliveries, birth order, place of residence and marital status.^{12–13,26,27}

Studies in Taiwan have suggested that aboriginality and place of residence may play important roles in determining birth weight,^{12,26} hence, it is worth mentioning the geographic differences between Aborigines in Taiwan. Less than 1% of the total population lives in mountain townships,²² which constitute some of the least urbanized areas in Taiwan. Although Aborigines comprise less than 2% of the total population,²⁸ non-Aborigines are the minority in mountain townships, where about one-third of Taiwan's Aborigines reside and where Aborigines make up 80% of the population (Ministry of Interior, Republic of China, unpublished data).²⁸

Compared with the general population, Aborigines are of poorer socioeconomic status (SES); additionally, Aborigines in mountain townships are in an even worse position as compared with Aborigines in other areas of Taiwan. For example, the average household income of Aborigines has been reported to be only 47% than that of the general population,^{29,30} but the average household income for Aborigines in mountain townships was found to be only 54% that of Aborigines in Taipei city.²⁹ However, the economic gap between Aborigines and non-Aborigines in mountain townships appears narrower because of the much poorer economic status of the non-Aborigines as compared with the general population. The average household income of Aborigines in mountain townships was found to be 89% than that of all Aborigines.²⁹ Although the household income of non-Aborigines in mountain townships has not been specified, government investigation found the average household income of residents of the least urbanized townships to be 68% of that for the whole of Taiwan.³⁰

This study focussed on the Aboriginal/non-Aboriginal (excluding foreign-born) differences in terms of giving birth to LBW babies in mountain townships of Taiwan. Non-Aborigines referred to herein are mainly Han Chinese, who migrated into Taiwan from China at different points in time. Foreign-born mothers were excluded from this study because of a peculiar phenomenon: they exhibit better birth outcomes with poorer SES, which differs from the general population.³¹ It is therefore not appropriate to discuss the two together.

Therefore, controlling for birth order and plurality, we collected birth registry data of single live babies born to

first-time mothers in Taiwan's mountain townships to study the associations between maternal aboriginality, age, demographic and socioeconomic factors and the risk of LBW.

Methods

Trained research assistants collected birth registry data from the household registration offices of all mountain townships with the exception of Lanyu, a township located off-shore. In order to review a sufficient large number of birth certificates, we collected data for a 2 year period (2004–2005). The Census Law in Taiwan was implemented in 1946, and requires either parent to register the birth and present the birth certificate at the local household registration office within 15 days of delivery (within 30 days since 1997). Live births must be registered in order that the child acquires citizen's rights. Pre-study approval was granted after each office reviewed the issue of confidentiality and found the study protocol to be acceptable.

From the birth certificates, we collected the following data: mother's date of birth, baby's date of birth, maternal race/ethnicity, mother's education, date of marriage and/or whether or not the father claimed responsibility for the child and birth weight. We reviewed the birth records of 2510 babies; birth data were excluded for infants born to mothers from a foreign country ($n = 39$) and if any data were missing on the mother's date of birth ($n = 11$), education ($n = 275$), ethnicity ($n = 250$), or birth weight ($n = 5$), leaving a total of 2032 subjects for analysis.

Regarding the recording of race/ethnicity on the birth certificate, this is only specified in the case of Aboriginal or foreign-born mothers, with Aborigines specifying their tribe and foreign-born mothers the country they came from; in all other cases, mainly Han Chinese, race/ethnicity is not detailed on the birth certificate. All mothers belonging to tribes were regarded as Aborigines in this study. The mothers were classified as married or unmarried based on whether the child was considered born in or out of wedlock. According to Article 1065 of the civil law in Taiwan, children are considered born in wedlock if they are claimed by their natural father, and the father's name appears on the birth certificate—this means that even the child of an unwed mother can be considered born in wedlock if his or her natural father's name and birth date appear on the birth certificate. Therefore, if neither a date of marriage nor the name of father was present on the birth certificate, the child was considered to be born to an unmarried mother, whereas the child was considered to be born to a married mother if the father's name appeared on the birth certificate. Maternal age was obtained by comparing the

maternal date of birth and the child's date of birth, and was categorized into two dichotomous subgroups, those below 20 years old and those 20 years old and above. Because all children are expected to complete junior high school in Taiwan's compulsory education system, the mothers were categorized into two dichotomous education subgroups, those who had nine or less years of schooling and those who had more.

The characteristics of the first-time mothers were analyzed descriptively. LBW were cross-tabulated with maternal variables and the independence of variables was further tested using the chi-square test. Mean birth weights were analyzed by marital status using analysis of variance (ANOVA) and the Scheffe test. Odds ratios were estimated using binominal logistic regression. All statistical operations were performed using SPSS version 12.0.

Results

Table 1 shows the characteristics of all women registered in mountain townships who gave birth for the first time to single live babies between 2004 and 2005: 85% of these mothers were Aboriginal, 27.5% were teenagers, 16.0% gave birth out of wedlock and 38.0% had received 9 years of education or less. A greater percent ($P < 0.01$) of Aboriginal mothers gave birth at a younger age as compared with non-Aboriginal mothers (births to teens, 29.2 and

Table 1 Characteristics of the mothers included in the study

| | Subtotal (%) | Aboriginality | | χ^2 |
|--------------------------------|-----------------|----------------------|--------------------------|----------|
| | | Aboriginal, n (%) | Non-Aboriginal, n (%) | |
| Age | | | | |
| <20 years | 27.5 | 504 (29.2) | 55 (18.0) | 16.4*** |
| ≥20 years | 72.5 | 1222 (70.8) | 251 (82.0) | |
| Marital status | | | | |
| Married | 78.8 | 1328 (76.9) | 273 (89.2) | 26.9*** |
| Unmarried, father named | 5.2 | 91 (5.3) | 14 (4.6) | |
| Unmarried, father not named | 16.0 | 307 (17.8) | 19 (6.2) | |
| Education (schooling years) | | | | |
| ≤9 years | 38.0 | 683 (39.6) | 89 (29.1) | 12.1*** |
| >9 years | 62.0 | 1043 (60.4) | 217 (70.9) | |
| Total (N) | | 1726 (84.9) | 306 (15.1) | |

*** $P < 0.01$.

Table 2 LBW percentages analyzed by maternal characteristics

| | Subtotal, n (%) | Aboriginality | | χ^2 |
|--------------------------------|-----------------|----------------------|--------------------------|----------|
| | | Aboriginal, n (%) | Non-Aboriginal, n (%) | |
| Subtotal | 288 (14.2) | 255 (14.8) | 33 (10.8) | 3.4* |
| Age | | | | |
| <20 years | 99 (17.7) | 94 (18.7) | 5 (9.1) | 3.1* |
| ≥20 years | 189 (12.8) | 161 (13.2) | 28 (11.2) | 0.8 |
| Marital status | | | | |
| Married | 202 (12.6) | 173 (13.0) | 29 (10.6) | 1.2 |
| Unmarried, father named | 13 (12.4) | 12 (13.2) | 1 (7.1) | 0.4 |
| Unmarried, father not named | 73 (22.4) | 70 (22.8) | 3 (15.8) | 0.5 |
| Education (schooling years) | | | | |
| ≤9 years | 131 (17.0) | 122 (17.9) | 9 (10.1) | 3.4* |
| >9 years | 57 (12.5) | 133 (12.8) | 24 (11.1) | 0.5 |

* $P < 0.1$.

18.0%, respectively). Additionally, Aboriginal mothers were found to be significantly ($P < 0.01$) more demographically and socioeconomically disadvantaged than non-Aboriginal mothers, as more gave birth out of wedlock (17.8 versus 6.2%), and more had received 9 years or less of education (39.6 versus 29.1%).

From Table 2, the overall proportion of infants of LBW in mountain townships was 14.2%. A greater percentage (17.7%) of teen mothers delivered babies of LBW as compared with their adult counterparts (12.8%), and a greater percentage ($P < 0.1$) of Aboriginal mothers (14.8%) gave birth to babies of LBW than non-Aboriginal mothers (10.8%). Combining age and aboriginality, we found that a much greater percentage ($P < 0.1$) of Aboriginal teens (18.7%) than non-Aboriginal teens (9.1%) gave birth to babies of LBW. Additionally, disadvantaged women were more likely to deliver babies of LBW than their more advantaged counterparts: specifically, a greater percentage of mothers with 9 years or less of education (17.0%) gave birth to babies of LBW than those with more than 9 years (12.5%). However, among the educationally disadvantaged, a greater percentage ($P < 0.1$) of Aboriginals delivered babies of LBW (17.9%) as compared with non-Aboriginals (10.0%). Regarding marital status, a greater percentage of mothers giving birth out of wedlock (22.4%) gave birth to babies of LBW as compared with those giving birth in wedlock (12.6% for married mothers and 12.4% for unmarried mothers).

According to the results shown in Table 2, the percentage of LBW babies differed by marital status. The results presented in Table 3 further demonstrate the mean weight and multiple comparisons between marital status categories using ANOVA and the Scheffe test, and show that babies born in wedlock weighed significantly more than those born out of wedlock, whether or not their mothers were actually married.

We estimated the odds ratios for the different maternal variables for LBW (Table 4). As per the figures presented in Table 3, we categorized marital status by whether or not the father's name appeared on the birth certificate; only those cases in which the certificate did not include the father's name were considered unmarried. In Model 1, we found that Aboriginal mothers were more likely to deliver babies of LBW (OR = 1.43, 95% CI: 0.98–2.11). This odds ratio decreased slightly to 1.38 (95% CI: 0.93–2.02) when controlling for maternal age. Note that the *P* values of these

two odds ratios were about 0.06, which was significant at the statistical significance level of 0.1 and was very close to the level of 0.05. In Model 2, teen mothers were found to be more likely to give birth to babies of LBW than adult mothers (OR = 1.43, 95% CI: 1.10–1.87) and in Model 3, mothers who gave birth out of wedlock and mothers with 9 years or less of schooling were found to be 77 and 25% more likely to deliver babies of LBW than their counterparts, respectively. Controlling for education and marital status, the differences in birth weight between the two aboriginality groups and the two age groups were no longer significant.

Discussion

Main findings of the study

We found that a significantly higher percentage of Aboriginals in mountain townships in Taiwan gave birth to newborns of LBW as compared with non-Aboriginals, for all women (14.8 versus 10.8%) and particularly for teen mothers (18.7 versus 9.1%), but after controlling for marital status and education, aboriginality and age did not significantly affect the birth weight of newborns. We conclude that marital status and education have a greater impact on birth weight than either aboriginality or age.

What is already known on this topic?

According to the WHO's estimate, the global rate of LBW in 2000 was 15.5%, and the rate in developing countries

Table 3 Mean birth weight, numbers and mean weight differences by marital status

| Marital status | Grams (n) | F | Scheffe test | Difference, 95% CI |
|---------------------------------|---------------|--------|--------------|---------------------|
| (1) Married | 2996.0 (1601) | 9.1*** | (1) > (3) | 122.7, (51.1–194.3) |
| (2) Unmarried, father named | 3013.3 (105) | | (2) > (3) | 104.0, (7.8–272.2) |
| (3) Unmarried, father not named | 2873.3 (326) | | | |

****P* < 0.01.

Table 4 Odds ratios (95% CI) for LBW analyzed by maternal characteristics

| | Model 1 | Model 2 | Model 3 |
|-----------------------------|------------------|------------------|------------------|
| Aboriginality | | | |
| Aboriginal | 1.43 (0.98–2.11) | 1.38 (0.93–2.02) | 1.27 (0.86–1.87) |
| Non-Aboriginal | 1 | 1 | 1 |
| Age | | | |
| <20 years | | 1.43 (1.10–1.87) | 1.20 (0.90–1.59) |
| ≥20 years | | 1 | 1 |
| Marital status | | | |
| Married | | | 1.77 (1.29–2.41) |
| Unmarried | | | 1 |
| Education (schooling years) | | | |
| ≤9 years | | | 1.25 (0.96–1.63) |
| >9 years | | | 1 |
| Intercept | –2.11 | –2.19 | –2.27 |
| –2LL | 1654.89 | 1648.10 | 1631.62 |

(16.5%) was more than double that of developed countries (7.0%).⁴

A generalized study found that about 7% of babies born to Taiwanese mothers are of LBW, increasing to about 8.6% if either of the parents is Aboriginal and 11.7% if both parents are Aboriginal. Infants born to Aboriginal parents were found to be more likely to be of LBW, even after adjusting for confounding variables.³²

However, the LBW level in Taiwan exhibits geographical variation.¹² Hospital-based studies reported that 6.8% of live newborns were of LBW in eastern Taiwan²⁶ and 2.8% in Taipei.³³

Findings on marital status and reproductive outcomes are quite consistent across countries,^{34–36} with a much higher percentage of LBW infants born to unwed women. Marriage often serves as a proxy for support, which is reported to greatly affect birth outcomes,^{37,38} suggesting that married women usually receive more emotional and economic support than unmarried women.^{37,39,40} As the family structure has changed over time, the reporting of the father's name on the birth certificate is now a better indicator of paternal support and involvement than marital status.⁴¹

Education is another important factor that influences the prevalence of LBW. It can reflect a mother's consciousness of her own health:³⁴ women with higher levels of education are more likely to know more about pregnancy, to seek adequate prenatal care and avoid behaviors that could damage their health.^{42,43}

What this study adds

Our study found that the LBW level in mountainous regions of Taiwan is higher than that of the remaining of the island at 14.2%, and 14.8% of Aboriginal mothers gave birth to babies of LBW, which is higher than that previously reported.³² This difference is very likely due to geographical variation: Aboriginals in mountain townships are more disadvantaged than Aboriginals in the other areas of Taiwan, and disadvantaged Aboriginals are more likely to give birth to babies of LBW. Although non-Aboriginal mothers in mountain townships were found to be better off than Aboriginal mothers in terms of LBW level, they did not experience any of the other benefits enjoyed by the general population. In fact, the proportion (10.8%) of non-Aboriginal mothers in mountain townships having babies of LBW is higher than the LBW incidence for Taiwan as a whole (5.0%). This is probably largely related to their lower SES as compared with the general population.

We found a less significant difference in LBW proportion between teen mothers and adult mothers (17.7 versus 12.8%) than the previous study (19 versus 9%),¹² which may be a result of a difference in study samples, as teen mothers tend not to deliver babies in large-scale hospitals unless they encounter severe pregnancy problems.¹¹

Research³² has found that the rate of LBW in Taiwan is similar to that of developed countries; however, we found that the incidence of LBW in mountain townships is very close to the WHO's estimation of LBW incidence for developing countries. Particularly, the percentage of babies born to teenage Aboriginal mothers that are of LBW was identified as being the highest (18.7%) of any of the subgroups in this study, and exceeded the WHO's estimate of LBW incidence in developing countries (16.5%). This indicates that residents in mountain townships, particularly Aboriginal teenage girls, are very disadvantaged, and greater attention should be paid to this issue by the government and the public.

Our study found that babies of unmarried women whose fathers did not claim them were significantly more likely to be of LBW. Unlike previous studies in Taiwan, we defined a mother as married if the father's name appeared on the certificate; otherwise, the mother was defined as unmarried. Unmarried mothers of infants whose fathers have not claimed them not only lack support from the infant's father, but also suffer from social discrimination because of giving birth out of wedlock. These women tended to be Aboriginals and teenagers; related programs should therefore target these groups to reduce the prevalence of LBW in Taiwan.

After adjusting for marital status and education, aboriginality no longer had a significant effect on the incidence of LBW, which differs from previous findings.³² Two factors may explain this: first, LBW level varies geographically in Taiwan, and in this study we only focussed on mountain townships; second, in the reference ethnicity group (non-Aboriginal), we excluded foreign-born mothers, who display better birth outcomes than the general population.³¹

Limitations of this study

In this study, we investigated the situation in mountain townships, which account for about one-third of all Aboriginals. Our findings cannot therefore represent the Aboriginal/non-Aboriginal differences in Taiwan, but do portray the picture in mountain townships. Mountain townships are, indeed, special; they differ from the rest of the island and are worthy of further investigation to improve understanding of these differences between Aboriginals and non-Aboriginals.

This study is limited in that it is based on the information supplied on registered birth certificates, which does not include detailed descriptions of other maternal factors such as unhealthy behavior¹⁷ that might confound the results. Particularly, smoking and alcoholism during pregnancy are known to greatly and negatively influence birth outcome¹⁷ and the prevalence of smoking and alcoholism among Aborigines is higher than that of the general population.⁴⁴

Finally, given the sample size of the study (2032), there is approximately a 60% chance of finding a significant difference for the one-sided test with a level of significance of 0.05.⁴⁵ The sample size attained had limited power to detect differences of likely clinical importance between the groups.

Acknowledgements

We greatly appreciate Hsin-Hsin Wang's assistance and the reviewers' comments.

Funding

The research was supported by grant CSMU 94-OM-B-008 from Chung-Shan Medical University.

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