

Association of Squatting Activities of Pregnant Women during the Antenatal Period and Labor Outcomes

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Abstract

Aim: To investigate impact of antenatal squatting activities on labour outcomes. **Methods:** All eligible primigravida women, with singleton cephalic fetuses, who presented to ward 18 of Colombo South Teaching Hospital, Sri Lanka, during the period 1st of February to 28th of May 2017 were invited into the study. Those who were already in active stage of labor (at least more than two moderate contractions per 10 minutes) on admission were excluded. Demographic data such as age, ethnicity, religion, educational level, occupation, latrine type in use, and booking Body mass index (BMI) were collected via an interviewer administered questionnaire. Data related to labor (modified Bishop score at onset of active labor, labor augmentation, pain relief, labor duration, mode of delivery, episiotomy or tears) and neonatal outcome (birth weight, APGAR score at 1, 5, 10 minutes) were collected from delivery notes. A pre tested interviewer administered questionnaire was used to obtain data regarding routine squatting activities during the previous 6 months. Pain visual analogue scale was used on day after delivery to assess the degree of labour pain. Duration of each squatting activity per day and number of days engaged with the activity per week; were used to calculate total squatting hours per week. In the absence of an accepted threshold for adequate squatting, we employed the sample mean as an operational data-driven threshold to define “more” against “less” squatting activities. Women who did not have squatting activities were considered as the controls. We used chi-square and Fisher’s exact tests to compare characteristics and outcomes between those engaging in more and less levels of squatting activity. We fitted a series of logistic regression models with each dichotomized outcome as the dependent variable, more/less squatting activity as the main independent variable of interest, and age, gestation period, BMI and patient’s occupation as covariates.

The resulting adjusted odds ratios (AOR) and their 95% confidence intervals (CI) and statistical significance ($p < 0.05$) were used to draw conclusions of adjusted associations. **Results:** We recruited 430 women into this study. Overall, 68% of the women were of 20 - 30 years old, 47% had normal body mass index and 65% were housewives. The most frequent squatting activities were for urination/defecation and clothes washing (146 and 62 minutes/week, respectively). Mean total time was 246 minutes per week, of which more than 147 women (34%) achieved above this level of squatting activities. Those with more squatting activities had a greater modified Bishop Score $\geq 6/10$ (92% vs 82%; $p < 0.01$); labor duration of < 6 hours (82% vs 56%; $p < 0.01$), less likely for labour augmentation (39% vs 51%; $p < 0.01$) and pain relief (53% vs 65%; $p = 0.013$). Similar results were obtained after adjustments for maternal age, BMI, gestational age and occupation. However, there were no significant differences in the mode of delivery (normal vaginal vs instrumental vs caesarean), episiotomy rate, birth weight and neonatal Apgar scores. **Conclusion:** Squatting activities of more than 246 minutes per week may improve labor outcome. Women should be encouraged to increase squatting exercises or incorporate more habitual squatting activities antenatally.

Keywords

Antenatal Squatting, Labor Outcomes

1. Introduction

In order to prevent complications and untoward obstetric outcomes, pregnant women are recommended various exercises during periodical preparations. Squatting exercises for strengthening pelvic floor, abdominal, back and thigh muscles [1] [2] are particularly highlighted. However, this is hardly a novel concept. In ancient times, pregnant women in Sri Lanka were encouraged to do extra activities such as picking up things such as leaves in the garden, unearthing grass and weeds and applying clay on the floor as to facilitate labor. Interestingly, all the above physical activities are directed towards acquisition and maintenance of the squatting posture.

Human positional habits are closely linked to culture. Based on the demographics and traditional cultural habits in Sri Lanka, women frequently engage in certain physical activities that require a squatting posture such as using the squatting pans, washing clothes, cooking using a fire on floor and weaving mats. However, these traditional cultural habits are diminishing rapidly with the widespread modernization and urbanization. Currently most women are working away from home and have an improved standard of living from a socio-economic perspective. With a busy schedule and need to balance work and home life, women have moved away from traditional practices. The modern Sri Lankan pregnant women have lost their traditional knowledge and practice acquired over millennia. They may not realize the benefits of squatting activities in

preparation for a successful and uncomplicated labour, therefore not replaced these squatting postures in other daily exercises or activities. Sri Lanka national statistics published by Family Health Bureau showed a substantial increase in caesarean section rate from 30.5% to 37.3% during 2013 to 2017. The public health impact of increased cesarean deliveries are, the cost and other morbidities such as severe bleeding, infections, painful scarring, blood clots, bowel obstructions, readmissions to the hospital, and longer-lasting pain [3]. Such observations have motivated us to undertake the present study focusing on the health impact of acquiring and maintaining squatting position in daily activities in labour and neonatal outcomes.

On a global level, the benefits of physical activity during the antenatal period in general have been examined [4] [5], which have prompted professional bodies to endorse physical activity during pregnancy. The 2018 update to the U.S. Department of Health and Human Services Physical Activity Guidelines for Americans reinforces prior recommendations of at least 150 minutes of moderate intensity aerobic activity per week during pregnancy and the postpartum period [6]. According to the UK Chief Medical Officers' Physical Activity Guidelines advised "Throughout pregnancy aim at least 150 minutes of moderate-intensity activity every week [7].

A meta-analysis, based on 4 randomized controlled trials, has reported no association between physical activity and caesarean section [8]. In contrary to another one, based on 16 randomized controlled trials, found structured physical exercise during pregnancy to be associated with a reduced risk of Caesarean section [9].

Another meta-analysis in 2015 has suggested that regular exercise during pregnancy was modestly associated with increased chance of normal delivery [10]. Further study has also demonstrated that an increased level of leisure time physical activity is associated with a less complicated mode of delivery, such as a reduced risk of emergency C-section and assisted vaginal deliveries [11].

Nascimento *et al.* describes other benefits of regular exercise during pregnancy such as high cardio respiratory fitness, preventing urinary incontinence, and reduction of low back pain and depression. The intensity of exercise appears to matter while the type is immaterial [12].

However, the prevalence of physical activity among pregnant mothers is as low as 20% [13]. In contrast to squatting during the antenatal period, much work has already been done on squatting during labor. Studies from Pakistan and India showed that childbirth in a squatting position resulted in less instrumental deliveries, perineal tears, or extension of episiotomies during the second stage of labor [14] [15]. Squatting was the normal birthing position in the past, but was rarely adopted in modern times. An Australian study found a third of women were not able to squat for more than 30 seconds [5].

Interestingly a small prospective observational pilot study conducted recently in India to "evaluate pregnancy and labor outcomes in the two types of toilet seats users (squatting type VS western style)". They did find favorable outcomes

in squatting toilet users in proportion of normal vaginal delivery, duration of second stage of labor, reduced genitourinary infection, etc. However, it was not possible to establish an exact association due to limited sample size and being a hospital based study [16].

Locally, little research on antenatal exercises among pregnant women has been conducted. One study found, “Knowledge and practices regarding antenatal exercises were suboptimal while their attitudes were mostly favourable among pregnant women attending DMH.” This called for the need to improve knowledge and practice on antenatal exercises [17]. Another found that emergency caesarean delivery was significantly greater in less prenatal physical active mothers ($p = 0.015$). However, activities such as climbing stairs and frequent weight lifting have been associated with unfavourable outcomes [18]. Also, high energy expenditure in second trimester is a risk factor while in third trimester it is protective against giving birth to an infant with low birth weight relative to the gestational age in uncomplicated pregnancies [19]. The above studies broadly cover effects of physical activity during pregnancy but did not consider habitual physical activities such as squatting, a research gap our study sought to address.

Many health care providers are unaware of the advantages of squatting posture. Labor will be quicker and comfortable because squatting lengthens the trunk, takes advantage of gravity and helps the fetus align with the angle of pelvis. It also facilitates the rotation of the fetus and allows excellent perineal access. Squatting helps to relax pelvic floor muscles and protects them from injuries and tears. As pregnancy progresses, the body’s center of gravity shifts and this leads to balancing issues; but not in regular squatters in whom the center of gravity shifts less and will help realign the body [20]. Squatting during labor helps develop birth canal flexibility and opens it by an additional 20% - 30%, increases pelvic diameter by 2 cm and maximizes the leverage of abdominal muscles [21]. Training of exercises leads to a shorter labor duration and comfort [22].

Squatting helps to regulate bowel movements thus preventing constipation and hemorrhoids [23]. Constipation, heartburn and hemorrhoids are common gastrointestinal complaints during pregnancy [24]. Squatting avoids toxin build-up in the colon. While at defecating using a commode type of latrine, the colon is in the continence mode and one has to strain (Valsalva maneuver) to evacuate. Valsalva maneuver exerts unnecessary pressure on the developing uterus and especially on the pelvic floor which already bears the extra weight of gravid uterus [25]. Descent of the pelvic floor can cause stretch injuries to the pudendal nerve leading to bladder incontinence, lower back pain and decreased libido. Use of squatting pans for defecation and urination eliminates the need of straining and protects pregnant women from pelvic floor prolapse and pressure on the uterus and promotes greater fetal circulation. The prevalence of low back pain during pregnancy is high as 60% which squatting pans usage help alleviate [26]. Pelvic floor exercises in the immediate postpartum period also may reduce the risk of future urinary incontinence.

Squatting has health advantages from multiple perspectives such as gastroen-

terology [23], urology [26], and sports medicine and rehabilitation [27] with no reports of adverse events.

Pregnancy and child birth is a marathon, not a sprint which involve muscles. To enhance muscle endurance those need to be prepared in advance.

Our main objective was to see the association in mode of delivery among women with more against less squatting habits.

We hypothesized that engaging in more squatting activities antenatally would be associated with more favorable birth outcomes as less need of caesarean section, less time spent in labour with better bishop score, lesser need of labour augmentation, lesser need of pain relief and lesser perineal injuries. In addition we hypothesized better neonatal outcome as good Apgar score, normal birth weight and lesser need of interventions during early neonatal period.

Base on the literature findings where squatting lengthens the trunk, utilizes gravity and helps the fetus to align with the angle of pelvis, facilitates the rotation of the fetus, allows excellent perineal access, birth canal flexibility, increases pelvic diameter by 2 cm and maximizes the leverage of abdominal muscles. All these will apply effective pressure on the cervix, to improve the bishops score. So that, duration of labour will be shortened and need of caesarean sections should be less among good squatters.

Since there is a dearth of scientific evidence on antenatal pelvic floor strengthening exercises in Sri Lanka, our goals are to describe the socio-demographic characteristics, squatting activities and labor outcomes among pregnant mothers. If our hypothesis is supported by the data, we can posit that societal benefits could be reaped by improving the awareness and recommending exercises that promote squatting in antenatal clinics and via school health curriculums.

2. Methodology

We conducted a descriptive study at a ward of Colombo South Teaching Hospital, which is a leading hospital in Sri Lanka serving patients of all cultural and socio-economic backgrounds. It covers a good mixture of traditional and modern cohort of women.

We recruited women irrespective of their age, race, religion, BMI (body mass index), educational back ground, and occupation of her or he partner. But we considered only primi gravida at term (completed 36 weeks + 6 days of period of gestation confirmed with dating scan) that went into spontaneous onset of labor during February-May, 2017 with a live singleton fetus at cephalic presentation to minimize bias. Exclusion criteria were being in established labor (more than two moderate contractions per 10 minutes) on admission; premature rupture of membranes; meconium stained liquor or any episode of per vaginal bleeding during current pregnancy period; electing caesarean section or induction of labor; cervical cerclage; engaging in regular strenuous exercises (engaging in pelvic floor exercises were not excluded); gestational diabetes mellitus; pregnancy induced hypertension, preeclampsia or eclampsia; medical disorders; symphysis

pubis pain; past abdominal or pelvic surgeries; placental abnormalities such as placenta previa, accreta or percreta; and a fetus with an abnormal presentation (breech, foot, hand, brow), abnormal lie (transverse) or gross fetal anomalies and prolapsed cord.

The ward has approximately 3000 admissions and 2000 births annually, and a caesarean section rate of approximately 30%. Current rate of caesarean deliveries was 30%, but caesarean deliveries due to lack of progression in our unit was 15%. If the caesarean delivery rate will be 10% among those with adequate squatting and 20% among those with less than average squatting; a sample size of 430 will have 80% power at 5% significance to detect the association.

Ethics Review Committee of the Post Graduate Institute of Medicine, University of Colombo, Sri Lanka provided the ethics clearance. The teaching hospital director permitted data collection.

The mothers were interviewed during the post-partum stay to minimize responder burdens for the mothers when administering questionnaires. Patient history was collected at a different room to ensure privacy where only an investigator was present with a chaperon. An information sheet was given to all participants prior to data collection explaining eligibility, the study and data collection process and written consent was obtained. The consent form clearly explained participation was purely voluntary, right to withdraw, independence of their treatment/care from decision to participate in the study, and confidentiality of data. Data collection was conducted without disturbing routine operations at the study setting.

Participant identification data wasn't recorded to maintain confidentiality.

Study Measures

Interviewer administered questionnaire included demographic information as age, ethnicity, religion, educational level, occupation, latrine type in use. Pain visual analogue scale was used on the following day of delivery to assess the pain experienced during labor. Data related to labor (modified Bishop score at onset of active labor, labor augmentation, pain relief, labor duration, mode of delivery, episiotomy or tears) and neonatal outcome (birth weight, APGAR score at 1, 5, 10 minutes) were collected from delivery notes. From the onset of three or more moderate contractions to delivery, was considered as "duration of labour" in this study.

Pre-pregnancy (or early booking if unavailable) weight of the mother and height were used to compute the body mass index. Definition of Squatting position is weight of body is on feet but knees and hips are bent [28]. The full squatting position shown in **Figure 1** was considered in our study.

A pre tested interviewer administered questionnaire was used to obtain data, regarding routing squatting activities during the previous 6 months. One off squatting activities was not considered. Habitual or routine activities being practiced over last 6 months were identified.



Figure 1. The relaxed, natural squatting posture.

The recorded duration for each squatting activity per day and number of days involved per week were used to calculate the time spent in squatting per week for that activity. Each squatting activity was summed to calculate “total number of squatting activity or time spent in squatting per week”.

Women who did not have squatting activities were considered as the controls. Those with high and low levels of squatting activity were determined based on “more than” or “less than” the sample mean. Physical activity guidelines for healthy pregnant and postpartum women recommend at least 150 minutes per week of moderate-intensity aerobic activity equivalent to brisk walking. Walking at 3 miles/hour equals to 3.3 MET (metabolic equivalent of task) activity. So, 3.3 METs for 150 minutes per week is equal to 500 MET-minutes per week [4] considered as the reference physical activity level in most studies. The squatting MET value is yet to be established [29]. Therefore, in the absence of proper reference, we considered the sample mean as an operational data-driven threshold to define more and less time spent squatting.

Mode of delivery: normal vaginal, instrumental or caesarean was the main outcome. Modified Bishop Score was used to assess the favorability of progression and duration of labor. Partograms were used to assess the progression of labor and CTG records were used to monitor the fetus. Apgar score was used to assess the neonate at 1, 5 and 10 minutes after delivery. Pain Visual Analogue scale (PVAS) was used to assess the pain at parturition and recorded 24 hours after delivery. Patients were educated on responding on a PVAS. PVAS has high reliability [30]. Other secondary outcomes included period of gestation at labor, need for labor augmentation; vaginal tears, need for episiotomy; need of pain medication; and the newborn’s need for resuscitation/observation/ventilation.

We used appropriate descriptive statistics to summarize study measures and outcomes both for the entire sample and separately for those engaging high and low levels of squatting activity. We used chi-square and Fisher’s exact tests to compare characteristics and outcomes between those engaging in high and low levels of squatting activity. To determine whether any associations between squatting and outcomes are not artifacts of the differences in participant characteristics but rather independent of them, we fitted a series of logistic regression

models with each dichotomized outcome as the dependent variable, high/low squatting activity as the main independent variable of interest, and age, gestation period, body mass index and patient's occupation as covariates. The resulting adjusted odds ratios (AOR) and their 95% confidence intervals (CI) and statistical significance were used to draw conclusions of adjusted associations.

3. Results

We recruited a total of 430 women into the study. Overall, approximately two thirds of the participants were in the 20 - 30 age group, within gestation period of 37 - 40 weeks, in the normal to overweight body mass index range of 19 - 30 kg/m², were housewives and had an education beyond the tenth grade [Table 1]. A vast majority had running water supply at home, and approximately a half each reported using a commode and a squatting pan in latrine at home. Racial and religious composition of the sample was similar to the national demographic proportions in Sri Lanka.

Most common squatting activities were during defecation and urination, followed by clothes washing [Table 2]. The average total time spent in squatting position per week across all activities was 246 minutes, which was operationally treated as a data-driven threshold to define "high" and "low" levels of squatting activities. Of the 430 participants, 147 (33%) women were found to have high level of squatting activities [Table 1]. Those who spent less time squatting were likely to be younger than 30 years old ($p = 0.0001$), have a gestation period of 37

Table 1. Participant characteristics: N (%).

Characteristic	All N = 430	Less Time Squatting < 246 Minutes N = 283	More Time Squatting ≥ 246 Minutes N = 147	p-Value
Age (years)				
<20	97	52 (54)	45 (46)	<0.001
20 - 30	291	211 (72)	80 (28)	
>30	42	20 (48)	22 (52)	
Gestation period (weeks)				
37 - 40	281	201 (72)	80 (28)	<0.001
>40	149	82 (55)	67 (45)	
BMI (kg·m ⁻²)				
<18.5	115	56 (49)	59 (51)	<0.001
18.5 - 24.9	201	150 (75)	51 (25)	
25.0 - 29.9	86	61 (71)	25 (29)	
≥30.0	28	16 (57)	12 (43)	
Race				
Sinhala	356	233 (65)	123 (35)	0.541
Tamil	46	29 (63)	17 (37)	
Muslim	28	21 (75)	7 (25)	

Continued

Religion				
Buddhism	339	225 (66)	114 (34)	0.177
Christians	39	20 (51)	19 (49)	
Hinduism	26	19 (73)	7 (27)	
Islam	26	19 (73)	7 (27)	
Education level				
Grade 1 - 5	4	4 (100)	0 (0)	<0.001
Grade 6 - 10	149	77 (52)	72 (48)	
Passed GCE-O/L	144	112 (78)	32 (22)	
Passed GCE-A/L	116	80 (69)	36 (31)	
Degree and above	17	10 (59)	7 (41)	
Occupation				
Clerical worker	58	48 (83)	10 (17)	0.005
Housewife	279	173 (62)	106 (38)	
Manual worker	52	39 (75)	13 (25)	
Professional	41	23 (56)	18 (44)	
Husband's occupation				
Clerical worker	102	77 (75)	25 (25)	0.107
Manual worker	235	151 (64)	84 (36)	
Professional	70	41 (59)	29 (41)	
Unemployed	18	12 (67)	6 (33)	
Not available	5	2 (40)	3 (60)	
Running water supply	406	266 (66)	140 (34)	0.594
Home latrine use				
Commode	235	200 (85)	35 (15)	<0.001
Squatting pan	195	83 (43)	112 (57)	
Workplace latrine use				
Commode	92	78 (85)	14 (15)	<0.001
Squatting pan	59	32 (54)	27 (46)	
Not available	279	173 (62)	106 (38)	

BMI = Body Mass Index; GCE-O/L = General Certificate of Education (Ordinary Level) Examination (equivalent to successful completion of 11 years of schooling); GCE-A/L = General Certificate of Education (Advanced Level) Examination (equivalent to successful completion of 13 years of schooling or graduation from high school).

Table 2. Time spent (minutes) in squatting position per week.

Activity	Mean ± SD
Resting position at home	11.4 (±76.4)
Cooking and meal preparation	19.4 (±70.5)
Washing clothes	61.6 (±94.3)
Defecation and urination	146.0 (±155.0)
Other household work	4.1 (±20.3)
At work	3.4 (±25.6)
Exercising	3.9 (±3.8)
Total time	245.9 (±227.5)

SD = Standard Deviation.

- 40 weeks ($p = 0.0006$), have a normal to overweight body mass index ($p < 0.0001$), an educational attainment of only GCE-O/L ($p < 0.0001$), and a clerical or a manual worker ($p = 0.0049$). This reflects younger generation is moving away from habitual squatting activities, but squatting has not shown clear impact on BMI.

Those who spent more time squatting were likely to have a modified Bishops score of at least 6/10 (92% vs 82%; $p = 0.006$), less likely to need labor augmentation (39% vs 51%; $p = 0.017$) or pain relief (53% vs 65%; $p = 0.013$), and more likely to have a labor duration less than 6 hours (82% vs 56%; $p < 0.0001$) [Table 3]. These findings are in favour of our hypothesis. Delivery mode ($p = 0.706$), episiotomy rate ($p = 0.927$), baby's birth weight ($p = 0.108$) and Apgar scores ($p = 0.238 - 1.000$) were not significantly different between the two groups of women. This is against our hypothesis. Results of mode of delivery could be affected by many confounders. It is difficult to exclude all. Indications for caesarean sections are many and often overlaps.

Table 3. Obstetric outcomes by amount of squatting.

Characteristic	Less Time Squatting	More Time Squatting	p-Value
	< 246 Minutes N = 283	≥ 246 Minutes N = 147	
Pain during labor			
None	0 (0.0)	2 (1.4)	0.142
Mild	20 (7.1)	15 (10.2)	
Moderate	85 (30.0)	46 (31.3)	
Severe	178 (62.9)	84 (57.1)	
Modified bishops score			
<6/10	51 (18.0)	12 (8.2)	0.006
≥6/10	232 (82.0)	135 (91.8)	
Labor augmentation	144 (50.9)	57 (38.8)	0.017
Need for pain relief	185 (65.4)	78 (53.1)	0.013
Pain medication			
None	98 (34.6)	69 (46.9)	0.009
Nitrous oxide	3 (1.1)	3 (2.0)	
Pethidine	174 (61.5)	75 (51.0)	
Other	8 (2.8)	0 (0.0)	
Labor duration (hours)			
<6	157 (55.5)	120 (81.6)	<0.0001
6 - 12	109 (38.5)	18 (12.2)	
>12	17 (6.0)	9 (6.1)	
Delivery mode			
Normal vaginal	215 (76.0)	109 (74.2)	0.706
Instrumental	9 (3.2)	7 (4.8)	
LSCS	59 (20.9)	31 (21.1)	
Episiotomy	230 (81.3)	120 (81.6)	0.927
Vaginal tears	3 (1.1)	9 (6.1)	0.004

Continued

Neonatal outcome			
Normal	271 (95.8)	144 (98.0)	0.528
Observation needed	10 (3.5)	3 (2.0)	
Early death	2 (0.7)	0 (0.0)	
Birth weight (g)			
2500 - 4500	257 (90.8)	126 (85.7)	0.108
<2500	26 (9.2)	21 (14.3)	
Apgar score at 1 minute			
≤3	12 (4.2)	3 (2.0)	0.238
4 - 7	0 (0.0)	0 (0.0)	
>7	271 (95.8)	144 (98.0)	
Apgar score at 5 minutes			
≤3	1 (0.4)	0 (0.0)	0.604
4 - 7	11 (3.9)	3 (2.0)	
>7	271 (95.8)	144 (98.0)	
Apgar score at 10 minutes			
≤3	1 (0.4)	0 (0.0)	1.000
4 - 7	0 (0.0)	0 (0.0)	
>7	282 (99.7)	147 (100.0)	

LSCS = Lower Segment Caesarean Section.

Adjusting for significant differences in maternal characteristics age, period of gestation, body mass index, and women's occupation, those who spent more time had 89% greater odds of having a modified Bishops score of at least 6/10 (AOR = 1.89; 95% CI = 0.94 - 3.82; $p = 0.075$) which was marginally statistically significant, 40% lesser odds of needing labor augmentation (AOR = 0.60; 95% CI = 0.37 - 0.96; $p = 0.034$), 58% lesser odds of needing pain relief (AOR = 0.42; 95% CI = 0.26 - 0.67; $p = 0.0003$), and 78% lesser odds of labor duration more than 6 hours (AOR = 0.22; 95% CI = 0.12 - 0.38; $p < 0.0001$). All these could be due to the added benefits of squatting as we mentioned earlier. Ability of applying effective pressure on the cervix in squatters, leads to improve the bishops score. By that, duration of labour will be shortened.

4. Discussion

We have described squatting activities of pregnant women, time spent on that and identified a few maternal characteristics associated with increased time spent squatting. The main findings of our study were that pregnant women who spent more time in squatting spent less total time in labor, better Bishops score, less likely to need of labor augmentation and were less likely to request pain relief. This is consistent with previous literature in pregnant women that found physical activity in general during pregnancy to be associated with shorter labor [31] [32] [33].

However, contrary to our hypothesis, there was no significant reduction in rates of caesarean or instrumental delivery or episiotomy among women who

spent more time in squatting. This was supported in meta-analysis based on 4 RCTs [8].

In contrary to another one, based on 16 randomized controlled trials, found structured physical exercise during pregnancy to be associated with a reduced risk of Caesarean section [9]. Another meta-analysis in 2015 has suggested that regular exercise during pregnancy was modestly associated with increased chance of normal delivery [10]. Further study has also demonstrated that an increased level of leisure time physical activity is associated with a less complicated mode of delivery, such as a reduced risk of emergency C-section and assisted vaginal deliveries [11]. But it is worth mentioning all those have considered physical activity in general.

Women who spent more time squatting were less likely to request pain relief. Similar findings were seen by Moraloglu *et al.* found that primiparas allocated to squatting positions had lower levels of labor pain and more satisfaction than those in supine positions [34]. The possible explanation for the mitigated labor pain in squatting position was due to the shortened labor. When the duration is reduced, consequently, less pain is felt by women [35].

Neonatal birth weight and Apgar scores were not significantly different between the two groups of women. Previous studies have also reported no association between exercise in general and fetal growth [36] [37]. Fetal growth can be varied on multi factorial reasons.

Most of the time spent in squatting position was when defecating and urinating, followed by washing clothes. The average total time spent in squatting position per week across all activities was 246 minutes which was taken as the threshold for this study.

We not only observed significantly better obstetric outcomes in women who spent more time squatting, but also demonstrated the association persisted independent of a liberal set of confounders including age, body mass index, period of gestation and women's occupation.

Limitations

Based on the findings from this study, women who squatted at least 246 min/week during their pregnancy spent less total time in labor compared to those who were less than that. However, no correlations were found. Our data suggest that 246 minutes of squatting activity may be a clinically significant threshold for reducing time in labor in pregnant women, and that there may not necessarily be a dose-response relationship. Sudden changes in living circumstances, infrequent physical activities, variations in clinical assessments as labour onset or progression could have affected the final result.

5. Conclusions and Recommendations

To the best of our knowledge, this is the first study to describe amount of time spent squatting in pregnant women in Sri Lanka and examine its association

with subsequent obstetric outcomes. Squatting is a physical activity which is inexpensive, easy and with minimal or no negative side effects.

Squatting could be the only single most useful posture which leads to contract, strengthen and maintain the resilience of all the muscles involved in parturition. Although physical exercise is recommended in antenatal clinics, compliance is very poor. Only 14% was practicing antenatal exercises per recommended frequency while a great majority (85%) had a favourable attitude [17]. Poor compliance is likely due to lethargy, tiredness and being too busy or uncomfortable in the third trimester [38]. If we can incorporate squatting in to daily habitual acts, we can overcome the poor compliance in our community.

Here we did not consider squatting as a labour or birthing position. There are significantly more women wishes to have epidural analgesia in labour nowadays, which made acquisition of squatting posture in labour impossible. It is therefore even more important to consider antenatal squatting than ever before.

Therefore, if we can incorporate an activity or posture into our routine habits we could achieve a higher level of compliance. Incorporating the forgotten squatting back to our routine habits as in traditional era could prevent many pregnancy complications. Because the squatting type latrine use is a common habit among squatters its use instead of a commode could be promoted as an initial step.

Alternatively, safe modification of an existing commode [Figure 2] to help user acquire squatting position while defecation or urination could be a more acceptable choice for some who are reluctant to use a squatting pan [39]

Contraindications to squatting could be rare knee joint pathologies as patello-femoral syndrome [40].

Further studies, including well-designed randomized trials are needed to establish an evidence based link between squatting and favourable outcomes, and definitive clinical recommendations on squatting as a physical activity during antenatal period can be made. Further comparison studies on squatting habits and squatting exercises prior to pregnancy vs antenatally vs birthing position could gather more evidence based information.



Figure 2. Modification of commode latrine.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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