Original Research Article

STATISTICAL ANALYSIS OF BIRTH WEIGHT AND GENDER OF NEW BORN INFANTS

Abstract

Introduction

Birthweight is an important determinant of infant morbidity and mortality. Its effect extends into adult life and may explain some non-communicable diseases that occur in adult life. Males weigh more than females. Birthweight is categorized into low, normal and high. This study analyses the relationship between gender and the categories of birthweights.

Materials and methods

Data on babies' gender and birthweights from 961 term life deliveries in a private general practice hospital were analyzed. Test on equality of the mean weights of males and females at the three categorical levels were done using z test and t tests as necessary.

Results

Mean birthweight is found to be 3.30 ± 0.495kg. Males weighed significantly heavier than females at mean weights of 3.343 ± 0.495kg and 3.258 ± 0.490kg respectively. At the category of low birthweight, males weighed 1.844 ± 0.297kg and females 1.992 ± 0.397kg. There is no significant difference. Similarly, the mean weights of males and females at the high birthweight category are 4.462 ± 0.343kg and 4.342 ± 0.219kg respectively with no significant difference. At the normal weight category males weighed significantly more than females at mean weights of 3.30 ± 0.359kg and 3.248 ± 0.392kg respectively.

Conclusion

Male babies weigh more than female babies only at the normal birth weight category. The factor selectively affecting birthweight of male babies must be acting at the category of normal birthweight only.

More studies are advocated to identify the factors and why they act only at the level of normal birthweight.

Keywords: Morbidity, term live deliveries, low birthweight, macrosomia.

Introduction

Birth weight is the first weight of a baby at birth measured within the first one hour of birth [1]. It is either low, normal or high. Low birth weight (LBW) is birth weight less than 2.5kg [1]. High birth weight or macrosomia is birth weight above 4kg [2]. Some literature state macrosomia to be birth weight equal to or more than 4.5kg [3]. For this study, macrosomia is taken as birth weight above 4.0kg [2]. Normal birth weight is therefore birth weight from 2.5kg to 4.0kg.

Birth weight is an important factor in child development. It is one of the important predictors of child mental development, survival and physical growth. Child's morbidity and mortality depend to a large extent on the child's birth weight [4,5,6]**.** Its importance is well highlighted in "Life Depends on Birth Weight" by Professor Nimi Briggs in a key note address he gave at an annual conference of the Society of Gynecology and Obstetrics in Nigeria (SOGON) in November 2003[7].

Low birth weight babies or babies born as small-for-gestational-age are disadvantaged early in life. They have higher risks of hypoglycemia, hyperbilirubinemia, respiratory distress syndrome, low APGAR score with the resultant poor quality of life with approximately 20 times increased risk of neonatal death more than babies born as appropriate-for-gestational-age weight [8,9,10,11]. Negrato and Gomes demonstrates a clear relationship between LBW and increased risk later in life of many diseases such as insulin resistance, cardiovascular diseases, renal diseases [12], etc. LBW is also a substantial risk factor for adult psychiatric morbidity and lowered overall functioning [13]. The global prevalence of LBW is 15.5% which amounts to about 20 million infants born each year, 96.5% of them in developing countries[14].

Macrosomia is also risk factor for many adult disorders. Macrosomic babies are at increased risk of adolescent obesity [15]. Macrosomia increases the risk of birth injuries like shoulder dystocia, clavicle fractures, brachial plexus injuries and their resultant consequences. It also puts the babies at increased risk of becoming obese at young age and development of type 2 diabetes later in life [16]. Macrosomia complicates 3 to 20% of all pregnancies worldwide and is commoner in developed countries [17,18].

Birth weight is influenced by intrauterine environment and genetic factors. Intra uterine growth retardation (IUGR) occurs when the fetus for any reason fails to get enough nutrients for its development. Some of the known reasons are hypertension in pregnancy, anemia in pregnancy

and malaria in pregnancy [19,20,21]. When the intrauterine environment is conducive and there is good supply of nutrients across the normal feto-placental membrane, fetal growth and weight gain may then depend on genetic factors [22]. The paternal birth weight is associated with birth weight of males and not with females [22]. Female birth weight is affected by intrauterine environment and maternal glucose values more than males [22].

Justification for the study

Much work has been done on birth weight but little has been done on the gender distribution of the categories of birth weights. LBW and macrosomia are all markers of morbidity in neonatal and adult life. If the morbid birth weight categories are associated with gender, then this knowledge can be helpful in anticipating differences in presentation and severity of anticipated morbidity in adult life when they occur. This knowledge will be useful to epidemiologists. The research will also enrich literature on the gender distribution of categories of birth weight.

Aim of the study

Since males weigh more than females, it will be expected that there will be more macrosomic males than females and more LBW females than males. These expectations are expressed in the form of hypotheses by the researchers. Since there are three categories, three hypotheses naturally emerge. This study intends to do a statistical analysis of categories of birth weights and gender distributions and test the hypotheses. The objectives are to test the hypotheses that:

1. Female underweight babies weigh less than male underweight babies
2. Male overweight babies weigh more than female overweight babies
3. Male normal weight babies weigh more than female normal weight babies

Materials and methods

This is a cross sectional study on the categories of birth weight and gender of new born babies. The data are from a private general practice hospital situated in Nkpor, an urban satellite town close to Onitsha in Anambra State of Nigeria. The hospital keeps records of deliveries. The folders of all deliveries from January 2015 to December 2016 were extracted for study. All full term live deliveries were studied. Full term is pregnancy carried to 37 weeks completed gestational age. Gestational age was calculated in weeks from first day of last menstrual period or by ultrasound scan done in the first trimester. Babies were weighed with Seca Babies' weighing scale. Birth weight less than 2.5kg was classified as low birth weight. Weights from

2.5kg to 4.0 kg were classified as normal weight while weights above 4.0 kg were classified as macrosomia. The baby's gender and birth weight were recorded in a data capture proforma.

Preterm babies and multiple gestations were excluded from the study because these are known factors in LBW. The study was on normal full term deliveries where birth weight was expected to be influenced by intrauterine environment and genetic factors.

The mean LBW, mean normal birthweight and mean high birthweight were calculated and the sex distribution shown in tables. Analysis was done with Statistical Package for Social Sciences (SPSS) version 20.

Statistical analysis

The mean weights in the three different categories of birth weights were obtained and Z – test was used for comparison of equality of proportion for large sample sizes T – test for small sample sizes. Analysis was done with Statistical Package for the Social Sciences (SPSS) version 20.

Ethical issues

The study did not involve life patients but recoeded data on the babies' birth weights and gender. Strict confidentiality of babies' and their mothers' identities was maintained.

Data presentation and analysis

There are 961 live births from 2015 to 2016 that met the inclusion criteria. The mean birth weight is 3.300kg with standard deviation of 0.4945. Males account for 486 (50.6%) of the deliveries while females account for 475 (49.4%). The mean weights are shown **in Table 1.**

Table 1. Distribution of babies weights by gender

Gender	Number (%)	Mean weight (sd)
Male	486 (50.6%)	3.343 (0.495)
Female	475 (49.4%)	3.258 (0.490)
Total	961 (100%)	3.300 (0.495)

sd is standard deviation. P – value 0.0037

The babies' weight is categorized into underweight, normal weight and overweight. **Table 2** below contains the distribution of categories of babies' mean weight by gender.

Table 2: Distribution of categories of babies' mean birthweights in kg and gender

Birth weight	Males	Females
< 2.5kg	N = 9 Mean low birth weight = 1.844 Sd = 0.297	N = 13 Mean low birth weight = 1.992 Sd = 0.397. P – value 0.335
2.5 kg – 4.0 kg	N = 448 Mean normal birth weight = 3.30 Sd = 0.359	N = 443 Mean normal birth weight = 3.248 Sd = 0.392. P – value 0.0196
>4.0kg	N = 29 Mean large birth weight = 4.462 Sd = 0.343	N = 19 Mean large birth weight = 4.342 Sd = 0.219. P – value 0.166

Hypothesis testing

Test of equality of mean birth weights of male and female babies. See **Table 1.**

The hypothesis is $H_0: \mu_1 = \mu_2$ while $H_a: \mu_1 > \mu_2$.

The null hypothesis is that there is no difference in the mean birth weights and the alternative hypothesis is that the male mean birth weight is more than the female mean birth weight.

z= 2.675, p = 0.0037

Thus H_0 is rejected. Male babies weigh more than female babies at birth.

The mean weights of the different categories of birth weight are calculated as in **Table 2**.

For equality of mean birth weights in the low birth weight category,

t = 1.007, p = 0.335.

Hence there is no significant difference between mean weights of male and female babies at the LBW category.

Using similar method of analysis for high birth weight babies (macrosomia) and similar hypothesis, there is no significant difference between mean weights of male macrosomia and female macrosomia t = 1.355, p = 0.166.

For test of difference in mean male normal birth weights and mean female normal birth weights, the Z test is used because the samples sizes are large, z = 2.067, P = 0.0196. Therefore, mean weight of normal weight male babies is significantly more than mean weight of normal weight female babies at birth.

Results

Mean birthweight is found to be 3.30 ± 0.495kg. Males have a mean birthweight of 3.343 ±0.495kg while females have a mean birthweight of 3.258 ± 0.490 kg. Males significantly weigh more than females.

The prevalence of low birth weight is found to be 2.3% while that of macrosomia is 5.0%.

The mean weight of low birth weight male babies is found to be 1.844 ± 0.297kg. That of low birthweight female babies is 1.992 ± 0.397kg. There is no significant difference between the mean weights. Similarly, the mean male high birth weight is 4.462 ± 0.343kg while that for females is 4.342 ± 0.219kg. There is no significant difference between them.

The mean male normal birth weight is 3.30 ± 0.359kg and that of the female is 3.248 ± 0.392kg. The mean weight of male normal weight babies is significantly higher than the mean weight of female normal weight babies.

Discussion

The mean birthweight of new born babies is found to 3.30kg from this study. This is higher than 3.13kg found by Ezugwu et al. in Enugu [21]. Swende found mean birth weight to be 3.08kg in Makurdi [23] while Adimorah et al. found it to be 3.17kg among Igbos in Nigeria [24]. All these values are lower than the one in our study probably because preterm deliveries were excluded in our study since preterm delivery as noted by Ugboma and Onyearugha, is a significant factor in low birth weight [19].

Mean male birth weight is found to 3.343kg and is significantly higher than mean female birth weight of 3.258kg. This is in agreement with Voldner et. al [22] but not in agreement with the findings of Swende who did not find any significant difference between mean birth weights of male and female babies. [23]

Low birth weight babies

The mean male low birth weight is found to be 1.833kg while the mean female low birth weight is found to be 1.992kg. The difference is not significant. This agrees with Ugboma and Onyearugha [19] and Ezugwu et al. [21]. In the low birth weight category, males and females do not have significant difference in their mean weights.

Macrosomia

The mean male high birth weight is found to be 4.462kg and is not significantly higher than the mean female high birth weight of 4.342kg. This agrees with other findings in literature [25,26,27]. So at the category of macrosomia, there is no significant difference between mean weights of males and females.

Normal birth weight

The mean normal birth weight of males in this study is found to be 3.30kg and for females it is found to be 3.28kg. The difference is significant. Males weigh more than females only at the normal birth weight category. It is known that fetal weight depends on intrauterine environment[12]. It has also been suggested that genetic factors also affect fetal weight by Volder et al. who found that paternal birth weight affects birth weight of male babies and not female babies [22]. They also found that maternal fasting plasma glucose and fasting plasma insulin affect birth weights of female babies and not male babies. These finding suggest fetal weight depends on their genetic predispositions. Our study suggests that this genetic effect on fetal weights is significantly felt only at the category of normal birth weight babies.

Conclusion

Male babies weigh significantly more than female babies at term birth. This significant difference in weight is only noticed at the category of normal birth weight babies. The genetic factor that makes males weigh more than females may have its greatest effect on the term normal weight babies.

Recommendation

More studies are recommended to identify the genetic factors that selectively act on male babies and why the effect is significantly felt only at the category of term normal birth weight babies.

References

1. WHO and UNICEF. Low birth weight: country, regional and global estimates. http://www.who.int/reproductivehealth/publications/monitoring/9280638327/en/. 2004. Accessed 24/5/17.
2. WHO. World Health Organization Expert Committee. Manual of the International Statistical Classification of diseases, injuries and causes of death. Geneva. 1975;1:355.
3. American College of Obstetricians and Gynecologists. Fetal macrosomia. ACOG Practice Bulletin No 22. Washington DC. 2000. https://www.acog.org/Resources-And-Publications/Practice-Bulletins-List *(Accessed May 24,2017).*
4. Daynia, E.B., Tobias, F.C. and Peter, A.C. (2010). Determinants of survival in very low birth weight neonates in a public sector hospital in Johannesburg. BMC Pediatr., 10:10–30.
5. Uthman, O.A. (2008). Effect of low birth weight on infant mortality: analysis using Weibull Hazard Model. Int J Epidemiol., 6:8.
6. Lawn, J.E., Cousens, S., and Zupan, J. (2005). 4 million neonatal deaths: When? Where? Why? Lancet, 365:891–990.
7. Briggs, N.D. (2004). Life depends on birth weight. Trop J Obstet *Gynaecol.,* 21(1): 71-77.
8. Jancevska, A., Tasic, V., Damcevski, N., Danilovski, D., Jovanovska, V. and Gucev Z. (2012). Children born small for gestational age (SGA). Prilozi., 33 (2): 47-58.
9. Bernstein, I.M., Horbar, J.D., Badger, G.J., Ohlsson, A., and Golan, A. (2000). Morbidity and mortality among very-low-birth-weight neonates with intrauterine growth restriction. The Vermont Oxford Network. Am J Obstet Gynecol., 182:198-206. 10.1016/S0002-9378(00)70513-8.
10. Clausson, B., Cnattingius, S., Axelsson, O. (1998). Preterm and term births of small for gestational age infants: a population-base study of risk factors among nulliparous women. Br J Obstet Gynecol., 105: 1011-1017.
11. McIntire, D. D., Bloom, S. L., Casey, B. M., and Leveno, K. J. (1999). Birth weight in a relation to morbidity and mortality among newborn infants. N Engl J Med., 340: 1234-1238. 10.1056/NEJM199904223401603.

12. Negrato, C. A., and Gomes, M. B. (2013). Low birth weight: causes and consequences. Diabetology and Metabolic Syndrome, 5:49. DOI: 10.1186/1758-5996-5-49.
13. Lærum, A. M. W., Reitan, S. K., Evensen, K. A. I., Lydersen, S., Brubakk, A. N., Skranes, J., and Indredavik, M. S. (2017). Psychiatric Disorders and General Functioning in Low Birth Weight Adults: A Longitudinal Study. Pediatrics, 139(2):e20162135. (Down loaded August 8, 2017).
14. WHO. (2017) Maternal, newborn, child and adolescent health. www.who.int/maternal_child_adolescent/topics/newborn/care_of_preterm/en/ Assessed 9th May 2017.
15. Wang, Y., Gao, E., Wu, J., Zhou, J., Yang, Q., Walker, M. C., Mbikay, M., RJ Sigal, R. J., RC Nair, R.,C., and Wen, S. W. (2009). Fetal macrosomia and adolescence obesity: results from a longitudinal cohort study. International Journal of Obesity, 33:923–928. doi:10.1038/ijo.2009.131; published online 30 June 2009.
16. Kamana, K. C., Shakya, S., and Zhang, H. (2015). Gestational Diabetes Mellitus and Macrosomia: A Literature Review. Ann Nutr Metab, 66(suppl 2):14–20. DOI: 10.1159/000371628. Published online: June 2, 2015.
17. French, H. M., and Simmons, R. A. (2011). Body size. In: Rudolph, C. D., Rudolph, A. M., Lister, G. E., First, L. R., and Gershon, A. A. editors. Rudolph's. Pediatrics, 22nd ed. New York: Mcgraw-Hill:196.
18. Koyanagi, A,, Zhang, J., Dagvadorj, A., Hirayama, F., Shibuya, K., Souza, J. P., et al. (2013). Macrosomia in 23 developing countries: An analysis of a multicountry, facility-based, cross-sectional survey. Lancet, 381:476-83.
19. Ugboma, H. A. A., Onyearugha, C. N. (2013). Low birthweight delivery: Prevalence and associated factors as seen at a tertiary health facility. Nigerian Journal of Clinical Practice, 16(2):184-187.
20. Oladeinde, H. B., Oladeinde, O. B., Omoregie, R., and Onifade, A.,A. (2015). Prevalence and determinants of low birth weight: the situation in a traditional birth home in Benin City, Nigeria. Afr Health Sci., 15(4): 1123–1129. doi: 10.4314/ahs.v15i4.10.
21. Ezugwu, E. C,. Onah, H. E., Odetunde, I. O., and Azubuike, J. C. (2009). Singleton low birth weight babies at a tertiary hospital in Enugu, South East Nigeria. The Internet

Journal of Gynecology and Obstetrics, 14(1). ISPUB.com/IJGO/14/1/11435. Downloaded May 17. 2017.

22. Voldner, N., Froslie, K. F., Godang, K., Bollerslev, J., and Henriksen, T. (2009). Determinants of birth weight in boys and girls. HUM ONTOGENET, 3(1):7–12. doi 10.1002/huon.200900001.
23. Swende, T. Z. (2011). Term birth weight and sex ratio of offspring of a nigerian obstetric population. Int J Biol Med Res., 2(2): 531-532.
24. Adimora, G. N., Chukwudi, N. K., and Ejike, O. (2004). Birth weights of full term newborn babies among the Igbos of Eastern Nigeria. Nigerian Journal of Clinical Practice, 7(1):33-36.
25. Onyearugha, C. N., and Ugboma, H. A. A. (2014). Macrosomia: Prevalence and predisposing factors as seen at a university teaching hospital, South-South Nigeria. Journal of Medical Investigations and Practice, 9(1):12-15. DOI: 10.4103/9783-1230.132551.
26. Ezegwui, H. U., LC Ikeako, L. C., and Egbuji, C. (2011). Fetal macrosomia: Obstetric outcome of 311 cases in UNTH, Enugu, Nigeria. Nigerian Journal of Clinical Practice, 14(3):322-326.
27. Akindele, R. N., Audu, L. I., and Mokuolu, O. A. (2017). Macrosomic Births in Abuja: A Case–Control Study of Predisposing Factors and Early Neonatal Outcome. Niger J Clin Pract., 20:320-7.