OBSTETRICS

Strenuous exercise during pregnancy: is there a limit?

Linda M. Szymanski, MD, PhD; Andrew J. Satin, MD

OBJECTIVE: The purpose of this study was to evaluate fetal responses to strenuous exercise in physically active and inactive women.

STUDY DESIGN: Forty-five healthy women (15 who were nonexercisers, 15 who were regularly active, 15 who were highly active) underwent a peak treadmill test at 28 weeks’ gestation to 32 weeks 6 days’ gestation. Fetal well-being (umbilical artery Doppler indices, fetal heart tracing/rate, biophysical profile [BPP]) was evaluated before and after exercise. Uterine artery Doppler scans were also obtained.

RESULTS: Umbilical and uterine artery Doppler indices were similar among activity groups and did not change with exercise (P > .05). BPP and fetal heart tracings were reassuring in all groups. However, subgroup analyses showed transient fetal heart rate decelerations after exercise and elevated umbilical and uterine artery Doppler indices in 5 highly active women. After this, BPP and fetal heart tracings were reassuring.

CONCLUSION: Overall fetal well-being is reassuring after short-duration, strenuous exercise in both active and inactive pregnant women. A subset of highly active women experienced transient fetal heart rate decelerations and Doppler changes immediately after exercise. Athletes may push beyond a threshold intensity at which fetal well-being may be compromised. However, potential impact on neonatal outcomes is unknown.

Key words: exercise, fetal well-being, pregnancy, umbilical artery Doppler measurement, uterine artery Doppler measurement


Existing guidelines for exercise during pregnancy do not address “vigorous” or “strenuous” exercise adequately.1,2 According to the American College of Obstetricians and Gynecologists (ACOG), information on strenuous exercise is scarce, and women who engage in such activities require close medical supervision.2 In the 2008 Physical Activity Guidelines for Americans, the US Department of Health and Human Services emphasizes that vigorous intensity aerobic activity during pregnancy has not been studied carefully and that women who have not been exercising before pregnancy should not begin vigorous exercise.1

One of the difficulties in the evaluation of existing research on exercise during pregnancy is that strenuous and vigorous are defined inconsistently. In the recent US Department of Health and Human Services guidelines, vigorous intensity is defined as 6.0 metabolic equivalents or, in relative terms, as 60-84% of aerobic capacity reserve (or heart rate reserve).1 Exercise over this intensity level in pregnant women is not addressed, and there is no defined upper limit of safety. The dilemma facing providers was summarized appropriately by Pivarnik et al3: “It is difficult for clinicians to counsel athletes adequately on safe levels of training during pregnancy. Any clinician who chooses not to follow the ACOG guidelines assumes some level of additional risk.” As a result of a lack of data, guidelines for vigorous or strenuous exercise are vague.

Thus, there is insufficient data to counsel pregnant women on strenuous exercise, particularly athletes who wish to continue training during pregnancy. When athletes turn to their provider for advice, they are unable to receive evidence-based responses. To further highlight the need for more information, a recent small study reported that fetal well-being may be compromised during strenuous exercise in elite athletes.4 Thus, the primary purpose of this study was to evaluate fetal responses to high intensity (ie, strenuous) exercise in active and inactive pregnant women.

MATERIALS AND METHODS

The current study is part of a larger investigation of exercise during pregnancy; results regarding fetal responses to current exercise recommendations for moderate and vigorous intensity exercise have been published.5 The present study includes unpublished data on fetal well-being and uterine artery Doppler data in response to strenuous exercise.

Participants included healthy women with low-risk, accurately dated (last menstrual period confirmed by first or second trimester ultrasound scans) pregnancies. Exclusion criteria included multiple gestation, body mass index of >35 kg/m², smoking, history of preterm delivery at <34 weeks’ gestation, cervical insufficiency or cerclage in place, placenta previa, any chronic medical condition, gestational diabetes mellitus or hypertension, or a fe-
tus with known structural or chromosomal abnormalities or with growth restriction. Testing was performed between 28 weeks and 32 weeks 6 days’ gestation. This gestational age range was chosen because fetal well-being tests, particularly umbilical artery Doppler measurements, are generally more informative at ≥28 weeks’ gestation.

Women were classified into 1 of 3 groups according to self-reported physical activity during the 6 months before and continuing into pregnancy: (1) non-exercisers who did not perform regular physical activity (defined as ≥20 minutes per session for ≥3 times per week), (2) regularly active women who described their activity as mild to moderate (2) regularly active women who described their activity as vigorous, and (3) highly active women who were predominantly runners who described their activity as vigorous ≥4 days per week. The Johns Hopkins University School of Medicine Institutional Review Board approved the protocol, and all participants provided written informed consent.

All women underwent a peak treadmill test to volitional fatigue according to a modified Balke protocol. In the current study, this is defined as strenuous exercise. After a warm-up at 3.0 mph and 0% grade, treadmill speed was maintained at 3.0 mph, and the incline was increased 2% every 2 minutes. After the incline reached 12%, it remained at this level, and speed was increased 0.2 mph every 2 minutes. Volitional fatigue was defined as the limit beyond which a participant no longer desired to continue the protocol. Treadmill time was recorded in minutes, excluding warm-up. Exercise capacity, which can be quantified by the measurement of oxygen consumption at maximal exercise (ie, VO2), is considered the best measure of cardiovascular fitness. Because it was not measured in this study, VO2 peak was estimated with the use of a validated prediction equation for pregnant women and is expressed as milliliters of oxygen used per kilogram of body weight per minute.

Maternal electrocardiograms were continuously recorded. Peak heart rate that was achieved during the test was recorded. Percent of predicted maximum heart rate that was achieved was calculated with the typical equation for the estimation of maximum heart rate (220 minus age). Rating of perceived exertion with the 0-10 point scale was obtained at the end of the test. This scale has been validated as an effective means to monitor exercise intensity.

Fetal well-being measures that were obtained at rest and immediately after exercise included umbilical artery Doppler data, fetal heart tracing, fetal heart rate (FHR), and biophysical profile (BPP). Uterine artery Doppler measures evaluated maternal blood flow. All testing was performed in the afternoon, starting between 3:30 and 7:30 PM. Women were instructed not to eat or drink anything except water for 1 hour before arrival. On arriving at the Fetal Assessment Center, the women lay in a semirecumbent position with a leftward tilt, and a fetal heart tracing was recorded. Fetal heart tracings were evaluated for “reactivity” according to established criteria for gestational age and were classified by the 3-tier interpretation system. Blood pressure and maternal resting heart rate were taken after 15 minutes of rest. After resting umbilical and uterine artery Doppler measures were obtained, participants performed the exercise test. Immediately after exercise, they returned to the semirecumbent position with a leftward tilt. Ultrasound scanning was performed to acquire umbilical and uterine artery Doppler measures followed by BPP and then fetal heart tracing.

Ultrasound scanning was performed by 1 researcher (L.M.S.), who is an obstetrician trained in maternal-fetal medicine. Umbilical artery flow velocity waveforms were assessed with the use of color Doppler imaging in a free loop of umbilical cord. Three to 5 time points, each of which contained a minimum of 3 sequential uniform waveforms, were recorded. Uterine artery Doppler measures were obtained from the maternal right side. Color flow Doppler data were used to assist in the identification of the uterine artery at the point of crossover with the (external) iliac artery, and velocimetry measurements were obtained approximately 1 cm distal to the crossover before branching of the uterine artery. The angle of insonation was always less than 50 degrees. Again, 3-5 time points, each of which contained 2-3 sequential uniform waveforms, were recorded for later analysis. Built-in software calculated the systolic-to-diastolic (S/D) ratio, resistance index, and pulsatility index (PI). Mean values were calculated for each frame and averaged over several time points. FHR was calculated from umbilical Doppler data. The immediate FHR after exercise was determined from the first Doppler measure.

Gestational age at delivery, mode of delivery, birthweight, and Apgar scores were obtained from delivery records and have been previously reported.

Sample size was calculated to achieve 80% power at the .05 level of significance with the use of umbilical artery S/D ratios, which was our primary outcome measure for fetal well-being. This variable was chosen because it can be measured precisely, can be reproduced, and has been used as a primary outcome variable in existing studies, providing data to perform a power analysis. Two analyses were performed. First, existing data that measured umbilical artery S/D ratios after exercise in pregnant women at 32 weeks gestation indicated that 12 women per group would be sufficient. Second, reference data that attempted to detect a change from the 50th percentile to the 75th percentile indicated that 11-13 women per group, depending on gestational age, would be sufficient. These percentiles were chosen to allow the detection of smaller differences among groups. Although a change from the 50th-90th percentile would likely be more clinically significant, this would have significantly decreased the number of women needed per group.

Shapiro-Wilkes tests were performed to evaluate for normality. One-way analysis of variance (ANOVA) was used to compare descriptive variables among groups. Bonferroni post-hoc analyses were used to probe significant differences among groups. Differences in FHR and Doppler indices before and after the exercise tests in the 3 groups were analyzed with a 2-way (group × time) ANOVA with repeated measures. Post-
hoc comparisons evaluated significant differences with the use of Bonferroni's method to correct for multiple comparisons. Subgroup analyses evaluated potential differences between those in the highly active group who experienced FHR decelerations after exercise to those in the highly active who did not. Because of the small sample sizes, the Kruskal-Wallis test was used to compare descriptive variables. Because of the unbalanced design in the subgroup analyses, FHR and Doppler indices were analyzed with a mixed effects regression analysis that examined the main effects of activity group and time (before-after) and accounted for within subject correlation and group by time interaction. Delivery data were analyzed by either 1-way ANOVA or chi-square (categoric variables). Statistical significance was reached at a probability value of < .05. Statistical analyses were performed with Stata software (version 12.1; StataCorp, College Station, TX).

**RESULTS**

Forty-five healthy pregnant women were divided into 3 groups by physical activity level. Subject characteristics have been reported previously. Briefly, groups were similar in age, body mass index, and gestational age (P > .05). Mean ages for the women who were nonexercisers, regularly active, and highly active were 32.9, 34.3, and 32.9 years, respectively. All women were normal weight before pregnancy. Gestational age at the time of testing was 30.7 ± 1.1, 30.2 ± 0.9, and 30.3 ± 1.0 weeks for women who were nonexercisers, regularly active, and highly active, respectively. As expected, maternal resting heart rate was lower in the highly active group (61.6 ± 7.2 beats/min) compared with the nonexercise (79.0 ± 11.6 beats/min) and regularly active (71.9 ± 7.4 beats/min) groups (P < .001). Maternal heart rate at peak exercise (nonexerciser group: 163.0 ± 18.8 beats/min; regularly active group: 163.3 ± 8.9 beats/min; highly active group: 172.4 ± 11.7 beats/min) and percent of predicted maximum heart rate that was achieved (nonexerciser group: 87% ± 10.8%; regularly active group: 87.9% ± 4.8%; highly active group: 92.1% ± 5.7%) were similar (P > .05). Predictably, treadmill time (nonexerciser group: 12.1 ± 3.6 min; regularly active group: 16.6 ± 3.4 min; highly active group: 22.3 ± 2.9 min) and predicted VO₂peak (nonexerciser group: 21.3 ± 2.5 mL/kg/min; regularly active group: 23.8 ± 2.2 mL/kg/min; highly active group: 27.7 ± 1.4 mL/kg/min) increased with increasing activity status (P < .001). Rating of perceived exertion was similar among the groups (non-exerciser group: 8.0 ± 1.6; regularly active group: 8.3 ± 1.3; highly active group: 9.1 ± 0.6).

All variables were distributed normally, except uterine artery S/D ratio and PI. These data were then analyzed with log transformations, which normalized the distributions. Nontransformed means and standard deviations are reported. FHR and Doppler indices before and after exercise by activity group are shown in Table 1. There were significant group differences in FHR (P = .017) and a statistically significant group by time interaction (P = .033), which indicated that the groups responded differently to the exercise. Planned comparisons revealed no group differences between FHR at rest; however, after exercise FHR in the highly active group was lower than the other groups (P < .05). Further evaluation of the data indicated that, after exercise, FHRs for the highly active group included 5 subjects with FHR decelerations after exercise. When the data were reanalyzed excluding these 5 subjects, the mean FHR after exercise in the highly active group was 149.3 ± 10.6 beats/min, and there were no group differences (P = .714). Additionally, after exercise FHRs increased (P < .001), and the group by time interaction was no longer significant (P = .553), which suggests that FHR responses were similar in the 3 groups.

Umbilical artery indices were similar among the 3 activity groups and changed minimally with exercise (P < .05). The main effect for time was significant for umbilical artery resistance index only; however, the interaction was not significant, and planned comparisons showed no differences between before and after exercise values for any group. Uterine artery indices were also similar among groups and did not change with exercise (P > .05). BPP scores were 8 of 8 within 30 minutes in 44 of 45 subjects. Time to 8 of 8 score was 32:57 minutes in 1 highly active participant. Fetal heart tracings were category I and met criteria for reactivity in all participants after exercise.

Five women experienced transient FHR decelerations immediately after exercise; the decelerations lasted from 2:08-3:12 minutes (average, 2:37 minutes). These 5 women were all in the highly active group. Table 2 displays subgroup analyses that compared the highly active women with FHR decelerations (n = 5 ) with highly active women without decelerations (n = 10). Subgroups did not differ in gestational age, treadmill time, maternal peak heart rate (which ranged from 162-192 and 152-184 beats per minute in those with and without FHR decelerations, respectively) or percent of predicted maximum maternal heart rate (P > .05). FHR, umbilical artery, and uterine artery indices were distributed normally. In addition to the significant differences in FHR between subgroups, umbilical and uterine artery Doppler indices were different. The significant subgroup by time interactions in Dopplers reflect different responses to the strenuous exercise by the subgroups. All participants in the FHR deceleration group scored 8 of 8 on the BPP within 30 minutes. In the highly active subjects without decelerations, 1 participant reached 8 of 8 in 32:57 minutes; all others were 8 of 8 within 30 minutes. All fetal heart tracings were category I and met criteria for reactivity after exercise.

**COMMENT**

There are 2 primary findings from this study. First, overall fetal well-being was reassuring after strenuous exercise in women who were both exercisers and nonexercisers. Second, a small subset of highly active women demonstrated transient FHR decelerations and alterations in umbilical and uterine artery Doppler indices immediately after exercise.

With strenuous exercise, all participants, regardless of activity status, reported perceived exertion ratings that were consistent with strenuous exercise and peak maternal heart rates were sim-
Fetal heart rate and Doppler indices before and after exercise in all groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groupa</th>
<th>Nonexercisers (n = 15)</th>
<th>Regularly active (n = 15)</th>
<th>Highly active (n = 15)</th>
<th>P valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal heart rate, beats/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>141.8 ± 8.4</td>
<td>137.7 ± 6.5</td>
<td>138.9 ± 8.1</td>
<td>Group: .017</td>
<td>Time: .660</td>
</tr>
<tr>
<td>After</td>
<td>148.5 ± 10.3</td>
<td>147.9 ± 16.2</td>
<td>126.8 ± 34.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbilical artery systolic-to-diastolic ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>2.58 ± 0.34</td>
<td>2.71 ± 0.38</td>
<td>2.69 ± 0.26</td>
<td>Group: .330</td>
<td>Time: .100</td>
</tr>
<tr>
<td>After</td>
<td>2.51 ± 0.42</td>
<td>2.45 ± 0.28</td>
<td>2.70 ± 0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbilical artery resistance index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>0.60 ± 0.05</td>
<td>0.62 ± 0.05</td>
<td>0.62 ± 0.04</td>
<td>Group: .306</td>
<td>Time: .018</td>
</tr>
<tr>
<td>After</td>
<td>0.59 ± 0.06</td>
<td>0.58 ± 0.05</td>
<td>0.62 ± 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbilical artery pulsatility index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>0.86 ± 0.11</td>
<td>0.90 ± 0.10</td>
<td>0.90 ± 0.07</td>
<td>Group: .236</td>
<td>Time: .074</td>
</tr>
<tr>
<td>After</td>
<td>0.83 ± 0.12</td>
<td>0.83 ± 0.09</td>
<td>0.91 ± 0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uterine artery systolic-to-diastolic ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>1.96 ± 0.48</td>
<td>1.91 ± 0.28</td>
<td>1.98 ± 0.32</td>
<td>Group: .279</td>
<td>Time: .518</td>
</tr>
<tr>
<td>After</td>
<td>1.85 ± 0.25</td>
<td>1.95 ± 0.41</td>
<td>2.17 ± 0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uterine artery resistance index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>0.46 ± 0.10</td>
<td>0.47 ± 0.08</td>
<td>0.48 ± 0.08</td>
<td>Group: .270</td>
<td>Time: .511</td>
</tr>
<tr>
<td>After</td>
<td>0.45 ± 0.07</td>
<td>0.47 ± 0.09</td>
<td>0.52 ± 0.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uterine artery pulsatility index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>0.61 ± 0.18</td>
<td>0.61 ± 0.13</td>
<td>0.64 ± 0.14</td>
<td>Group: .232</td>
<td>Time: .457</td>
</tr>
<tr>
<td>After</td>
<td>0.59 ± 0.12</td>
<td>0.62 ± 0.16</td>
<td>0.73 ± 0.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Data are given as mean ± SD; ** 2-way analysis of variance with repeated measures; main effects are for group and time (before and after exercise) and group by time interaction; † Includes 5 subjects with bradycardias.


iller. Umbilical artery S/D ratio, which is a common measure that is used to evaluate fetal well-being, fell within the 25th-50th percentile for gestational age according to reference values and did not significantly change with exercise. Similarly, uterine artery Doppler measures, which are a reflection of maternal blood flow, were near the 50th percentile for gestational age according to reference intervals and did not significantly change with strenuous exercise. Furthermore, fetal heart tracings were classified as category I and met established criteria for reactivity after exercise in all women; the BPPs were reassuring. Although one participant’s time to a BPP of 8 of 8 was 32.57 minutes, this is not likely clinically significant.

An intriguing finding in this study was the transient FHR decelerations that were experienced by a subset of participants. Interestingly, each woman who experienced an immediate FHR deceleration after exercise was in the highly active group. The subgroup numbers are small; thus, the data must be interpreted cautiously. It is also important to note that these decelerations were of short duration (mean, 2:37 minutes), which technically does not meet the definition of a bradycardia that is defined as lasting ≥10 minutes. However, in addition to the FHR decelerations, changes were also seen in umbilical and uterine artery parameters. In the highly active women with FHR decelerations, the umbilical artery S/D ratio increased with exercise, which is a different and potentially more concerning response. Additionally, uterine artery PI increased to the 90th percentile according to reference data, which may indicate a brief relative reduction in maternal blood flow to the uterus in some women immediately after strenuous exercise. This brief alteration in resistance indices did not appear to affect overall fetal well-being, because all of the participants scored 8 of 8 BPPs shortly after exercise and because all fetal heart tracings were reactive. Importantly, we recently reported no FHR decelerations or untoward fetal responses after vigorous exercise (defined as 60-84% of heart rate reserve), which suggests that this response may occur only with exercise intensity over the “vigorous” threshold.

Our results are similar to a recently published study that evaluated fetal well-being after strenuous exercise between 23-29 weeks’ gestation in Olympic-level athletes. In 2 of the 6 athletes, fetal “bradycardias” were noted when maternal heart rate exceeded 90% of maximum. Additionally, elevated umbilical artery PI was seen in these 2 women. Uterine artery Doppler studies determined overall blood flow was <50% of the initial value in these women. Their fetuses recovered quickly with no signs of sus-
tained bradycardia or elevated Doppler indices in the next 10 minutes. The overall conclusions by the authors were that fetal well-being may be compromised when exercise intensity exceeds 90% of maximum maternal heart rate and that uterine artery blood flow was reduced 25-60% during intensive exercise. However, similar to the current study, they recognize the sample size was small and that the results should be interpreted with caution. It is difficult to compare our findings with those of Salveson et al. in terms of the percent of predicted maximum heart rate that was achieved during exercise. Because they did not report maternal heart rate data, we were unable to determine how the percent of maximum heart rate that was achieved was calculated. With the use of standard prediction equations in the present study, all highly active participants achieved >90% of predicted maximum heart rate. Although those participants with FHR decelerations achieved a slightly higher percentage (95.9% vs 90.3%), this was not statistically significant. Importantly, the sample sizes are small, which made it difficult to draw conclusions. Additionally, the accuracy of predicting maximum heart rate in pregnant women is unclear because existing literature indicates conflicting results with some studies that have reported no change in maternal maximum heart rate with pregnancy; other reports suggest an attenuation.

In the present study, the mean peak maternal heart rates that were achieved by all activity groups were significantly >140 beats/min, which is the threshold heart rate many providers advise women not to exceed during exercise. Notably, ACOG removed this restriction from their exercise recommendations in 1994. More data are needed before we are able to provide evidence-based threshold heart rates for exercising women.

A strength of our study is that a variety of fetal well-being tests were performed, all of which were reassuring in all women after strenuous exercise. Additionally, we evaluated both exercisers and nonex-
ercisers, which is important because exercise recommendations differ depending on a woman’s activity status.\textsuperscript{1,2}

An obvious limitation to this study is that the fetal well-being measures were not evaluated during exercise. Monitoring FHR during exercise is technically difficult; previous early investigations likely reported artifact from exercise movement.\textsuperscript{18,19} We believe that the immediate results after exercise are a good representation of fetal well-being. It is often hypothesized that maternal hypoxemia contributes to fetal bradycardia. We did not measure maternal oxygenation status or lactate with exercise. However, if the fetus was hypoxic during the exercise, the measures after exercise likely would be nonreassuring. We did not see any nonreassuring fetal responses to exercise, and the decelerations were all transient. Moreover, Salvesen et al\textsuperscript{5} did not find differences in lactate levels between the exercisers with and without fetal bradycardias. It has also been speculated that fetal bradycardias with maternal exercise may be related to maternal catecholamine release,\textsuperscript{20,21} which leads to a reduction in uterine blood flow. Importantly, in these studies, which are similar to the current study, the brief “bradycardic” episodes appeared to be well-tolerated by the fetuses.

Another limitation to the present study is that it involves only healthy women of normal weight before pregnancy. Responses may be different in obese women and women with medical complications, such as hypertension or diabetes mellitus. We also evaluated only responses to strenuous exercise at 1 time point in the third trimester. Responses could differ at different gestational ages. Additionally, this study was not powered to evaluate neonatal outcomes. However, all delivery data were reassuring, and all deliveries were uncomplicated. All women delivered at term, with the exception of 2 participants (1 nonexerciser [36 weeks 1 day gestation] and 1 highly active participant [36 weeks 6 days’ gestation]). Both of these neonates were discharged home on day 2 with their mothers.

In conclusion, overall fetal well-being is reassuring after short-duration, strenuous exercise in both active and inactive pregnant women. However, a subset of highly active women experienced transient FHR decelerations and alterations in umbilical and uterine artery Doppler indices immediately after exercise. Although all of the fetuses subsequently showed reassuring fetal testing responses and the decelerations were short in duration, further research is needed on exercise in pregnant athletes to determine whether an upper limit of exercise exists that, if exceeded, places the fetus at risk. Pregnant athletes, particularly elite athletes, may benefit from individualized exercise prescriptions because they may push themselves beyond a threshold at which measures of fetal well-being may be compromised. However, the clinical significance of a transient “bradycardia” is unclear. Whether this translates into adverse neonatal outcomes is not known. No available neonatal data suggest adverse outcomes.

REFERENCES