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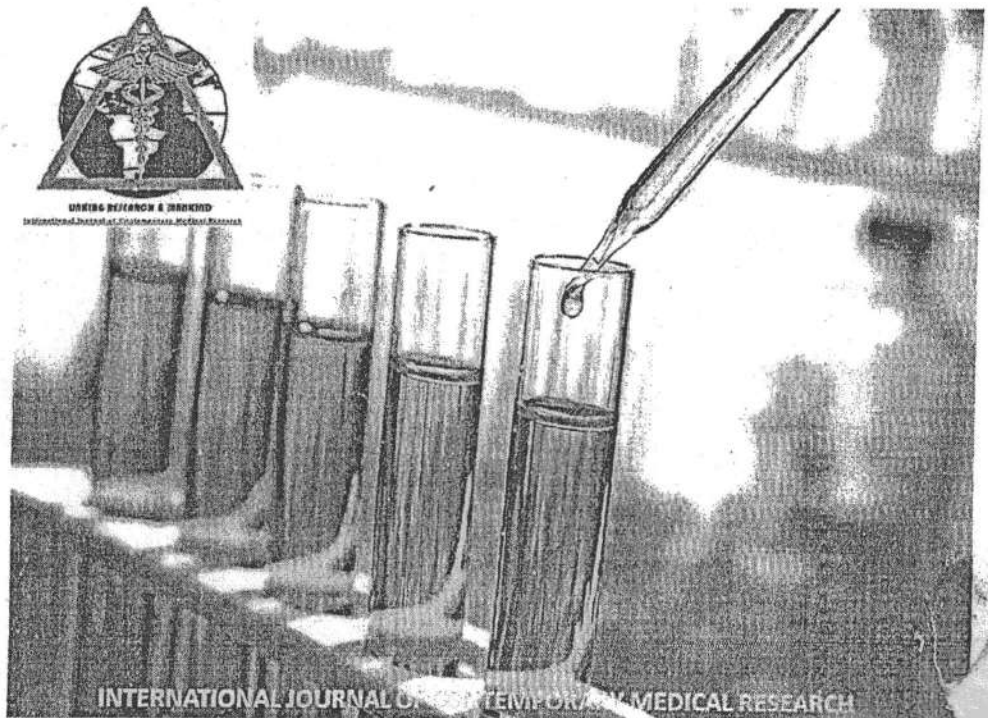
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INTERNATIONAL JOURNAL OF CONTEMPORARY MEDICAL RESEARCH

**Marascuilo Method of Multiple Comparisons (An Analytical Study of Caesarean Section Delivery)**

Sunanda T Wagh1, Naser Ahmed Razvi2



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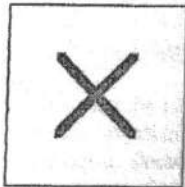
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# Marascuilo Method of Multiple Comparisons (An Analytical Study of Caesarean Section Delivery)

Sunanda T Wagh<sup>1</sup>, Naser Ahmed Razvi<sup>2</sup>

## ABSTRACT

**Introduction:** From last three decades it was observed that the trend of caesarean section delivery is increasing in Indian community. Further this trend is not uniform for its States. This rate differ from place to place with respect to urban, rural, tribal community and also with respect to type of institution either government or private. Techniques in inferential statistics are applied to assess these differences. In order to analyse the proportions of CS, statistical inference i.e. Z-test, Chi-square test and Marascuilo's methods are applied.

**Material and methods:** While sampling, in order to ensure the inclusion of villages, urban areas and tribal (Adivasi) regions two stage sampling is adopted. Observations and records from hospitals were used for collecting data. The data collection from these health care institutions was undertaken from 1 Jan 2009 to 31 December 2009. Data was analyzed on SPSS 22.

**Results:** Rejecting the null hypothesis of equality of proportions by chi square test concluded that not all population proportions are equal. Because the result of the chi square test for equality of proportions does not specifically focus the significantly different pairs, there is need to use a multiple comparisons procedure that is the Marascuilo procedure which enables us to make comparisons between all pairs of groups.

**Conclusion:** The rate of caesarean section is high in urban private sector and very low in tribal areas. A difference is statistically significant in all fifteen comparisons involving 6 population proportions.

**Keywords:** Caesarean section, Proportion, Marascuilo procedure.

## INTRODUCTION

A Caesarean section is the technical name for delivering a baby by operating the mother under anesthesia rather than allowing normal labor and delivery. It is recommended in cases where there is distress due to wrong positioning of the baby in the womb, obstruction or due to many more reasons. In few years we observed that there is remarkable increase in the rate of caesarean section (CS) in both developed and developing countries. India is also showing the same increasing trend. The study is carried out to investigate the real reasons for this increasing trend. The reasons for the said phenomenon are either medical or nonmedical. Several studies have shown that the rate of CS differ from place to place and from region to region. Therefore, we carried out a multicentre, large sample, cross sectional study to analyse the CS rate in Nasik division in Maharashtra state during the year 2009. WHO recommended that no region should have a CS rate over 10-15%.<sup>1,2</sup> Based on a survey by the World Health Organization (WHO) on methods of delivery during the period 2007-08, the rates of CS in Asian countries was 27%.<sup>3</sup>

The aim of our study was to estimate the overall CS rate in Maharashtra, and to describe the factors associated with the increased CS rate in Region.

## MATERIAL AND METHODS

The study population comprised women who gave birth during the period 1<sup>st</sup> January 2009 to 31<sup>st</sup> December 2009. Total 61 hospitals from 5 districts of Nasik region namely Nasik, Ahmadnagar, Dhule, and Jalgaon and Nandurbar comprise the sample. The data include hospitals from rural areas (26), urban areas (35), Private Hospitals (31) and Government Hospitals (30) which includes municipalities, autonomous hospitals and Medical colleges. We selected 61 Maternity hospitals and number of deliveries in the hospitals from the registers that occurred during 2009, excluding miscarriages or termination of pregnancy before 28 gestational weeks. The sampling method for each population is simple random sampling. The samples are independent. The overall rate of CS in the Nasik division was estimated as 20.74 %.

## STATISTICAL ANALYSIS

Statistical hypothesis testing is an essential component of biological and medical studies for making inferences and estimations from the collected data in the study; however, there are several methods to study the phenomenon under consideration. In order to compare CS rates in different regions we can have different test procedures such as Chi-square test for testing independence of attribute, Z test for testing equality of two proportions and Marascuilo's test for testing equality of several proportions. We compare these methods for inference and Marascuilo method is better as it provides the magnitude of variation in the pairs of proportions.

The method applied for testing the homogeneity of proportions is based on the chi-square distribution via contingency tables.<sup>4</sup> To test the null hypothesis of no difference in the proportions among the 6 populations, when we have samples from 6 populations, we can test whether there are significant differences in the proportion of CS for these populations using a contingency table approach. We construct the contingency table has two rows and 6 columns.

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Areas	Urban Gov	Rural Gov	Urban Private	Rural Private	Tribal Gov Urban	Tribal Gov Rural	Total
fo( CS)	6240	1948	1614	412	940	163	11317
Normal	22561	21428	3440	1016	10541	2692	61678
Total	28801	23376	5054	1428	11481	2855	72995
fe (CS)	4465.249	3624.168	783.5621	221.3943	1779.991	442.6335	11317
fo-fe	1774.751	-1676.17	830.4379	190.6057	-839.991	-279.633	
(fo-fe)^2/ fe	705.3894	775.2234	880.1182	164.0989	396.3982	176.6583	3097.886**

Table-1: Calculation of Chi- Square Statistic

	Rural		Urban		Pooled Estimate P	Q = 1 - P	I Z I	P Value
	P <sub>1</sub>	n <sub>1</sub>	P <sub>2</sub>	n <sub>2</sub>				
Government	0.083	23376	0.217	28801	0.157	0.843	41.6373 <sup>a1</sup>	< 0.001
Private	0.289	1428	0.319	5054	0.313	0.687	2.21974 <sup>a2</sup>	0.02643*
	Government		Private					
	P <sub>1</sub>	n <sub>1</sub>	P <sub>2</sub>	n <sub>2</sub>				
Rural	0.083	23376	0.289	1428	0.095	0.905	25.653 <sup>b1</sup>	<.001
Urban	0.217	28801	0.319	5054	0.232	0.768	15.9525 <sup>b2</sup>	<0.001
	Rural		Urban					
Adivasi Government	P <sub>1</sub>	n <sub>1</sub>	P <sub>2</sub>	n <sub>2</sub>				
	0.057093	2855	0.081874	11481	0.077	0.923061	4.44641 <sup>a3</sup>	<0.001

a1 : Proportion of cesarean section in Government Hospitals in rural and urban do differ significantly, a2 : Proportion of cesarean section in Government Hospitals in rural and urban do differ significantly, b1: Proportion of cesarean section in Private And Government Hospitals in rural differ significantly, b2 : Proportion of cesarean section in Private And Government Hospitals in urban differ significantly, a3 : Proportion of cesarean section in Government Hospitals in rural and urban area of Nandurbar do differ significantly.

Table-2: Proportions of cesarean section deliveries by regional and institution characteristics.

Type of Region	Proportion p <sub>i</sub>	Observed Proportion	1-p <sub>i</sub>	Sample size ni
Rural Govt	P <sub>1</sub>	0.08333	0.9167	23376
Rural Private	P <sub>2</sub>	0.288515	0.7115	1428
Urban Govt	P <sub>3</sub>	0.216659	0.7833	28801
Urban Private	P <sub>4</sub>	0.319351	0.6806	5054
TribalGovt Rural	P <sub>5</sub>	0.057093	0.9429	2855
TribalGovt Urban	P <sub>6</sub>	0.081874	0.9181	11481

Table-3: Region wise Caesarean Section proportions.

	Difference	Value	Critical range	Significant
1	p1-p2	0.205185	0.00602	Yes
2	p1-p3	0.133329	0.03989	Yes
3	p1-p4	0.236021	0.00605	Yes
4	p1-p5	0.026237	0.02183	Yes
5	p1-p6	0.001456	0.01119	No
6	p2-p3	0.288515	0.00058	Yes
7	p2-p4	0.030836	0.02183	Yes
8	p2-p5	0.231422	0.03458	Yes
9	p2-p6	0.206641	0.03989	Yes
10	p3-p4	0.102692	0.00811	Yes
11	p3-p5	0.159566	0.00809	Yes
12	p3-p6	0.134785	0.00808	Yes
13	p4-p5	0.262258	0.02183	Yes
14	p4-p6	0.237477	0.02182	Yes
15	p5-p6	0.024781	0.00853	Yes

Table-4: Calculations by Marascuilo's procedure.

in rural and urban areas. This difference is still persistent in private and government hospitals. The proportions of CS in rural government hospitals and that in urban adivasi areas are almost same and equal to 8 percent.

DISCUSSIONS

According to area of residence there has been substantial upward trend in the rate of caesarean section delivery in Nasik division of Maharashtra compare to Normal delivery. Results from the table-3 shows that increased CS rates in urban areas as compare to rural areas. Further in private hospitals this rate is still increasing when compared with the Government hospitals. Previous studies have shown that at the national level, C-section make up about 9 percent of all deliveries but with huge regional variations, and also, a large rural-urban differential. Clearly, as private facilities have expanded, so has the rate of operated deliveries. There have been similar findings in studies conducted in other states of India like West Bengal and Kerala.<sup>8,9</sup> The study results point that the proportion of CS in four clusters is significantly different. This is tested using Chi - Square test in Table -1. A difference is statistically significant if its value exceeds the critical range value. That all the comparisons involving 6 populations significantly different from each other as far as proportions of CS is concern. Results indicate that private hospitals are largely responsible for this increased CS. According to the above data deliveries by cae