

Nature or Nurture? Factors Influencing Newborn Weight

Doğa mı, Yetiştirme mi? Yenidoğan Kilosunu Etkileyen Faktörler

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ABSTRACT

Objective: A pattern is emerging leading to a rise in birth weights and instances of macrosomia in numerous countries globally. Our study's objective is to contrast the average birth weights between 2016 and 2020. We aim to explore whether there exists a tendency toward increased mean birth weight and higher rates of macrosomia. Additionally, we seek to assess how neonatal gender, birth method, maternal age, and birth season impact newborn weight.

Material and Method: Retrospective analysis encompassed data from a combined 1,348 newborns in 2016 (n: 692) and 2020 (n=656), all born within the 37-40 weeks gestational range. A statistical analysis was conducted on data related to the birth weight of newborns, their gender, gestational duration, the age of the mothers, method of delivery, and the time of year they were born.

Results: The research findings indicated a significant increase in the occurrence of macrosomia (defined as birth weight ≥ 4000 g), rising from 4.8% in 2016 to 8.2% in 2020. In both years, there is a modest positive correlation between the age of the mother and the weight of the newborns. In 2020, a significant disparity in birth weight was noticed between infants delivered via cesarean section and those delivered through the natural birthing process. The study indicated that the season of birth did not have any impact on birth weight.

Conclusion: Macrosomia rates experienced an upsurge in 2016. Maternal age, gender of the newborn, and gestational age were examined as distinct risk factors contributing to macrosomia. The study noted that both maternal age and neonatal gender influenced newborn weight, whereas birth seasons had no impact on neonatal weight.

Key Words: Newborn, Birth weight, Macrosomia

ÖZET

Amaç: Dünya genelinde birçok ülkede doğum ağırlıklarının yükselmesi ve makrosomi vakalarının artışına işaret eden bir eğilim ortaya çıkıyor. Çalışmamızın amacı, 2016 ile 2020 arasındaki ortalama doğum ağırlıklarını karşılaştırmaktır. Ortalama doğum ağırlığında artış eğilimi ve makrosomi oranlarında artış olup olmadığını araştırmayı amaçlıyoruz. Ayrıca, yenidoğan cinsiyeti, doğum yöntemi, anne yaşı ve doğum mevsiminin, yenidoğan ağırlığına nasıl etki ettiğini değerlendirmeyi amaçlıyoruz.

Gereç ve Yöntem: Geriye dönük analiz, 2016 (n: 692) ve 2020 (n=656) yıllarında doğan toplam 1.348 yenidoğanın verilerini içeriyordu. Tüm yenidoğanlar, 37-40 hafta gebelik aralığında doğmuşlardır. Yenidoğanların doğum ağırlığı, cinsiyeti, gebelik süresi, anne yaşı, doğum yöntemi ve doğum mevsimiyle ilgili istatistiksel bir değerlendirme yapıldı.

Bulgular: Çalışma, makrosomi (doğum ağırlığı ≥ 4000 g) vakalarında belirgin bir artış ortaya koydu; bu oran 2016'da %4.8'den 2020'de %8.2'ye yükseldi. Her iki yılda da, anne yaşı ile yenidoğan ağırlığı arasında hafif bir pozitif ilişki tespit edilmiştir. 2020'de, sezaryen ile doğan bebekler ile normal doğum yapan bebekler arasında doğum ağırlığında dikkate değer bir artış gözlemlendi. Çalışma, doğum mevsiminin doğum ağırlığı üzerinde herhangi bir etkisi olmadığını gösterdi.

Sonuç: Makrosomi oranları 2020 yılında bir yükseliş yaşadı. Çalışma, hem anne yaşının hem de yenidoğan cinsiyetinin yenidoğan ağırlığını etkilediğini, ancak doğum mevsiminin yenidoğan ağırlığı üzerinde herhangi bir etkisinin olmadığını belirtti. Anne yaşı, yenidoğanın cinsiyeti ve gebelik yaşı, makrosominin katkı sağlayan ayrı risk faktörleri olarak incelendi.

Anahtar Kelimeler: Yenidoğan, Doğum ağırlığı, Makrosomi



INTRODUCTION

Birth weight stands as a crucial metric that mirrors the conditions within the womb. Accumulating evidence indicates that infants born with birth weights significantly higher or lower than expected for their gestational age are associated with adverse perinatal outcomes and an increased risk of cardio-metabolic problems in their later lives (1). The most frequently utilized threshold is a weight exceeding 4500 g, although a weight exceeding 4000 g is also commonly employed (2). Macrosomia refers to surpassing a specific growth threshold, regardless of the gestational age. Furthermore, the frequency of macrosomia varies among

distinct racial and ethnic groups, impacting approximately 6-10% of newborns (3). The occurrence of macrosomia, leading to detrimental effects on both the mother and newborn, has experienced a significant increase over the last decade. Macrosomia may result in difficulties such as shoulder dystocia, perinatal oxygen deprivation, brachial plexus injuries, congenital abnormalities, and a heightened frequency of admissions to intensive care units. For mothers, this scenario can also lead to postpartum hemorrhage, prolonged labor, tears in the perineal area, thromboembolic events, a higher probability of undergoing a cesarean section, and complications associated with anesthesia. Apart from

gestational diabetes mellitus, the primary factors increasing the likelihood of macrosomia in newborns include maternal obesity, increased weight gain during pregnancy, advanced maternal age, multiple pregnancies, post-term gestation, factors related to ethnicity and race, as well as the male gender of the fetus (4). Our study aims to compare the average birth weights between 2016 and 2020, and to examine whether there exists a rising pattern in the mean birth weight and rates of macrosomia during this timeframe. We evaluate the relationship between the gender of the newborn, the method of delivery, the age of the mother, and the season of birth in relation to the weight of the newborn. Previously, there has been no investigation into the influence of seasons on newborn weight and macrosomia rates, particularly within the central Anatolian region of Türkiye. In this context, our study will serve as an augmentation to the current corpus of literature.

MATERIALS AND METHODS

Study design

This research was conducted within the Obstetrics and Gynecology Department of Afyonkarahisar State Hospital, covering the periods from January 1st to December 31st in both 2016 and 2020. The research was granted ethical authorization by the Ethics Committee for Non-Interventional Research at Afyonkarahisar Health Sciences University Faculty of Medicine, as evidenced by Decision No: 196, issued on April 13, 2020, following 36 committee meetings. The study involved documenting the birth weights of newborns in grams, categorized by their gestational age. It conducted statistical analyses to compare the data from 2016 and 2020 in a retrospective inquiry. These measurements of newborn weights were conducted using a precise digital scale, with an accuracy level of 5 grams. The weight measurements were taken during the first hour after birth, prior to any feeding, and with the baby in an unclothed state. The research also included an examination of the newborn's gender, the age of the mother in years, the length of gestation in weeks, the method of delivery, and the specific season of birth for both the years 2016 and 2020.

Study Group

All birth records from the years 2016 and 2020 were meticulously reviewed. Retrospective data were gathered from newborns born to mothers aged between 18 and 40 years, with gestational ages falling within the range of 37 to 40 weeks. In the year 2016, there were a total of 1,681 births, while in 2020, the number rose to 1,839 births. Among these, 688 births from 2016 and 887 births from 2020 were considered for inclusion in the study. The study excluded patients with significant maternal illnesses that could potentially impact the health of the baby and measurements of neonatal birth weight. The research deliberately excluded various conditions, including diabetes mellitus, hypertension, congenital heart disease, chronic pulmonary diseases (such as COPD, cystic fibrosis, asthma) leading to maternal hypoxemia, hematological disorders like severe anemia, sickle cell anemia, and thalassemia, as well as maternal malnutrition due to conditions like Crohn's disease, ulcerative colitis, or gastric bypass surgery. Rheumatologic illnesses such as SLE and rheumatoid arthritis, infants born to mothers with TORCH group infections, and newborns with placental anomalies were also not part of the study. The research did not encompass cases involving multiple pregnancies, chromosomal abnormalities, or congenital anomalies in newborns. This study intentionally omitted multiple pregnancies due to the potential dangers

they pose to both mothers and infants. These risks encompass preterm birth, low birth weight, preeclampsia, postpartum bleeding, restricted fetal growth, neonatal health issues, and a heightened rate of neonatal death.

Statistical analysis

Categorical variables were represented using counts and corresponding percentages (n%), whereas continuous variables were summarized by indicating the mean \pm standard deviation (SD). For the comparison of year groups and categories of newborn weight, the Chi-square test was employed. In the years 2016 and 2020, separate analyses using Student's t-test were conducted to compare newborn weights across different gender and delivery method categories. One-way ANOVA was utilized to ascertain the presence of significant distinctions in mean newborn weight with regard to maternal age and season variables that included more than two categories. To assess the homogeneity of variances and conduct multiple comparisons among groups, Scheffe tests were applied. Logistic regression analysis was conducted to identify significant predictors of the macrosomia variable. In the preliminary phase, univariate analysis was employed to evaluate potential risk factors that could exert an influence on macrosomia. These risk factors included variables such as maternal age, gender, year of birth, gestational age, and season of birth. Subsequently, based on a significance criterion of $p < 0.25$, the variables of maternal age, gender, and gestational age were selected for inclusion in the multiple logistic regression analysis. A statistical significance level of 0.05 was utilized for all statistical tests. All analytical procedures were executed using Statistical Package for the Social Sciences software, version 26 (SPSS, Version 26.0).

RESULTS

In our study, we observed that the average weight of newborns in 2020 (3334.3 ± 480.1) was significantly greater than that of newborns in 2016 (3253.7 ± 3240.0) ($p = 0.010$). In 2020, births tended to occur at a more advanced gestational week, and there existed a statistically significant distinction when compared to 2016. In 2020, we observed a median gestational age of 39 weeks, whereas in 2016, it stood at 38 weeks ($p < 0.001$). However, when comparing newborn weights within the same gestational week, there were no statistically significant differences between 2016 and 2020 ($p > 0.05$). Interestingly, both in 2016 and 2020, male newborns consistently displayed higher birth weights than their female counterparts ($p < 0.001$). The mean maternal age was 28.7 ± 5.2 for 2012 and 28.6 ± 5.4 for 2016, with no statistically significant difference noted in the average maternal age between the two years ($p = 0.762$). (Table 1)

What's intriguing is that in both 2016 and 2020, we observed a trend where newborn birth weight increased as maternal age advanced. There was a subtle positive correlation between maternal age and newborn weight in both 2016 and 2020 ($p < 0.001$), with correlation coefficients of 0.156 and 0.152, respectively. When exploring the relationship between the gestational week at birth and newborn weight, we discovered a significant increase in newborn weight with each subsequent gestational week ($p < 0.001$). For proper contextualization, it's of paramount importance to delineate the definitions pertaining to birth weight. Low birth weight is conventionally demarcated as a live birth weight below 2500 grams. Conversely, macrosomia is frequently defined by birth weights that surpass the 4000-gram mark, occasionally extending to 4500 grams. Birth weights within the range

Table 1: Comparison of Newborn Weight, Gestational Age, and Maternal Age in 2016 and 2020

Year	Average Newborn Weight (g)	Gestational Age (weeks)	Maternal Age (years)	Correlation between Maternal Age and Newborn Weight	Newborn Weight Comparison (p-value)	Male vs. Female Newborn Weight (p-value)
2016	3253.7±240.0	38	28.7±5.2	0.156 (p<0.001)	No significant difference (p>0.05)	Male > Female (p<0.001)
2020	3334.3±480.1	39	28.6±5.4	0.152 (p<0.001)	No significant difference (p>0.05)	Male > Female (p<0.001)

of 2500 to 4000 grams are considered within the norm. In our research, we specifically identified newborns with birth weights equal to or exceeding 4000 grams as infants falling under the macrosomia category. The incidence of newborns with low birth weight was 3.7%, while the rate of newborns with normal birth weight was 91.4%, and the occurrence of macrosomic births was 4.8% during the year 2016. The proportion of newborns with low birth weight was 4.3%, while the percentage of newborns with a normal birth weight was 87.6%. Additionally, the rate of macrosomic births stood at 8.1% in the year 2016. A significant statistical rise in the

America, Europe, Australia, and China, a trend of rising birth weights among newborns was noted (5). In our publication, we determined that the mean birth weight of infants delivered in 2020 was greater in comparison to those born in 2016. Furthermore, it was observed that births in 2020 took place at a later gestational week compared to 2016. We believe that this disparity in birth weight could potentially be attributed to this difference in gestational timing. Nonetheless, it is imperative to underline that there were no statistically significant fluctuations observed in neonatal weights when comparing the years 2016 and 2020 within the same gestational week.

Table 2: Distribution of Low, Normal, and Macrosomic Births in 2016 and 2020 with Statistical Significance

Year	Low Birth Weight (%)	Normal Birth Weight (%)	Macrosomic Births (%)	Statistical Significance (p-value)
2016	3.7	91.4	4.8	-
2020	4.3	87.6	8.1	0.033

macrosomy rate was noted in 2020 (p=0.033). (Table 2) During the year 2016, there were a total of 687 births. Among these, 362 births (52.7%) were carried out through caesarean section, while 323 births (47.1%) followed the normal vaginal delivery route. In the year 2016, there were a total of 885 births. Among these, 484 births (54.6%) were delivered via caesarean section, while 401 births (45.2%) followed the normal vaginal delivery route. In the year 2016, no statistically significant distinction in birth weight was observed between infants delivered via cesarean section and those born through the vaginal delivery route (p=0.212). However, in 2020, newborns born through cesarean section exhibited a statistically significant increase in birth weight

However, it is noteworthy that our analysis does illuminate an upsurge in the prevalence of macrosomia rates. To conduct a comprehensive exploration of potential risk factors associated with macrosomia, we judiciously employed logistic regression analysis. The discerned results unequivocally pinpoint maternal age, newborn gender, and gestational age as formidable risk factors for macrosomia (6). Of particular significance is the prominence of gestational age, emerging as the predominant determinant influencing birth weight in term singleton infants, thus aligning harmoniously with the empirical findings of our present study. A parallel investigation conducted in China, spearheaded by Yi and colleagues, lent credence to these assertions (7). Their findings converged with

Table 3: Comparison of Cesarean Section and Vaginal Delivery Rates in 2016 and 2020

Year	Total Births	Cesarean Section (%)	Vaginal Delivery (%)	Statistical Significance (p-value)
2016	687	52.7	47.1	0.212
2020	885	54.6	45.2	0.014

compared to infants delivered vaginally (p=0.014). (Table 3) It is worth noting that the influence of seasons on newborn weight did not yield statistically significant findings in both years (p>0.05). Our research employed an extensive multiple logistic regression analysis, revealing several independent predictors of macrosomia. These included maternal age (odds ratio [OR]=1.09; 95% confidence interval [CI], 1.05-1.14), gender (OR=1.95; 95%CI, 1.28-2.97; P=0.002), year (OR=1.62; 95%CI, 1.05-2.49; P=0.030), the 39th gestational week (OR=2.61; 95%CI, 1.18-5.76; P=0.018), and the 40th gestational week (OR=2.92; 95%CI, 1.29-6.58; P=0.010).

DISCUSSION

In research carried out within the past decade in North

our own, elucidating that maternal age, pregnancy-related weight gain, and gestational age are integral factors conferring a heightened risk for macrosomia. Additionally, an expanding body of scientific inquiry substantiates the ascending trajectory in macrosomia rates. Certain studies posit that this surge may be intricately associated with an augmentation in maternal body mass index (BMI). Moreover, it is worth emphasizing that infants born with higher birth weights often embark on a developmental trajectory characterized by an amplified body mass index (BMI) throughout their subsequent life stages. This developmental course is intricately linked to an increased susceptibility to specific categories of malignancies. It is imperative to acknowledge that this

research lacks comprehensive data concerning maternal weight gain during pregnancy and maternal body mass index (BMI) (8). Consequently, the full extent of the impact of these factors on macrosomia remains beyond the scope of our investigation. Our observations underscore a noteworthy gender-based disparity, with female participants exhibiting lower birth weights in contrast to their male counterparts (9). Additionally, there exists a discernible trend suggesting lower birthweights within both the youngest and oldest maternal age groups. It is a widely accepted convention that the optimal age range for childbirth typically falls between 20 and 34 years (10). However, it is pertinent to note that the preterm birth rate increases significantly for offspring born to mothers aged under 17, as well as for pregnancies occurring after the age of 40. Furthermore, a surge is observed in admissions to neonatal intensive care units and an elevated incidence of fetal abnormalities in pregnancies beyond the age of 40. Pertinently, our research findings resonate with existing literature, which suggests that the risk of perinatal mortality surges to 2.7 times greater in pregnancies occurring after the age of 40. Additionally, it has been reported that maternal age exceeding 35 years triples the risk of fetal macrosomia (11). Within the confines of our study, we deliberately opted to include mothers whose ages fell within the range of 18 to 40 years. Notably, our findings unveiled a marked distinction in maternal age between newborns with macrosomia and those with typical birth weights, with the former group being characterized by a tendency towards relatively higher maternal ages. It is noteworthy that a study conducted in Israel posited a hypothesis suggesting a potential connection between heightened sunlight exposure during the final weeks of pregnancy and an accompanying increase in birth weight. However, our study, in contrast to these findings, conveys a different perspective. Our analysis revealed that seasonal variations did not exert any discernible impact on birth weight. This conclusion was derived from an examination of the

average birth weight of newborns delivered in 2016 and 2020 across different seasons. It is crucial to underscore that our study was conducted in a region located in central Anatolia, Turkey, where abundant sunlight prevails consistently throughout all seasons. This unique environmental factor may have contributed to the absence of observable seasonal effects on birth weight within our study. In a broader context, it is imperative to acknowledge that the present study is not immune to certain limitations, the primary one being the inherent challenges associated with accessing digital data from the period before 2016. The retrospective nature of our study inherently imposes inherent limitations. Regrettably, pertinent information concerning factors that could potentially exert an influence on newborn weight and the incidence of macrosomia remained inaccessible from the digital database registry. These factors encompassed crucial elements such as the mother's body mass index, pregnancy-related weight gain, maternal marital status, educational background, the frequency of pregnancy check-ups, employment status, as well as behavioral habits including smoking, alcohol consumption, and substance use. In light of these inherent constraints, our data analysis brought to the fore a significant and noteworthy trend when comparing the year 2020 to 2016. This discernible trend revealed a marked increase in both newborn weights and the prevalence of macrosomia in the year 2020. Moreover, our observations suggest that neonatal weight is affected by both maternal age and the gender of the newborn, while there is no apparent correlation between neonatal weight and the changing seasons. These discoveries emphasize the significance of taking maternal age, newborn gender, and gestational age into account as notable risk factors for the development of macrosomia. We anticipate that the data gathered during our study will make a valuable contribution to the field of antenatal care within gynecology and obstetrics clinics, as well as to the broader realm of public health.

Conflict of Interest: No conflict of interest was declared by the authors

Ethics: This research is approved by the Ethics Committee for Non-Interventional Research at Afyonkarahisar Health Sciences University Faculty of Medicine (Date: April 13, 2020, Decision Number: 196).

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