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Review of Literature on Efficacy and Safety of Birthing Positions with Emphasis on International Cultural Influences on Obstetric Care

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Purpose Statement

The birthing convention in the U.S. is such that most individuals give birth supine in a hospital bed, without the knowledge that there are alternative positions available. Globally, the physical position of the birthing person during labor is often influenced by personal preference, medical indication, hospital guidelines, and cultural beliefs and expectations. To understand the complex and multifaceted landscape of best practices regarding birthing position, this clinical topic review of vaginal birthing positions in the second stage of labor will detail risks and benefits, explore limitations to implementation, and provide a knowledge base to assist providers in counseling their patients on the selection of an optimal birthing position. Medical providers must be readily prepared with clinical evidence describing various birthing positions to best counsel their patients during labor and delivery and to understand when non-supine birthing positions may be an acceptable or optimal alternative to the norm.

Abstract

Background: When examining most non-Westernized societies, parturients hold all the power in the birthing space with traditional birth attendants and medical staff serving as guiding forces and protectors, not directors of the process. Social media in Western countries is filled with stories from birthing people who felt unsupported, ignored, or discriminated against by their healthcare providers; this is particularly prevalent in parturients who express a preference for non-supine birthing positions. *Methods*: This work is a review of the existing body of literature on quantitative and qualitative outcome measures of alternative birthing positions. In total, 44 articles were analyzed and synthesized exploring second-stage labor duration, maternal hemorrhage, neonatal APGAR scores, and perineal injury. *Results*: Quantitative outcome measures of perineal injury, duration of second-stage labor, and immediate postpartum maternal and neonatal outcomes demonstrated notable heterogeneity. There is no consensus that alternative birthing positions are more harmful than non-flexible sacrum positions. The existing body of evidence concludes that flexible sacrum positions are favorable for decreased second-stage duration. The data on neonatal outcomes, parturient outcomes, and perineal injury between sacrum-flexible and non-sacrum-flexible positions is heterogeneous. *Conclusion*: There is no significant trend in medical evidence to suggest increased risk in alternative, flexible-sacrum positions. Birth outcomes are multivariable, and any decision-making must be individualized to accommodate the patient's medical status and comfort. It is important to provide pregnant people with evidence-based counseling on potential outcomes associated with a birth position.

Keywords: birthing position, supine, upright, squatting, sacrum-flexible, culture, tradition

Introduction

In the US today, maternal mortality rates are some of the highest in the nation's history at 32.9 deaths per 100,000 live births in 2021[1]; this is a 40% increase from 2020 and an incidence that is ten times that of other comparable high-income nations[2-7]. Despite comprising more than half of the world's population, individuals capable of becoming pregnant continue to be some of the most marginalized in the United States and around the world, bearing the burden of discrimination from basic social disrespect to unthinkable violence.[8,9] The maternal mortality rate is just one instance of this inequity. In industrialized nations, birth has become a medicalized journey. While there are clear benefits, like access to emergency resuscitative services for both parturient and neonate, there is evidence that consequences of this transition include both real and perceived limitations on autonomy.[9] In many ways, the standards of care regarding birthing positions have become disempowering to parturients. In the Western world, patterns of devaluation, silencing, and forcible adjustment of personal choice to accommodate the convenience of health providers is a pervasive burden on parturients[10-14]. This begs the question, to what extent does the lack of comprehensive birthing education, informed consent, and the devaluation of the goals of the parturient in the current American obstetric culture cause the parturient and neonate harm that could be otherwise avoided by improved communication and open-mindedness about the birthing position?

Western medical providers remain largely unaware of the intricacies of global traditional and cultural medical norms, particularly in obstetrics. In doing so, providers predispose themselves to perpetuate biases that limit progress in medicine and directly impact the quality of care provided to their patients. Providers must understand the history, cultural significance, and efficacy of commonly encountered birthing positions, evaluate potential risks and benefits to best

educate their patients, and support them in their ultimate decisions on birthing position. This paper will serve as an introductory examination of birthing positions and the opportunities that should be available to parturients throughout the country, regardless of their background.

The disparity in health outcomes between white parturients and black and brown parturients must be acknowledged; this exists both within the United States and globally.[15,16] The multicultural focus of research and the international origins of the sources included in this review maintain generalizability to the population of parturients in North America, particularly the United States. This focus also gives a platform to the systemically silenced voices of cultural minorities, especially those in colonized nations. This work is unique in its attempt to emphasize non-European sources and decenter Western medicine. This ensures an evaluation of safety and efficacy that is minimally influenced by the Eurocentric norms that have historically overshadowed and erased traditional practices.

It must be recognized that the database search highlighted a scarcity of authenticated high-quality research evidence on traditional health information. With the lack of official documentation of regional traditions, this analysis cannot claim to be a comprehensive understanding of all birthing practices and preferences. Rather, it opens the mind to the vastness of traditional knowledge of physiologic birth and the impossibility of one optimal birthing position.

Also note that the existing body of research on obstetrics refers to birthing individuals using binary terminology (female, woman). These terms are critical identifiers for individuals receiving obstetric care and simultaneously exclude those who have the anatomic and physiologic capability of pregnancy but do not identify as women. The author's original writing will employ more neutral medical terms like parturient to recognize and honor all individuals.

Methods/Evidence Acquisition

Evidence was accessed through a comprehensive search of the Web of Science, Cochrane, and PubMed academic databases using the keyword search “birthing position”. The PICO search criteria used were women of childbearing age; birthing position; upright vs supine; and maternal and neonatal outcomes. MeSH term alternatives and additive keywords included supine, upright, squatting, cultural influence, and traditional birthing practices. Within returned articles, generalized keyword searches for “position”, “birthing position”, “supine”, “upright”, and “squatting”, and the author’s discretion, were used to rule out articles whose topics were not relevant.

Articles evaluating the outcomes of various birthing positions were analyzed if perineal injury, duration of second-stage labor, maternal hemorrhage, or neonatal APGAR scores were used as outcome measures. Exclusionary criteria included any database entries for which only an abstract could be found published online, articles published before 1990, articles for which the research objective(s) lacked relevance to the goal of evaluating the merits of various birthing positions, research involving epidural anesthesia, and articles not published in English. French language articles were an exception as the author is proficient. Special emphasis was placed on articles written about or by non-European and non-North American populations.

Results/Discussion/Evidence Synthesis

Medical Determinations of Safety and Efficacy of Birthing Positions

The extensive anecdotal success of alternative birthing positions in non-Western nations and indigenous communities suggests that, unless medically contraindicated, there is no basis on which to deny an individual their preferred birthing position. To confirm this, an extensive exploration of existing research on the medical implications of various birthing positions will

now be detailed. Duration of second-stage labor, perineal trauma, and maternal and neonatal outcomes will be the primary foci. For ease of analysis, birth positions are categorized into flexible sacrum positions (FSP), which are those that are non-weight-bearing on the sacrum—kneeling, standing, all-fours, squatting, birth seat, and lateral; and non-flexible sacrum positions (NSP), which include semi-recumbent, lithotomy, and supine. These categorizations loosely follow other common divisions of positions, upright/supine and vertical/horizontal.

Duration of the Second Stage of Labor

The duration of the second stage of labor is a valuable index of the efficiency of maternal expulsive efforts and the overall progression of labor. This section will highlight and clarify some inconsistencies within the existing research that compares birthing position and second-stage duration. One review studied a pooled weighted mean difference with a random effect model to find an overall reduction of second-stage duration by 21.118 minutes for those birthing in a flexible sacrum position, 95% CI [11.839-30.396] minutes.[17] Significant heterogeneity was noted between the studies that comprised this final statistical analysis, but this does not curtail the authors' recommendation that individuals should be encouraged to labor in their most comfortable position.[17] A study from Turkey where the squatting birth position is culturally engrained and used nearly universally in the local population demonstrated a mean length of 2nd stage labor that was 34 min shorter when squatting than in a supine position, 21.02 +/- 5.60 min vs 55.40 +/- 6.91 min, $p<0.001$ indicating a statistically significant reduction in labor duration.[18]

Further studies stratified their participants by primiparity and multiparity, finding that the mean second-stage duration of labor was 23 minutes shorter in squatting primiparas than in semi-recumbent primiparas ($p=0.04$) and 13 minutes shorter in squatting multiparas than in semi-recumbent multiparas ($p=0.02$).[19] In a synthesis of 19 trials including 5811 participants, upright

positioning leads to decreased duration of the second stage, with a mean duration of -6.16 minutes, 95% CI [-9.74 to -2.59 minutes], p = 0.0007.[20,21] Note that in this meta-analysis, generalizability is limited by the total sample size and demographics of participants.

The mean duration of the expulsive period was over 3 min shorter among individuals delivering in a vertical rather than horizontal position, though the difference in duration did not reach statistical significance, p=0.06.[22] Another study using the categories sacrum flexible and sacrum non-flexible showed a measurable decrease in duration in sacrum flexible positions, but this result also lacked statistical significance.[23] Other research does not support a significant difference in duration between sacrum flexible and sacrum non-flexible ($p > 0.05$).[24]

The general trend throughout these sources suggests favorable results in terms of statistical significance that suggest advocating for upright or sacrum flexible positions. No adverse effects on the length of the second stage were reported in upright or sacrum flexible positions. As such, providers should encourage mobility in positioning throughout the second stage to maximize comfort in terms of pain perception, the sensation of strength in pushing, the desire for mobility, and other variables[22-24]. Please see Appendix A, Table 1: Duration of Second Stage Labor for a summarization of the literature reviewed.

Immediate Postpartum Maternal and Neonatal Health Indicators

Maternal and neonatal mortality is predicted by hemodynamic outcomes and APGAR scores, respectively. This section evaluates birthing positions in the context of these essential measures of postpartum health to determine the immediate risks and benefits of alternative birthing positions for parturients and neonates postpartum.

The APGAR score, a universal measure for neonatal health upon delivery uses a threshold for poor outcomes of APGAR <7 at 1 and/or 5 minutes after delivery. In upright

delivery positions, 0.3% of neonates had an APGAR score <7 at 1 minute. In supine positions, this incidence was 1.3% ($p>0.05$). Further statistical findings of OR 0.72, 95% CI [0.46 – 1.1326] confirm a nonsignificant trend towards a decreased frequency of APGAR <7 at one minute in vertical position deliveries.[23,24]

Most studies have found no significant difference in neonatal outcomes regardless of parturient delivery position.[23] One found APGAR scores at 1 and 5 minutes to be 8.0 and 8.9, respectively in the vertical delivery position. Neonates delivered in the horizontal position had APGAR scores at 1 and 5 minutes were 7.9 and 9, respectively, with no observed statistically significant difference between the vertical and horizontal groups.[22] In a cohort study of 200, despite all measured neonatal complications having less frequent occurrences in the squatting group, there was still no significant difference in the proportion of infants with 1 and 5-minute APGAR scores less than 7 indicating that there is potential for neonatal benefit from delivery in the squatting position. Further research must be conducted to determine the significance, strength, and generalizability of the data.[19]

This multitude of studies suggests that the birthing position is inconsequential to neonatal outcomes. Other variables that have a greater effect on the neonate include fetal presentation, umbilical cord incidents, or oligohydramnios. Of note, there is one quasi-experimental study of 1190 Ethiopian parturients that did demonstrate statistical significance against the safety of flexible sacrum positions, showing in its data that when delivered in the flexible sacrum positions, 28.3% of neonates had a low APGAR score (<7) as compared to 15.60% in the supine position deliveries RR 0.61, 95%CI [0.42-0.89].[25] While this isolated study is not enough to change the face of obstetric practice, it does alert healthcare providers to proceed with caution and inform the parturient of the potential risks.

Neonatal safety in alternative birthing positions is relatively well-established; parturient safety must also be ensured. In the later stages of pregnancy, pregnant individuals are advised not to lay directly on their backs, and providers are trained to minimize examining the pregnant patient in a supine reclined position.[26-29] Motivation for this standard is multifaceted, but some posit that this practice avoids compression of the inferior vena cava by the distended uterus and fetus.[30-32] Based on this principle, it appears counterintuitive that a supine position is standard during labor when strong, high-volume, consistent blood flow throughout the systemic circuit is essential. Research inquiries bring this very circumstance into question.

By virtue of physiology and gravity, vertical and lateral recumbent positions best support parturient hemodynamics during the delivery process. These avoid compression of major vessels and maximize circulation to the parturient and fetal circulatory systems.[33] Although most parturients in the United States continue to progress through the second stage in the lithotomy position, the use of such supine positions is associated with negative parturient, fetal, and neonatal hemodynamic outcomes.[20]

Hemodynamic optimization by birth position reaches no static conclusion in research, with heterogeneous and conflicting data prevailing. In upright positions, the third stage of labor may be associated with an increased risk of hemorrhage and more blood volume loss, OR = 1.71, CI 95 % [1.31–2.23].[33] Other data suggests that when evaluating parturient blood loss, no significant difference can be found between upright and horizontal positioning. Three of 307 individuals hemorrhaged in the upright position, and 6 of 301 individuals hemorrhaged in the horizontal position ($p > 0.05$).[24] A nonrandomized, controlled clinical trial found that mean blood loss in the supine position was 358 cm^3 compared to non-supine positions at 295 cm^3,[23] and a

randomized clinical trial showed mean blood loss in a vertical position was 554.5g as compared to 516.6g in a horizontal position.[22]

Incidence of hemorrhage has also been studied alongside hemorrhage volume; a 1993 cohort study found the incidence of postpartum hemorrhage was 7.5% in the squatting group and 10% in the semirecumbent group.[19] A 2003 case control study concluded that upright positioning caused only 1% of parturients to lose >500mL of estimated blood volume while supine caused 2% of parturients to lose >500mL of estimated blood volume.[24] In all of these studies, the results continue to be nonsignificant.

Over the same period that the use of sacrum flexible positions as an intervention increased from 1% to 76% frequency, the odds of maternal and neonatal complications decreased by 46% in a controlled cohort study.[34] While this does not guarantee causation, the temporality is convincing to indicate a correlation. In the same study median blood loss was reduced from 200mL to 150mL which was statistically significant with $p<0.001$.[34] Contrarily, a French review of literature in 2005 concluded that in vertical positions, the third stage of labor may be associated with an increased risk of hemorrhage and more blood volume loss, OR = 1.71, CI 95% [1.31–2.23].[33]

Altogether, a review of literature concluded that the existing body of evidence suggests the use of the supine position is associated with more negative parturient, fetal, and neonatal hemodynamic outcomes than sacrum-flexible positions.[20] This review found more statistically insignificant evidence than not, and outcomes were generally heterogeneous. It is still reasonable to state that there is minimal increase in the risk of hemorrhage when comparing supine positioning to upright positioning; the isolated study suggests this adverse outcome should cause providers to use caution and be diligent in monitoring their patients postpartum. Please see

Appendix A, Table 2: Neonatal Outcomes- APGAR Score and Appendix A, Table 3: Maternal Outcomes- Hemorrhage for a summarization of the literature reviewed.

Perineal Trauma and OASI

Neonatal APGAR scores and parturient hemorrhaging predominate the monitoring and examination objectives in the immediate postpartum period, but perineal trauma is a routine complication that also must be addressed. A major concern when considering the recommendation and implementation of upright birthing positions is the incidence of perineal injury, specifically tears. Perineal trauma and obstetric anal sphincter injury (OASI) is an insightful outcome measure based on its clear diagnostic criteria for severity. Even when stratified for other birthing variables like parity, newborn weight, and anesthesia, no clear consensus on the effect of birthing position on the incidence and severity of perineal laceration has been reached.

Non-flexible sacrum positions show some increased risk of tearing in an Ethiopian study population 95%CI [17.8-24.4],[25] corroborated by data from a population of parturients in the Netherlands. In non-flexible sacrum positions, these individuals had the highest rate of 3rd- and 4th-degree tears at 5.6% (p=0.017) compared to parturients delivering in other positions.[35] A measurable trend towards a lower rate of intact perineum postpartum just missed the margin of statistical significance (p=0.056).[35] Lithotomy, specifically, had an increased risk of perineal trauma in both nulliparous and parous Swedish parturients despite stratification, seen as an adjusted RR of 1.17; 95%CI [1.06-1.29] and an adjusted RR of 1.66, 95% CI [1.35-2.05], respectively.[36] Contrarily, a multivariate analysis from Brazilian data suggested the supine position was protective and reduced OASI in the population by 63%, 95%CI [0.22-0.99].[37] Note that the overall relationship between birth position and OASI was non-significant in the Brazilian

population studied, p = 0.458.[37] Despite some conflicting data, patterns of risk may suggest that non-flexible sacrum positions have higher rates of perineal trauma, and may also point to increased severity of the perineal injury.

The same Ethiopian study mentioned above found a significantly decreased incidence of tearing, 95% CI [9.0-15.6][25] in flexible sacrum positions which was corroborated by Swedish parturients who have decreased risk of perineal laceration in specifically the lateral birthing position, adjusted RR 0.79, 95% CI [0.68-0.92].[36] Flexible sacrum positions had no statistical significance in the Brazilian study, showing similar rates of OASI between upright and supine birthing (p=0.120).[37] There was no association between position and sutured perineal injury, OR 1.02, 95% CI [0.86-1.21], and no association with severe perineal trauma, OR 0.68, 95% CI [0.26-1.79.[35] A non-significant trend towards higher intact perineum rate in flexible sacrum positions was seen in the Netherlands, adjusted RR 1.4, 95% CI [0.96-2.04].[38] Other data specifically for parous parturients from the Netherlands population suggested the sitting and squatting positions conveyed an increased risk of perineal injury, adjusted RR 1.36, 95%CI [1.03-1.8] and adjusted RR 2.16, 95%CI [1.15-4.07].[36] In the squatting position, evidence demonstrates significantly less severe and fewer perineal lacerations and fewer medically necessary episiotomies, (p=0.0001).[19,23]

Contradictory evidence suggests an increase in the rate of specifically second-degree perineal tears in a population of parturients using flexible sacrum position, RR 1.63, 95% CI [1.29–2.05].[20] This potential for increased risk in non-flexible sacrum positions is corroborated by multiparous, non-VBAC parturients who utilized a birth seat; significant increases in labial tears 95% CI [1.33-2.33], vaginal tears >3cm, 95%CI [1.29-4.63], and 2nd-degree perineal tears 95% CI [1.13-1.92] were found in those giving birth in a seated position.[39] This same population

experienced significant decreases in intact genital tracts postpartum 95% CI [0.56-0.92].[39] Similar results were found in multiparous VBAC parturients within the same study, with significant increases in 2nd and 3rd-4th degree tears, 95% CI [1.39-12.94] and 95% CI [5.13-65.94], respectively.[39] A significant decrease in those with no perineal tears or episiotomy 95% CI [0.07-0.79] was seen in parturients sitting on a birthing seat.[39] An increased speed of fetal expulsion due to gravity and a hindered ability of the provider to provide physical perineal support or implement other protective measures could explain these results showing more frequent and more severe perineal injury in parturients delivering on a birth seat.

Parity continues to be an essential variable by which to stratify data in a further study evaluating midwife-attended birth. Soong and Barnes show a statistically significant increase in overall perineal trauma requiring sutures in semi-recumbent (NSP) and all-fours positions (FSP) 95% CI [1.01-1.33] and 95% CI [0.62-0.96] respectively. They later note that for nulliparous parturients specifically, the all-fours position (FSP) is significantly protective for perineal laceration requiring sutures 95% CI [0.47-0.93] with no other upright or horizontal positions showing any significant difference.[40] Soong and Barnes note that regardless of clinician advocacy for alternative birthing positions, parturients primarily delivered in a semi-recumbent position, citing a possible lack of appropriate muscular fitness and/or endurance in modern Australian parturients to maintain alternative positions throughout labor.[40] This raises the idea that alternative, and especially upright, birthing positions tend to be prevalent in non-Westernized countries or communities where the average level of physical fitness is often higher due to the daily demands of living activities.

There is no overwhelming evidence across studies and patient populations to indicate that a position should be avoided due to the risk of perineal injury. There is a trend towards increased

incidence and severity of perineal trauma in non-flexible sacrum positions; at a minimum, patients should not be discouraged from attempting alternative positions.

The implications of this evidence are such that providers must be flexible and communicative with their patients, providing sufficient antepartum education on the options for and risks associated with birthing positions. Providers must take on the responsibility of accommodating the dynamic preferences of the parturient during their labor and delivery process. Please see Appendix A, Table 4: Perineal Trauma for a summarization of the literature reviewed.

Social Implications of Opportunities to Utilize Preference in Birthing Position

A focus on the medical implications of birthing positions should not preclude the consideration of the effects on patient satisfaction, provider comfort, demonstration of cultural competency, and the implementation of patient-centered care. The overwhelming consensus from studies of communities around the world is that medicalized birthing environments do not support birthing positions other than supine.[10-12,41-51] This leads to parturients avoiding skilled medical care and seeking the aid of traditional birth attendants, community, and family throughout the labor and delivery process at home.[42,44,45,47,50] This inflexibility in the institutional setting puts individuals at risk by discouraging them from laboring and delivering in a medical facility.

Study participants who birthed in a medical facility alleged their preferences for birthing positions were denied. Some experienced physical abuse or restraint surrounding the circumstances of their positioning. The reality is that denial of a preferred position is an insidious form of obstetric violence and is easily escalated to more overt forms of abuse.[8,9,52,53] Obstetric violence, prevalent globally, finds its foundation in gender, race, and class inequities that erase autonomy and continue to undermine the power of birthing people;[9,53] the normalization and

pervasiveness of this phenomenon beget its perpetuity. There is reason for concern that the basic principle of informed consent is not upheld with regard to patient education on birthing positions.

The relationship between birthing position and culture cannot be understated. This is exemplified by research from Vietnam and Laos, where parturients gave birth in an upright position supported from the back by a birth attendant.[12,41] Similarly in Tanzania, Ghana, Kenya, Mexico, and India birth traditionally occurs in the upright position (sitting, squatting, or kneeling) with the availability of various culturally-specific physical supports like ropes or trees for parturients to hold on to for stability.[13,42-45,47,49-51] After European influence spread through these countries post-colonization, Western medicine overtook these traditional practices and lead to supine positioning being the ubiquitous form of birthing, as few modern parturients know any alternative. Reports cite that parturients' use of the supine position during labor and/or delivery is involuntary,[12,13,46] which may be perceived as a reinforcement of the inherent power imbalance between the provider and the patient.

In qualitative reports, participants cited their perception of pain, strength in pushing, and ease of breathing as reasons for preferring non-supine positions. However, patients' apprehension and aversion towards supine positioning is not exclusively based on their comfort. Rather, their cultural and religious norms require privacy and modesty to maintain dignity; supine, and specifically lithotomy, birthing positions are perceived to violate these standards of behavior.[10,46,51] This incompatibility of cultural norms with a forced birthing position is unacceptable.

The wealth of medical knowledge providers hold should never overshadow the individual's expertise on their own body and lived experience. Further examples of providers

utilizing the power dynamic to their advantage and disempowering their patients are exposed by qualitative research in South Africa.[54] For reasons such as discomfort with deviating from the conventions of the setting in which they work and preconceived fears of alternative birth, South African midwives repeatedly imposed their cultural conventions on the parturients they were serving, disregarding preferences of the parturients' culture.[54]

South Africa is met in this inequity by Brazil, where a study comprised of primarily black and brown parturients found that in antepartum care and labor and delivery, health professionals condescended to the knowledge and preference of indigenous individuals with the desire to birth upright while normalizing birth in lithotomy by referring to the position as "instinctive".[8]

In other cultures, alternative birthing positions are relatively well-known, yet remain under-recommended and even discouraged by healthcare workers in institutions.[55] Research in Central India reports that less than half of nurses recommend squatting positions to laboring people, frequently citing convenience for the provider as motivation for encouraging supine positioning.[55] Other barriers to using alternative birthing positions have been reported as lack of training or experience with delivery in these positions, inadequate facilities or equipment to accommodate various positions or changes in positions, and challenges with communication with the parturient.[56]

This omnipresent refusal to recognize and encourage patient autonomy in birth positioning is concerning at best and a dehumanizing contribution to the pandemic of obstetric violence at worst. Providers must commit to a rights-based approach to birth despite the influence of colonialism and patriarchy that reinforce this power imbalance between provider and patient. Birthing can be approached with humility by the provider as they prioritize their role as birth companions as highly as their role as healthcare professionals. Providers must respect

patient preference to the extent that is medically allowable. Providers also have a responsibility to ensure that the patients can fulfill the essential criteria of informed consent and equitably contribute to shared decision-making.

Conclusion

The implications of the rich cultural diversity of birth position traditions combined with the relatively well-studied but heterogeneous physiologic and psychologic effects of birthing position secure this topic's importance in obstetric discourse for the foreseeable future. Regarding physiologic outcomes for both parturient and neonate, the data shows no clear superior birthing position. The evidence for risk in the alternative, non-supine birthing positions does not show any significant adverse effect as compared to Western traditional supine positioning. As such, alternative positions should not be prohibited.

Emphasizing patient-centered care by comprehensively educating parturients on their labor and delivery position options and supporting parturients' autonomy in selecting a position and maintaining mobility if desired greatly improves patient perceptions of care. Medical providers can use this evidence to counsel their patients on the risks and benefits. Engaging the patient in shared decision-making is a tenet of the patient-centered care concepts so often highlighted in recent medical education. Promoting patient choice in birthing position is a primary way to achieve these goals in the field of obstetrics.

Appendix A: Tables*

**Green = outcome supports safety and efficacy of alternative birthing positions and is statistically significant; Red = outcome does not support safety and efficacy of alternative birthing positions and is statistically significant; Yellow = no difference is noted between position categories or difference in outcome is not statistically significant*

Table 1: Duration of Second Stage Labor

First Author	Year	Study Design	Population (n)	Key Findings	Comments
Berta	2019	review of literature	1680 citations	a pooled weighted mean difference with random effect model to find an overall reduction of the duration of the second stage of labor for those birthing in a flexible sacrum position, with an overall decrease of 21.118(95%CI:11.839-30.396) minutes	
Golay	1993	cohort study	200	Primiparous individuals had a second-stage duration 23 min shorter in squatting than semirecumbent p=0.04; multiparous individuals had a second-stage duration 13 minutes shorter in squatting than semirecumbent p=0.02	
Gupta	2017	review of literature	32	Birthing in an upright position was associated with a mean reduction in duration of second-stage labor of 6.16 seconds (95% CI -9.74 to -2.59 minutes; P = 0.0007)	Interpret this result with caution due to large differences in size and direction of effect in individual studies; this is low quality evidence.
Bodner-Adler	2003	case-control study	307	There was no statistical significance in difference of second-stage duration between the two groups (p > 0.05)	
Bomfim-Hyp polito	2000	randomized clinical trial	248	The mean duration of the second stage was over 3 min shorter in the vertical delivery positions than in horizontal positions; this difference did not reach statistical significance (P=0.06)	
Thies-Lagergr en	2020	prospective cohort study	4663	Using stratified data for analysis, primiparous participants not using a birth seat were in a semi-recumbent position; 44.4% had a second stage duration of 0-29 min, significantly less than 51.8% of primiparous participants who were upright in a birth seat and experienced this short second stage duration (P<0.001). Multiparous participants showed no significant difference in duration of second-stage between positions (p=0.002). Unstratified data showed 70.6% of no birth seat had a 0-29 min second stage, as compared to 64.9% of all participants using a birth seat with p<0.001.	
Huang	2019	review of literature	N/A	Compiling data for meta-analysis suggests that upright positions allows a mean reduction in second-stage labor of 6.6 min when compared to the supine position (95% CI:9.74-2.59)	
Moraloglu	2017	prospective cohort study	102	when comparing squatting and supine positions the mean duration of the squatting group's second-stage of labor was 34 min shorter than in the supine group (21.02 ± 5.60 min versus 55.40 ± 6.91 min; P < 0.001),	
Badi	2022	Quasi-Experi mental	1190	The mean difference between flexible sacrum positioning and the supine position was a 26 min increase in second-stage labor for the supine individuals (p<000, CI: 23-28)	

Table 2: Neonatal Outcomes- APGAR Score

First Author	Year	Study Design	Population (n)	Key Findings	Comments
Badi	2022	Quasi-Experimental	1190	When delivered in the flexible sacrum positions, 28.3% of neonates had a low APGAR score (<7) as compared to 15.60% in the supine position deliveries. RR 0.61 (95%CI: 0.42-0.89).	
Terry	2006	non-randomized, controlled clinical trial	198	Supine positioning APGAR scores at 1- and 5-minutes were 8.1 and 8.9, respectively; Nonsupine APGAR scores at 1- and 5- minutes were 8.4 and 9.2, respectively. There is no statistically significant difference between the groups.	
Bomfim-Hyppolito	1998	randomized clinical trial	248	Vertical positioning APGAR scores at 1- and 5-minutes were 8.0 and 8.9, respectively; Horizontal APGAR scores at 1- and 5- minutes were 7.9 and 9, respectively. There is no statistically significant difference between the groups.	
Golay	1993	cohort study	200	Regardless of delivery position infants demonstrated excellent 1-minute and 5-minute Apgar with no statistical difference	Each of the variables used to measure neonatal complications had less frequent occurrences in the squatting group despite statistical insignificance.
Bodner-Adler	2003	case control study	614	There were no significant differences in rates of APGAR score < 7 at 1 and 5 minutes (1/307 vs. 4/307; 0/307vs. 0/307) between upright and supine positioning at delivery.	

Table 3: Maternal Outcomes- Hemorrhage

First Author	Year	Study Design	Population (n)	Key Findings	Comments
Terry	2006	non-randomized, controlled clinical trial	198	Mean blood loss in the supine position was 358 cm^3 compared to non-supine positions at 295 cm^3.	Blood loss is estimated, which does not lend the measurement to valid statistical analysis.
Bomfim-Hyppolito	1998	randomized clinical trial	248	Mean blood loss in a vertical position was 554.5g as compared to in a horizontal position at 516.5g.	p = 0.52 is insignificant, and blood loss is estimated.
Golay	1993	cohort study	200	Incidence of postpartum hemorrhage was 7.5% in the squatting group and 10% in the semirecumbent group.	Each of the variables used to measure maternal complications had lower occurence in the squatting group despite statistical insignificance.
Bodner-Adler	2003	case control study	614	Upright positioning caused only 1% of parturients to lose >500mL estimated blood volume; supine caused 2% of parturients to lose >500mL estimated blood volume. This difference is not statistically significant.	
Pervin	2018	controlled cohort study	1,051	Researchers advocating for the use of upright and lateral positioning over supine positioning found that over the same period of time that the use of these sacrum flexible positions increased from 1% to 76% frequency, the odds of maternal and neonatal complications decreased by 46%. Median blood loss was reduced from 200mL to 150mL which was statistically significant with p<0.001.	
Racinet	2005	review of literature	NA	In vertical positions, the third stage of labor may be associated with an increased risk of hemorrhage and more blood volume loss (OR = 1.71, CI 95 % 1.31–2.23)	
Roberts	2007	review of literature	NA	The use of the supine position is associated with negative parturient, fetal, and neonatal hemodynamic outcomes.	

Table 4: Perineal Injury

First Author	Year	Study Design	Population (n)	Key Findings
Badi	2022	Quasi-Experimental	1190	In the supine position, there were increased rates of tearing (RR 20.9; 95%CI: 17.8-24.4). The flexible sacrum positions showed decreased rates of tearing (RR 11.9; 95% CI: 9.0-15.6).
Reis	2019	Retrospective Cohort Analysis	1728	A multivariate analysis supported supine positioning as a protective intervention against obstetric anal sphincter injury (OASI), reducing rates by 63%: 0.47 (95%CI 0.22-0.99). In univariate analysis, OASI rates were similar between upright and supine (p=0.120).
Edqvist	2016	population-based prospective cohort study	2992	There appeared to be no association between sutured perineal injury and parturient position(OR 1.02; 95% CI 0.86-1.21) and no association with severe perineal trauma and parturient position (OR 0.68; 95% CI 0.26-1.79).
Warmink-Perdijk	2015	prospective cohort study	1196	Non-flexible sacrum positions had the highest rate of 3rd and 4th-degree tears (p=0.017) at 5.6% and a nonsignificant trend towards the lowest rate of intact perineum (p=0.056). Sacrum flexible positions demonstrated a nonsignificant trend towards higher rates of intact perineum (adjusted RR 1.4; 95% CI 0.96-2.04).
Elvander	2015	prospective population-based cohort study	113279	Nulliparous: Of the non-flexible sacrum positions, lithotomy demonstrated an increased risk with an adjusted RR of 1.17 (1.06-1.29). Of the sacrum flexible positions, there appears to be a decreased risk in lateral positioning with an adjusted RR of 0.79 (0.68-0.92).
				Parous: Of the non-flexible sacrum positions, lithotomy demonstrated an increased risk with an adjusted RR of 1.66 (1.35-2.05). There is an increased risk of perineal injury with birth seat and squatting in this study with an adjusted RR of 1.36 (1.03-1.80) and an adjusted RR of 2.16 (1.15 and 4.07) respectively.
Golay	1993	cohort study	200	There was no significant difference found, but of the primiparous participants 23.5% had intact perineum postpartum in non-flexible sacrum positions, and in flexible sacrum positions 55.8% had intact perineum. Of the multiparous participants, there was no difference in intact perineum with both positioning groups demonstrating a rate of 43.8%. Regarldless of parity, significantly fewer and less severe perineal lacerations and fewer episiotiomies occurred in the squatting group P=0.001.
Terry	2006	non-randomized, controlled clinical trial	198	Only 22% of parturients delivering in non-flexible sacrum positions were left with intact perineums. Of the parturients in flexible sacrum positions, 60% left intact; Infants born to mothers in nonsupine positions were delivered with significantly less tearing of the perineum (P<.001).
Roberts	2007	review of literature	NA	Flexible sacrum positions showed an increase in second-degree perineal tears (RR, 1.63; 95% CI, 1.29–2.05).
Thies-Lagergren	2020	prospective cohort study	4663	In primiparous individuals, delivering upright in a birth seat showed an increase in labial tears (non-birth seat 45.7%, birth seat 58.5% (Adjusted OR, 1.67; CI: 1.40–1.98). In multiparous individuals, delivering upright in a birth seat also showed an increase in labial tears (non-birth seat 14.8%, birth seat 25.6% (Adjusted OR, 1.80; CI: 1.40–2.31).
Bomfim-Hyp	1998	randomized clinical trial	248	A nonsignificant difference showed non-flexible sacrum positions with laceration at a rate of 44%, and flexible sacrum positions at 47%.
Bodner-Adler	2003	case control study	614	Supine positioning as opposed to upright showed fewer occurrences by the proportion of the study group population with perineal trauma for all degrees of perineal trauma with statistical significance (p=0.078). Supine positioning also had less vaginal and labial trauma which was not statistically significant.
Pervin	2018	cohort study	1,051	Researchers advocating for the use of upright and lateral positioning over supine positioning found that over the same period of time that the use of these sacrum flexible positions increased from 1% to 76% frequency, the frequency of cervical tear was reduced significantly (3.8% to 1.5%, P = 0.02).

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