Journal of Midwifery & Reproductive Health

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The Relationship between Cormic Index and Mode of Delivery

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ARTICLEINFO

Article type:
Original article

Article History:
Received: 14-Oct-2015
Accepted: 19-Jan-2016

Key words:
Anthropometry
Body mass index
Cephalopelvic disproportion
Cesarean section

ABSTRACT

Background & aim: The risks of maternal mortality and morbidity associated with cesarean delivery are three and two times higher than vaginal delivery, respectively. The majority of cesarean sections are due to failure to progress in labor. One of the common risk factors for failure to progress is small maternal body size. Cormic index is an indicator of body composition assessment, which estimates trunk and leg length. In this study, we aimed to investigate the relationship between Cormic index and mode of delivery.

Methods: This descriptive, cross-sectional study was performed on 170 pregnant women referred to Omolbanin Hospital of Mashhad, Iran. Standing and sitting heights were measured at the onset of active phase of labor. Cormic index was calculated as sitting height/standing height×100. Mode of delivery was followed and recorded. Kruskal-Wallis and Bonferroni-corrected Mann-Whitney tests were performed, using SPSS version 16.

Results: The mean Cormic index was 52.04±2.85. There was a significant relationship between mode of delivery and Cormic index, sitting and standing heights, and leg length measures. However, there was no significant relationship between body mass index and mode of delivery.

Conclusion: Our findings indicated that mode of delivery is associated with Cormic index. With high Cormic indices (long trunk and short legs) the rate of assisted delivery rose compared to vaginal and cesarean deliveries.

► *Please cite this paper as*:
Pourshirazi M, Golmakani N, Esmaeili H, Ebrahimzadeh Zagami S, Golmakani N. The Relationship between Cormic Index and Mode of Delivery. Journal of Midwifery and Reproductive Health. 2017; 5(1): 800-805.

DOI: 10.22038/jmrh.2016.7571

Introduction

The ultimate goal of delivery directing team is to perform a safe delivery. Caesarean section is used to save lives of mothers and their infants in difficult deliveries (1). Risks of maternal mortality and morbidity caused by cesarean section are three and two times higher than vaginal delivery, respectively (2). Other risks of cesarean delivery for mothers include maternal bleeding during and after surgery, wound infection, infertility, and deep vein thrombosis in the leg (3). The maximum acceptable rate of cesarean delivery, which has favorable results for both mothers and their neonates, is estimated to range between 10% and 15% (4).

In Iran, Monitoring and Evaluation System of Fertility Services by Ministry of Health Treatment and Medical Education in 2000 announced that cesarean rate based on the information recorded in university hospitals was 48%, and this rate in private hospitals was over 90% of total deliveries and even 100% in some hospitals (3). The high rate of caesarean

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section is a global problem and it is observed even in countries ranking higher than Iran in terms of health indicators and access to health services.

For instance, during 1970-2010, cesarean rate in the United States from 4.5% increased to 32.8% of all births (2). Nowadays, absolute indications for cesarean section include cephalopelvic disproportion, transverse or oblique attitude of the fetus, placenta previa, placental abruption, cord prolapse, and severe preeclampsia, while relative indications for cesarean section are macrosomia, breech presentation, and history of previous cesarean. The rate of these cases is estimated to range between 5.8% and 8.5% of total births (2, 3).

The cause of 68% of unplanned cesarean deliveries for fetus with cephalic presentation is failure to progress in labor (2). A common risk factor for failure to progress is mother's small size (5). Until the late nineteenth century, numerous physicians, especially obstetricians and gynecologists, tried to find different markers to identify women at risk of abnormal delivery progress (6).

Ample studies have assessed the relationship of anthropometric indices with labor disorders and mode of delivery. Studies showed that labor progress declines with increasing maternal body mass index (BMI) (7-10). Zhang et al. (2002) proposed that obesity is the cause of uterine contraction disorders during labor (10). Berendzen (2013) reported that cesarean section rates soared with high BMIs (11). Some studies suggest that maternal short stature and leg length are the risk factors for cephalopelvic disproportion (CPD) (12-14).

Nevertheless, others believe that height and leg length are not associated with inadequacy of the mother's pelvis (15, 16). Today, the majority of prenatal care programs are only based on maternal height measurements for detection of pregnant women at risk for difficult delivery (17). Maternal height is an indirect indicator of maternal pelvic capacity and has little predictive value in the performed studies. Former studies exhibited that short height alone cannot be considered as a predictive factor for mode of delivery, and combination of other risk factors with maternal height can have better clinical application for prediction of delivery outcomes (13, 15, 16, 18, 19). However, Kordi et al. (2009) suggested that external pelvimetry of transverse diagonal of Michaelis sacral and ischial tuberosities can predict more than 60% of difficult deliveries in nulliparous women (20).

One indicator of body composition assessment is Cormic index (CI) or sitting height ratio that is defined as height/sitting height×100 and estimates trunk and leg lengths. Factors such as age, genetics, environment, and lifestyle (e.g., health and nutrition) affect Cormic index in adulthood (21, 22). The index varies among different individuals and groups, such that Asian and Far East populations have short lower limbs with mean Cormic index of 53-54%; this rate for Europeans and Africans is reported to be 52% and 51%, respectively (21, 22).

Ridgeway et al. (2011) demonstrated that height (r=0.5) and sitting height (r=0.49) were associated with true conjugate of pelvis, as well as pelvis inlet and outlet areas (14). In a study performed by Sebhatu (2001), it was reported that cephalopelvic disproportion could not be accurately predicted by height and sitting height (23). Van Bogaert (1999) revealed that height and length of the spine (from vertebrae of the neck to the sacral hiatus) were shorter in women undergoing cesarean section due to inadequate pelvis, compared to those who had vaginal delivery (15).

Given that there is no specific method for predicting mode of delivery in the latent phase or in the early stages of active labor, and considering the importance of preventing unnecessary labor trials and high rate of cesarean due to difficult delivery, this study was performed to determine the relationship between Cormic index and mode of delivery.

Materials and Methods

This descriptive, cross-sectional study was performed on 170 nulliparous and second gravid women referred to Omolbanin (R) Hospital of Mashhad, Iran, during August 2014-May 2015. The sample size was calculated to be 150 cases based on a pilot study and the correlation formula with confidence level of 95% and test power of 80%; ultimately, 170 cases were studied.

After approval of the Ethics Committee of Mashhad University of Medical Sciences, convenience sampling was performed and written consent was obtained from the participants. The inclusion criteria were maternal age of 18-35 years, gestational age of 38-42 weeks, cephalic presentation, singleton pregnancy, cervical dilatation of 3-5 cm, spontaneous labor, lack of medical and midwifery problems, pre-pregnancy BMI<30 kg/m^2, pregnancy weight gain within the normal range, non-use of regional and inhaled analgesia techniques for childbirth, and lack of obvious pelvic inadequacy (If diagonal conjugate was equal or more than 11.5 cm, pelvic side walls were converging and pubic arch angle was equal or more than 90 degrees, then the pelvis was considered adequate).

The exclusion criteria included mothers undergoing elective or emergency cesarean section due to fetal distress or precipitous delivery and mothers whose newborn's birth weight was within the range of 2500-4000 g.

Standing and sitting heights were measured at the onset of active phase, such that the mothers stood next to a wall with their feet and knees together, knees straight, heels, legs, hip, shoulders, back of the head parallel to the wall, their body completely flat and stretched, hands hanging on both sides, and looking straight ahead. The horizontal plate of the stadiometer was placed over the mother's head and standing height was measured. Afterwards, the mothers sat on a chair with its dorsal surface perfectly smooth and graded, and sitting height was measured as the distance between top of the head and the sitting site on the chair. Cormic index was calculated as sitting height/standing height×100, and leg length was calculated by subtracting sitting height from standing height (Figure 1) (21, 22).

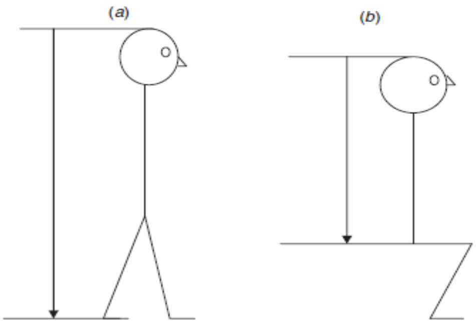

Figure 1. Operational definition for (a) standing and (b) sitting heights

Then, mode of delivery was followed and the results were recorded. The tools used in this study included a demographic and midwifery information form, a form related to pelvic bone examination on admission, wall stadiometer, and a chair for measurement of sitting height. Content validity of the forms was confirmed, and its reliability was established by assessor agreement. The reliability of the tape measure was confirmed by a metal stadiometer, and reliability of the wall stadiometer was confirmed by a scaled wooden ruler.

Kruskal-Wallis test was used for comparison of Cormic index, standing and sitting heights, BMI, and leg length. Bonferroni-corrected Mann-Whitney test was run for paired comparison of mode of delivery in terms of Cormic index, standing and sitting heights, and leg length. Spearman's correlation coefficient test was performed to investigate the relationship of Cormic index with duration of the active phase of first stage and duration of second stage of labor, using SPSS version 16. P-value of less than 0.05 in Kruskal-Wallis and Spearman correlation coefficient tests, and p-value less than 0.016 in Bonferroni-corrected Mann-Whitney test was considered significant. A total of 171 patients were enrolled at the beginning of the study, one of whom was excluded due to neonatal weight of more than 4000 g; thus, analysis was conducted on 170 cases.

Results

The mean age of the subjects was 24.85±5.07 years, their mean standing height was 160.85±6.51 cm, the mean sitting height was 83.60±3.88 cm, mean BMI was 22.96±3.54 kg/m^2, the mean leg length was 77.24±6.96 cm, and the mean Cormic index of the subjects was 52.04±2.85. Among the participants, 115 (67.6%) were nulliparous and 55 (32.4%) were second gravid.

Kruskal-Wallis reflected that mode of delivery is significantly associated with Cormic index, sitting and standing heights, as well as leg length (P<0.05). However, BMI was not significantly associated with mode of delivery (P=0.3; Table 1).

The results of Bonferroni-corrected Mann-Whitney test showed a significant difference between vaginal and assisted deliveries in terms

Table 1. Kruskal-Wallis test for comparison of anthropometric indices in terms of mode of delivery

Anthropometry index	Mode of delivery			Test result
	Vaginal delivery (n=138)	Forceps and Vacuum (n=11)	Cesarean section (n=21)	
Cormic index	52.3 (3.6)*	56.3 (3.3)	52.7 (5.9)	X^2=20.95 P<0.001
Standing height	160 (10.4)	153 (5)	163.5 (9)	X^2= 17.67 P<0.001
Sitting height	82 (5)	86 (4)	84 (6.25)	X^2= 6.03 P =0.049
Body mass index	22.2 (6.1)	24.2 (3.8)	23 (4.2)	X^2= 2.4 P =0.3
Leg length	76 (7.6)	67 (6)	77 (13.5)	X^2=25.01 P<0.001

*Data was described by median and interquartile range

cesarean section and assisted delivery (P<0.001, z=3.59), while no significant difference was noted between vaginal delivery and cesarean section regarding Cormic index (P=0.923, z=0.097). There was a significant difference between vaginal and assisted deliveries and between cesarean section and assisted delivery in terms of standing height (P<0.001, z=3.9; P<0.001, z=3.81, respectively); however, no statistically significant difference was found between vaginal delivery and cesarean section in terms of standing height (P=0.204, z=1.27).

Moreover, there was a significant difference between vaginal and assisted deliveries in terms of sitting height (P=0.016, z=2.48), while no statistically significant difference was found between vaginal delivery and cesarean section and between cesarean section and assisted delivery regarding sitting height (P=0.755, z=0.31; P=0.098, z=1.65, respectively).

In addition, a significant difference was observed between vaginal and assisted deliveries and between cesarean section and assisted vaginal delivery in terms of leg length (P<0.001, z=4.92; P<0.001, z=4.13, respectively), while no statistically significant difference was found in terms of leg length between vaginal delivery and cesarean section (P=0.495, z=0.682). Spearman's correlation coefficient test showed that Cormic index was not significantly associated with duration of active phase of the first stage of labor (P=0.46, r=-0.06), but a positive correlation was observed between Cormic index and duration of active phase of the second stage of labor (P=0.02, r=0.19), such that duration of the second stage prolongs with a high Cormic index.

Discussion

This study demonstrated a significant difference between different delivery modes in terms of Cormic index, sitting and standing heights, and leg length, such that Cormic index was higher in assisted delivery compared to vaginal delivery and caesarean section. In addition, sitting height was higher in assisted delivery compared to vaginal delivery and caesarean section, but was not statistically different from cesarean delivery. In other words, women with higher sitting height and Cormic index underwent assisted delivery.

Our study also showed that standing height and leg length were shorter in assisted delivery compared to vaginal delivery and caesarean section, such that women who had shorter standing height and leg length experienced assisted delivery. Furthermore, no significant difference was noted between standing height in vaginal delivery and cesarean section that was similar with the results of Burgess. He showed that mean standing height was not significantly different between women undergoing cesarean section due to CPD and those with vaginal delivery; however, those with cesarean section had shorter legs (24).

Van Bogaert (1999) also reported that the height and lower limbs were shorter in women who had cesarean section due to cephalopelvic disproportion compared to those with vaginal delivery; he reported shorter spine in women undergoing cesarean delivery due to CPD (15). Nevertheless, in our study, assisted delivery was observed more commonly in women with greater sitting heights.

This difference might be due to the fact that Van Bogaert defined trunk length as the length of spine (from vertebra of the neck to the sacral hiatus), while in our study, trunk length was characterized as the distance from top of the head to seating site.

The most common indications for assisted vaginal delivery include excessive fatigue and prolonged second stage of labor (2). In the present study, a positive correlation was noted between Cormic index and duration of the second stage of labor, as women with higher Cormic index experienced an elongated second stage. This result is consistent with those of Ridgeway et al. (2010) and confirms the relationship between Cormic index and pelvic size.

The study of Ridgeway et al., which was performed on 96 disarticulated pelvises, indicated that all anthropometric indices were significantly associated with true conjugate and pelvis inlet and outlet areas, such that correlation coefficients for standing height with true conjugate and pelvic inlet and outlet areas were 0.5, 0.56, and 0.38, respectively, and for sitting height with true conjugate and pelvic inlet and outlet areas were 0.49, 0.5, and 0.28, respectively. In that study, this relationship was positive, in other words, hip size was bigger with higher trunk lengths (14). Nevertheless in the current study, the second stage of labor was prolonged incases with longer trunk lengths. Fetal descent mainly occurs after complete cervical dilation. Moreover, most of the major movements occur during the second stage of labor, which are necessary for the baby to pass through the birth canal.

Accordingly, cephalopelvic disproportion appears in many cases during the second stage (2). On the other hand, Ukwuma reported that factors such as age, genetics, environment, and lifestyle (health, nutrition, etc.) are the reasons for variation of mean Cormic index across populations (22). Since the study of Ridgeway et al. was performed on African-Americans and European-Americans, the discrepancy between their study and ours can be attributed to the factors mentioned by Ukwuma. Sebhatu revealed that height and sitting height have low sensitivity (35%) in predicting the delivery outcomes (23). The findings of that study were not consistent with ours that can be due to the cut-off point for sitting height in the study by Sebhatu (23).

In the current study, no link was observed between BMI and mode of delivery, while Berenzen exhibited that BMI was higher in women who underwent caesarean section (11). It seems that the reason for this dissimilarity between the mentioned study and the current one is that the subjects with BMI>30 kg/m^2 and abnormal weight gain during pregnancy were excluded from our study.

The limitations of this study include not controlling for environmental conditions such as lighting, presence of strangers, unfamiliar sounds, and places that are important factors in the labor progress. Nonetheless, it was tried to relatively control them by sampling in one center (Omolbanin Hospital) during daytime (morning and afternoon). Future studies are recommended to evaluate the sensitivity of Cormic index in predicting mode of delivery.

Conclusion

There is a relationship between Cormic index and mode of delivery, that is, higher Cormic index (long trunk and short legs) was associated with prolonged second stage of labor, leading to increased rate of assisted delivery compared to vaginal delivery and cesarean section. Since there is no accurate and specific method for predicting delivery outcomes, evaluation of Cormic index can be beneficial due to its simplicity and availability.

Acknowledgements

This study was extracted from a thesis approved by Mashhad University of Medical Sciences on January 13th 2013 (code No. 922743). We wish to thank the Deputy of Research of their financial support and the midwifery staff in Emergency and Maternity Departments of Omolbanin Hospital and Ms. Saeedeh Sadat Sajadi for their cooperation.

Conflicts of Interest

The authors declare no conflicts of interest.

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