International Journal of Nursing Sciences 6 (2019) 460–467

HOSTED BY

Contents lists available at ScienceDirect

International Journal of Nursing Sciences

journal homepage: http://www.elsevier.com/journals/international-journal-of-nursing-sciences/2352-0132

Review

A review and comparison of common maternal positions during the second-stage of labor

Jing Huang [a], Yu Zang [a], Li-Hua Ren [a], Feng-Juan Li [b], Hong Lu [a,*]

[a] School of Nursing, Peking University, Beijing, China
[b] Maternal and Child Health Hospital of Xinjiang Uyghur Autonomous Region, Uyghur, China

ARTICLE INFO

Article history:
Received 2 March 2019
Received in revised form
28 May 2019
Accepted 17 June 2019
Available online 20 June 2019

Keywords:
Second labor stage
Parturition
Posture
Review

ABSTRACT

The second-stage of labor is the most stressful part of childbirth process and the proper maternal position during this period is paramount for women's safe vaginal birth. Midwives play a pivotal role in managing maternal positions during the second-stage of labor. However, there is limited evidence to support an ideal maternal position during the second-stage of labor. Further, the difference between different maternal positions might not be apparent. This paper aims to review and compare the benefits and risks of common maternal positions during the second-stage of labor, thereby to provide midwives evidence-based practical guidelines.

What is known?

- The second-stage of labor is the most stressful part of childbirth both for the women and midwives. Management of the second-stage of labor is key responsibility for midwives.
- Certain maternal positions during the second-stage of labor have potential benefits in promoting optimal maternal and neonatal outcomes, but the risks and benefits of each maternal position may not be apparent.

What is new?

- Upright and lateral positions may have more potential benefits in improving maternal and neonatal outcomes and dealing with certain obstetric complications.
- Certain upright positions such as squatting position and sitting position, may correlate with perineal trauma and greater blood loss.
- Lithotomy and supine position should be avoided for the possible increased risk of severe perineal trauma, comparatively longer labor, greater pain, and more fetal heart rate patterns.

1. Introduction

The second-stage of labor is defined as beginning with complete dilation of the cervix (10 cm) and ending with expulsion of the fetus [1]. The median duration is approximately 50 min for nulliparas and about 20 min for multiparas, which is highly variable [2]. The second-stage of labor is often the most stressful part of the childbirth process for the woman and fetus, and consequently for the care providers [3]. Prolonged duration of the second-stage of labor increases the risk of maternal and fetal complications [4–8]. For example, the prolonged second-stage of labor or pushing has been associated with an increased risk for postpartum hemorrhage [4], operative birth, third- and forth-degree lacerations [1], low Apgar score [5] and neonatal asphyxia-related complications [9]. Maternal and neonatal complications which happened during this period may be life threatening. For this reason, there is a necessity to manage the second-stage of labor in order to orchestrate safe vaginal deliveries.

Certain maternal positions during the second-stage of labor have potential benefits in promoting optimal maternal and neonatal outcomes. Familiarity in managing maternal positions during this stage is essential to midwifery practice. Several evidence-based guidelines suggested that maternal positions serve as the non-medical intervention to facilitate the progress of childbirth [3,10,11]. For puerperae, assuming proper maternal positions can greatly improve their sense of control and enables them to

* Corresponding author.
E-mail addresses: Luhong@bjmu.edu.cn, jillhuang@bjmu.edu.cn (H. Lu).
Peer review under responsibility of Chinese Nursing Association.

https://doi.org/10.1016/j.ijnss.2019.06.007

foster a positive birth experience [12], thus making coping with labor easier and reducing negative psychological implications [1,13]. Some kinds of maternal positions may shorten the duration of the second-stage of labor [14–16], thereby possibly minimizing the risk of complications. Certain maternal positions can even be applied to deal with obstetric complications [17,18]. Conversely, if adopting an unfavorable position, women might suffer from a series of negative outcomes, such as severe perineal trauma [19–21], post-partum urinary incontinence [22] and greater blood loss [14,23]. The fetus or newborn is also faced with increased risk of complications [14].

Since no evidence exists to support the most ideal maternal positions for every woman, the maternal position has been controversial over a long period. In earliest times, the most common position during labor and delivery has been some form of upright (or vertical) position [24,25]. Till the mid-seventeenth century, a French obstetrician Francois Mauiceau introduced semi-recumbent position to women during the labor for the easy access in applying forceps [25]. Then, this position popularized to many developed and developing countries around the world and gradually evolved into recumbent or lithotomy position(or horizontal positions) [25]. Although it seems that adopting horizontal positions has become the norm, numerous studies found the advantages in horizontal positions outweighed by the disadvantages. World Health Organization recommended upright position in 1996 and stated women should choose the maternal position according to their preference [26]. Although many researches have shed light on the use of different maternal position during the second-stage of labor, but the pros and cons of each position might not be apparent. This paper aims to review and compare six common positions during this stage and thereby helping women and midwives get the full picture of the benefits and risks of these positions, which might support optimal labor and improve midwifery practice.

2. Common maternal positions during the second-stage of labor

Maternal position can be classified as either upright(vertical) or horizontal position. The horizontal positions can be simply described as those where the woman's feet are on the ground [27]. Whereas in horizontal positions, woman mainly lies on the bed with her weight supported by her back [1]. Nonetheless, such classification may not be rigorous enough. The key reference defining woman's maternal position can date back to 1976. Atwood classified maternal position into two categories: upright positions and neutral positions [28]. In upright position, the line connecting centers of woman's third and fifth lumbar vertebrae is more nearly vertical than horizontal. Whereas in neutral position, the line is more nearly horizontal than vertical [28]. Generally, upright positions include sitting, squatting, kneeling, and standing. Supine, lithotomy and lateral positions are considered as horizontal positions.

The characteristics of the placement of common maternal positions during the second-stage of labor are summarized in Table 1.

2.1. Lithotomy position

In lithotomy position, the woman rests on back, her legs are neither bent with her feet flat on the surface, placed in stirrups, straight leg supports or held by attendants [28]. In China, the lithotomy position is widely applied in hospitals and clinical settings [29,30]. In a French study, 87.6% of midwives reported that they prefer dorsal positions, which include lithotomy positions, and their regular using of stirrups was also reported by 66% [31]. Despite the fact that lithotomy position offers convenience for midwives and obstetricians to monitor the progression of labor and implement hands-on maneuvers when necessary [27,32], concerns persist regarding the risks of such positions.

2.2. Supine position

In supine position, the woman lies flat on her back or with her trunk slightly raised (<45° to the horizontal), her legs may be out straight, bent with her feet flat on the bed, in the leg rests, or drawn up and back toward her shoulders [33]. Several evidence-based guidelines encourage and help women to move and adopt any position they find most comfortable throughout labor and childbirth, except supine or semi-supine position [3,34,35]. Despite the scientific evidence against the use of supine position, current literature suggests that supine positions are the most common position assumed by women during childbirth worldwide [36]. For example, in many Asian countries, women usually assume supine position to give birth [37]. A cross-sectional descriptive survey conducted by Zileni et al. have shown that, about 99.2% Malawi women know about the supine as a birthing position, and the majority (91.4%) give birth in supine position [36]. Supine positions are also popular in developed countries. A national survey of America reported that more than two-thirds (68%) of women undergoing vaginal delivery give birth in supine position [38].

2.3. Lateral positions (side-lying positions)

Lateral positions, which also called side-lying positions, including pure side-lying and exaggerated Sims position (semi-prone) [33]. In pure side lying position, the woman lies on her side with both hips and knees flexed and a pillow between her legs, or with her upper legs raised and supported [33]. In addition, left lateral position also refers to the Sims position, which is a variation in the lateral position [18]. In exaggerated Sims position, the woman lies on her side with lower arm behind (or in front of) her trunk, her lower leg extended, and her upper hip and knee flexed 90° or more, she rolls partly toward her front [33]. Lateral positions are easy, reproducible, and comfortable [39]. The French midwives prefer lateral positions during the second-stage of labor for women both with and without epidural analgesia [40].

2.4. Sitting positions

Sitting positions include semi-sitting and sitting upright; in semi-sitting, the woman sits with her trunk at an angle greater than 45° to the bed; in sitting upright position, the women sits straight up on a bed, chair, or tool [33]. Based on several published studies, it seems that sitting positions are comparatively more popular in some western developed countries than in Asian countries [37,41]. In a French study, sitting position with a birth seat was the most common maternal position during the second-stage of labor (30.3%) [41]. As was reported in a Swedish study, the most frequently used maternal position during a spontaneous vaginal birth was sitting with birth seat ($n = 83$; 45.1%) [42]. However, for women who come from some Asian countries, even if they desire to give birth in sitting positions, they have limited access to adopt sitting positions during childbirth, because the position of lying on one's back is routinely practiced during childbirth in these countries [37].

2.5. Kneeling positions

Kneeling positions may vary from upright kneeling to all fours' position [14]. Generally, all fours also called hands and knees position. In this position, the woman kneels, leans forward, and

Table 1
The characteristics of the placement of common maternal positions during the second-stage of labor.

Classification		Characteristic of placement
Upright(vertical) positions	Sitting position	Sitting on a bed, chair, or tool, with one's trunk tilted to more than 45° to the horizontal.
	Squatting position	Lowering the trunk from standing, with certain supports to keep balance.
	Kneeling positions	Kneeling with one's trunk upright or palms on ground/cushion.
Horizontal positions	Lateral position	Lying on one's side with upper leg close to chest
	Supine position	Lying flat on one's back or elevating one's trunk to less than 45° to the horizontal.
	Lithotomy position	Lying flat on one's back with legs raised.

supports herself on either the palms of her hands or her fist [33]. In some developed countries, such as French, the kneeling position is one of the most frequently used positions and midwives are well trained to support women in this position during childbirth [43]. Compared with other positions, kneeling positions are rarely used in some Asian countries [37]. The possible reasons could be the lack of relevant knowledge and skilled midwives.

2.6. Squatting position

In the squatting position, a woman's weight rests mainly on her feet, but her knees are markedly bent, and again, she may lean or pull on some support [28]. The squatting position is often regarded as the most natural position, which is very similar to the habitual resting position of the chimpanzee and perhaps many of us [14]. However, a major disadvantage of squatting position is the difficulty for pregnant women to maintain squatting for a long time [44]. Accordingly, the advent of supporting tools may solve such problem. In some area, such as Malawi, only a small number of women(1.1%) know about that squatting position can be applied during childbirth; consequently, very few women (0.3%) assume squatting position during the second-stage of labor [36].

3. Comparisons of maternal positions

3.1. Accelerating the progress of labor

Extant literature has specified that prolonged the second-stage of labor may increase the risk of maternal and neonatal complications; therefore, shortening the duration of the second-stage of labor is of great significance.

Over the course of delivery, maternal positions play an important role in the descent of fetal head. It is well acknowledged that upright positions have more benefits in facilitating the labor progress than horizontal positions. The most recent cochrane review, which explored the impacts of positions during the second-stage of labor on women without epidural anaesthesia, suggested that upright positions can reduce the duration of the second-stage of labor by a mean of 6.6 min as compared with supine position (95% CI:9.74–2.59) [14].

Squatting position, which is commonly used every day, is effective in shortening the second-stage of labor. In particular, additional support combined with the custom that women in some parts of the world squat to defecate, relax and work, may add plus to squatting position. A observational study found that the duration of the second-stage of labor decreased by 9 min in both primiparas and multiparas in squatting position when compared with supine position (dorsal recumbent) [15]. These findings are in line with those of Moraloglu et al., whose study was based on Turkish primiparas [45]. Turkish women use squatting position to defecate and accustom themselves to squatting position [45]. By evaluating the maternal and neonatal outcomes between squatting position with hand bar and supine position modified to semi-fowler (45° to the horizontal) during the second-stage of labor, they demonstrated that the mean length of the second-stage of labor was 34 min shorter in the squatting group than in the supine group (21.02 ± 5.60 min versus 55.40 ± 6.91 min; $P < 0.001$), and the difference was statistically significant [45]. Except for bars, ankle supports also have been developed to relieve leg soreness and maintain the balance. A recent randomized controlled trail revealed that an ergonomic ankle support aid for squatting position can reduce pushing times [44]. Women adopt squatting position with ankle support during childbirth have better pushing experience than those without [44].

Sitting position, the same as squatting position, belongs to upright position and may serve as a non-medical intervention to facilitate labor progress. Accordingly, when there is a prolonged labor, sitting position may be beneficial. Thies-Lagergren et al. conducted a randomized controlled trail evaluating sitting position with birth seat, they found that women allocated to birth seat had a significantly shorter the second-stage of labor in comparison with other positions such as lateral position with or without stirrups, supine position, and standing position (95%CI: 0.96–0.98; $P < 0.01$), and was likely to receive less synthetic oxytocin for augmentation [46].

Several physiological mechanisms have been specified in promoting labor progress when adopting upright positions. First, the gravity effects have been noted in previous studies [14,16,27]. As in upright positions, pushing efforts act on a downward direction as well as gravity, it is understandable that the descent of fetal head will be easier [27]. Second, contractions are stronger and more effective in upright positions [14,15,27,33]. The contractions of uterine is an unique phenomenon of labor, which facilitate the descent of fetus and create distensible structure accommodating fetus [1]. However, there is no compelling evidence to prove that upright positions have more benefits than horizontal positions in regard to the intensity of contractions [27]. Third, upright positions increase the size of pelvic diameter thereby enabling faster labor progress [14,15,27,47,48]. For example, squatting position increases the pelvic outlet by approximately 20% [1].

Horizontal positions, however, are less likely to accelerate the labor progress. When laboring in supine or lithotomy position, woman's weight is mainly supported by her back [1], which requires woman to push against gravity and puts the fetus in an unfavorable drive angle in relation to pelvic [33]. Further, contractions are frequent but less effective in supine or lithotomy position [33,49].

Over the years, attempts to develop a modified supine position have been tried. In a Chinese study, researchers modified supine position by elevating the head of bed to 60°, which possibly promotes an optimal drive angle to aid the descent of fetal head through the passage, thereby shortening the second-stage of labor [50].

3.2. Alleviating maternal pain

Generally, labor pain mainly includes lower abdominal pain, contraction-related back pain and continuous low back pain [1].

Labor pain is inevitably experienced by women during delivery, and woman's perception of labor pain varies from person to person, which is affected by both physical and psychological factors [1,51,52]. Additionally, it has been reported that severe labor pain is in relation with post traumatic stress symptoms [53]. Therefore, providing continuous support and individualized care during labor to ameliorate labor pain are key responsibilities for midwives.

Previous studies suggested that upright positions may have potential benefits in reducing labor pain [11,16,45], although there is little convincing evidence to prove the effectiveness of upright positions. Upright positions could possibly help women with their self-determination when considering their preferred maternal position during labor. Further, it has commonly been assumed that retaining supine position during the second-stage of labor may increase labor pain [11,16,45].

A randomized trail from Iran evaluated the influence of lithotomy, sitting and squatting position on pain intensity using visual analogue scale and verbal scale of McGill during the second-stage of labor. In this trail, they found that the mean pain severity in lithotomy (2.27) and squatting positions (2.48) was significantly less than that in sitting (5.33) position ($P = 0.001$) during the latent phrase of the second-stage of labor. while in the active phrase of the second-stage of labor, pain severity was significantly less in squatting position (6.14) compared to the other two positions (7.59 and 7.41 in sitting and lithotomy positions, respectively) ($P = 0.024$) [16]. Their findings revealed that squatting position may be conducive to less labor pain. Similarly, Moraloglu et al. found that healthy primiparas allocated to squatting position had lower level of labor pain and more satisfaction than those in supine positions [45]. A possible explanation for the mitigated labor pain in squatting position may be the shortened labor. When the duration is reduced, consequently, less pain was felt by women [15], this can also be applied to interpret the reduced pain in other upright positions.

Apart from squatting position, sitting position may also play a role in reducing labor pain. A Indian study indicated that a semi-sitting position was correlated with less labor pain [54]. In this study, they compared pain level using visual analogue scale among primiparas, the authors found that the mean value of pain level in semi-siting group (3.4) was lower than the supine group (7.86)($P < 0.05$), and the difference was statistically significant [54]. Another Chinese study focused on maternal outcomes of supported sitting position with leaning forward manner at the end of active stage and the beginning of the second-stage of labor, their findings showed that women assuming sitting position had less labor pain than those in supine position [55]. The mechanism of action for relieving labor pain in sitting position are as follows: firstly, like all the upright positions, sitting position can avoid the pressure from the weight of uterus on the waist, which may relieve back pain [33,47,55]; secondly, a growing body of evidence suggested that sitting position with a birth seat can give women a greater sense of control and better self-efficacy, which may theoretically reduce woman's pain perception thereby relieving the labor pain [1,46]; third, the reduced labor pain could be a consequence of shortened labor.

In terms of supine position, there is conclusive evidence against the adoption of such position as well as lithotomy position. when assuming supine position, it can make women feel helpless and limits her possibility to move freely [43]. Accordingly, making it more difficult for women to cope with labor pain. Supine positions and lithotomy positions, are devoid of the favorable psychological and physical mechanisms to reduce labor pain. In addition, there may be more direct pressure from the fetal head on the vaginal wall in supine position, and this can increase pain [43].

3.3. Reducing perineal trauma

Most women undergoing vaginal birth may sustain some degree of perineal trauma [56–59], which can result in both short- and long term morbidities after delivery [58,60,61]. Regarding these complications caused by perineal trauma, promoting perineal integrity and preventing perineal trauma are the major focuses of midwifery care during the second-stage of labor.

The perineal trauma is classified into four degrees. The first-degree tear is defined as injury to perineal skin and/or vaginal mucosa; the second-degree tear involves perineal muscles; third-degree tear involves the anal sphincter complex; the anal sphincter complex and anorectal mucosa. Obstetric anal sphincter injuries (OASIS) encompass both third- and fourth-degree perineal tears [62]. The two leading causes of perineal trauma are natural tears and episiotomy [63].

Maternal positions known to preventing perineal trauma include certain kinds of upright positions and lateral position, whereas lithotomy and supine position are regarded as risk factors for severe perineal trauma. The cochrane review based on women without epidural anaesthesia reported that upright positions were associated with reduced episiotomies (average *RR* 0.75, 95% CI:0.61–0.92), possible increased second degree perineal tears (*RR* 1.20, 95% CI 1.00–1.44) when compared with supine position during the second-stage of labor, and there was no difference in the third- and fourth-degree tears between them(*RR* 0.72, 95% CI 0.32–1.65) [14].

When it comes to squatting position and sitting position, however, there is no consensus on the protective effect of these positions on reducing perineal trauma. Elvander et al. examined the association between maternal positions and OASIS based on 113, 000 spontaneous births [21]. In their study, they found a twofold higher risk for OASIS (*RR*:2.16, 95%CI:1.15–4.07) in multiparas adopting squatting position as compared to those in sitting position through the second-stage of labor [21]. These results are consistent with those of another study, in which women have a greater risk of OASIS in squatting position(*OR* 2.92, 95%CI 1.04–8.18) during childbirth compared with reference group on bed (woman lies on bed with the trunk position at 45–60° to the horizontal or in a lateral-recumbent position) or water births [64]. Overall, it could conceivably be hypothesized that women assume squatting position during the second-stage of labor are more likely to suffer from OASIS. The possible reason for increased perineal trauma in squatting position may be the difficulty for midwives in controlling extension of fetal head [1]; Besides, women may experience a triggered stimulus to push in final phase of the second-stage of labor [64].

With respect to sitting position, it is somewhat surprising that connection exists between birth seat and perineal trauma among multiparas. Elvander et al. reported that the use of birth seat during the second-stage of labor increases the risk of OASIS among multiparas (adjusted *RR* 1.36, 95% CI:1.03–1.80) [21]. In a Swedish study conducted by Thies-Lagergren et al., they noted that birth seat did not entail increased risk of adverse perineal outcome in primiparas and it may even be protective against episiotomies [23]. The different perineal outcomes between multiparas and primiparas using the birth seat are probably due to the shorter duration of the second-stage of labor in multiparas in combination with more effective push efforts in birth seat, which may result in a suddenly forceful pressure on the premium. Moreover, sitting with birth seat as a position where severe tearing can occur when midwife is not skilled or careful [41]. Still, further research on birth seat is needed.

As far as perineal trauma is concerned, several attempts have been made to examine the protective maternal position during the second-stage of labor. A considerable amount of literature has been

published on protective effects of kneeling position and lateral position on perineum. Since lateral positions represent an established protective factor for perineum [21,30,65,66], we put major focus on kneeling position.

With regard to kneeling position, the Irish and New Zealand expert midwives favor the all-fours position for preserving the perineum intact at birth, for both greater visualization of and reduced pressure on the perineum [67]. Further, kneeling position enables the woman to move more freely and there is no external pressure on the pelvis [42]. Several studies offered some important insights into the effects of kneeling position on perineal outcomes. In a study from Norway, kneeling position was associated with the lowest risk of OASIS (adjusted *OR*: 0.15; 95% CI: 0.03 to 0.70) when compared with semi-recumbent positions (includes birth seat squatting position) [43]. A randomized controlled trial conducted in China which compared maternal and neonatal outcomes between hands-and-knees position and supine position, the authors found that the women giving birth in hands-and-knees position had lower rates of episiotomy and second-degree perineum laceration (including episiotomy), and higher rates of intact perineum and first-degree perineal tears when compared with those in supine position [68]. Contrary to these positive findings, Haslinger et al. noted an increased risk of perineal trauma in kneeling position (*OR* 2.14, 95%CI:1.05–4.37) compared with the reference group on bed [64]. This discrepancy could be attribute to the different placement of kneeling position [43]. In Haslinger's study, delivery in the kneeling position was performed on the bed, which may influence the tension in the thighs and buttocks to stay balanced, and kneeling on bed also affect the relaxation of the pelvic floor muscles and limits woman's freedom to move [43].

To date, convincing evidence has been found associating lithotomy and supine positions with perineal trauma. Hence, there is little doubt that lithotomy and supine position should be avoided during the second-stage of labor.

Lithotomy position has been identified as a risk factor for severe perineal tears [20]. A Western Australian retrospective cohort study reported that the women who sustained severe perineal trauma during childbirth are more likely to give birth in lithotomy position [19]. The prevalence of OASIS is relatively high among women who give birth in lithotomy position. In a population-based study of 113 000 spontaneous births, the prevalence of OASIS among 850 primiparas assuming lithotomy position was 7.1%, whereas in 194 multiparas, the prevalence was 2.6%, both were the highest when compared with other positions [21]. Another study from French involved 3717 births, the rate of OASIS among 28 women who adopted lithotomy position was 32.1%, which was the highest one [43]. The increased risk of OASIS under lithotomy position may due to the stress and tension on the perineum with one's leg abducted in an exaggerated manner [1]. Further, lithotomy position can cause greater pressure on the sphincter during the expulsion of the fetus [21]. Nevertheless, it may be reasonable to assume that the vast majority of women with high risk pregnancy would give birth in lithotomy position. Lithotomy position allows easy access for the midwife or obstetrician to monitor the fetus and facilitate hands-on approaches to manage perineum [21,32], this may partly explain the correlation between OASIS and lithotomy position. The same as lithotomy positions, supine position may increase the risk of OASIS [43], due to the important stretching of perineal muscle [22].

3.4. Decreasing blood loss

Postpartum hemorrhage is the leading cause of maternal mortality worldwide [69,70]. The American College of Obstetricians and Gynecologists' (ACOG) defined postpartum hemorrhage as cumulative blood loss greater than or equal to 1,000 ml or blood loss accompanied by signs or symptoms of hypovolemia within 24 h after the birth process (includes intrapartum loss) regardless of route of delivery, they also stated blood loss greater than 500 ml should be considered as abnormal [71].

In the recent decades, one concerns raised about the possible greater blood loss in upright positions during the second-stage of labor, although these positions have been recommended as the most favorable positions to adopt during the second-stage of labor.

A recent cochrane review based on women without epidural analgesia reported that upright positions were associated with an increased estimated blood loss greater than 500 ml (*RR*:1.48, 95% CI 1.10–1.98) when compared with supine positions, and they also found that there was no clear difference in blood loss between upright positions and supine positions when low quality trials were excluded from the analysis (*RR* 1.59, 95% CI 0.90–2.80) [14]. Another meta-analysis, which based on the same population, the authors found that upright positions slightly increased the postpartum hemorrhage ratio (*RR*:1.389, 95%CI 1.123–1.717) [72].

In regard to some specific upright positions, for instance, sitting position with a birth seat may increase blood loss. A randomized controlled trial from Sweden confirmed that the women giving birth with birth seat had blood loss greater than 500 ml when compared with birth in any other position (*RR*1.20, 95% CI 1.03–1.41), but there was no difference in bleeding over 1000 ml (*RR*1.13, 95%CI 0.94–1.47) [23]. Nonetheless, the authors stated that the blood loss under 1000 ml can be considered as physiological in healthy population [23]. Other two studies examined the hands and knees position and squatting position respectively, they did not find any difference in the amount of postpartum bleeding [45,68].

3.5. Promoting fetal and newborn well-being

Promoting fetal and newborn well-being are essential components of midwifery management, which are paramount for women and their families. In order to improve neonatal outcomes, Midwives should avoid unfavorable maternal positions that may jeopardize fetal or newborn well-being in their efforts.

It is suggested that upright positions and lateral position may potentially be conducive to improved neonatal outcomes, whereas lithotomy and supine position should be avoided for their possible deleterious effects.

Gupta at al conducted a cochrane review, which showed that fewer abnormal fetal heart rate patterns were recorded in the upright position (*RR* 0.46, 95% CI 0.22–0.93), but there was no clear difference in numbers of babies admitted to neonatal intensive care whose mothers gave birth in upright and supine positions (*RR* 0.79, 95% CI 0.51–1.21) [14]. In another study which concerned the labor augmentation and fetal outcomes in relation to maternal positions, albeit the transfers to the neonatal intensive care unit (NICU) did not differ statistically significant among various maternal positions(*RR*:0.94; 95%CI 0.64–0.36), the authors noted that among two-thirds of the infants who were transferred to the NICU, 70% of their mothers were either in a semi-recumbent position ($n = 5$) or in supine with stirrups ($n = 17$) during the childbirth [73]. Moreover, the results from an Australian study indicated women who gave birth in semi-recumbent position, their babies had more Apgar scores <7 at 5 min [74].

Although there is a dearth of data to identify the most beneficial maternal position to promote fetal or newborn well-being, the advantages of upright positions and lateral positions in terms of fetal heart rate patterns are evidenced by the theoretical mechanism.

When women assuming lithotomy or supine positions during labor, their intra-abdominal vessels may be compressed; accordingly, leading inadequate maternal flow into the placental and

causing uteroplacental perfusion declined; thus, more fetal heart rate abnormalities occurred [1,33,47]. Conversely, upright positions and lateral position may avoid compression of intra-abdominal vessels, especially the inferior vena cava thereby fewer fetal heart rate patterns are found in these positions.

3.6. Treating certain obstetrics complications

Beyond the impacts on maternal and neonatal outcomes, maternal positions have been envisioned as postural treatments to certain obstetric complications, such as shoulder dystocia and fetal occiput posterior position. Although there is relatively little information to draw any conclusions about the effectiveness of maternal position in treating shoulder dystocia and fetal posterior position, maternal positions remain a strategy of potential benefits.

All fours position is regarded as a possible method in resolving shoulder dystocia. The American College of Obstetricians and Gynecologists (ACOG) suggested that all fours position (Gaskin all-fours maneuver) may be useful in relieving shoulder dystocia for women without anaesthesia [75]. In a Dutch study, the all fours position was executed as a maneuver for the management of shoulder dystocia, it was the second most used maneuver overall (26.6%) after the failure of initial McRoberts maneuver [17]. In this study, the authors reported that all fours maneuver was the first maneuver in 17/64 cases (26.6%) with a success rate of 29.4% [17]. Although the precise mechanism for the disimpaction of the shoulders in all fours position is not clear, there are some possible explanations. First, the movement to all fours position may dislodge the impacted shoulder [33,75]. Second, all fours position can contribute to the widest pelvic outlet [33,68]. Third, when there is bilateral impaction of the shoulders, the gravity of the fetus may work to move the posterior shoulder forward over the sacral promontory [33].

Apart from shoulder dystocia, several studies investigated the effects of maternal positions on facilitating spontaneous fetal rotation to occiput anterior position (OA) [18,39]. For example, lateral positions may serve as a non-medical intervention to enhance the rotation of an occiput posterior fetus.

A modified Sims position on the side of the fetal spine was used in a Spanish study which recruited pregnant women with epidural analgesia, it turned out that the spontaneous rotation of the fetal head to occiput anterior occurred in 50.8% of the Sims position group, and in 21.7% of the free position group [18]. However, in another study, Le Ray et al. failed to prove the effectiveness of lateral position in fetal occiput posterior position [39]. They found the occiput anterior rates did not differ significantly between the lateral position(which termed lateral asymmetric decubitus posture by the authors) and supine position(dorsal recumbent) groups at complete cervical dilation (43.7% vs 43.2%, respectively; $P = 0.565$) or at birth (83.1% vs 86.4%, respectively; $P = 0.436$) [39]. Le Ray et al. concluded that short duration of the maternal posturing could be an explanation for their negative results, because both maternal position and uterine contractility play important roles in the induction of fetal head rotation [39].

The related maternal and neonatal outcomes of different maternal positions during the second-stage of labor are summarized in Table 2.

Table 2
The related maternal and neonatal outcomes of different maternal positions during the second-stage of labor.

Maternal position	Related maternal and neonatal outcomes
Lithotomy positions	Obstetric anal sphincter injury [21,43]
	Abnormal fetal heart rate [14]
Supine positions	Urinary incontinence [22]
	Abnormal fetal heart rate [14]
	Obstetric anal sphincter injury [43]
Lateral positions	Fewer perineal tears [21,30,66]
Sitting positions	Less labor pain [54]
	Increased blood loss [23]
	Shortened the second-stage of labor [47]
	Obstetric anal sphincter injury [21]
	Fewer episiotomies [76]
Kneeling positions	Fewer episiotomies [68]
	Shortened the second-stage of labor [68]
	Fewer perineal tears [43]
Squatting positions	Fewer perineal tears [43]
	Shortened the second-stage of labor [15,45]
	Less labor pain [16]

4. Conclusion

Over the course of the second-stage of labor, upright and lateral positions may have more potential benefits in improving maternal and neonatal outcomes and dealing with certain obstetric complications. However, when women give birth in upright position, especially in squatting and sitting position, midwives should pay close attention to the perineum to prevent perineal trauma. Furthermore, since extant evidence indicated that upright positions may correlate with blood loss greater than 500 ml, midwives should take this into account and be prepared to any emergencies. In terms of supine and lithotomy positions, unless women feel comfortable in these positions, otherwise lithotomy and supine position should be avoided for the increased risk of severe perineal trauma, comparatively longer labor, greater pain, and more fetal heart rate patterns.

Midwives play a pivotal role in caring and supporting women during the childbirth, therefore, in order to support an optimal labor for the women, fetus and newborn, midwives should master the skills and techniques needed to apply different maternal positions and provide relevant knowledge of maternal positions to women.

Conflicts of interest

There is no conflict of interest to declare.

Funding

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2019.06.007.

References

[1] King TL, Brucker MC, Jevitt CM, Osborne K. Varney's midwifery. sixth ed. Burlington: Jones& Bartlett Learning; 2018.
[2] Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, et al. Williams obstetrics. 25th ed. United States of America: McGraw-Hill Education; 2018.
[3] Kopas ML. A review of evidence-based practices for management of the second stage of labor. J Midwifery Women's Health 2014;59(3):264–76.
[4] Looft E, Simic M, Ahlberg M, Snowden JM, Cheng YW, Stephansson O. Duration of second stage of labour at term and pushing time: risk factors for postpartum haemorrhage. Paediatr Perinat Epidemiol 2017;31(2):126–33.
[5] Altman M, Sandstrom A, Petersson G, Frisell T, Cnattingius S, Stephansson O. Prolonged second stage of labor is associated with low Apgar score. Eur J Epidemiol 2015;30(11):1209–15.
[6] Quinones JN, Gomez D, Hoffman MK, Ananth CV, Smulian JC, Skupski DW, et al. Length of the second stage of labor and preterm delivery risk in the subsequent pregnancy. Am J Obstet Gynecol 2018;219(5):467e1–8.
[7] Cheng YW, Caughey AB. Defining and managing normal and abnormal second

stage of labor. Obstet Gynecol Clin N Am 2018;44(4):547–66.
[8] Grantz KL, Sundaram R, Ma L, Hinkle S, Berghella V, Hoffman MK, et al. Reassessing the duration of the second stage of labor in relation to maternal and neonatal morbidity. Obstet Gynecol 2018;131(2):345–53.
[9] Sandstrom A, Altman M, Cnattingius S, Johansson S, Ahlberg M, Stephansson O. Durations of second stage of labor and pushing, and adverse neonatal outcomes: a population-based cohort study. J Perinatol 2017;37(3):236–42.
[10] WHO Reproductive Health Library. WHO recommendation on birth position (for women without epidural analgesia). Geneva: World Health Organization; 2018. https://extranet.who.int/rhl/topics/preconception-pregnancy-childbirth-and-postpartum-care/care-during-childbirth/care-during-labour-2nd-stage/who-recommendation-birth-position-women-without-epidural-analgesia. [Accessed 20 April 2019].
[11] National Collaborating Centre for Women's and Children's Health. Intrapartum Care:Care of healthy women and their babies during childbirth. NICE; 2017. Clinical Guideline 190:Methods, evidence and recommendations, https://www.nice.org.uk/guidance/cg190/evidence/full-guideline-pdf-248734770. [Accessed 20 April 2019].
[12] Nieuwenhuijze MJ, de Jonge A, Korstjens I, Bude L, Lagro-Janssen TL. Influence on birthing positions affects women's sense of control in second stage of labour. Midwifery 2013;29:e107–14.
[13] Carquillat P, Boulvain M, Guittier MJ. How does delivery method influence factors that contribute to women's childbirth experiences? Midwifery 2016;43:21–8.
[14] Gupta JK, Sood A, Hofmeyr GJ, Vogel JP. Position in the second stage of labour for women without epidural anaesthesia. Cochrane Database Syst Rev 2017;5:CD002006.
[15] Dani A, Badhwar VR, Sawant G, Salian SC. Comparative study of squatting position vs dorsal position during second stage of labor. J Evidence Based Med Healthcare 2015;2(54):8769–73.
[16] Valiani M, Rezaie M, Shahshahan Z. Comparative study on the influence of three delivery positions on pain intensity during the second stage of labor. Iran J Nurs Midwifery Res 2016;21(4):372–8.
[17] Kallianidis AF, Smit M, Van Roosmalen J. Shoulder dystocia in primary midwifery care in The Netherlands. Acta Obstet Gynecol Scand 2016;95(2):203–9.
[18] Bueno-Lopez V, Fuentelsaz-Gallego C, Casellas-Caro M, Falgueras-Serrano AM, Crespo-Berros S, Silvano-Cocinero AM, et al. Efficiency of the modified Sims maternal position in the rotation of persistent occiput posterior position during labor: a randomized clinical trial. Birth 2018;45(4):385–92.
[19] Hauck YL, Lewis L, Nathan EA, White C, Doherty DA. Risk factors for severe perineal trauma during vaginal childbirth: a Western Australian retrospective cohort study. Women Birth 2014;28(1):16–20.
[20] Frigerio M, Manodoro S, Bernasconi DP, Verri D, Milani R, Vergani P. Incidence and risk factors of third- and fourth-degree perineal tears in a single Italian scenario. Eur J Obstet Gynecol Reprod Biol 2018;221:139–43.
[21] Elvander C, Ahlberg M, Thies-Lagergren L, Cnattingius S, Stephansson O. Birth position and obstetric anal sphincter injury: a population-based study of 113 000 spontaneous births. BMC Pregnancy Childbirth 2015;15(252):1–9.
[22] Serati M, Di Dedda MC, Bogani G, Sorice P, Cromi A, Uccella S, et al. Position in the second stage of labour and de novo onset of post-partum urinary incontinence. Int Urogynecol J 2016;27(2):281–6.
[23] Thies-Lagergren L, Kvist LJ, Christensson K, Hildingsson I. No reduction in instrumental vaginal births and no increased risk for adverse perineal outcome in nulliparous women giving birth on a birth seat: results of a Swedish randomized controlled trial. BMC Pregnancy Childbirth 2011;(22):1–9.
[24] Liu YC. Position during labor and delivery : history and perspective. J Nurse Midwifery 1979;24(3):23–6.
[25] Dunn PM. Francois Mauriceau (1637-1709) and maternal posture for parturition. Arch Dis Child 1991;66:78–9.
[26] Technical Working Group. Care in normal birth: a practical guide. Birth 1991;24(2):21–123. World Health Organization 7.
[27] Desseauve D, Fradet L, Lacouture P, Pierre F. Position for labor and birth: state of knowledge and biomechanical perspectives. Eur J Obstet Gynecol Reprod Biol 2017;208:46–54.
[28] Atwood RJ. Parturitional posture and related birth behavior. Acta Obstet Gynecol Scand 1976;55:3–25.
[29] Zhang HY, Shu R, Zhao NN, Lu YJ, Chen M, Li YX, et al. Comparing maternal and neonatal outcomes between hands-and-knees delivery position and supine position. Int J Nurs Sci 2016;3(2):178–84.
[30] Long XL, Lin Y. Effect of lateral birth positions on mother and fetus: a meta-analysis. J Nursing Sci 2018;33(13):96–100 [in Chinese].
[31] Barasinski C, Debost-Legrand A, Lemery D, Vendittelli F. Practices during the active second stage of labor: a survey of French midwives. Midwifery 2018;60:48–55.
[32] Santos RC, Riesco ML. Implementation of care practices to prevent and repair perineal trauma in childbirth. Rev Gaucha Enferm 2016;37(spe). e68304.
[33] Simkin P, Handson L, Ancheta R. The labor progress handbook: early interventions to prevent and treat dystocia. 4 th ed. Hoboken: John Wiley&Sons; 2017.
[34] Miller S, Abalos E, Chamillard M, Ciapponi A, Colaci D, Comandé D, et al. Beyond too little, too late and too much, too soon: a pathway towards evidence-based, respectful maternity care worldwide. The Lancet 2016;388(10056):2176–92.
[35] WHO recommendations. Intrapartum care for a positive childbirth experience. Geneva: World Health Organization; 2018. https://apps.who.int/iris/bitstream/handle/10665/260178/9789241550215-eng.pdf. [Accessed 20 April 2019].
[36] Zileni BD, Glover P, Jones M, Teoh K, Zileni CW, Muller A. Malawi women's knowledge and use of labour and birthing positions: a cross-sectional descriptive survey. Women Birth 2017;30(1):e1–8.
[37] Withers M, Kharazmi N, Lim E. Traditional beliefs and practices in pregnancy, childbirth and postpartum: a review of the evidence from Asian countries. Midwifery 2018;56:158–70.
[38] Declercq ER, Sakala C, Corry MP, Applebaum S, Herrlich A. Major survey findings of listening to mothers(SM) III: pregnancy and birth: report of the third national U.S. Survey of women's childbearing experiences. J Perinat Educ 2014;23(1):9–16.
[39] Le Ray C, Lepleux F, De La Calle A, Guerin J, Sellam N, Dreyfus M. Lateral asymmetric decubitus position for the rotation of occipito-posterior positions: multicenter randomized controlled trial EVADELA. Am J Obstet Gynecol 2016;215(4):511e1–7.
[40] Barasinski C, Debost-Legrand A, Lemery D, Vendittelli F. Positions during the first stage and the passive second stage of labor: a survey of French midwives. Midwifery 2018;56:79–85.
[41] Edqvist M, Radestad I, Lundgren I, Mollberg M, Lindgren H. Practices used by midwives during the second stage of labor to facilitate birth - are they related to perineal trauma? Sex Reprod Healthc 2018;15:18–22.
[42] Johansson M, Thies-Lagergren L. Swedish fathers' experiences of childbirth in relation to maternal birth position: a mixed method study. Women Birth 2015;28(4):e140–7.
[43] Tunestveit JW, Baghestan E, Natvig GK, Eide GE, Nilsen ABV. Factors associated with obstetric anal sphincter injuries in midwife-led birth: a cross sectional study. Midwifery 2018;62:264–72.
[44] Lin YC, Gau ML, Kao GH, Lee HC. Efficacy of an ergonomic ankle support aid for squatting position in improving pushing skills and birth outcomes during the second stage of labor: a randomized controlled trial. J Nurs Res 2018;26(6):376–84.
[45] Moraloglu O, Kansu-Celik H, Tasci Y, Karakaya BK, Yilmaz Y, Cakir E. The influence of different maternal pushing positions on birth outcomes at the second stage of labor in nulliparous women. J Matern Fetal Neonatal Med 2017;30(2):245–9.
[46] Thies-Lagergren L, Hildingsson I, Christensson K, Kvist LJ. Who decides the position for birth? A follow-up study of a randomised controlled trial. Women Birth 2013;26(4):e99–104.
[47] Gizzo S, Di Gangi S, Noventa M, Bacile V, Zambon A, Nardelli GB. women's choice of positions during labour: return to the past or a modern way to give birth? A cohort study in Italy. BioMed Res Int 2014;2014(638093):1–7.
[48] Reitter A, Daviss BA, Bisits A, Schollenberger A, Vogl T, Herrmann E, et al. Does pregnancy and/or shifting positions create more room in a woman's pelvis? Am J Obstet Gynecol 2014;211:662e1–9.
[49] Lawrence A, Lewis L, Hofmeyr GJ, Styles C. Maternal positions and mobility during first stage labour. Cochrane Database Syst Rev 2013;8:CD003934.
[50] Cao HX, Li WW, Li Y. The comparison of the impacts on childbirth between a modified position and free positions during second-stage labor. Journal of Qilu Nursing 2014;20(8):122–3 [in Chinese].
[51] Klompa T, Witteveen AB, de Jonge A, Huttona EK, Lagro-Janssen AL. A qualitative interview study into experiences of management of labor pain among women in midwife-led care in The Netherlands. J Psychosom Obstet Gynaecol 2017;38(2):94–102.
[52] Klomp T, Mannien J, de Jonge A, Hutton EK, Lagro-Janssen AL. What do midwives need to know about approaches of women towards labour pain management? A qualitative interview study into expectations of management of labour pain for pregnant women receiving midwife-led care in The Netherlands. Midwifery 2014;30(4):432–8.
[53] Garthus-Niegel S, Knoph C, von Soest T, Nielsen CS, Eberhard-Gran M. The role of labor pain and overall birth experience in the development of post-traumatic stress symptoms: a longitudinal cohort study. Birth 2014;41(1):108–15.
[54] Santhi Anuratha, Kokilavani. Effectiveness of semi sitting position during 2nd stage of labour on maternal and neonatal outcomes among primigravida. Nurs J India 2012;103(6):272–5.
[55] Hu XN, Lin SQ, Yu LZ. Influence of supported sitting up position with leaning forward manner at the end of active stage and the beginning of second stage of labor on maternal delivery outcome. J Nursing Sci 2016;31(18):49–51 [in Chinese].
[56] AasheimV, Nilsen ABV, Reinar LM, Lukasse M. Perineal techniques during the second stage of labour for reducing perineal trauma. Cochrane Database Syst Rev 2017;6:CD006672.
[57] Vieira F, Guimarães JV, Souzab MC, Sousa PM, Santosc RF, Cavalcantea AM. Scientific evidence on perineal trauma during labor: integrative review. Eur J Obstet Gynecol Reprod Biol 2018;223:18–25.
[58] Bulchandani S, Watts E, Sucharitha A, Yates D, Ismaila KM. Manual perineal support at the time of childbirth: a systematic review and meta-analysis. BJOG 2015;122:1157–65.
[59] Edqvist M, Hildingsson I, Mollberg M, Lundgren I, Lindgren H. Midwives' management during the second stage of labor in relation to second-degree tears—an experimental study. Birth 2017;44(1):86–94.

[60] Abedzadeh-Kalahroudi M, Talebian A, Sadat Z, Mesdaghinia E. Perineal trauma: incidence and its risk factors. J Obstet Gynaecol 2019;39(2):206–11.
[61] Diko S, Guiahi M, Nacht A, Connell KA, Reeves S, Bailey BA, et al. Prevention and management of severe obstetric anal sphincter injuries (OASIs): a national survey of nurse- midwives. Int Urogynecol J 2019. https://doi.org/10.1007/s00192-019-03897-x.
[62] The management of third-and fourth-degree perineal tears:green-top guideline No 29. Royal College of Obstetricians and Gynaecologists; 2015. The Management of Third- and Fourth-Degree Perineal Tears:Green-top Guideline No. 29.June, https://www.rcog.org.uk/globalassets/documents/guidelines/gtg-29.pdf. [Accessed 20 April 2019].
[63] Ugwu EO, Iferikigwe ES, Obi SN, Eleje GU, Ozumba BC. Effectiveness of antenatal perineal massage in reducing perineal trauma and post-partum morbidities: a randomized controlled trial. J Obstet Gynaecol Res 2018;44(7):1252–8.
[64] Haslinger C, Burkhardt T, Stoiber B, Zimmermann R, Schaffer L. Position at birth as an important factor for the occurrence of anal sphincter tears: a retrospective cohort study. J Perinat Med 2015;43(6):715–20.
[65] Meyvis I, Van Rompaey B, Goormans K, Truijen S, Lambers S, Mestdagh E, et al. Maternal position and other variables: effects on perineal outcomes in 557 births. Birth 2012;39(2):115–20.
[66] Suzuki S. Birthing postures and birth canal lacerations. J Matern Fetal Neonatal Med 2017;30(10):1243–6.
[67] Smith V, Guilliland K, Dixon L, Reilly M, Keegan C, McCann C. Irish and New Zealand Midwives' expertise at preserving the perineum intact (the MEPPI study): perspectives on preparations for birth. Midwifery 2017;55:83–9.
[68] Zhang HY, Huang SR, Guo XL, Zhao NN, Lu YJ, Chen M, et al. A randomised controlled trial in comparing maternal and neonatal outcomes between hands-and-knees delivery position and supine position in China. Midwifery 2017;50:117–24.
[69] Say L, Chou D, Gemmill A, Tunçalp Ö, Moller A, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. The Lancet Global Health 2014;2(6):e323–33.
[70] Shakur H, Roberts I, Fawole B, Chaudhri R, El-Sheikh M, Akintan A, et al. Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial. Lancet 2017;389:2105–16.
[71] American College of Obstetricians and Gynecologists. Postpartum hemorrhage. Practice bulletin No. 183. Obstet Gynecol 2017;130:e168–86.
[72] Deliktas A, Kukulu K. A meta-analysis of the effect on maternal health of upright positions during the second stage of labour, without routine epidural analgesia. J Adv Nurs 2018;74(2):263–78.
[73] Thies-Lagergren L, Kvist LJ, Sandin-Bojo AK, Christensson K, Hildingsson I. Labour augmentation and fetal outcomes in relation to birth positions: a secondary analysis of an RCT evaluating birth seat births. Midwifery 2013;29(4):344–50.
[74] Dahlen HG, Dowling H, Tracy M, Schmied V, Tracy S. Maternal and perinatal outcomes amongst low risk women giving birth in water compared to six birth positions on land. A descriptive cross sectional study in a birth centre over 12 years. Midwifery 2013;29:759–64.
[75] American College of Obstetricians and Gynecologists. Shoulder dystocia. Practice bulletin No. 178. Obstet Gynecol 2017;129:e123–33.
[76] Warmink-Perdijk WDB, Koelewijn JM, de Jonge A, van Diem MT, Lagro-Janssen ALM. Better perineal outcomes in sitting birthing position cannot be explained by changing from upright to supine position for performing an episiotomy. Midwifery 2016;34:1–6.