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Chapter

Safe Childbirth and Motherhood in African Great Lakes Region: External Pelvimetry in Nulliparae and Scheduled Caesarean Section

Jean-Baptiste Kakoma, Xavier Kinenkinda, Fanny Malonga, Joseph Nsambi, Micrette Ngalula, Jeanne Ngoy and Jean Kalibushi

Abstract

The authors have carried out a literature review of targeted relevant research with a focus on two countries of the African Great Lakes Region, i.e. Rwanda and the Democratic Republic of the Congo (DRC). The aim was to find a common thread between nulliparity and timely caesarean section through external clinical pelvimetry. Higher rates of nulliparity and caesarean section were found with poor outcome in terms of foeto-maternal prognosis. External clinical pelvimetry presented in Rwandan and Congolese nulliparae the same characteristics during pregnancy and at delivery: lower average values in comparison with multiparae who never experienced caesarean section; average values significantly lower in women who underwent caesarean than in those who delivered naturally; and a gradual and significant decrease in caesarean section rate as pelvic sizes increased. Cephalopelvic disproportion, the main cause of mechanical dystocia, was associated with significantly lower pelvic average values. On the basis of an appropriate tool to predict cephalopelvic disproportion and taking as an illustration of complication the case of obstetrical fistulas, the authors finally advocate the use of the pelvimeter to screen in time pelvises at higher risk for cephalopelvic disproportion in resource-constrained environment.

Keywords: childbirth, nulliparae, external pelvimetry, caesarean, African Great Lakes Region

1. Introduction

Childbirth is a challenging process that can end in complications that could lead to death, especially when major risk factors are not recognised or dealt with at the right time. It is estimated that about 830 women die every day in the world as a result of complications related to pregnancy or childbirth, and the total number of deceased women in 2015 was estimated at 303,000, although the global maternal mortality ratio decreased by 2.3% per year between 1990 and 2015 [1, 2]. The situation is even worse when it comes to pregnant women in developing countries

where deliveries are not most of times attended by skilled health professionals with obvious poor-rich inequalities [3]. Cross-sectional surveys in 80 low and middle-income countries have shown inequalities in the coverage of place of delivery and skilled birth attendance (SBA): SBA deliveries at home and facility non-SBA deliveries were more common in rural than in urban areas and among the poorest in all concerned regions including Sub-Saharan Africa [4]. Another multi-country study showed that only 17.7% of the poorest women versus 54.1% of the richest women used public facilities in Sub-Saharan Africa; and among home births in the poorest, 56% were unattended whereas 41% were attended by a traditional birth attendant [5]. Similar findings have also been reported by other studies [6–9], and in remote areas of limited-resources environment, home-birth practices alone or with the assistance of traditional matrons are the rule [10]. These practices are transmitted from generation to generation in the villages of some developing countries. Globally, about 60 million women give birth every year outside health facilities, primarily at home, and 52 million are not attended by qualified health professionals [11]. The lack of universal skilled attendance leading to lowest emergency obstetric care is explained by a number of reasons, namely the health system deficiency, financial and geographical barriers, mother's educational level, husband's occupation, wrong perception of the household decision maker, hostile behaviour of health personnel, traditional beliefs, and age at first pregnancy [5–8, 12, 13]. Among all pregnant women, nulliparae are at higher risk in abovementioned conditions as unplanned caesarean deliveries leading to adverse foeto-maternal outcomes are not an exception in a poor environment [14, 15]. Therefore, most of caesarean sections are emergency ones, as attending matrons always attempt at all costs to deliver vaginally babies regardless of the situation according to certain ethnocultural beliefs. This perception persists even among immigrant women in developed countries [16]. Consequently, in case of cephalopelvic disproportion, unsuccessful attempts to give birth vaginally result in neglected prolonged labour resulting in an emergency caesarian section in appalling conditions, particularly in the presence of transport and financial barriers as is the most common case. This also happens in health centres of urban areas when the health system is completely disorganised. Thus, foeto-maternal morbidity and mortality become higher to the point of making hospitals statistics alarming. In one hand, newborn death, uterine rupture and obstetric fistula are among complications with the saddest impact on a surviving primiparous woman and her family with regard to the pronatalist African culture. In the other hand, cephalopelvic disproportion due to generally contracted pelvis or large foetal head circumference is one of caesarean section indications in nulliparae and pregnant women aged less than 19 [17–20]; and this should also be the case in settings characterised by early marriages and lack of appropriate pregnancy monitoring. Besides, it is also known that external pelvimetry is nowadays controversial and no longer in favour with many obstetricians [21, 22], now that new, more powerful diagnostic tools, e.g. CT pelvimetry using multi detector CT and magnetic resonance-based serial pelvimetry [23, 24], are available and which will take time to reach pregnant women in resource-limited areas. Meanwhile, results from some surveys in Sub-Saharan Africa and elsewhere have shown a significant relationship between some external pelvic diameters and cephalopelvic disproportion or dystocia indication for caesarean section in nulliparae [25–28]. Our aim is in fine to advocate, on the basis of our findings in the African Great Lakes Region, the reintroduction of pelvimeter as a cheap and helpful tool in hands of well-trained health professionals, in order to promote scheduled caesarean sections, and therefore to prevent harmful outcomes such as newborn death, uterine rupture and obstetric fistula in young mothers leaving in resource-limited environment.

2. Context

Apart from background data, findings from surveys and studies concerned in next sections have been collected in two countries of the African Great Lakes Region at the heart of Africa; namely, Rwanda and the Democratic Republic of the Congo. Rwanda is a tiny and landlocked country, which is the more densely populated ($519/\text{km}^2$) in Sub-Saharan Africa. Its infrastructure and qualified manpower was greatly impacted by the 1994 genocide in general and specifically in the health sector [29]. About 90% of population is presently covered by the national mutual health insurance, while the country was steadily moving towards reaching some MDG by 2015 deadline [30]. Surely, financial dependence on external assistance is still high, and the shortage of human resources for health still challenging. However, Rwanda is one of the rare African countries that have allocated an appreciated part of their national budget to health, and since more than a decade, efforts and innovative solutions are ongoing to train, deploy and retain health professionals, should education programmes and retention strategies be regularly and appropriately readjusted, as far as human resources remain a tremendous challenge in the public sector [31]. On the whole, Rwanda is rather doing well economically and in the social sectors. The Democratic Republic of the Congo (DRC), as far as it is concerned, is one of the “Big Five” countries in Africa with a surface area estimated at $2,345,000 \text{ km}^2$ and a population of more than 80 million. DRC was all destined to be one of the best performing countries on the continent given its diversified natural resources, the proportion of actual qualified manpower and its basic infrastructure of departure at the time of its independence (30th June 1960). Apart from few ephemeral peaks of light development, this country, undermined by endless rebellions and the neglect of its political class, ended up being one of the failed countries of the world [32]. Its health system is a total mess: no evident leadership and vision, and very far from a minimum of transparency and accountability. As a result, we are witnessing a resurgence of old epidemics, the activation of old endemics, the spread of sexual violence and the worsening of the Ebola virus infection. We are not far from a “not assistance to a people in danger” situation!

3. Childbirth, motherhood and nulliparity

3.1 Background

There are many risk factors that can compromise childbirth and motherhood as far as emergency caesarean section is concerned in limited resources settings. Among these is parity, namely nulliparity and multiparity [33, 34]. Concerning nulliparity in general, it is worldwide known that nulliparous women are at higher risk of pregnancy, delivery and neonatal complications. They are prone to anaemia, pre-eclampsia, anal sphincter injury, operative vaginal delivery, postcaesarean surgical site infection, dystocia, caesarean delivery, inadequate uterine contractions, foetal malposition, cephalopelvic disproportion, premature labour, low birth weight, funisitis, neonatal morbidity, perinatal mortality, induction of labour, routine episiotomy, hypertensive complications, and postpartum haemorrhage [33–42]. The situation is similar for teenagers who are pregnant [43]. All these cases become very worrying when it comes to pregnant women living in remote areas of conflict or postconflict regions, and even in urban areas in absence of qualified health professionals, suitable motivation and appropriate equipment. Rwanda is a postconflict region while DRC is still a conflict region, especially the eastern part of

the country. The situation is most crucial in DRC when Rwanda is doing well as far as Universal Health Coverage and MDG achievement are concerned [44, 45].

3.2 Findings in Rwanda and DRC

A recent health facility-based cross-sectional study has been carried out in Rwanda (Kigali and Northern Province) from 2014 to 2015 through structured interviews and medical records ($n = 817$). This study has shown a higher rate of nulliparity (41.1%) as assessed through self-reported data from postpartum women [46]. This should not be shocking, as there are many young marriages in Rwanda after the 1994 genocide for reasons that are understandable. However, this high rate of nulliparity is also accompanied by high levels of risk associated with first pregnancy and childbirth. A previous cross-sectional case-control study ($n = 600$) at Muhima District Hospital in Kigali has shown in 2009 that nulliparous women were at higher risk than multiparae with regard to many obstetrical and neonatal outcomes. Nulliparous women were significantly prone to: lower weight ($p = 0.016$); malaria crisis ($p = 0.031$); induction of labour ($p = 0.008$); caesarean delivery ($p < 0.001$); episiotomy ($p < 0.001$); failure of descent ($p = 0.037$); transfer to neonatal care (0.025), and lower average birth weight ($p < 0.001$) [41].

In DRC, a recent cross-sectional and analytical study of singleton births in postpartum women ($n = 4197$) reported, from December 2013 to May 2014, a nulliparity rate of 19.9% in 10 referral maternity hospitals in Lubumbashi, Upper Katanga Province. Primiparous women (i.e. nulliparous before delivery) as compared with multiparae were during pregnancy at higher risk for: high blood pressure (OR = 1.91 [1.32–2.74]); malpresentation (OR = 1.95 [1.16–3.17]); oxytocin use (OR = 2.03 [1.64–2.52]); caesarean section (OR = 2.04 [1.47–2.83]); episiotomy (OR = 11.89 [8.61–16.43]); eclampsia (OR = 4.21 [1.55–11.44]); lower rate of 5th minute APGAR score (OR = 1.55 [1.03–2.32]); and higher rate of early neonatal mortality (OR = 1.80 [1.08–2.98]) [47].

4. Caesarean section delivery

4.1 Background

It has been suggested by the World Health Organisation (WHO) that caesarean section rate should range between 5 and 15% in order to benefit to mother, foetus and newborn [48, 49]. Therefore, a rate above 15% is assimilated to unjustified use of surgical delivery, while a rate below 5% reveals a population's lack of access to medical technology [31]; besides, evidence based results show that there is no correlation, at population level, between caesarean rates higher than 10% and reduction of maternal and newborn mortality [50]. Nowadays, more and more claims around the world stigmatise the shocking rising trends of caesarean section, especially in private sectors as 'on demand caesarean section' or 'caesarean section on maternal request' has become a routine indication in medical practice [51, 52]. Given maternal and perinatal complications associated with caesarean section, efforts are recommended to provide surgical delivery to only women in real need, assuming that the medical environment is appropriate [50]. Thus, there is a need to be more cautious as regards caesarean section indications and quantity regulation in order to reduce health costs as well as maternal and foetal risks [50, 51]. In this regard, the prevailing situation in the countries of African Great Lakes region is generally frightening, particularly in DRC given the conflict or postconflict environment.

4.2 Findings in Rwanda and DRC

For more than a decade, different scientific reports in Rwanda have revealed higher rates of caesarean compared to the upper limit (15%) for caesarean section set by WHO. In 2006 and 2007, two descriptive cross-sectional studies found caesarean section rates of 41% and 33.7% in a urban national reference hospital (Kigali city) and a rural district hospital (Northern Province), respectively [53, 54]. Two other cross-sectional studies (descriptive and case-control) conducted in 2008 and 2009 have also shown higher rates of caesarean, i.e. 21.05% and 28% (versus 10.7% in multiparae), in nulliparous women from a rural area (Huye/Southern Province; n = 152) and Kigali city (n = 600), respectively [41, 55]. In DRC, a retrospective study was carried out in Lubumbashi on 34,199 deliveries from five referral hospitals for a period of five years (2009 to 2013). This study noticed an overall caesarean section rate of 10.65% with a slight increase from 2009 (10.24%) to 2013 (11.38%). Almost one caesarean section out of two (48.6%) occurred in an emergency context and the majority (51.4%) of caesareans after unsuccessful attempt to give birth naturally. Unfortunately, the 11% increase in caesareans did not bring any benefit in terms of foeto-maternal prognosis as there was no significant change in perinatal mortality rate whereas overall maternal mortality rate jumped from 2.3‰ in 2009 to 6.4‰ in 2013, which was a highly significant 317.5% increase (p = 0.005) [56]. Five months later (December 2013–May 2014), an abovementioned analytical cross-sectional study on primiparae (nulliparae before delivery) reported in the same environment a caesarean rate of 13.03% (versus 6.84% in multiparae) in postpartum primiparous women with a poor neonatal outcome [47].

5. External pelvimetry and ways of delivery in nulliparae and multiparae

5.1 Background

Since more than two centuries, women pelvic architecture and pelvic girdle measurements have been a matter of scientific concern for obstetricians. Women pelvis and pelvimetry have been deeply studied in the eighteenth and the nineteenth century by a number of eminent scientists among whom Hendrik Van Deventer, Jean Louis Baudelocque, Gustav Adolf Michaelis, Franz Karl Joseph Naegele, Stein Jr., and Carl Conrad Theodor Litzman [57]. Different types of pelvimeters became common tools in maternity wards and delivery rooms. In the past, young trainees in medicine, assistants in obstetrics and midwives constantly and regularly used these pelvimeters, which were familiar to them. Gradually, this instrument disappeared from hospital maternities to end up only in a few health centres held by old nuns. This was the case in Rwanda and DRC. Moreover, the effectiveness of pelvimeter has for some time become questionable for most obstetricians under the pressure of advances in technology during the ending twentieth century and given the alleged lack of satisfactory scientific evidence [21, 22]. However, we are still living in a world where health care equity and access to quality health care remain to date an unattainable dream worldwide and even when it comes to different social classes within some industrialised countries. Therefore, it is the duty of scientists and men in the field to look for simple ways and inexpensive tools to help the many left behind, especially young pregnant women in resource-constrained countries in an environment dominated by all kinds of barriers. It is in this context that a number of studies have been conducted on the relationship between anthropometric parameters including height, weight as well as external pelvic diameters and ways of delivery in some parts of the world, and more particularly in Sub-Saharan Africa, Central Africa and African Great Lakes region [25–28]. Reported findings below are

products of researches conducted in Rwanda (Southern Province and Kigali city) and DRC (Lubumbashi, Upper Katanga Province).

5.2 Findings in Rwanda and DRC

Results from Rwanda and DRC were obtained from research projects carried out either within the framework of an institutional cooperation (Southern Province of Rwanda) or as requirements for academic degrees of master's or PhD in medicine (Kigali/Rwanda and Lubumbashi/DRC) under the scrutiny of a same supervisor in 2007, 2010 and 2017. Data were collected at antenatal care clinics and at admission to delivery rooms in nulliparae and multiparae. Statistics central values and spread were identified for different external pelvic diameters and two other anthropometric parameters (height and weight). Concerned pelvic parameters were: intercrestal or biiliac diameter, interspinous diameter, intertrochanteric diameter, anteroposterior (Baudelocque's) diameter or external conjugate, intertuberous or bi-ischiatic diameter, and the base of Trillat's triangle or prepubic diameter. Only multiparae with no previous caesarean experience and nulliparae without pelvic malformations were selected so that measurements in multiparae were considered as base normal sizes while those in nulliparae could be considered as a mixture of normal and abnormal pelvic sizes as long as they had not yet faced the process of childbirth in the same environment (rural and urban areas in Rwanda, and urban area in DRC). Later on, delivery ways were observed in only nulliparous women with a single foetus in vertex presentation.

5.2.1 Pelvic measurements in multiparae and nulliparae in the Southern Province of Rwanda

Huye District in the Southern Province of Rwanda served as the framework of a cross-sectional and analytical study in nulliparae ($n = 312$) and multiparae ($n = 314$) at prenatal care settings on randomly fixed days from December 2007 to January 2008. Pelvic measurements were taken and average pelvic sizes in multiparae who have always delivered per vaginam were compared to those in nulliparae (Student's t test). The aim of the study was to describe and characterise external pelvic parameters in Rwandan pregnant women in a rural area. Average sizes were significantly greater in multiparae than in nulliparae except for the intertrochanter diameter and the base of the Trillat's triangle (**Table 1**). These preliminary findings suggested the fact that external pelvic diameters of multiparous women without previous caesarean experience would belong to pelvises best suited for delivery. It is worth noting that measurements in both multiparae and nulliparae were normally distributed (Kolmogorov-Smirnov test) [58].

Diameters (cm)	Multiparae ($N = 314$) Mean \pm SD	Nulliparae ($N = 312$) Mean \pm SD	p^*
Intercrestal (biiliac)	23.92 \pm 1.56	23.38 \pm 1.60	0.001
Interspinous	22.20 \pm 1.60	21.74 \pm 1.58	0.001
Intertrochanteric	27.32 \pm 1.98	27.04 \pm 2.12	0.087
Intertuberous	9.67 \pm 0.68	9.22 \pm 0.76	0.001
Anteroposterior	17.92 \pm 1.61	17.48 \pm 1.50	0.001
Base of Trillat's triangle	13.43 \pm 0.84	13.78 \pm 1.00	0.001

*Student's t test.

Table 1.
Comparison of pelvic diameters between Rwandan multiparae and nulliparae in the Southern Province.

5.2.2 Pelvic measurements in multiparae and nulliparae in Kigali City/Rwanda

A cross-sectional and analytical study was also carried out in Kigali City (Kigali University Teaching Hospital and Muhima District Hospital) from May 2009 to June 2010 in nulliparae ($n = 318$) and multiparae ($n = 303$) at admission in delivery rooms. One of the specific objectives of the study was also to describe and characterise pelvic and anthropometric parameters in Rwandan pregnant women in an urban area. Student's *t* test was used to compare average values observed in multiparae and nulliparae. Average sizes in multiparae who never experienced caesarean section were also significantly greater than in nulliparae for all considered pelvic diameters (**Table 2**). The same abovementioned implication about pelvis suitability in multiparae was suggested while average pelvic sizes in both multiparae and nulliparae were smaller in rural women from the rural area (Southern Province) than in their urban counterparts (Kigali City). Nutritional status was suggested as the factor that would explain this difference [59].

Diameters (cm)	Multiparae (N = 318) Mean ± SD	Nulliparae (N = 303) Mean ± SD	<i>p</i> *
Intercrestal	26.58 ± 0.01	24.33 ± 0.16	0.327
Interspinous	24.04 ± 0.09	23.73 ± 0.17	0.014
Intertrochanteric	29.09 ± 0.13	28.88 ± 0.20	<0.001
Intertuberous	12.90 ± 0.10	12.25 ± 0.13	<0.001
Anteroposterior	18.62 ± 0.18	18.14 ± 0.12	<0.001
Base of Trillat's triangle	15.27 ± 0.10	14.39 ± 0.13	<0.001

*Student's *t* test.

Table 2.
 Comparison of pelvic diameters between Rwandan multiparae and nulliparae in Kigali city.

5.2.3 Pelvic measurements in multiparae and nulliparae in DRC

A descriptive cross-sectional study as part of a large research project in the city of Lubumbashi was carried out from February 2016 to August 2017 in nulliparae ($n = 535$) and multiparae ($n = 938$) on pelvic and anthropometric parameters. Data were collected at antenatal clinics and admission to delivery rooms in seven maternities. The aim of the study was among others to profile external pelvic sizes in nulliparae and multiparae who used to give birth naturally. At first glance, external pelvic diameters sizes showed also a greater or lesser difference between Congolese multiparae and nulliparae in Lubumbashi (**Table 3**). The same deduction made about pelvis suitability for Rwandan women could also be applied to Congolese women [60].

Pelvic measurements (cm)	Multiparae (N = 938) Mean ± SD	Nulliparae (N = 535) Mean ± SD
Intercrestal	26.02 ± 2.17	24.69 ± 2.28
Interspinous	22.94 ± 2.37	21.79 ± 3.78
Intertrochanteric	29.81 ± 2.72	29.26 ± 2.98
Intertuberous	10.22 ± 0.94	9.77 ± 1.51
Anteroposterior	20.22 ± 1.32	19.94 ± 1.92
Base of Trillat's triangle	13.04 ± 1.31	13.00 ± 1.82

Table 3.
 Pelvic measurements in multiparae and nulliparae in DRC.

5.2.4 External pelvic diameters in nulliparae and caesarean section in Rwanda

A prospective, longitudinal and descriptive study was conducted in 152 Rwandan parturients out of the 312 nulliparae who participated in a previous study on external clinical pelvimetry at antenatal care settings in Huye District/Southern Province of the country [58]. From December 2007 to April 2008, the investigators went over all the health centres and hospitals in the Huye District to look for deliveries of nulliparae involved in the abovementioned survey. Apart from pelvic and anthropometric measurements (already taken at antenatal care settings), the only considered medical parameters were the mode of delivery, the vertex presentation of the foetus, and singleton live birth. Deliveries and caesarean sections were blindly performed by midwives, general practitioners and specialists who did not take part in the survey. Yates' chi-square test was used to compare observed proportions. Results showed that caesarean section rates were more or less higher for values below the predefined thresholds for pelvic diameter sizes, i.e. average minus one standard deviation (**Table 4**). The difference was only significant for the base of the Trillat's triangle and the intertuberous diameter [61].

Diameters (cm)	Way of delivery		<i>p</i> *	
		Per vaginam (N = 120)		Caesarean (N = 32)
Intercrestal	<22	11 (68.7%)	5 (31.3%)	0.290
	≥22	100 (80.1%)	27 (19.9%)	
Interspinous	<20	7 (77.8%)	2 (22.2%)	0.929
	≥20	113 (79%)	30 (21%)	
Intertrochanteric	<28	23 (71.9%)	9 (28.1%)	0.269
	≥28	97 (80.8%)	23 (19.2%)	
Intertuberous	<8	4 (44.4%)	5 (55.6%)	0.009
	≥ 8	116 (81.1%)	27 (18.9%)	
Anteroposterior	<17	23 (71.9%)	9 (28.1%)	0.260
	≥17	97 (80.83%)	23 (19.17%)	
Base of Trillat's triangle	<11	0 (0.00%)	4 (100%)	0.001
	≥11	120 (81.1%)	28 (18.9%)	

* χ^2 test with Yates' correction.

Table 4.
Pelvic diameters and caesarean section in Rwandan nulliparae.

5.2.5 External pelvic diameters in nulliparae and caesarean section in DRC

A descriptive cross-sectional study was conducted in Lubumbashi from February 2016 to August 2017 in 400 nulliparae in order to compare ways of delivery associated with different sizes of two external pelvic diameters, namely the intertuberous diameter and the base of the Trillat's triangle. Pelvic measurements were already taken at antenatal care settings and the following parameters were collected after delivery: the mode of delivery, the vertex presentation of the foetus, and singleton live birth. Deliveries and caesarean sections were blindly performed by midwives, general practitioners and specialists who did not take part in the survey. Yates' chi-square and Student's *t* test were used to compare observed proportions and average values, respectively. Lowest dimensions of the base of the Trillat's triangle or prepubic diameter (i.e. <11 cm) and of the intertuberous diameter (i.e. <8 cm) were associated with higher caesarean section rates (i.e. 69.23 and 91.67% respectively) while highest dimensions (i.e. ≥16 and ≥12 cm respectively) were associated with lower caesarean section rates (8.33 and 5% respectively) in nulliparae, and

the difference was highly significant. On the whole, there was a gradual decrease in caesarean section rates as the size of the base of Trillat's triangle and of the intertuberos diameter increased (Tables 5 and 6). Related average diameter sizes were also significantly lower in women who delivered by caesarean section, i.e. 11.99 ± 1.37 cm versus 12.82 ± 1.39 cm for the prepubic diameter, and 9.10 ± 1.23 cm versus 10.27 ± 1.10 cm for the intertuberos diameter ($p < 0.001$) [62].

At the same time and under the same conditions, 453 nulliparae were involved in a concomitant descriptive cross-sectional study about other external pelvic diameters. The same relationship was reproduced with regard to average sizes of pelvic diameters, which were significantly lower in women who have undergone caesarean than in those who gave birth naturally (Table 7) [63].

Trillat's triangle base (cm)	Caesarean		Vaginal delivery		Total		<i>p</i> *
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
<11	18	69.23	8	30.77	26	100	<0.001
11–11.9	28	38.89	44	61.11	72	100	
12–12.9	26	24.30	81	75.70	107	100	
13–13.9	19	19.39	79	80.61	98	100	
14–14.9	10	17.54	47	82.46	57	100	
15–15.9	3	10.71	25	89.29	28	100	
≥16	1	8.33	11	91.67	12	100	

* χ^2 test with Yates' correction.

Table 5.
 Trillat's triangle base and obstetrical outcome in nulliparae in DRC.

Intertuberos diameter (cm)	Caesarean		Vaginal delivery		Total		<i>p</i> *
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
<7.9	11	91.67	1	8.33	12	100	<0.001
8–8.9	23	69.70	10	30.30	33	100	
9–9.9	30	29.70	71	70.30	101	100	
10–10.9	31	24.60	95	75.40	126	100	
11–11.9	8	9.09	80	90.91	88	100	
≥12	2	5.00	38	95.00	40	100	

* χ^2 test with Yates' correction.

Table 6.
 Intertuberos diameter and obstetrical outcome in nulliparae in DRC.

Pelvic diameters (cm)	Caesarean Mean \pm SD (Median)	Vaginal delivery Mean \pm SD (Median)	<i>p</i> *
Biiliac	25.46 \pm 2.10 (25 cm)	24.14 \pm 1.92 (24 cm)	<0.001
Antero-superior iliac interspinous	21.80 \pm 2 (22 cm)	23.03 \pm 2.31 (23 cm)	<0.001
Intertrochanter	27.68 \pm 2.24 (28 cm)	29.44 \pm 2.82 (29 cm)	<0.001
Baudelocque	18.34 \pm 1.77 (18 cm)	20.78 \pm 1.88 (20 cm)	<0.001
Conjugata vera pelvis [#]	9.35 \pm 1.76 (9 cm)	11.79 \pm 1.92 (11 cm)	<0.001

[#]Baudelocque's diameter minus 9 cm.

*Wilcoxon signed-rank test.

Table 7.
 Pelvic diameters and obstetrical outcome in nulliparae in DRC.

5.2.6 Caesarean section indications and external pelvic diameters in Rwanda

A cross-sectional and analytical study was made on data collected from 32 operated parturients among 152 nulliparae who gave birth with singleton pregnancy at term and vertex presentation within the three first months of the abovementioned prospective longitudinal survey in the Southern Province of Rwanda [61]. Anthropometric measurements (external pelvic diameters in cm) were collected at first antenatal care consultation. At childbirth, midwives and physicians monitored labour in a blind way and the following data were collected after delivery by the investigators: way of delivery (per vaginam or caesarean section), and caesarean section indication. Student's *t* test was used to compare mean values from a normally distributed population (Kolmogorov-Smirnov test). This study showed a relationship between external pelvic sizes and caesarean section indications related to obstructed labour due to pelvic dystocia. Clinically diagnosed pelvis contraction was characterised by smaller average measurements in comparison with other caesarean section indications. Apart from biiliac (intercrestal) diameter, observed differences were statistically significant for all other external pelvic diameters, i.e. antero-superior iliac interspinous, intertrochanter, Baudelocque's, and intertuberous (**Table 8**) [55].

Diameters (cm)	Contracted pelvis (N = 9)	Other indications (N = 23)	Mean difference	<i>p</i> *
Biiliac	22.83 ± 2.59	23.45 ± 1.34	0.62	0.375
Antero-superior Iliac interspinous	20.87 ± 1.59	21.94 ± 1.15	1.07	0.043
Intertrochanter	25.70 ± 2.56	27.72 ± 2.26	2.02	0.036
Baudelocque	16.20 ± 1.17	18.50 ± 1.31	2.30	0.001
Intertuberous	7.76 ± 0.43	9.26 ± 0.68	1.50	0.001
Trillat's base	12.17 ± 2.26	13.98 ± 0.93	1.81	0.003

*Student's *t* test.

Table 8.

External pelvimetry and caesarean section indication in Rwandan nulliparae.

5.2.7 Pelvic dystocia and external pelvic diameters in DRC

A cross-sectional descriptive study with an analytical component in nulliparae (*n* = 535) was conducted in seven referral hospitals in the city of Lubumbashi from February 2016 to August 2017 in order to describe the morphological characteristics (anthropometric and pelvimetric externally) and to identify their thresholds for the specification of appropriate determinants and the development of a predictive score for the type of delivery (vaginal versus caesarean) in pregnant women. Only 535 nulliparae who gave birth with singleton pregnancy at term and vertex presentation were involved in this study; and only caesarean sections indicated for mechanical dystocia were considered. A predictive score (TABIT score: TA for "taille", i.e. height; BI for "bi-ischiatique", i.e. intertuberous; and T for "Trillat", i.e. prepubic diameter) was defined after logistic modelling to predict the occurrence of mechanical dystocia. Three criteria emerged as predictors (determinants) of mechanical dystocia: maternal height < 150 cm (OR adjusted = 2.96 [1.49–5.87]), bi-ischiatic or intertuberous diameter < 8 cm (OR adjusted = 15.96 [3.46–73.56]) and Trillat's triangle base or prepubic diameter < 11 cm (OR adjusted = 2.34 [1.36–4.01]). The total number of points attributed to the three determinants was 5 (<2 = low risk,

2–3 = moderate risk, and >3 = high risk). This scoring system had a sensitivity of 23.81%, a specificity of 97.80%, a predictive value of a positive test of 76.92%, and that of a negative test of 80.65%. The area under the ROC curve was 0.6549, within the range of acceptable values [64]. Although this tool can already be operational in conjunction with clinical data, efforts will be made to improve this scoring system by including one additional parameter to increase sensitivity, and uterine height as a proxy for foetal parameters is the most targeted obstetrical variable. In so doing, we could have a simple and cheap tool, usable by any health professional at antenatal clinics and after parturients admission to delivery room.

6. Home-birth practice and vaginal childbirth at all costs

6.1 Background

Home-birth practice usually happens in remote rural areas where qualified health professionals are rare, even absent or unknown; this is the case in most conflict areas of DRC and particularly in Upper Katanga province for several years past. In these conditions, the matrons are at work without any restraint. The tacit rule is to give birth whatever the cost by natural way. In a context of financial and geographical barriers, and facing the lack of qualified health staff coupled with the lack of adequate infrastructure and equipment, one has no choice but to wait for a possible favourable evolution of childbirth under the supervision of the matrons or any other person in charge of the parturients in the community who often do not hesitate to resort to the traditional medication. All this may result in obstructed labour or dystocia, which often occurs when the foetal head is stuck in the mother's pelvis, interrupting blood flow to the surrounding tissues. This results afterwards in prolonged ischemia which may progress to tissue necrosis, the fall of which leads to fistulas formation. Most of the time, cephalopelvic disproportion, which is one of the most frequent indications of caesarean section in nulliparae in our environment [41, 55, 56], is the primum movens of this process. Obstetric fistulas (urogenital) have debilitating consequences such as urinary incontinence, faecal incontinence or both, and damage to the vulva and thighs. They bring about well-known social ostracism and dehumanising stigmatisation with a urge impact on social, psychological, and sexual life of patients, more particularly in a context of extreme socioeconomic precariousness. In developed countries the incidence of vesicovaginal fistula is 0.3–2%, while it is not known in developing countries because of the underreporting of cases; and if it can be annually estimated, only a certain portion can benefit from treatment [65–67].

6.2 Findings in DRC

A descriptive cross-sectional study was carried out from September 2009 to December 2013 in Upper Katanga Province (DRC) after five mass treatment campaigns in six health districts (Pweto, Kilwa, Mitwaba, Kasenga, Kashobwe and Lubumbashi). This study that involved 242 patients depicted a gloomy situation about sociodemographic and obstetrical characteristics of these patients at the time of fistula: 40.1% aged <20, 90.6% of nulliparae, 94.6% of vaginal delivery; 85.9% of ≥48 hours labour duration, 70.7% of home-birth practice, 93.4% of neonatal mortality, and 71.5% of patients living alone. Clinical parameters related to fistula were as follows: a history of fistula of 5 years and more (33.5%), vesico-vaginal fistula (96%) and failure of fistula repair (14%) [68]. This situation is only the tip of an iceberg as not all women concerned could be reached by the awareness campaigns.

Therefore, it is obvious that obstetric fistula is a real public health problem in the DRC, and particularly in nulliparae. Concerning prolonged labour and caesarean section performed under inappropriate conditions, other equally serious complications are uterine rupture, which compromises the reproductive capacity, as well as the high maternal and perinatal morbidity and mortality. And yet all this would be avoidable if we could act upstream by predicting the outcome of the pregnancy (i.e. the way of delivery) with a high probability so that the maternal and perinatal prognosis could be considerably improved.

7. Conclusion

Results from studies on childbirth and motherhood in two countries of the African Great Lakes Region, namely Rwanda and the Democratic Republic of the Congo, highlighted high rates of nulliparity, which have had a deleterious effect on obstetrical and perinatal outcomes. Higher rates of caesarean section have been observed, especially in nulliparous women. One of the most frequent indications of caesarean section was cephalopelvic disproportion that leads to prolonged and obstructed labour in a context of lack of qualified health professionals. As most of the time, cephalopelvic disproportion results from pelvis inadequacy to allow the foetus to negotiate the birth canal, pelvic diameters represent the essential parameters to be taken into account in predicting the route of delivery and preventing serious maternal and perinatal complications following caesarean sections in poor conditions. In Rwanda as well as in DRC a significant relationship has been found between accessible external pelvic diameters and obstetrical outcomes (natural delivery and caesarean section), while cephalopelvic disproportion was the main caesarean section indication. This relies heavily on the question of the usefulness of pelvic evaluation in nulliparae during pregnancy in countries with limited resources, especially in remote areas. It is therefore a noble human duty to seek appropriate, efficient and evidence-based solutions and tools to help improve the health of the mother-child couple, which is part of all global goals. In this context, the early detection of nulliparae at higher risk of cephalopelvic disproportion, as soon as they are pregnant, would protect them and their infants by avoiding unscheduled caesarean sections and complications that could have life-long consequences or could endanger life. We believe that pelvimeter, this simple affordable tool, could be, in expert hands, one of those needed tools in resource-limited settings. Pregnant youngsters could thus benefit from the advantageous effects of a timely caesarean section and enjoy a safe motherhood, and besides, childbirth would not at all be a very dangerous event for both mother and child.

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