CHILDHOOD HEALTH, GROWTH AND DEVELOPMENTAL OUTCOMES AFTER CESAREAN BIRTH IN AL AZHAR UNIVERSITY HOSPITALS

By

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ABSTRACT

Introduction: *Cesarean delivery is now one of the most common operations in both developed and developing countries and concerns have been raised about possible associations between it and a number of adverse childhood health outcomes.*

Aim of the study: *To measure the prevalence of selected adverse health outcomes (asthma, diabetes, obesity, anthropometric measurements and developmental outcome) in children born by Caesarian section as compared to those born by normal vaginal delivery.*

Patients and Methods: *This study was carried out 600 mothers selected by simple random method according to sample size divided according to type of delivery into two equal groups aimed to measure the prevalence of selected adverse health outcomes (asthma, diabetes, obesity, general examination and developmental outcome) in children born by Caesarian section (CS) as compared to those born by normal vaginal delivery (NVD). Those children (middle childhood age i.e., 6-12 years) randomly selected from children presented or admitted to pediatric outpatient clinics or pediatric wards in both Al Hussein and Sayed Galal university hospitals during the period from May to October 2020.*

Results: *There is statistically significant difference between NVD Group and CS Group according to their outcome of child regarding childhood asthma, diabetes and obesity (p-value < 0.05). While There is no statistically significant difference between NVD Group (Age 6-8years) and CS Group (Age 6-8years) according to their outcome of child regarding general examination and developmental outcome.*

Conclusion: *The present study showed that prevalence of chronic diseases (asthma, DM and obesity) increased in children born by Cesarean section than those born vaginally.*

Keywords: *Cesarean Section, Vaginal Delivery, Complications, Outcomes.*

INTRODUCTION

Cesarean delivery is now one of the most common operations in both developed and developing countries **(Betrán et al., 2007)** and concerns have been raised about possible associations between it and a number of adverse childhood health outcomes **(Cho et al., 2007)**.

A caesarean section (CS) can be a life-saving intervention when medically indicated, but this procedure can also lead to short-term and long-term health effects for women and children **(Cho et al., 2007)**.

The increasing use of CS, particularly without medical indication, an increased understanding of its health effects on women and children has become crucial **(Jane et al., 2018)**.

There is emerging evidence that babies born by CS have different hormonal, physical, bacterial, and medical exposures, and that these exposures can subtly alter neonatal physiology. Short-term risks of CS include altered immune development, an increased likelihood of allergy, atopy, asthma and reduced intestinal gut microbiome diversity **(Jane et al., 2018)**.

The Series shows that the global rate of caesarean birth has doubled in the past 15 years to 21%, and is increasing annually by 4% **(Jane et al., 2018)**.

The world health organization (WHO) has designed new guidance to reduce unnecessary caesarean sections rates **(Jane et al., 2018)**.

Among its evidence-based recommendations are those addressing women's fears, concerns, and misperceptions. In some countries, it has become fashionable and considered "modern" or safer to deliver without labor. Some women will have had a traumatic previous birth or complications, or believe incorrectly that a vaginal birth is not possible after a previous caesarean section. CS was associated with increased risks of overweight and obesity in offspring **(Jingjing et al., 2017)**.

Aims of the Work

This study aimed to measure the influence of selected adverse health outcomes (asthma, diabetes, obesity, anthropometric measurements and developmental outcome) in children born by Caesarian section as compared to those born by normal vaginal delivery.

PATIENTS AND METHODS

This is a retrospective cohort study included all children in middle childhood age (usually defined as ages 6 -12 years). Included children (fulfilling inclusion criteria) were randomly selected from those children presented or admitted to pediatric outpatient clinics or pediatric wards in both Al Hussein and Sayed Galal university hospitals. The selected children (middle childhood age i.e., 6-12 years old) divided into three groups according to age: 1st group: aged 6-8, 2nd group: from >8-10 and 3rd group from >10 – 12 years old.

Sample size:

Assuming obesity as the main outcome, which has a prevalence of 15% in the pediatric population (18), and an alpha level of 0.05% and power of 80%, and an odds ratio of 1.8%, and an odds ratio of 1.8% for obesity among children born by CS compared to normal vaginal delivery, a sample size of 298 in each group of the study group is needed.

Total number of studied children will be 600 children (300 in the Caesarian cohort and 300 in the NVD cohort).

Recruitment of the study subjects will be during the period from May to October 2020.

I. Patients:

Inclusion criteria:

- 6-12 years and sex: both sexes will be included.

Exclusion criteria:

- Age: <6 or >12years.

II. Methods:

The selected women subjected to an interview questionnaire for data collection. It includes socio-demographic data, habits, reproductive history and medical profile for herself and her child.

Data collection:

It includes socio-demographic data, habits, reproductive history and medical profile for herself and her child. Our study will use data that will be collected by using interviews and paper questionnaires.

Data will be collected using a pre-designed questionnaire which includes:

1. Socio-demographic characteristics as age, education, residence, occupation, habits (e.g., smoking), age of marriage and consanguinity.
2. Reproductive profile entails number of pregnancies, deliveries, and abortions, marriage to first pregnancy period, history of any gyno-obstetric problems, or Caesarean delivery (CD).
3. Detailed history of the subject child's birth will be obtained. It involves age at delivery, the preceding birth interval, type of conception, type of pregnancy, antenatal care, hospital or intensive care unit admission, timing of delivery, type of delivery, cause of CS and vaginal trial before surgery (if any), place of birth, and birth weight.
4. Medical profile for herself and her child will also be collected. Medical history of the child will include: age, sex, gestational age, perinatal history developmental history, nutritional history and history of fatigue intolerance if any, history suggesting asthma or any chronic illness.
5. Also, history of school attendance and educational achievement will be obtained.
6. Direct assessments of the children will be conducted: through clinical examination (including anthropometric measurements (body weight (Kg), height (Meter)), developmental assessment and calculating BMI (weight/height2) using WHO charts.

Statistical analysis:

IBM SPSS-22 program (Inc, Chicago, IL, USA) has been used to preform statistical analysis. Data have been examined for normal distribution via the Shapiro Walk testing. Qualitative data have been presented as frequency and relative percentage. Chi square testing ($\chi 2$) has been utilized to determine change among 2 or more groups of qualitative variables. Quantitative data have been presented as mean ± SD (Standard deviation). Nondependent sample t-testing has been utilized in comparing among 2 nondependent groups of normal distribution variables (parametric data) &Mann-Whitney testing. P value < 0.05 was judged significant.

Ethical consideration:

1. Written informed consent was obtained from parents or legal guardians before the study.
2. Approval by the local ethical committee was obtained before the study.
3. The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.
4. All the data of the patients and results of the study are confidential &the patients have the right to keep it.
5. The patient has the right to withdraw from the study at any time.

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RESULTS

Table (1): Comparison between mothers delivered by NVD and CS groups according to their Socio-demographic characteristics

Maternal demographic characters	NVD Group *(n=300)*	CS Group *(n=300)*	Test	p-value
Age (years)				
Mean ± SD	36.12±5.18	34.92±4.03	t=9.928	0.002*
Range	24-54	23-47		
Education				
Illiterate	19 (6.3%)	7 (2.3%)	x^2=21.998	<0.001**
Preparatory	50 (16.7%)	56 (18.7%)		
Primary	35 (11.7%)	47 (15.7%)		
Secondary	145 (48.3%)	169 (56.3%)		
University	48 (16.0%)	20 (6.7%)		
Residence				
Rural	64 (21.3%)	59 (19.7%)	x^2=0.256	0.613
Urban	236 (78.7%)	241 (80.3%)		
Occupation of the mother				
House wife	233 (77.7%)	250 (83.3%)	x^2=3.068	0.080
Working	67 (22.3%)	50 (16.7%)		
Smoking				
No	297 (99.0%)	299 (99.7%)	x^2=1.007	
Yes	3 (1.0%)	1 (0.3%)		

Using: t-Independent Sample t-test; x2: Chi-square test; z-Mann-Whitney z-test
p-value>0.05 NS; *p-value <0.05 S; **p-value <0.001 HS

This table shows that there was statistical significant difference regarding mother age & education in both groups.

Table (2): Comparison between NVD and CS Groups (Age 6-8 years) according to prevalence of chronic diseases among the studied children

Prevalence of childhood chronic diseases	NVD Group (Age 6-8years) *[n=100]*	CS Group (Age 6-8years) *[n=100]*	x^2	p-value
Asthma	4 (4%)	12 (12%)	4.326	0.038*
DM	1 (1%)	8 (8%)	5.672	0.017*
Obesity	2 (2%	9 (9%)	4.690	0.030*
BMI Interpretation with Z-score				
Normal	93 (93.0%)	84 (84.0%)	6.779	0.148
Obesity	2 (2.0%)	9 (9.0%)		
Overweight	2 (2.0%)	4 (4.0%)		
Severe thinness	1 (1.0%)	0 (0.0%)		
Thinness	2 (2.0%)	3 (3.0%)		
Developmental outcome				
Normal	96 (96%)	97 (97%)	1.005	0.605
Mental Delay	3 (3%)	3 (3%)		
GDD	1 (1%)	0 (0%)		

Using: x2: Chi-square test; p-value>0.05 NS

This table shows that there was highly statistically significant higher as regarding asthma, DM and obesity in CS group compared to NVD group. While there is no statistically significant difference between NVD Group (Age 6-8years) and CS Group (Age 6-8years) according to their outcome of child regarding General examination and developmental outcome.

Table (3): Comparison between NVD and CS Groups (Age >8-10 years) according to prevalence of chronic diseases and developmental aspect among the studied children

Prevalence of Childhood Chronic diseases	NVD Group (Age >8-10 years) *[n=100]*	CS Group (Age >8-10 years) *[n=100]*	x^2	p-value
Asthma	3 (3%)	11 (11%)	4.891	0.027*
DM	0 (0%)	2 (2%)	2.010	0.156
Obesity	1 (1%)	7 (7%)	4.664	0.031*
BMI Interpretation with Z-score				
Normal	95 (95.0%)	82 (82.0%)	9.255	0.047*
Obesity	1 (1.0%)	7 (7.0%)		
Overweight	3 (3.0%)	6 (6.0%)		
Severe thinness	0 (0.0%)	1 (1.0%)		
Thinness	1 (1.0%)	4 (4.0%)		
Developmental outcome				
Normal	99 (99%)	95 (95%)	4.082	0.129
Mental Delay	0 (0%)	4 (4%)		
GDD	1 (1%)	1 (1%)		

This table shows that there was highly statistically significant between CS group compared to NVD group regarding asthma and obesity while no statistically significant regarding DM, General examination and developmental outcome in CS group compared to NVD group.

Table (4): Comparison between NVD and CS Groups (Age >10-12 years) according to prevalence of chronic diseases and developmental aspect among the studied children

Prevalence of Childhood Chronic diseases	NVD Group (Age >10-12 years) *[n=100]*	CS Group (Age >10-12 years) *[n=100]*	x^2	p-value
Asthma	1 (1%)	9 (9%)	6.703	0.010*
DM	2 (2%)	9 (9%)	4.690	0.030*
Obesity	3 (3%)	11 (11%)	4.891	0.027*
BMI Interpretation with Z-score				
Normal	95 (95.0%)	72 (72.0%)	23.479	<0.001**
Obesity	1 (1.0%)	19 (19.0%)		
Overweight	4 (4.0%)	5 (5.0%)		
Severe thinness	0 (0.0%)	0 (0.0%)		
Thinness	0 (0.0%)	4 (4.0%)		
Developmental outcome				
Normal	100 (100%)	99 (99%)	0.024	0.896
Mental Delay	0 (0%)	1 (1%)		
GDD	0 (0%)	0 (0%)		

Using: x2: Chi-square test; p-value>0.05 NS

This table shows that there was highly statistically significant between CS group compared to NVD group regarding asthma, DM and obesity while no statistically significant regarding developmental outcome and anthropometric measurements in CS group compared to NVD group.

Table (5) Comparison between NVD Group and CS Group according to prevalence of chronic diseases among the studied children regarding Asthma, DM and Obesity

Characteristics of Maternal	NVD Group *(n=300)*	CS Group *(n=300)*	x^2	p-value
Asthma	8 (2.7%)	32 (10.7%)	15.332	<0.001**
DM	3 (1.0%)	19 (6.3%)	11.961	0.004*
Obesity	6 (2.0%)	27 (9.0%)	14.118	0.002*

Using: x2: Chi-square test; p-value>0.05 NS; **p-value <0.001 HS

This table shows that was highly statistically significant higher asthma in CS group compared to NVD group. Also, there was statistically significant higher DM in CS group compared to NVD group. While, there was statistically significant higher obesity in CS group compared to NVD group.

DISCUSSION

This study was carried out upon 600 mothers divided according to type of delivery into two equal groups aimed to measure the prevalence of selected adverse health outcomes in children born by Caesarian section (CS) as compared to those born by normal vaginal delivery (NVD).

There was highly statistically significant difference between groups regarding the educational level with (p-value= <0.001). The CS group had higher percentage of secondary educated mothers than the NVD group.

It was found that by increasing education level, more mothers prefer cesarean operation **(Alimohamadian et al., 2003; Garmaroodi)**.

In the study of **Ayalew et al., (2020)**, more than two-thirds of mothers (67.2%) were from urban areas. (44.6%) of the respondents attended secondary and college-level education, (58.9%) were housewives. Mothers who came from urban residents were 4.04 times more likely delivered through cesarean section than those who came from an urban residence (AOR=4.04, 95% CI: 2.19–7.45). Urban relative to rural place of residence had been associated with higher cesarean rates **(Boatin et al., 2018)**.

There was highly statistically significant difference between groups as regards place of birth with (p-value= 0.016). The CS group had higher percentage of delivery at general hospitals than the NVD group.

Children who had caesarean births were more likely to be from advantaged areas, born in private hospitals, their mothers were more likely to have private health care, pre-existing diabetes, hypertension or high BMI (≥ 30 kg/m2) **(Begum et al., 2019)**.

While different results were found by **Prado et al., (2018)** regarding the type of financing, the C-section rate was 35% in public services and 75% in private services.

Results of the prevalence of chronic diseases and developmental aspect between the studied children (age 6-8 years) in the present study showed that (10.5%) were asthmatic, (8%) had DM, (13.3%) were obese, in addition BMI interpretation with z-score, we found that the majority were normal and (5.5%) had obesity, regarding other complications it was found that (1.2%) had CP, while (88.7%) of children were at average general examination.

Blustein et al., (2013) assessed associations of caesarean section

with body mass from birth through adolescence. Caesarean delivery was consistently associated with increased adiposity, starting at 6 weeks (+0.11 s.d. units, 95% CI: 0.03-0.18; P=0.005), through age 15 (BMI z-score increment+0.10 s.d. units, 95% CI: 0.001-0.198; P=0.042). By age 11 caesarean-delivered children had 1.83 times the odds of overweight or obesity (95% CI: 1.24-2.70; P=0.002).

At 6 months of age, children born by CS had a significantly higher BMI but this did not persist into future childhood. There was no evidence to support an association between mode of delivery and long-term risk of obesity in the child **(Masukume et al., 2019)**.

An association was evident between caesarean delivery and asthma at age 6-7 years **(Liao et al., 2020)**.

In the current study, we found that childhood chronic diseases were more prevalent in CS born children (asthma, DM and obesity) (age 6-8 years) with highly statistically significant difference (p-value 0.038, 0.017, 0.030, respectively).

In **Rutayisire et al., (2016)** cross-sectional study of 8900 preschool children aged 3-6 years, 67.3 % were born via CS, of whom 15.7% were obese. Cesarean delivery was significantly associated with the risk of overweight [OR 1.24; (95% CI 1.07-1.44); p = 0.003], and the risk of obesity [OR 1.29; (95% CI 1.13-1.49); p < 0.001] in preschool children.

In contrast to our results, a nationwide study from Norway found no association between CS and the incidence of type 1diabetes in children **(Stene et al., 2003)**.

In the present study, it was found that childhood chronic diseases were more prevalent in CS born children (asthma and obesity) (age >8-10 years) with highly statistically significant difference (p-value 0.027, 0.031, respectively). There was highly statistically significant higher obesity in CS group compared to NVD group with (p-value <0.047).

Our results agree with **Huh et al., (2012)**, they found that at age 3, 15.7% of children delivered by caesarean section were obese compared with 7.5% of children born vaginally.

Mothers in the NVD group showed significantly greater affectionate behavior and encompassing compared to mothers in the CS group in the study of **(Gathwala and Narayanan, 1991)**.

In the current study, we found that childhood chronic diseases were more prevalent in CS born children (asthma, DM and obesity) (age >10-12 years) with statistically significant difference (p-value 0.010, 0.030, 0.027, respectively). In addition, BMI interpretation with z-score, there was highly statistically significant difference between groups (p-value <0.001).

In agreement with these results, a meta-analysis (including children aged 0–14 years in 18 of 20 studies) recorded around 20% increased type 1 diabetes risk for caesarean births **(Cardwell et al., 2008)**.

Wang et al., (2013) studied the relationship between (C-section) and the risk of overweight and obesity in children in grade 6 (mean age, 11.92 years). C-section was associated with an increased risk of overweight and obesity in children in grade 6, but the relationship differed according to gender.

Our results agree with **Thavagnanam et al., (2008)** meta-analysis, they found a 20% increase in the subsequent risk of asthma in children who had been delivered by Caesarean section. Also, **Sevelsted et al., (2016)** confirmed that cesarean delivery to be a risk factor for childhood asthma. In contrast to these results; **Werner et al., (2007)** found no evidence that children being delivered by caesarean section have an increased risk of asthma.

In agreement with our results; **Barros et al., (2012)** assessed whether CS births lead to increased obesity during childhood, adolescence, and early adulthood in 3 birth cohorts. Subjects born by CS had 50% higher prevalence of obesity at 4, 11, and 15 y of age but not at 23 y of age. While, in the study of **Pei et al., (2014)**, the proportion of obese children was greater in the cesarean delivery group compared with the vaginal delivery group at age 2 years (13.6% versus 8.3%), but not at older ages.

Children delivered by cesarean section more commonly developed respiratory tract infections, obesity and the manifestations of asthma than children delivered vaginally **(Słabuszewska-Jóźwiak et al., 2020)**.

In our study the prevalence of Overweight and obesity is more in CS than NVD this due to altered gut microbiota in baby delivered by CS this increase the risk of obesity and other health conditions **(perz-Munoz et al., 2017)**.

Also breast feeding is contributing factor which decrease prevalence of obesity **(Victoria et al., 2015)**.

The prevalence of asthma is more in CS than NVD this is explained also by abnormal gut microbiota which altere the development of immune system **(Hurre et al., 2008)**.

And increase the neonatal respiratory morbidity between children delivered by CS increase the risk of asthma **(Birnkrant et al., 2006)**.

The increase of prevalence of T1DM in baby delivered by CS explained by alerted gut colonization which affect the development of immune system and modulate its responses to external agent and affect the function of Beta cells **(Vehik Debelea, 2012)**.

CONCLUSION

The present study showed the prevalence of chronic diseases (asthma, DM and obesity) increased in children born by Cesarean section than those born vaginally.

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تأثير الولادة القيصرية على صحة ونمو ونماء الأطفال بمستشفيات جامعة الأزهر

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تعتبر الولادة القيصرية واحدة من أشهر العمليات الجراحية في كلا من البلاد المتطورة والبلاد النامية وهناك اهتمام واضح لدراسة احتمالية حدوث أثار جانبية بصحة الأطفال مع زيادة معدل الولادات القيصرية.

الهدف من هذه الرسالة: هو مقارنة معدل حدوث مضاعفات صحية للأطفال بين كل من الأطفال المولدين عن طريق الولادات الطبيعية والولادات القيصرية.

أجريت هذه الرسالة على 600 حاله من كلا الجنسين داخل مستشفى السيد جلال الجامعي ومستشفى الحسين الجامعي، جامعه الازهر بالقاهرة خلال الفترة من مايو 2020 الى نهاية شهر ديسمبر 2020.

خلصت هذه الدراسة إلي الاتي:

زيادة معدل حدوث مضاعفات صحية في صوره زيادة نسبه السمنة وارتفاع معد الإصابة بحساسية الصدر المزمنة وداء البول السكرى لدى الأطفال المولودين عن طريق الجراحات القيصرية عنه في الولادة الطبيعية.