

# **Waterbirths: a comparative study**

## **A prospective study on more than 2000 waterbirths**

Dr. med. Verena **Geissbuehler**, MD, Head of the clinic for obstetrics and gynecology of the cantonal hospital (Thurgauisches Kantonsspital), 8501 Frauenfeld/Switzerland.

PD Dr. med. Jakob **Eberhard**, MD, Director of the clinic for obstetrics and gynecology of the cantonal hospital (Thurgauisches Kantonsspital), 8501 Frauenfeld/Switzerland, and "Privatdozent" at the University of Zurich Switzerland.

Requests for reprints **and** correspondence:

Dr. med. Verena **Geissbuehler**

Leitende Aerztin Frauenklinik

Thurgauisches Kantonsspital

CH-8501 Frauenfeld/Switzerland

Tel: 0041-52-723 72 53 (office hours)

Fax: 0041-52-723 73 64

e-mail: [vgeissbuehler@bluewin.ch](mailto:vgeissbuehler@bluewin.ch)

## **Summary**

### **Background**

Waterbirths were introduced in 1991 as part of a new birth concept which consisted of careful monitoring and birth management, restrictive use of invasive methods and free choice of different birth methods.

### **Methods**

After the introduction of this new birth concept a prospective observational study was initiated. All parturients of the region give birth in our clinic without preselection, ours being the only birth clinic of the region. 2% of the parturients will be referred to a larger birth clinic (university clinic) mainly because of preterm births before the end of the 33<sup>rd</sup> week of pregnancy. Every one of the 7508 births between November 1<sup>st</sup>, 1991 and May 21<sup>st</sup>, 1997 was analysed. In this article the birth parameters of mother and child in the most often chosen spontaneous birth methods will be compared to assess the safety of alternative birth methods in general and of waterbirths in particular. 2014 of these 5953 spontaneous births were waterbirths, 1108 were Maia-birthing stool births and 2362 bedbirths (vacuum extractions not included).

### **Findings**

The parity and age of the mother as well as the newborn's birthweight are comparable in all three groups: water-, Maia-birthing stool- and bedbirths.

An episiotomy will be cut in only 12.8% of the births in water, in 27.7% of the births on the Maia-birthing stool and in 35.4% of the bedbirths. These differences are statistically significant. In spite of the highest episiotomy rates, the bedbirths also show the highest 3<sup>rd</sup> and 4<sup>th</sup> degree laceration rates (4.1%), thus the difference between bedbirth rates and alternative birth method rates for severe lacerations is significant. The mothers' blood loss is the lowest in waterbirths. Fewer painkillers are used in waterbirths and the experience of birth itself is more satisfying after a birth in water.

The average arterial blood-pH of the umbilical cord as well as the APGAR scoring at 5 and 10 minutes are significantly higher after waterbirths. Infections of the neonate do not occur more often after waterbirths. No case of water aspiration or of any other perinatal complication of the mother or child which might be water-related was reported.

### **Interpretation**

Waterbirths and other alternative births such as Maia-birthing stool births do not demonstrate higher birth risks for the mother or for the child than bedbirths if the same medical criteria are used in the monitoring as well as in the management of birth.

KEYWORDS: Waterbirth  
Alternative birth method  
Birth concept  
Maia-birthing stool  
Episiotomy  
Perineal laceration  
Bedbirth

## **Introduction**

A new birth concept (1) was introduced in 1991 at our clinic for obstetrics and gynecology of the cantonal hospital of Frauenfeld/Switzerland. This concept consisted of the careful monitoring and management of the birth process, the restrictive use of invasive methods as well as the free choice of the birth method. This was introduced in response to the growing desire of many parturients for alternative birth methods, more respect of the natural birth process and less aggressive birth management. The wishes of the parturients were taken seriously. Waterbirths, to be understood here as the birth of the baby under water and other alternative birth methods such as Maia-birthing stool births were offered. The natural process of birth was respected; medical measures and technique are toned down, without compromising on the security that classical medicine offers.

A prospective observational study was started on the 1<sup>st</sup> of November, 1991 to answer the question of how safe waterbirths or other alternative birth methods are and to counter prejudice with relevant data. The aim of this study is to compare the quality of alternative birth methods, especially that of waterbirths (when the quality of the monitoring and the birth management is unchanged), with the traditional "bedbirth".

### Birth management in Frauenfeld

The midwife supports the parturient during the different stages of labour. The parturients have a chance to try different positions in or out of the water (where they are never left unattended and can regulate the water temperature themselves) and choose accordingly the birth method they feel the most comfortable with. They have the following possibilities to try and choose from: different positions on the wide bed, sitting on the Maia-birthing stool, the "Roma" wheel, or the birthing bag, "on all fours" on a mat or in the upright position by holding a rope or the bath tub (figure 1 to 5). The husband / partner and midwife (more seldom the

doctor) might help in the decision making. Choosing the birth method is a process which might end only with the birth itself.

The parturient may eat and drink as much as she wishes. If she feels nauseated or thirsty she will receive more fluids intravenously whether she is in or out of the tub.

The management of the different stages of labor and the monitoring of the fetal heart rate are done in the same way, independently of the birth method. We monitor the fetal heart rate electronically, mostly intermittently during the first stage of labor, and continuously in the second stage of labor because this seems to be less disrupting at this point than intermittent monitoring. The monitoring is in most cases external; of course only a telemetrical monitoring system may be used in waterbirth (we use the monitoring systems of Hewlett Packard and Corometrics with watertight transducers). The indication for a vaginal operative delivery or caesarean section remain the same, independently of the chosen birth method.

The delivery room team has the choice between different kinds of analgesics. In general the parturient and the midwife/doctor decide together which type of analgesics and what dose will be needed; these decisions are taken in every case individually. The choice extends from suppositories, injections (Hyoscinbutylbromid, Propyphenazon, Tramadol), homeopathic remedies (classical homeopathy), and acupuncture to epidural analgesia. The epidural analgesia is performed by the anaesthesiologist on duty.

A midwife and a doctor are always present at birth. The midwife or the doctor guards the perineum (in or out of the water in an identical fashion). Depending on the individual situation the midwife will suggest spontaneous pushing or pushing on command. In a waterbirth the baby is brought immediately after birth to the surface, emerges face down and is put on its mother's chest.

The umbilical cord is then clamped, the blood collected for the arterial and venous pHs which are determined in the delivery room itself (Chiron diagnostics 248h). The APGAR scoring system is applied at 1 minute, 5 minutes and again at 10 minutes after birth. The newborn infant will be closely observed as it lies on its mother's chest, and it will be kept warm with a preheated towel or in the water with an overhead infrared heater.

The third stage of a waterbirth will usually take place in the water while the mother holds her child.

## Methods

Our birth clinic meets the obstetrical needs of a clearly defined, mostly rural region of 150'000 inhabitants. The yearly birth rates have fluctuated between 1216 and 1421 births during the observation period (1991 to 1997). All parturients of the region give birth in our clinic without preselection, ours being the only birth clinic of the region. 2% of the parturients will be referred to a larger birth clinic (university clinic) mainly because of preterm births before the end of the 33<sup>rd</sup> week of pregnancy. The referral rate and the reasons for referral remain basically the same during the observational period.

On the 1<sup>st</sup> of November, 1991, we started a prospective observational study and since then have documented every birth with a standardized questionnaire in five parts (1). We have collected parameters concerning the mother and the child in this way. The parturient who will give birth in our clinic receives the first part of the questionnaire at home 6 to 8 weeks before birth, and will bring the completed form with her when she enters the hospital for birth. In this part of the questionnaire, the mother-to-be is asked questions about her expectations and wishes concerning birth management, birth methods and the expected pain. She may also express her fears. During labour, after birth and again before the new mother leaves the hospital (usually 4-7 days after birth) the attending midwife and doctor record the objective information concerning labour, birth and the postpartum phase. In addition to this objective information, the mother is asked questions about the pain experienced during the different stages of labour, and about her birth experience in general. A 100mm long visual analog scale is then shown with to the left the term "wonderful " and to the right the term "dreadful". The woman will mark a line, more to the left or to the right depending on how she feels about her birth experience. A minimal comprehension of the German language as well as a little time are required for this part of the questionnaire. We use a „short“ questionnaire containing only the questions on objective data for the 25% non-German speaking parturients (foreigners).

For the purposes of this paper we have used the objective data concerning all of the births between the 1<sup>st</sup> of November, 1991 and the 21<sup>st</sup> of May, 1997, a total of 7508 births.

Why a randomized study was impossible, and why we choose the place of birth to define our birth method groups

When we conceived the study, it was already clear that a randomization would not be accepted by our parturients. They wanted to decide on the birth method themselves and be able to change their minds during labour.

In the prenatal part of the questionnaire of the prospective observational study, the parturients' wishes concerning birth methods prior to birth, expressed 6-8 weeks before birth, are not as clear as one might think. Waterbirth is the most common named wish at this point, but most women can imagine other birth methods as well, and express this in the questionnaire by indicating different possibilities. The factors that influence the choice of a birth method are complex and should be addressed in a separate paper. The different aspects that could influence the woman's decision are: personal past experience of labour as well as related birth experiences (relatives, books etc), the partner's wishes and experience of birth, the midwife's suggestions and preferences, and of course the on-going labour (experiencing the contractions and finding the optimal way to cope with the pain during labour).

The decisive factor and only clearly defined element for the definition of the birth method is the actual place of birth so that we defined the birth method itself as intervention. All births in the waterbirth group are therefore defined as complete births of the baby under water while the mother remains in the tub. A similar definition is used for all other birth methods. These definitions were chosen for their simplicity and their clarity.



The statistical analysis is computerized (Systat 5-0 for windows). We used the chi-square test when analysing qualitative information and the Mann-Whitney-U test when analysing quantitative data, since our data did not follow a normal distribution (statistical counselling: Prof. T. Gasser, Department for Biostatistic, Institute of Social and Preventive medicine, University of Zurich/Switzerland).

## Results

79.3% of the 7508 analysed births are spontaneous single births in cephalic presentation (table 1). 9.6% of the 7508 births were caesarean sections, a low rate for Switzerland, 8.4% of the births were operative vaginal deliveries; we prefer the vacuum to the forceps extraction. 1.8% of the births were spontaneous breech births and 0.9% spontaneous twin births.

The group of the spontaneous births of singleton in cephalic presentation is composed of the following subgroups (table 2): 2014 births in water, 1108 births on the Maia-birthing stool, 2362 births on a wide bed in a half-sitting position (the vacuum extractions are not included in the bedbirth group) and 469 not as popular birth methods such as the "Roma" wheel, the birthing bag, "on all fours", or standing with or without the assistance of the rope or the wall bars.

The following distribution concerning parity was described: 34% of the waterbirth group, 35% of the Maia-birthing stool group, 35% of the bedbirth group and 32.5% of the group including the rarer birth methods were nulliparous women. The average age of the mothers-to-be was 29 in the different groups. 40 weeks was the average pregnancy length in all groups. The average length of birth is 305 minutes in the waterbirth group, 335 minutes in the Maia-birthing stool group and 344 minutes in the bedbirth group. 22% of the women in the waterbirth group, 29% in the Maia-birthing stool group and 47% in the bedbirth group are foreigners (mostly from south and eastern Europe).

Shoulder dystocia occurred 6 times (0.29%) in the waterbirth group, never in the Maia-birthing stool group and 11 times (0.46%) in the bedbirth group.

Meconium stained amniotic fluid was observed in the waterbirth group in 100 parturients (5%), in the Maia-birthing stool group in 101 parturients (9.1%) and in the bedbirth group in 297 parturients (12.6%).

The average rate of preterm rupture of the membrane and induction of labor were the same with around 8% and 11% in the different groups.

The results of a comparison of different aspects of birth (perineal injuries, blood loss, neonatal birth parameters, use of analgesics and birth experience) for the three most common spontaneous birth methods for singletons in cephalic presentation (water-, Maia-birthing stool-, bedbirths) follow.

### **Perineal injuries (table 3)**

Comparing the episiotomy rates of the three most common birth methods, we see that at 12.8% the episiotomy rate is the lowest after waterbirths, bedbirths reach 35.4%, the highest of the episiotomy rates. The differences of rates between the three birth methods are statistically significant.

The bedbirths in our study presented the highest rates of 3<sup>rd</sup> and 4<sup>th</sup> degree lacerations. We find only 2.7% of 3<sup>rd</sup> and 4<sup>th</sup> degree tears after waterbirth and 2.3% after birth on the Maia-birthing stool. This difference is not significant; whereas in alternative birth methods and bedbirths the differences of rates are significant. The frequency of first and second degree lacerations shows the opposite tendency from the episiotomy rates. First and second degree lacerations are found statistically significantly more often after waterbirths and Maia-birthing stool births than after bedbirths. There is no tearing at all in a statistically significant higher number of waterbirths (27.6%), compared to 22.2% after births on the Maia-birthing stool and 24.9% after bedbirths.

However there are significantly higher numbers of labia tears after waterbirths than after Maia-birthing stool births or bedbirths.

Clitoris tears are luckily very rare in all birth methods.

#### **Blood loss (table 4)**

The mother's blood loss is defined as the drop in haemoglobin (g/l), the haemoglobin levels being determined before birth and again on the 2<sup>nd</sup> to 4<sup>th</sup> day after birth. 1809 waterbirths, 1004 Maia-birthing stool births and 2245 bedbirths were analysed to determine the amount of blood loss. The lowest blood loss is found after waterbirths. The highest blood loss is found after Maia-birthing stool births. The differences of blood loss between waterbirths and other birth methods, as well as between Maia-birthing stool births and bedbirths are both statistically significant. Ambulatory births, in which the mother prefers to spend her childbed at home and therefore leaves the hospital within 24 hours of birth, account for the missing haemoglobin values in these groups.

#### **Neonatal birth parameters (table 5)**

An average birth weight of 3430g is found after waterbirths, 3400g after Maia-birthing stool births and 3390g after bedbirths. We see no significant difference in birth weight between bed-, water- and Maia-birthing stool births.

The average arterial blood pH was 7.30 after waterbirths, 7.29 after Maia-birthing stool and 7.26 after bedbirths. These differences are significant.

The average APGAR score at 5 minutes is significantly higher after waterbirths than after bedbirths, and also significantly higher after Maia-birthing stool births than after bedbirths.

The average APGAR scores at 10 minutes show the same significant differences as at 5 minutes.

Missing measurements or the missing documentation of measured values account for the smaller groups (n) for the analysis of the different neonatal parameters.

0.6% of the newborn infants born in water, 1.1% of the babies born on a Maia-birthing stool and 1.05% of the babies born in bed suffer from an infection. The differences between our three groups are not statistically significant. The commonest infection of the neonate found during the first week of life is non-specific conjunctivitis. Pneumonia, infections of the urinary tract, skin infections and diarrhoea are rare.

### **Use of analgesics (table 6)**

70.6% of the women who gave birth in water, 66.1% of the women who gave birth on the Maia-birthing stool and 54.1% of the women who gave birth on a bed needed no pain-killers at all. The differences between the waterbirth group and the Maia-birthing stool group are significant; the differences between the waterbirth group and the bedbirth group are even highly significant.

The women who gave birth on a bed had the highest need for analgesics. The women who gave birth in water used fewer analgesics in all but one category: they had the highest use for homeopathic remedies. The three groups show significant differences in the use of pain-killers: the waterbirth group used fewer suppositories, injections, and epidural analgesia but more homeopathic remedies. The bedbirth group and Maia-birthing stool group also show a significant difference: the Maia-birthing stool group used fewer suppositories, injections, and epidural analgesia as well as a much smaller number of homeopathic remedies. It is basically possible to have a waterbirth with an epidural analgesia. In practice, women will mostly give birth in water with an epidural catheter when this analgesia had been needed during the first stage of labour, and could be discontinued in the second stage. Homeopathic remedies are prescribed by midwives trained in classical homeopathy.

### **Birth experience, visual analog scale (table 7)**

1587 women after waterbirths, 770 women after Maia-birthing stool births and 1315 women after bedbirths have returned the questionnaire with the visual analog scale on their birth experience (100mm long visual analog scale with to the left the word „wonderful“ and to the right the word „dreadful“). The rate of foreigners is higher in the bedbirth group, the reason why fewer women of this group answer the questions on birth experience that require a minimal command of the German language. The difference between waterbirths and Maia-birthing stool births is significant, the difference between alternative birth methods (waterbirth and Maia-birthing stool birth) and bedbirths is also significant. The experience of birth after a waterbirth is closer to "wonderful " than after a Maia-birthing stool birth, a bedbirth being the furthest away from "wonderful " birth experiences.

## Discussion

Waterbirths rapidly became the most popular birth method. They make up 34% of the 5953 spontaneous single births with cephalic presentations that this study contains; this is therefore the most often chosen alternative birth method. In the past three years waterbirths have reached more than 40% of the spontaneous single births (1).

There have been different reactions to the introduction of alternative birth methods, and especially waterbirths. The mothers-to-be were delighted. The great interest the media showed was quite unexpected. Through this mediatisation our clinic was suddenly propelled into the limelight, caught between alternative circles that supported us (6, 7, 8, 9, 10) and classical obstetrical circles that were in opposition (2, 3, 4, 5, 11). These issues were debated at different Swiss and German conferences. The opponents to waterbirths were afraid of possible complications: aspiration of the bathwater, drowning of the newborn infant, higher rates of 3<sup>rd</sup> and 4<sup>th</sup> degree lacerations, postpartal blood loss, infections of the neonate and of the mother, hyper- or hypothermia.

As the data and experience were scarce in this field these fears were quite understandable. To give answers to these questions and fears we decided to start a prospective observational study. The first results of our observational study (12, 13, 14, 15, 16) and studies from Germany (17, 18) already showed quite clearly that with careful monitoring and birth management the feared complications did not occur.

The episiotomy is the commonest but also the most questioned practice in obstetrics (19, 20). Even if studies have proven the contrary (21, 22, 23, 24), it is still a widespread belief that with episiotomies 3<sup>rd</sup> and 4<sup>th</sup> degree lacerations are avoided, that they are easier to repair, and that they heal better than lacerations. In our study the episiotomy rates were the lowest after waterbirths and the 3<sup>rd</sup> and 4<sup>th</sup> degree lacerations significantly less frequent than

in bedbirths which also have the highest episiotomy rates. We see no preventive effect of an episiotomy on severe perineal lacerations. The question as to why the episiotomy rates are lower in waterbirth remains unanswered: Are the tissues made softer by the warm water so that they extend more easily? Or is the perineum simply more difficult to get at in water than in a bedbirth? This second possibility is supported by the fact that there are significantly fewer episiotomies performed in Maia-birthing stool births where the perineum is also not as easy to get at than in bedbirth.

The lower blood loss in waterbirths could be explained by the hydrostatic pressure in the tub, by the less important perineal lacerations or possibly by a facilitated control of the 3<sup>rd</sup> stage of labour (blood spreading in water is perceived as more impressive than blood on a bed being absorbed directly). The bleeding in the Maia-birthing stool birth is probably stronger because of the high hydrostatic pressure in the wound in an upright sitting position. To keep the blood loss as low as possible, the women could change from upright- to lying position after birth for the 3<sup>rd</sup> stage of labour.

The results concerning the neonates' birth parameters such as pH of the arterial umbilical cord blood and APGAR scores, are especially encouraging. In over 2000 waterbirths we have never had a case of aspiration of the bath water. No neonate has ever drowned or died after birth as a consequence of a waterbirth. This has been explained by an inhibitory reflex - the diving reflex (25, 26, 27) - which shows that when the face, or especially the glottis, comes in contact with a fluid, respiration movements are inhibited. It was postulated that this diving reflex is responsible for the inhibition of water aspiration in utero as well as during a birth in water and later in life when diving. Aspiration will occur only when the diving reflex fails, because of anaesthesia or severe asphyxia. The mechanism also explains the far-reaching phenomenon of meconium aspiration in utero (28). The fear that the neonates' first breath will be triggered by the decompression of the thorax at birth, and thus will cause a



water aspiration, is therefore unfounded. The first breath will be taken only later when the face comes into contact with air.

Contrary to expectations and contrary to the small amount of literature that exists on the subject (29, 30), infections of the neonate after waterbirths were not more frequent than in other birth methods. A strong dilution of the micro-organism is obtained by the large quantity of water contained in our tubs (560 litres) and by continual water renewal. This probably reduces the risk of infections for the mother and child. There is of course no such thing as a sterile environment in any birth method, the vagina being colonized. It is clear that we still need microbiological studies to confirm these on-going hypotheses.

We have never seen a disregulation in body temperature of mother or child, even when the women wished to bathe two hours or even longer.

The need and the type of analgesics used in birth management are often discussed by obstetricians, midwives and mothers-to-be. Opinions on this subject differ widely (31, 32). Women need fewer painkillers in waterbirths than in other birth methods. We think this has to do with the relaxing effect of water and the facilitated movement in its weightlessness. The greater freedom of movement and the immediate closeness of the partner in the Maia-birthing stool births may explain the lower use of painkillers in Maia-birthing stool births than in bedbirths. Because of these diversions the pain might seem more bearable.

Our analysis of the visual analog scale has shown that women who give birth in water have the most satisfying birth experiences; this is probably one of the reasons why this method has become the most popular birth method (33).

We are conscious of the fact that our birth method groups - waterbirth, Maia-birthing stool and bedbirth - are not comparable on all points. We have already mentioned the contradic-

tion between our new birth concept and a randomization. The precise analysis of the personality profile and risk profile of the women in these different birth method groups will be addressed in a different paper. We expect to find that the bedbirth group presents probably, as a whole, a higher risk profile than the other birth method groups because of its higher proportion of foreigners. Foreigners do not benefit from prenatal care as often or as regularly as the Swiss population because of the language barrier and lack of information about the local possibilities.

Our monitoring and birth management are the same in all birth method groups so that for example the indication for an operative delivery is the same. We have even noticed that our birth management in waterbirths is somewhat more careful than in the other groups so that parturients are asked to leave the tub at the slightest sign of an abnormal electronical fetal heart rate tracing. In this way the monitor tracings are evaluated more severely in water- than for example in bedbirths. This might explain the significantly higher arterial blood pH of the umbilical cord as well as the higher APGAR scores in waterbirths. In general preterm babies, that is before the 37<sup>th</sup> week of pregnancy, are not born in water. This is so that any respiratory distress syndrome is clearly seen to be caused by prematurity.

Seven years after the introduction of our new birth concept consisting of careful monitoring and birth management, the restrictive use of invasive methods, as well as the free choice of different birth methods, we can conclude that waterbirths and other alternative birth methods can very well be integrated into classical birth management. Alternative birth methods introduce more caring into birth management, promote mutual respect, bring more comprehension and acceptance between parturients and the obstetrical team.

We can also demonstrate with our data that waterbirths and other alternative birth methods are safe for the mother as well as for the child, provided a consequent and correct obstetrical monitoring is assured. Furthermore waterbirths demonstrate advantages such as fewer epi-

siotomies, higher rates of intact perineum, lower blood loss and lower use of painkillers. Moreover, neonatal infections do not occur more frequently and waterbirths may enhance the experience of birth. Of course we are not as naïve as to think that the introduction of alternative birth methods will solve all problems. Obstetrical emergencies occur in alternative birth methods also, and these need prompt and correct handling. We want to emphasize again that conscientious obstetrical monitoring as well as careful birth management are always necessary, regardless of the birth method chosen. Good cooperation and a trusting relationship between the parturients and the delivery room team (midwives, doctors as well as other medical staff) is crucial for excellent and safe obstetrical management and the success of the delivery ward.

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| <b>Births</b>                                             | <b>n</b>    | <b>%</b>   |
|-----------------------------------------------------------|-------------|------------|
| <b>Vaginal births:</b>                                    |             |            |
| Single spontaneous births with cephalic presentation      | 5953        | 79.3       |
| Breech - single - vaginal births                          | 135         | 1.8        |
| Twin - vaginal births                                     | 66          | 0.9        |
| Vacuum extraction of singleton with cephalic presentation | 632         | 8.4        |
| <b>Caesarean sections:</b>                                |             |            |
| Elective caesarean deliveries                             | 317         | 4.2        |
| Non elective caesarean deliveries                         | 405         | 5.4        |
|                                                           |             | 9.6        |
| <b>Total</b>                                              | <b>7508</b> | <b>100</b> |

**Table 1: Groups of vaginal births and caesarean sections**

| <b>Birth methods</b>                                                | <b>n</b>    | <b>%</b>   |
|---------------------------------------------------------------------|-------------|------------|
| Water                                                               | 2014        | 34         |
| Maia-birthing stool                                                 | 1108        | 18         |
| Bed (vacuum extractions excluded)                                   | 2362        | 40         |
| Others ("Roma" wheel, birthing bag, rope, "on all fours", standing) | 469         | 8          |
| <b>Spontaneous single births with cephalic presentation</b>         | <b>5953</b> | <b>100</b> |

Table 2: **Birth methods used in spontaneous single births with cephalic presentation**



| Genital wounding through birth | Water (A) |        | Maia-birthing stool (B) |        | Bed (C) |        | A versus B  | A versus C  | B versus C  |
|--------------------------------|-----------|--------|-------------------------|--------|---------|--------|-------------|-------------|-------------|
|                                | n         | (%)    | n                       | (%)    | n       | (%)    |             |             |             |
| Number of patients             | 2014      |        | 1108                    |        | 2362    |        |             |             |             |
| Episiotomy                     | 275       | (12.8) | 307                     | (27.7) | 838     | (35.4) | p<0.001(s)  | p<0.001(s)  | p<0.001(s)  |
| I°/II° laceration              | 1031      | (51.2) | 517                     | (46.7) | 822     | (34.8) | p<0.05 (s)  | p<0.001(s)  | p<0.001(s)  |
| III°/IV° laceration            | 55        | ( 2.7) | 26                      | ( 2.3) | 97      | ( 4.1) | p>0.05 (ns) | p<0.05 (s)  | p<0.05 (s)  |
| No tear at all                 | 555       | (27.6) | 246                     | (22.2) | 587     | (24.9) | p<0.05 (s)  | p<0.05 (s)  | p>0.05 (ns) |
| Vaginal tear                   | 398       | (19.8) | 160                     | (14.4) | 344     | (14.6) | p<0.05 (s)  | p<0.0001(s) | p>0.05 (ns) |
| Labia tear                     | 430       | (21.4) | 152                     | (13.7) | 305     | (12.9) | p<0.0001(s) | p<0.0001(s) | p>0.05 (ns) |
| Clitoris tear                  | 12        | ( 0.6) | 6                       | ( 0.5) | 16      | ( 0.7) | p>0.05 (ns) | p>0.05 (ns) | p>0.05 (ns) |

s = statistically significant difference

ns = not statistically significant difference

**Table 3: Genital lesions after water-, Maia-birthing stool- and bedbirths**

|                 | <b>Water</b>    | <b>Maia-birthing<br/>stool</b> | <b>Bed</b>      |                   |                   |                   |
|-----------------|-----------------|--------------------------------|-----------------|-------------------|-------------------|-------------------|
|                 | <b>(A)</b>      | <b>(B)</b>                     | <b>(C)</b>      | <b>A versus B</b> | <b>A versus C</b> | <b>B versus C</b> |
| No. of patients | 1809            | 10042245                       |                 |                   |                   |                   |
| Mean (g/l)      | - 4.1           | - 9.1                          | - 6.6           |                   |                   |                   |
| Max./min.       | - 40.2 / + 10.9 | - 60.0 / + 4.2                 | - 58.2 / + 12.8 |                   |                   |                   |
| SD              | 14.4            | 18.7                           | 18.6            |                   |                   |                   |
| p               |                 |                                |                 | p<0.0001(s)       | p<0.0001(s)       | p<0.0001(s)       |

s = statistically significant difference

Max./min. = maximal / minimal data

**Table 4: Blood loss in different birth methods: comparison of haemoglobin drop before birth and 2 to 4 days after birth**

|                                                                                                                                 | Water       | Maia-birthing<br>stool | Bed         |            |             |              |
|---------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------|-------------|------------|-------------|--------------|
|                                                                                                                                 | (A)         | (B)                    | (C)         | A versus B | A versus C  | B versus C   |
| <b>Weight</b>                                                                                                                   |             |                        |             |            |             |              |
| No. of patients                                                                                                                 | 2012        | 1106                   | 2359        |            |             |              |
| Mean (g)                                                                                                                        | 3430        | 3400                   | 3390        |            |             |              |
| SD                                                                                                                              | 477         | 456                    | 520         |            |             |              |
| p                                                                                                                               |             |                        |             | p=0.41(ns) | p=0.06(ns)  | p=0.45 (ns)  |
| <b>Arterial blood pH of the umbilical cord</b>                                                                                  |             |                        |             |            |             |              |
| No. of patients                                                                                                                 | 1991        | 1095                   | 2322        |            |             |              |
| Mean                                                                                                                            | 7.30        | 7.29                   | 7.26        |            |             |              |
| Min./max.                                                                                                                       | 7.01 / 7.50 | 6.98 / 7.45            | 6.95 / 7.48 |            |             |              |
| SD                                                                                                                              | 0.77        | 0.85                   | 0.78        |            |             |              |
| p                                                                                                                               |             |                        |             | p=0.005(s) | p<0.0001(s) | p<0.0001 (s) |
| <b>APGAR 5/10 min.</b>                                                                                                          |             |                        |             |            |             |              |
| No. of patients                                                                                                                 | 2011        | 1106                   | 2354        |            |             |              |
| Mean                                                                                                                            | 9.8 / 9.9   | 9.8 / 9.9              | 9.6 / 9.9   |            |             |              |
| Min./max.                                                                                                                       | 7/10 / 7/10 | 5/10 / 7/10            | 5/10 / 7/10 |            |             |              |
| SD                                                                                                                              | 0.5 / 0.3   | 0.6 / 0.4              | 0.7 / 0.3   |            |             |              |
| p 5 min.                                                                                                                        |             |                        |             | p=0.61(ns) | p<0.0001(s) | p<0.0001(s)  |
| 10 min.                                                                                                                         |             |                        |             | p=0.25(ns) | p<0.0001(s) | p=0.001(s)   |
| <b>Neonatal infections</b>                                                                                                      |             |                        |             |            |             |              |
| No. of patients                                                                                                                 | 2014        | 1108                   | 2362        |            |             |              |
| Pulmonary                                                                                                                       |             | 1                      | 1           |            |             |              |
| Urogenital                                                                                                                      |             | 1                      |             |            |             |              |
| Ocular                                                                                                                          | 10          | 9                      | 20          |            |             |              |
| Others                                                                                                                          | 2           | 1                      | 4           |            |             |              |
| TOTAL                                                                                                                           | 12 (0.6%)   | 12 (1.1%)              | 25 (1.05%)  | p>0.05(ns) | p>0.05(ns)  | p>0.05(ns)   |
| s = statistically significant difference<br>ns = not statistically significant difference<br>Min./max. = minimal / maximal data |             |                        |             |            |             |              |

**Table 5: Neonatal birth parameters in different birth methods: birth weight, arterial umbilical cord blood pH, APGAR scores at 5 and 10 minutes after birth, neonatal infections**

| Use of analgesics        | Water (A)       |        | Maia-birthing stool (B) |        | Bed (C) |        | A versus B   | A versus C   | B versus C   |
|--------------------------|-----------------|--------|-------------------------|--------|---------|--------|--------------|--------------|--------------|
|                          | n               | (%)    | n                       | (%)    | n       | (%)    |              |              |              |
|                          | No. of patients | 2014   |                         | 1108   |         | 2362   |              |              |              |
| No painkillers           | 1422            | (70.6) | 732                     | (66.1) | 1279    | (54.1) | p<0.05 (s)   | p<0.0001 (s) | p<0.0001 (s) |
| Suppositories            | 238             | (11.8) | 177                     | (15.9) | 496     | (20.9) | p<0.001 (s)  | p<0.0001 (s) | p<0.001 (s)  |
| Injections               | 205             | (10.2) | 162                     | (14.6) | 533     | (22.6) | p<0.001 (s)  | p<0.0001 (s) | p<0.0001 (s) |
| Epidural analgesia       | 8               | (0.4)  | 22                      | (2.0)  | 191     | (8.1)  | p<0.0001 (s) | p<0.0001 (s) | p<0.0001 (s) |
| Homeopathic remedies etc | 442             | (21.9) | 171                     | (15.4) | 438     | (18.5) | p<0.0001 (s) | p<0.01 (s)   | p<0.05 (s)   |

s = statistically significant difference

**Table 6: Use of analgesics in birth management**

|                 | Water   | Maia-birthing<br>stool | Bed      |            |             |             |
|-----------------|---------|------------------------|----------|------------|-------------|-------------|
|                 | (A)     | (B)                    | (C)      | A versus B | A versus C  | B versus C  |
| No. of patients | 1587    | 770                    | 1315     |            |             |             |
| Mean (mm)       | 31.3    | 34.6                   | 42.2     |            |             |             |
| SD              | 20.5    | 21.6                   | 23.4     |            |             |             |
| Min./max.       | 0 / 100 | 0 / 100                | 20 / 100 |            |             |             |
| p               |         |                        |          | p=0.003(s) | p<0.0001(s) | p<0.0001(s) |

s = statistically significant difference

Min./max. = minimal / maximal data

**Table 7: Birth experience as perceived by the mother 4 to 7 days after birth. 100mm long visual analog scale with to the left the term „wonderful“ and to the right the term „dreadful“.**

## **Legends for illustration**

- Fig. 1 Waterbirth
- Fig. 2 Maia-birthing stool
- Fig. 3 Wide bed
- Fig. 4 "Roma" wheel
- Fig. 5 Birthing bag, mat and rope