Effects of infants' birth order, maternal age, and socio-economic status on birth weight

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ABSTRACT

الأهداف: دراسة أثر ترتيب المولود، وعمر الأم، والحالة الإجتماعية على وزن المولود.

الطريقة: أجريت دراسة مقطعية على عينة الدراسة 858 أم في مجتمع الدراسة لتسعة مراكز صحية الذين حضروا لموعد التطعيم الأول للمولود خلال مدة 6 شهر في عام 2010م. جمعت البيانات الديموغرافية والصحية للأم ووزن المولود من خلال الزيارات وملفات المستشفى. أجري اختبار تحليل الانحدار المتعدد و الأنوفا لتحليل البيانات.

النتائج: كان وزن المولود الأول والرابع أقل من وزن المولود الثاني والثالث في جميع أعمار الأمهات. كما ارتفع وزن المولود للأمهات اللاتي يبلغن 24 عام ومن ثم استقر. أثر جنس المولود، وعمر الأم 24–20 عام، والمولود الثاني والثالث بشكل إيجابي على وزن المولود وارتبط نقص وزن المولود مع عمر الأم 19–15، 39–35، و 44–40 عام، وضعف الحالة الاقتصادية، والحصول على الشهادات العليا. وفي مجموعة أعمار الأم 19–15، و 44–40 عام، والمولود الثاني كان هنالك ارتباط وتأثير غير مرغوب فيه على وزن المولود.

خاتمة: ارتبط كلاً من الوصول إلى الخدمات الصحية والتكافؤ وعمر الأم والعوامل الديموغرافية مع وزن المولود.

Objectives: To determine the effects of infants' birth order, maternal age, and socioeconomic status (SES) on birth weight.

Methods. This cross-sectional study included a sample of 858 mothers recruited over a 6-month period in 2010, in a defined population of 9 urban health centers, and who were admitted for their infants' first vaccination. Maternal clinical data, demographic data, and infants' birth weight were obtained from the interview and maternal hospital files. Multiple regression and analysis of variance were used for data analysis.

Results: First and fourth births had lower birth weights compared with second and third births in all maternal ages in controlling parity, birth weight increases with maternal age up to the early 24, and then tends to level off. Male gender, maternal age 20-24 years, second and third births had a significant positive effect on birth weight. Lower family economic status and higher educational attainment were significantly associated with lower birth weight. For women in the 15-19 and 40-44 years age groups, the second birth order was associated with the most undesirable effect on birth weight.

Conclusion: Accessibility of health care services, parity, maternal age, and socioeconomic factors are strongly associated with infants' birth weight.

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Birth weight is an important indication of health status of the infant and the principal factor that determines the infant's survival and physical and mental growth in the future.[1] Besides accessing to health care system, other factors such as birth order, maternal age, and socioeconomic status are also important predictors of birth weight.[2,3] The effect of parity on birth weight has been investigated in previous studies, but the results are controversial. Some of the studies claimed that increasing parity has been associated with increasing pre-pregnancy maternal weight, which has direct effects on maternal health and possibly birth weight[4,5] but others reported that increasing parity implies having children in the home, which could increase social and financial stress for families.[6] Also, previous researches frequently observed association between mother's

age and various quality-of-life measures, including perinatal, neonatal and infant mortality, preterm delivery, and low birth weight have yielded inconsistent results. Whereas few studies reported negative findings,[7] the bulk of epidemiological evidence suggested that, depending on the setting, either teenage or old-age pregnancies represented high-risk categories.[2,8,9] In the study conducted on 6931 infants showed no significant association between age of mother with low birth weight.[7] Conversely, Roof et al[8] study of 1255 infants noted that maternal age, rather than parity, was found to be the most important predictor of negative birth outcome.[8] As well, previous studies have shown controversial results on the effect of socioeconomic factors on pregnancy outcomes and newborn conditions.[10-12] Kehinde et al[10] study of 280 infants showed that disadvantaged socioeconomic status was associated with lower mean birth weights. However, Finch[11] showed no effect of occupational grade on infants' birth weight. In spite of free and universal access to health care, an increased rate of low birth weight has been noted in Iran.[13] Little is known of the effect of maternal age, socioeconomic status and birth order on birth weight of Iranian infants. Additionally, previous studies reported inconsistent results on the effect of different factors on birth weight. Therefore, this study aimed to determine the influence of birth order, maternal age, and socioeconomic status individually and jointly on birth weight of Iranian infants.

Methods. The research sample included 858 mothers in a defined population of 9 urban health centers who were admitted for their infants' first vaccination from April to September 2010. Health centers which were included in this study were located in 3 different SES districts that provided by the Province Health Center within the metropolitan area of Tabriz City, Iran. In addition, mothers completed a socioeconomic questionnaire including questions on occupation status of husbands, household income, acquisition of house and personal car. These 3 different districts and data from questionnaire were used to determine the SES of the mothers. Also, subjects' education level included 3 levels ranging from "illiterate" to "university degree". All mothers were categorized in low, intermediate, and high socioeconomic groups. Other data obtained from interview and maternal hospital files was: infant's gender and birth weight (recorded to the nearest 10 grams by calibrated scales (electronic scales: Soehnle, max weight 20 kg, accurate to 10 g in hospital), mother's age, parity, history of miscarriage, time interval from previous birth, history of cigarette smoking during pregnancy. All subjects were extremely compliant with the study procedure.

The criteria for inclusion of mothers were having 15-44 years of age with singleton births, and infants who were full term with normal birth weight (2500-4000 grams) with no congenital anomalies. Also, birth order was limited to the first to fourth births.

The study protocol was approved by the Ethics Committee of Tabriz University of Medical Science (Ethical code: 8639). All subjects were informed on the content of the study and if they agreed to participate, a written informed consent was obtained.

Statistical analysis. Statistical analysis was performed using SPSS version 13.0 and the descriptive data were reported as means and SD's. Normal distribution of data was verified with the Kolmogorov-Smirnov test. Between-group comparisons were made using analysis of variance and Tukey post-hoc test. Multiple linear regressions using the backward technique were used to analyze the association of each potential factor with infants' birth weight. All of the tests were performed 2-sided and $p<0.05$ was considered statistically significant.

Results. Maternal demographic and socioeconomic characteristics and birth outcome by birth order are presented in **Table 1**. In total, the mean maternal age, infants' birth weight and gestational age were 27.35±5.2 years, 3325±460 gr and 38.9±0.6 weeks respectively. Also, reading across the rows, maternal age increased from first to fourth births and between groups comparisons were significant ($p<0.05$). Additionally, birth weight increased appreciably from first to second births ($p=0.042$) and decreased from second to fourth births significantly ($p=0.031$). Reading across the rows, the number of families with low economic status increased from first to fourth births but between groups comparisons were not significant ($p>0.05$). In the case of maternal education, reading across the rows, the number of mothers with college education decreased from first to fourth births which were significant between groups ($p<0.05$). Also, none of the mothers were smokers.

Figure 1 depicts mean birth weight in different maternal ages by parity. As shown in the figure, in all maternal ages, first and fourth birth orders have lower

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birth weight than second and third births. Additionally, in contrast to second births, infants with fourth birth order had lower birth weight in all maternal ages with the minimum level at 15-19 years of age group. Birth weight increases with maternal age up to the early 24 and then tends to level off while controlling for parity.

Table 2 represents infants' birth weight in different SES groups by birth order. Analysis of variance showed significant difference in infants' birth weight in 3 SES groups in total and fourth birth order (p<0.05). Tukey post-hoc comparisons of the 3 SES groups indicated that infants belonging to mothers with high economic status had significantly higher birth weight than whom in low economic status in total (p=0.033) and fourth birth order (p=0.024). In the case of maternal education, reading down the columns, Tukey test showed that illiterate mothers had infants with significant higher birth weight than mothers with college education in total (p=0.03) and third birth order (p=0.021).

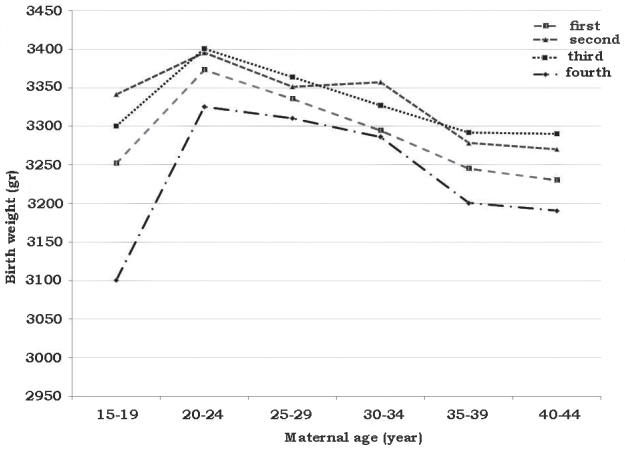

Figure 1 - Mean birth weight in different maternal ages by parity.

Table 3 presents the results of multivariable regression models of birth weight which were significant controlling for covariates such as birth order, maternal age, interaction of maternal age and birth order and socioeconomic status. Male gender resulted in a 54 g increase in birth weight. In different age groups, maternal age 20-24 years accounted for a 98 g increment in birth weight and adversely, maternal age 40-44 years accounted for the largest decrease in birth weight. Also, second and third births tended to increase birth weight 115 and 103 g respectively. The results of interaction between maternal age and birth order showed that for women in the 20-24 years age group, second birth order and for women in the 25-29 years age group, third birth order had positive effect on birth weight. For women in the 15-19 and 40-44 years age groups, the interaction of age and second birth order was associated with the most undesirable effect on birth weight. Regarding to the socioeconomic status, lower family economic status and higher educational attainment was associated with lower birth weight.

Discussion. The results of this study showed that first and fourth births had generally lower birth weight than both second and third births in all maternal ages. Also, male gender, maternal age 20-24, second and third births had significantly positive effects on birth weight. By restricting our analysis to singleton births without congenital anomalies, in this study, we examined the effect of parity on birth weight. As indicated in **Tables 2 & 3**, the largest effect of parity on birth weight comes at the transition from first to second births

Table 1 - Demographic characteristics by birth order of infants included in a study in Tabriz, Iran.

Variables	Birth order				
	First (n=511)	Second (n=257)	Third (n=70)	Fourth (n=20)	Total (n=858)
*,†Maternal age (mean ± SD)	25.75 ± 4.7[a]	29.33 ± 4.2[b]	33.08 ± 4.6[c]	36.6 ± 4.6[d]	27.35 ± 5.2
*,†Child birth weight (grams ± SD)	3252 ± 430[a]	3425 ± 470[b]	3367 ± 390[b]	3257 ± 480[b]	3325 ± 460
Gestational age (weeks ± SD)	38.4 ± 0.5	38.7 ± 0.9	39 ± 0.7	39.6 ± 0.7	38.9 ± 0.6
Gender (male, %)	51.5	55.3	50	55	53
Socioeconomic status					
High (%)	49.6	49.7	39.5	39	44.4
Moderate (%)	27.7	32.9	39.5	20	30.2
Low (%)	22.7	17.4	21.1	41	25.5
Maternal education					
§Illiterate (%)	1.3	4.0	13.6	27.8	11.6
§Under graduate (%)	74.3	83.9	76.3	72.2	76.6
§College (%)	24.4	12.1	10.2	0	9.1

*Analysis of variance, significant difference between groups (p<0.05), †Tukey test: significant difference between unparalleled characters (a and b, a and c, a and d, b and c, b and d, c and d), §Kruskal-Wallis test: significant difference between groups (p<0.05).

Table 2 - Infants birth weight in different socioeconomic status (SES) groups by birth order included in a study in Tabriz, Iran.

Variables	Total (n=858)	Birth order First (n=511)	Second (n=257)	Third (n=70)	Fourth (n=20)
Birth weight based on different SES					
†High (gr ± SD)	3426 ± 522[a]	3294 ± 505	3529 ± 510	3470 ± 317	3411 ± 464a
Moderate (gr ± SD)	3352.7 ± 400	3279 ± 374	3378 ± 570	3404 ± 399	3350 ± 470
†Low (gr ± SD)	3198.5 ± 400[b]	3183 ± 484	3370 ± 366	3229 ± 436	3012 ± 633b
Birth weight based on maternal education					
†Illiterate (gr ± SD)	3397.7 ± 387[a]	3304 ± 407	3492 ± 496	3530 ± 392a	3315 ± 464
Under graduate (gr ± SD)	3324.5 ± 429	3338 ± 414	3450 ± 434	3460 ± 693	3200 ± 665
†College (gr ± SD)	3186 ± 514[b]	3115 ± 379	3332 ± 589	3112 ± 235b	0

†(Tukey test) significant difference between unparalleled characters reading across the columns. These results are based on unadjusted/univariate models.

Table 3 - The association of different factors with infants' birth weight in multiple linear regression model with 95% confidence intervals.

Variables	*Gram changes in birth weight	*P*-value	95% CI Lower bound	Upper bound
Male	54	0.037	28	81
Maternal age				
15-19	-175	0.015	-261	-89
20-24	98	0.023	48	148
35-39	-35	0.04	-56	-15
40-44	-252	0.033	-356	-147
Birth order				
Second	115	0.02	67	161
Third	103	0.031	64	143
Age *birth order interaction				
30-34 * first	-146	0.013	-201	-90
15-19 * second	-280	0.027	-384	-176
20-24 * second	41	0.047	17	66
35-39 * second	-86	0.02	-118	-54
40-44 * second	-458	0.01	-569	-346
25-29 * third	78	0.036	45	110
35-39 * third	-17	0.029	-25	-10
40-44 * third	-116	0.039	-162	-69
Socioeconomic status				
Low	-44	0.041	-67	-22
Maternal education				
College	-107	0.019	-149	-64

*Adjusted for the infant gender, birth order, maternal age, interaction of maternal age and birth order and maternal socioeconomic status and education.

when, being the second order increases 115 gram in birth weight. However, this trend is reduced in third and fourth birth order. The results of this study were similar to the results of the recent study conducted by Swamy et al[2] who showed that first born infants were generally smaller than infants of higher birth order. Testosterone may have a role in this regard. Elevated levels of testosterone in the uterus decrease birth weight and the level of testosterone decreases with maternal parity or age. Thus, low-parity children have low birth weight because they may be exposed to relatively higher levels of testosterone than those born to mothers of high parity.[14]

As presented in **Table 3**, higher parity at younger maternal ages, especially 15-19 years, appears to have undesirable effects on birth weight. Previous studies found young maternal age as a risk factor for preterm and term low birthweight.[2] Pregnant adolescents often have additional risk factors that can affect birth outcomes, for example inadequate prenatal care and reproductive development and maturation.[15] Birth weight increases with maternal age up to the early 24s and then tends to level off while controlling for parity (**Figure 1**). Irrespective of parity, the immensity of evidence supports an increased risk of perinatal mortality, preterm delivery and low birth weight among elderly mothers, especially those >40 years of age.[9,16] Naeye[17] proposed a biological justification, whereby sclerotic lesions in the myometrial arteries may cause under perfusion leading to higher risk for perinatal mortality and morbidity outcomes.

In this study, lower family economic status was associated with lower birth weight (**Tables 2 & 3**). Several studies have shown different results on effect of socioeconomic factors on pregnancy outcomes.[10-12] The result of recent study conducted by Zeka et al[18] suggested that reduced birth weight was higher among the more socially disadvantaged families.

The mechanism behind this association is complex, but there are indications that psychological stress may have a role. Compared with the more advantaged, individuals of low socioeconomic status are believed to experience more severe daily stressors.[19] Evidence supports the idea that stress can increase the risk of having a low birth weight or preterm birth.[20] The results of present study showed that maternal higher

educational attainment was associated with lower birth weight (**Tables 2 & 3**). This is inconsistent with the finding of Zeka et al[18] and Young et al[12] a who indicated that mothers with lower educational attainment were more likely of adverse births than mothers who had higher education.[12] For justify this result, it should be mentioned that in our study, 66% of educated women had their first birth in their early 30's compared with 14% of under educated and illiterate women which could result in 146 grams decrease in birth weight (**Table 3**). Also, despite our study, in the Zeka et al[18] and Young et al[12] research, preterm infants as well included in the survey which could results in the different outcomes.

The limitations of our study include a lack of information on maternal pre-pregnancy body mass index, diet and placental weight which could have an effect on the birth weight. Also, the other limitations pertain to the sample size and type of study (cross-sectional). Analysis and interpretation of cross-sectional data are limited so the findings of this study need to be verified using the longitudinal design and higher sample size for concise conclusion.

To sum up, the results of our study showed that, as well as the accessibility of health care services at no out-of-pocket expense, parity, maternal age and other socioeconomic factors are strongly associated with infants' birth weight. Further studies are needed to confirm these associations.

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References

1. Roudbari M, Yaghmaei M, Soheili M. Prevalence and risk factors of low-birth-weight infants in Zahedan, Islamic Republic of Iran. ***East Mediterr Health J*** 2007; 13: 838-845.
2. Swamy GK, Edwards S, Gelfand A, James SA, Miranda ML. Maternal age, birth order, and race: differential effects on birthweight. ***J Epidemiol Community Health*** 2012; 66: 136-142.
3. Fairley L. Changing patterns of inequality in birthweight and its determinants: a population-based study, Scotland 1980-2000. ***Paediatr Perinat Epidemiol*** 2005; 19: 342-351.
4. Lee SK, Sobal J, Frongillo EA, Olson CM, Wolfe WS. Parity and body weight in the United States: differences by race and size of place of residence. ***Obes Res*** 2005; 13: 1263-1269.
5. Vaktskjold A, Van Trí D, Odland J, Sandanger T. Parity and Birth Weight in the Khanh Hoa Province, Vietnam. T***he Open Women's Health Journal*** 2010; 4: 1-4.
6. Kodzi IV, Kravdal Ø. What has high fertility got to do with the low birth weight problem in Africa? ***Demographic Research*** 2013; 28: 713-732.
7. Adamson H. Low birth weight in relation to maternal age and multiple pregnancies at Muhimbili National Hospital. ***Dar Es Salaam Medical Students' Journal*** 2007; 14: 55-58.
8. Roof KA, Hopkins WD, Izard MK, Hook M, Schapiro SJ. Maternal age, parity, and reproductive outcome in captive chimpanzees (Pan troglodytes). ***Am J Primatol*** 2005; 67: 199-207.
9. Joseph KS, Allen AC, Dodds L, Turner LA, Scott H, Liston R. The perinatal effects of delayed childbearing. ***Obstet Gynecol*** 2005; 105: 1410-1418.
10. Kehinde OA, Njokanma OF, Olanrewaju DM. Parental socioeconomic status and birth weight distribution of Nigerian term newborn babies. ***Niger J Paed*** 2013; 40: 299-302.
11. Finch BK. Socioeconomic gradients and low birth-weight: empirical and policy considerations. ***Health Serv Res*** 2003; 38: 1819-1841.
12. Young RL, Weinberg J, Vieira V, Aschengrau A, Webster TF. A multilevel non-hierarchical study of birth weight and socioeconomic status. ***Int J Health Geogr*** 2010; 9: 36.
13. Movahedi M, Hajarizadeh B, Rahimi A, Arshinchi M, Amirhosseini K, Haghdoost AA. Trends and geographical inequalities of the main health indicators for rural Iran. ***Health Policy Plan*** 2009; 24: 229-237.
14. Skjærvø GR, Røskaft E. Early conditions and fitness: effect of maternal parity on human life-history traits. ***Behavioral Ecology*** 2012; 24: 334-341.
15. Sangalang BB, Barth RP, Painter JS. First-birth outcomes and timing of second births: a statewide case management program for adolescent mothers. ***Health Soc Work*** 2006; 31: 54-63.
16. Hsieh TT, Liou JD, Hsu JJ, Lo LM, Chen SF, Hung TH. Advanced maternal age and adverse perinatal outcomes in an Asian population. ***Eur J Obstet Gynecol Reprod Biol*** 2010; 148: 21-26.
17. Naeye RL. Maternal age, obstetric complications, and the outcome of pregnancy. ***Obstet Gynecol*** 1983; 61: 210-216.
18. Zeka A, Melly SJ, Schwartz J. The effects of socioeconomic status and indices of physical environment on reduced birth weight and preterm births in Eastern Massachusetts. ***Environ Health*** 2008; 7: 60.
19. Lanting CI, Buitendijk SE, Crone MR, Segaar D, Bennebroek Gravenhorst J, van Wouwe JP. Clustering of socioeconomic, behavioural, and neonatal risk factors for infant health in pregnant smokers. ***PLoS One*** 2009; 4: e8363.
20. Hilmert CJ, Schetter CD, Dominguez TP, Abdou C, Hobel CJ, Glynn L, et al. Stress and blood pressure during pregnancy: racial differences and associations with birthweight. ***Psychosom Med*** 2008; 70: 57-64.