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A correction notice has been issued for this document on the Obstetrics & Gynecology website. View the Correction Number 804 (Replaces Committee on Obstetric Practice This Committee Opinion was developed by the Committee on Obstetric Practice with the assistance of
committee members Meredith L. Birsner, MD; and Cynthia Gyamfi-Bannerman, MD, MSc. ABSTRACT: Exercise, defined as physical activity consisting of planned, structured, and repetitive bodily movements done to improve one or more components of physical fitness, is an essential element of a healthy lifestyle, and obstetriciangynecologists and
other obstetric care providers should encourage their patients to commence exercise as an important component of optimal health. Women who habitually engaged in vigorous-intensity aerobic activity or who were physically active before pregnancy can continue these activities during pregnancy and the postpartum period.
Observational studies of women who exercise during pregnancy have shown benefits such as decreased gestational diabetes mellitus, cesarean birth and operative vaginal delivery, and postpartum recovery time. Physical activity also can be an essential factor in the prevention of depressive disorders of women in the postpartum period. Physical
activity and exercise in pregnancy are associated with minimal risks and have been shown to benefit most women, although some modification to exercise routines may be necessary because of normal anatomic and physiologic changes and fetal requirements. In the absence of obstetric or medical complications or contraindications, physical activity, and exercise routines may be necessary because of normal anatomic and physiologic changes and fetal requirements.
in pregnancy is safe and desirable, and pregnant women should be encouraged to continue or to initiate safe physical activity and exercise during pregnancy and the postpartum period. Regular physical activity in all phases of life,
including pregnancy, promotes health benefits. Pregnancy is an ideal time for maintaining or adopting a healthy lifestyle and the American College of Obstetricians and Gynecologists makes the following recommendations: Physical activity and exercise in pregnancy are associated with minimal risks and have been shown to benefit most women,
although some modification to exercise routines may be necessary because of normal anatomic and physiologic changes and fetal requirements. A thorough clinical evaluation should be conducted before recommending an exercise program to ensure that a patient does not have a medical reason to avoid exercise. Women with uncomplicated
pregnancies should be encouraged to engage in aerobic and strength-conditioning exercises before, during, and after pregnancy. Obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers and the providers of the providers
Activity restriction should not be prescribed routinely as a treatment to reduce preterm birth. Additional research is needed to study the effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effects of exercise on pregnancy-specific conditions and outcomes and the effects of exercise on pregnancy-specific conditions are present to the exercise of exercise of exercise on pregnancy-specific conditions are present to the exercise of exe
to create an improved evidence base concerning the effects of occupational physical activity on maternalfetal health. This document has been revised to incorporate recent evidence regarding the benefits and risks of physical activity and exercise during pregnancy and the postpartum period. Physical activity, defined as any bodily movement
produced by the contraction of skeletal muscles 1 in all stages of life, maintains and improves cardiorespiratory fitness, reduces the risk of obesity and associated comorbidities, and results in greater longevity. Women who begin their pregnancy with a healthy lifestyle (eg, exercise, good nutrition, nonsmoking) should be encouraged to maintain those
healthy habits. Women who do not have healthy lifestyles should be encouraged to view the prepregnancy period and pregnancy as opportunities to embrace healthier routines. Exercise, defined as physical activity consisting of planned, structured, and repetitive bodily movements done to improve one or more components of physical fitness 1, is an
essential element of a healthy lifestyle, and obstetriciangynecologists and other obstetric care providers should encourage their patients to continue or to commence exercise as an important component of optimal health. The World Health Organization and the American College of Sports Medicine have issued evidence-based recommendations
indicating that the beneficial effects of exercise in most adults are indisputable and that the benefits far outweigh the risks 2 3. 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 4. This activity should be spread throughout the week. The guidelines advise that women who habitually engaged in vigorous-intensity aerobic activity or who were physically active before pregnancy and the postpartum period. Additionally, women who are
pregnant should be under the care of an obstetrician-gynecologist or other obstetric care provider who can monitor the pregnancy. Women who are pregnant can consult their obstetrician-gynecologist or other obstetric care provider about whether or how to adjust their physical activity during pregnancy and postpartum 4. Physical
inactivity is the fourth-leading risk factor for early mortality worldwide 2. In pregnancy, physical inactivity and excessive weight gain have been recognized as independent risk factors for maternal obesity and related pregnancy complications, including gestational diabetes mellitus (GDM) 5 6 7. Concerns that regular physical activity during
pregnancy may cause miscarriage, poor fetal growth, musculoskeletal injury, or premature delivery have not been substantiated for women with uncomplications, physical activity in pregnancy is safe and desirable, and pregnant women should be
encouraged to continue or to initiate safe physical activities Box 1, Box 2. WalkingStationary cyclingAerobic exercisesHydrotherapy, water aerobicsModified from Berghella V, Saccone G. Exercise in pregnancy! Am J Obstet Gynecol 2017;216:3357. Higher incidence of
Lower incidence of: Excessive gestational weight gainGestational diabetes mellitusGestational hypertensive disorders*Preterm birthLower birth weight*Defined as gestational hypertension or preeclampsiaModified from Berghella V, Saccone G. Exercise in pregnancy! Am J Obstet Gynecol 2017;216:3357.Most pregnant patients can
exercise. There are few maternal medical conditions in which aerobic exercise is absolutely contraindicated. When questions exist regarding safety of aerobic exercise in pregnancy, consultation with relevant specialists and subspecialists (eg, obstetrics and gynecology, maternal medical conditions in which aerobic exercise is absolutely contraindicated. In
women who have obstetric or medical comorbidities, exercise regimens should be individualized. Obstetric care providers should evaluate women with medical or obstetric care providers should be individualized. Obstetric care providers should evaluate women with medical or obstetric care providers and other obstetric care providers should be individualized.
physiologic changes that should be considered when prescribing exercise. The most distinct changes during pregnancy are weight gain and a shift in the point of gravity that results in progressive lordosis. These changes lead to an increase in the forces across joints and the spine during weight-bearing exercise. As a result, more than 60% of all
pregnant women experience low back pain 13. Strengthening abdominal and back muscles could minimize this risk. Blood volume, heart rate, stroke volume, and cardiac output normally increase during pregnancy, and systemic vascular resistance decreases Table 1. These hemodynamic changes establish the circulatory reserve necessary to sustain
the pregnant woman and fetus at rest and during exercise. Maintaining a supine position during exercise after 20 weeks of gestation may result in decreased venous return due to aortocaval compression from the gravid uterus, leading to hypotension, and this hemodynamic change should be considered when prescribing exercise modifications in
pregnancy 14 15 16. In pregnancy, there also are profound respiratory changes. Minute ventilation increases up to 50%, primarily as a result of the increased tidal volume. Because of a physiologic decrease in pulmonary reserve, the ability to exercise anaerobically is impaired, and oxygen availability for aerobic exercise and increased work load
consistently lags. The physiologic respiratory alkalosis of pregnancy may not be sufficient to compensate for the developing metabolic acidosis of strenuous exercise. Decreases in subjective work load and maximum exercise performance in pregnant women, particularly in those who are overweight or obese, limit their ability to engage in more
strenuous physical activities 17. Aerobic training in pregnant women 18 19 20. Temperature regulation is highly dependent on hydration and environmental conditions. During exercise, pregnant women should stay well hydrated, wear loose-fitting clothing, and
avoid high heat and humidity to protect against heat stress, particularly during the first trimester 1. Although exposure to heat from sources such as hot tubs, saunas, or fever has been associated with an increased risk of neural tube defects 21, exercise would not be expected to increase core body temperature into the range of concern. At least one
study found no association between exercise and neural tube defects 22. Most of the studies addressing fetal response to maternal exercise and birth weight. Studies have demonstrated minimum to moderate increases in fetal heart rate by 1030 beats per minute over the baseline during or after exercise 23 24
25 26. Three meta-analyses concluded that the differences in birth weight were minimal to none in women who exercise during pregnancy compared with controls 27 28 29. However, women who continued to exercise vigorously during the third trimester were more likely to deliver infants weighing 200400 g less than comparable controls, although
there was not an increased risk of fetal growth restriction 27 28 29. A cohort study that assessed umbilical artery blood flow, fetal heart rates, and biophysical profiles before and after strenuous exercise in the second trimester demonstrated that 30 minutes of strenuous exercise was well tolerated by women and fetuses in active and inactive
pregnant women 26. More data are needed from athletes who may exert beyond the accepted vigorous definition of up to 85% of capacity, and it is possible that there is an absolute level of intensity (or duration, or both) that exists, and if exceeded, could place the fetus at risk. Individualized exercise prescriptions may be warranted in pregnant
athletes to ascertain whether there is a threshold beyond which fetal well-being may be compromised 30. The benefits of exercise during pregnancy has been shown to improve or maintain physical fitness 8 9 27. Observational studies of women who exercise during pregnancy have
shown benefits such as decreased GDM (Odds Ratio [OR] 0.103; 95% CI, 0.0130.803) 6 32 33 34, cesarean birth (Relative Risk 0.69, 95% CI, 0.42, 0.82) 35 and operative vaginal delivery 9 35 36, and postpartum recovery time 9. Physical activity also can be an essential factor in the prevention of depressive disorders of women in the postpartum
period 37 38. In pregnancy, greater self-reported overall physical fitness and cardiorespiratory fitness are needed to explore whether improving physical fitness before and during pregnancy could decrease pain during the peripartum period. A 2017
randomized controlled trial that included 300 overweight or obese women with uncomplicated, singleton gestation found that cycling exercises initiated in the first trimester and performed at least 30 minutes, 3 times per week until 37 weeks of gestation, significantly reduced the incidence of GDM, significantly
reduced gestational weight gain at less than 25 weeks of gestation, and lowered neonatal birth weight 40. Although these investigators found no significant differences between the exercise and control groups in the incidence of other outcomes, such as preterm birth, gestational hypertension, cesarean birth, and macrosomia, all these outcomes were
less frequent in the exercise group. A 2017 systematic review and meta-analysis 41 showed a significantly reduced risk of gestational hypertension, and cesarean birth in women who performed aerobic exercise 3060 minutes 27 times per week, as compared with women who were more sedentary 41. Studies have
shown that exercise during pregnancy can lower glucose levels in women with GDM 42 43 or help prevent preeclampsia 44. Exercise has shown only a modest decrease in overall weight, and obese women 45 46. Another 2017 systematic review and meta-analysis 47 showed that, for overweight and obese
women with a singleton pregnancy, compared with women who were more sedentary, aerobic exercise for about 3060 minutes 37 times per week during pregnancy is associated with a reduction in the incidence of preterm birth (RR 0.62, 95% CI, 0.410.95) 47. Aerobic exercise in overweight and obese pregnant women also is associated with a
significantly lower incidence of GDM and, therefore, should be encouraged 47. A 2016 systematic review and meta-analysis in normal-weight pregnant women with a singleton uncomplicated gestation showed that aerobic exercise for 3590 minutes 34 times per week is not associated with an increased risk of preterm birth or with a reduction in mean
gestational age at delivery. Exercise was associated with a significantly higher incidence of cesarean birth, with a significantly lower incidence of GDM and hypertensive disorders 48. Finally, a 2019 systematic review and meta-analysis 49 found that in mothers with pregestational medical
conditions (chronic hypertension, type 1 diabetes and type 2 diabetes), prenatal exercise reduced the odds of cesarean birth by 55% and did not increase the risk of adverse maternal and neonatal outcomes (OR 0.45; 95% CI, 0.220.95) although findings are based on limited evidence, suggesting a need for high-quality investigations on exercise in this
population of women. Pregnancy is an ideal time for behavior modification and adoption of a healthy lifestyle because of increased motivation and frequent access to medical supervision. Patients are more likely to control weight, increased motivation and frequent access to medical supervision.
tools such as the Five As (Ask, Advise, Assess, Assist, and Arrange), originally developed for smoking cessation, have been used successfully for diet and exercise counseling 51 52. Obstetriciangynecologists and other obstetric care providers can consider adopting the Five As approach for women with uncomplicated pregnancies who have no
contraindications to exercise. The principles of exercise pregram to ensure that a patient does not have a medical reason to avoid exercise program that leads to an
eventual goal of moderate-intensity exercise for at least 2030 minutes per day on most or all days of the week should be developed with the patient and adjusted as medically indicated. Because blunted and normal heart-rate responses to exercise have been reported in pregnant women, the use of ratings of perceived exertion may be a more effective
means to monitor exercise intensity during pregnancy than heart-rate parameters 53. For moderate-intensity exercise, ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion should be 1314 (somewhat hard) on the Borg ratings of perceived exertion s
exercising, she likely is not overexerting herself 54. Women should be advised to remain well hydrated, avoid long periods of lying flat on their backs, and stop exercising if they have any of the warning signs listed in Box 3. Vaginal bleedingAbdominal painRegular painful contractionsAmniotic fluid leakageDyspnea before
exertionDizzinessHeadacheChest painMuscle weakness affecting balanceCalf pain or swellingPregnant women who were sedentary before pregnancy should follow a more gradual progression of exercise intensity has not been established, women who were regular exercisers before pregnancy and who have
uncomplicated, healthy pregnancies should be able to engage in high-intensity exercise programs, such as jogging and aerobics, with no adverse effects. High-intensity or prolonged exercise in excess of 45 minutes can lead to hypoglycemia; therefore, adequate caloric intake before exercise programs, such as jogging and aerobics, with no adverse effects.
essential to minimize this risk 55. Prolonged exercise should be performed in a thermoneutral environment or in controlled environme
exercised in which physical activity was self-paced in a temperature-controlled environment, core body temperatures rose less than 1.5C over 30 minutes and stayed within safe limits 31. Table 3 lists suggestions for an exercise plan in pregnancy 31. Finally, although physical activity and dehydration in pregnancy have been associated with a small
increase in uterine contractions 57, a 2016 systematic review and meta-analysis in normal-weight pregnant women with singleton uncomplicated gestations demonstrated that exercise for 3590 minutes 34 times per week is not associated with an increased risk of preterm birth or with a reduction in mean gestational age at delivery 48.Box 1 lists
examples of safe exercises in pregnancy. Women with uncomplicated pregnancies should be encouraged to engage in aerobic and strength-conditioning exercises before, during, and after pregnancy because of the
inability of the fetal pulmonary circulation to filter bubble formation 58. Women living at sea level were able to exercise safely at altitudes higher than 6,000 feet, suggesting this altitudes may be able to exercise safely at altitudes higher than 6,000 feet, suggesting this altitudes may be able to exercise safely at altitudes higher than 6,000 feet, suggesting this altitude is safe in pregnancy 59, although more research is needed.
feet.In those instances in which women experience low-back pain, exercise in water is an alternative 60. A study of the apparent weight reduction that lowers the maternal osteoarticular load due to buoyancy 61. There may be
additional benefits of aquatic exercise as well. A randomized controlled trial of an aquatic physical exercise program during pregnancy consisting of three 60-minute exercises demonstrated a greater rate of intact perineum after childbirth (OR 13.54, 95% CI, 2.7566.56) 62. Pregnant women with obesity should be encouraged to engage in a healthy
lifestyle modification in pregnancy that includes physical activities and judicious diets 5. Women should start with low-intensity, short periods of exercise among pregnant women with obesity, women assigned to exercise
demonstrated modest reductions in weight gain and no adverse outcomes 45 63. Vigorous-intensity exercise completed into the effects of vigorous-intensity exercise in the first and second trimesters and of exercise intensity exceeding 90% of maximum
heart rate 64. Competitive athletes require frequent and close supervision because they tend to maintain a more strenuous training postpartum sooner than other women. Such athletes should pay particular attention to avoiding hyperthermia, maintaining proper hydration, and
sustaining adequate caloric intake to prevent weight loss, which may adversely affect fetal growth. An elite athlete can be defined generally as an athlete with several years of experience in a particular sport or sports who has competed successfully against other high level performers and trains year-round at a high level; an elite athlete generally
trains at least 5 days per week, averaging close to 2 hours per day throughout the year 30. In addition to aerobic training was not considered a safe activity in early guidelines for exercise during pregnancy because
of potential injury and possible fetal heart decelerations resulting from Valsalva maneuvers. Consequently, there is sparse literature on this topic 30. It is prudent for elite athletes who wish to continue strenuous activity during pregnancy to have a clear understanding of the risks, to obtain approval from their health care providers, and to consider
decreasing resistance load compared with prepregnant conditions. High-impact activities with increased risk of blunt trauma should be avoided, and it also is important that the pregnant elite athlete avoid overheating when performing their sport or participating in intense training 30. Several reviews have determined that there is no credible
evidence to prescribe bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients prescribed prolonged bed rest in pregnancy for the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients predating the prevention of preterm labor, and it should not be routinely recommended 65 66. Patients predating the predating the prevention of preterm labor, and the prevention of preterm labor.
in women at risk for preterm birth who are placed on activity restriction, including bed rest, and there are multiple studies documenting untoward effects. Activity restriction should not be prescribed routinely as a treatment to reduce preterm birth 67.
Additionally, there is no evidence that bed rest reduces preeclampsia risk, and it should not be routinely recommended for the primary prevention of preeclampsia and its complications 68. The evidence regarding a possible association between fetalmaternal health outcomes and occupational physical activity is mixed and limited. A meta-analysis
based on 62 reports assessed the evidence relating preterm delivery, low birth weight, small for gestational age, preeclampsia, and physical work load) 69. Although the analysis was limited by the heterogeneity of exposure definitions, especially for
lifting and heavy work load, most of the estimates of risk pointed to small or null effects. In contrast, a cohort study of more than 62,000 Danish women reported a doseresponse relationship between total daily burden lifted and preterm birth with loads more than 1,000 kg per day 70. In this study, lifting heavy loads (greater than 20 kg) more than 10
times per day was associated with an increased risk of preterm birth. The National Institute for Occupational Safety and Health uses an equation that determines the maximum recommended weight limit for a broad
range of lifting patterns for pregnant women, as well as lifting conditions that pose a higher risk of musculoskeletal injury 72 Figure 1. Obstetriciangynecologists and other obstetric care providers can use their best clinical judgment to determine a recommended plan for the patient. This plan may include a formal request for an occupational health
professional to perform an analysis to determine maximum weight limits based on actual lifting condition or assist with writing appropriate letters to employers to help obtain accommodations 73. Several reports indicate that womens level of participation in exercise programs diminishes after childbirth, frequently leading to overweight and obesity 74
75. The postpartum period is an opportune time for obstetric care providers to recommend and reinforce a healthy lifestyle. Resuming exercise routines may be resumed gradually after pregnancy as
soon as medically safe, depending on the mode of delivery (vaginal or cesarean birth) and the presence or absence of medical or surgical complications. Some women are capable of resuming physical activities within days of delivery. Pelvic floor exercises can be initiated in the immediate postpartum period. Abdominal strengthening exercises,
including abdominal crunch exercises and the drawing-in exercises and the drawing-in exercises abdominal pressure by pulling in the abdominal wall muscles, have been shown to decrease the incidence of diastasis recti abdominal wall muscles, have been shown to decrease the incidence of diastasis recti abdominal pressure by pulling in the abdom
exercise in lactating women has been shown to improve maternal cardiovascular fitness without affecting milk production, composition, or infant growth 78. Women who are lactating should ensure adequate hydration before
or contraindications, physical activity in pregnancy is safe and desirable, and pregnant women should be encouraged to continue or to initiate safe physical activities. Obstetric care providers should evaluate women with medical or obstetric care providers should evaluate women with medical or obstetric care providers should be encouraged to continue or to initiate safe physical activities.
activity participation during pregnancy. Although the evidence is limited, exercise results in benefits to pregnancy outcomes, and there is no evidence of harm when exercise is not contraindicated. Physical activity and exercise during pregnancy promote physical fitness and may prevent excessive gestational weight gain. Exercise may reduce the risk
of gestational diabetes, preeclampsia, and cesarean birth. Additional research is needed to study the effects of exercise on pregnancy-specific conditions and outcomes and to clarify further effective behavioral counseling methods and the optimal type, frequency, and intensity of exercise. Similar research is needed to create an improved evidence
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 . 2021 Nov 25;17(1):1831. doi: 10.1177/15598276211052277For apparently healthy pregnant women, regular physical activity is recommendations for physical activity and exercise during pregnancy in 1985. Atthat time, pregnant women were advised to not
exceed a heart rate of 140 beatsper minute with physical activity. The heart rate recommendation wassubsequently removed with the recommendations on physical activity for pregnantand postpartum women. The recommendation included exercising at a fairly
lightto somewhat hard perceived intensity and at less than 6080% of age-predictedmaximum heart rate, usually not exceeding a heart rate of 140 beats per minute. Women often seek advice from healthcare providers on physical activity during regnancy, yet providers report concern about giving appropriate physicalactivity guidance. This paper
summarizes the key scientific literature onmonitoring absolute and relative exercise intensity in relation to the currentACOG recommendation. This paper also provides practical guidance to assisthealthcare providers in relaying this information to pregnant
women. Keywords: exercise prescription, heart rate, intensity, perceived exertion, pregnancy, women who are physically active can derive numerous benefits, such asprevention of excessive gestational
weight gain and gestational diabetes mellitus; decreased risk of preeclampsia; and reduced length of labor and incidence of lower backpain.1,2 Uncommon acuterisks of physical activity during pregnancy include hyperthermia, musculoskeletalinjury, and reduced uteroplacental blood flow that could injure the fetus or cause fetalgrowth
restriction.2,3Yet, despite the supportive evidence for physical activity, pregnant women from theUnited States are insufficiently physically active during pregnancy.4,5Women often seek guidance about physical activity during pregnancy from their healthcareproviders6,7,8; those who seek advice are morelikely to report exercising during pregnancy
particularly in the laterstages. 9,10 However, some pregnant women characterize provider advice about physical activity as overly conservative, vague, and confusing. 6,7,11,12,13,14,15,16,17,18 This is not surprising, given that providers report concern about giving appropriate physical activity guidance. 19,20 Physical activity recommendations,
therefore, provide important information to both womenand healthcare providers. The recommendations should consider frequency, duration, type, and intensity of physical activity. In particular, intensity of physical activity hasbeen a source of confusion to both pregnant women and their providers. Restriction ofmaternal heart rate during physical activity hasbeen a source of confusion to both pregnant women and their providers. Restriction ofmaternal heart rate during physical activity hasbeen a source of confusion to both pregnant women and their providers.
activity in pregnancy was first introduced with theinaugural American College of Obstetricians and Gynecologists (ACOG) guidance issued in 1985.21 The guidance indicated that exercise target heart rate for pregnant women shouldbe set 2530% lower than at other times and should not exceed 140 bpm (Table 1). It is unclear how the 140 bpm value
was originally derived. Exercise Intensity Recommendations from ACOG, 1985 to 2020. Year, reference Background text from ACOG guideline ACOG guideline ACOG guideline ACOG guideline ACOG guideline ACOG, 1985 to 2020. Year, reference Background text from ACOG guideline ACOG gui
general, target heart rates for pregnant and postpartum women should be approximately 25-30% lower thanwould be appropriate at other times. (page 2)Pregnantand postpartum women who exercise should be advised to measureheart rates during activity and given limits to follow. (page 2)Pregnancy only: Maternal heart rate should not
exceed140 beats per minute. (page 4)Heart rate should bemeasured at times of peak activity. Target heart rates and limits established in consultation with the physician should notbe exceeded. (page 4)1994, Technical Bulliten #18922Conflicting evidence exists concerning maternal heart rate response to steady-state aerobic exercise
duringpregnancy; both blunted and normal responses to weight-bearing exercise intensity and lower targetheart rates because of potential adverse effects. (page 68) Not mentioned 2002 Committee Opinion
#26723Not mentionedNot mentioned2015 Committee Opinion #65027Blood volume, heart rate, stroke volume, andcardiac output normally increase during pregnancy, whilesystemic vascular resistance decreases. (page 3)Because blunted and normal heart-rate responses toexercise have been reported in pregnant women, the use ofratings of
perceived exertion may be a more effective means tomonitor exercise intensity during pregnancy than heart-rate parameters.83 For moderate-intensity exercise, ratings of perceived exertion (Table 1 ACOG). Using the talk test isanother way to measure exertion. As long as a
woman can carry on conversation while exercising, she is likely not overexerting herself.84 (page 4)2020 ACOG Committee Opinion #80428Blood volume, heart rate, stroke volume, and systemic vascular resistance decreases. (page e179)Furtherresearch is needed on the effects of vigorous
intensity exercise in the first and second trimesters and of exercise intensityexceeding 90% of maximal heart rate. 85 (page e183)Quote from 2015 (because blunted.) repeated onpage e182Intensity of exercise, less than 60-80% of agepredicted maximal maternal heart rate, usually not exceeding 140beats per minute; ratings of perceived exertion 12-14
(Table 3ACOG) The heart rate recommendation was removed in the next update from ACOG in 199422 and in 2002.23 Despite the removal of heart rate recommendations, healthcare providers continuedgiving advice from the 1985 ACOG guidelines using the heart rate restriction of 140bpm.7,8,11,19,24,25,26 For example, in a small study,67% of
physicians self-reported that heart rate should stay below 140 bpm several yearsafter the restriction was removed.25 In the 2015 updated guidance, the use of perceived exertion was supported withmoderate intensity during
pregnancy (withquotations for the first 2 changes extracted from Table 2 for exercise in the first trimesterwith more than 12 weeks gestation). First, heart rate should stay less than 6080% ofage-predicted maximum. Based on the American College of Sports Medicine (ACSM)recommendations, the flagship organization providing scientifically based
exerciseprescription guidance through their Guidelines for Exercise Testing and Prescriptionsince 1975,29,30 this rangeextends from the upper end of light intensity to the lower end of vigorous intensity intens
80% of age predicted maximal heartrate usually not exceeding 140 bpm57-63%64-76%77-95%% heart rate reserveNot applicable30-3940-59%60-89%Rating of perceived exertion on the Borg scale12-14Fairly light to somewhat hard9-11Very light to somewhat hard14-17Somewhat hard14-17Somewhat hard to very hardFour Examples
Calculating Target Heart Rate for ACSM Moderate Intensity for aTheoretical 30 Year Old Woman using the Fox and Tanaka Formulas with andwithout Accounting for resting heart rate 70 bpmFox formulaTarget
30) Heart rate reserve of 120 bpm(190-70) Target heart rate rate maximal Maximal heart rate maximal Maximal heart rate of 187 bpm using theart rate of 187 bpm using theart rate maximal Maximal heart rate of 187 bpm using theart rate with potential error of 11bpm120 (109 to 131) to 142 (131 to 153) bpm117 (106 to 128) to 140 (129 to 151) bpm2alculation using % heart rate maximal Maximal heart rate of 187 bpm using theart rate maximal heart rate of 187 bpm using theart rate maximal heart rate maximal hea
Tanakaformula ([208.7*30])Target heart rate in moderate intensity would range from 120 (64%*187) to 142 (76%*187) bpm Differences between guidelines can
cause confusion for both healthcare providers and pregnant women. For example, the 2018 Physical Activity Guidelines for Americans31 and the 2020 World Health Organization Guidelines for pregnant women. For example, the 2018 Physical Activity and Sedentary Behavior32 do not include target heart rates for pregnant women. Woreover, the 2019 Canadian Guidelines for pregnancy and Sedentary Behavior32 do not include target heart rates for pregnant women.
provide heart rate recommendations during physical activity, but they differ from those of ACOG by taking account of age and intensity recommendation 28 by summarizing the key scientific literature on the use of heart rate and perceived exertion to monitor exercise intensity during pregnancy. The
overarching goalis to try to assist healthcare providers as they counsel women on their physical activity and exercise intensity during pregnancy. Physical activity is any bodily movement produced by skeletal muscles that results inenergy expenditure. 30,31 Exercise is not synonymous with physical activity, but ratheris a component of physical activity
that is planned, repetitive, and structured. Asstated, key components of physical activity include frequency, duration, time, type, and intensity or the magnitude of effort required to perform a given physical activity, which can be expressed in either absolute orrelative terms. 31 Absolute intensity is based on the work that
is being performed, expressed as a metabolic equivalent (MET). It does not consider an individuals cardiorespiratory fitness, which may be higher or lower than the assigned MET value of an activity. Incontrast, relative intensity, expressed as a percent of maximum aerobic capacity, accounts for cardiorespiratory fitness and is assessed based on
measured oxygenuptake, heart rate, or perceived exertion. The ACSM recommends that exercise intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using either absolute (MET values) or relative (oxygenuptake, heart rate, and perceived exertion) values. 30 Absolute intensity is prescribed using exertion and perceived exertion in the exertion of the e
the ACOG suggests monitoring intensitybased on heart rate and perceived exertion, 28 which we review here. As background, heart rate increases linearly with oxygen uptake until near maximal effort, making it a reasonable indicator of exercise intensity. 34 In the absence of a recent maximal exercise test to provide maximal heartrate, a number of
formulas can be used to estimate maximal heart rate. Severalformulas are predicated on maximal heart rate declining with age in a linearfashion.35,36 Derived in 1971, the first equation is the widely used Foxformula based on (220-age).37 In 2001, Tanaka et al.38 performed a meta-analysis of 351 studies and derived an alternative predictive formula
for maximal heart rate: (208 [.7 * age]). When the Fox and Tanaka formulas were rigorously evaluated among 762 sedentary adults with maximal bicycle exercise tests, maximal predicted heart rate at maximal effort.35 There was a larger error among Blacks and those
with older age, lowercardiorespiratory fitness, and higher body mass indices. The ACOG recommendations indicate the use of age-predicted maximum maternal heart rate which can be derivedusing either the Fox or Tanaka formulas. Calculation of exercise intensity can be performed with or without accounting forresting heart rate. The estimation
formula accounting for resting heart rate beforethe intensity values are assigned is the Karvonen formula or heart rate more closely corresponds to submaximal aerobic capacity thannot accounting for it. Based on a review of studies conducted
from 1966 to 2010, the Karvonen formula was recommended over other alternatives. 41 In a large study of adults, exercise intensity based on estimated heart rate at maximum effort. 42 Not surprisingly, given the prior findings on the
evaluation of the Fox and Tanaka formulas, 35 large inter-individual variability was found. Based on this variability, theauthors indicated that using a standard and unique formula to predict aerobicexercise intensity can yield relatively high error in a single subject and shouldraise the question of whether relying on the currently recommended
equivalence between heart rate reserve and percent of oxygen uptake reserve to prescribe andmonitor aerobic exercise intensity is still acceptable. 42 Nevertheless, when accounting for resting heart rate ranges should be calculated at
a lower percent range (Table 2). The ACSM defines intensity differently depending on the use of percent of maximalheart rate reserve (e.g., Karvonen formula) (Table 2). The ACSM defines intensity, 30 assuming that maximal heart rate was
obtained from a maximal exercise test. While a maximal exercise test. While a maximal test is the best method for assessing maximal heart rate examples provided in Ref. [30]) instead of a maximal exercise test can provide greater accuracythan relying on the Fox
or Tanaka formulas. Examples of the formulas applied to atheoretical woman 30 years of age are provided in Table 3. Based on our examples, targetheart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range forpercent of maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly depending on the method used with a higher range for maximal heart rates vary slightly dependent variety of the 
conducted as early as 1938 found resting cardiac output (strokevolume multiplied by heart rate) to be higher in pregnant women than when notpregnant women from 8 weeks gestation to 17 weeks postpartum. 45 Average resting heart rate rose
from early pregnancy to delivery by 10 to 20bpm and, following delivery, dropped to a level lower than during early in pregnancy (Figure 1). In 1985, Clapp46 documented resting heart rate was 7 bpm higher at 4 weeksgestation compared to pre-
pregnancy. Resting heart rate gradually increased to 32weeks gestation and then plateaued for the remainder of pregnancy to delivery (Figure 2). This finding has been substantiated in other studies. 47,48 Plot of mean heart rate (bpm) among women serially
measured throughoutpregnancy and postpartum (n = 18)*; Abbreviation: bpm, beats per minute; PP, postpartum. *The data were plotted using mean heart rate (ppm) among women runners serially measured before and during pregnancy (n = 10)*; Abbreviation: bpm, beatsper minute.
*The data were plotted using mean heart rate provided inTable 1 of the study.46These early study findings are supported by more recent work indicating earlyhemodynamic changes with pregnancy, starting around 25 weeks gestation.49 During submaximal weight-bearing and nonweight-bearing exercise, measures ofoxygen uptake, stroke volume,
and heart rate are higher during pregnancy compared tonon-pregnant states. 47,50 In a small study of active women, heart rate during the samelevel of submaximal exercise was on average 8 bpm higher in third trimesterpregnant women compared to non-pregnant controls, but was similar at maximal effort. 48 Others have reported that maximal
effort heart rate may be reduced due to theblunted sympathetic nervous system response to exercise late in pregnancy could meaningfully differ with the autonomic balance shift toward increased sympathetic control and away from parasympathetic control. 47,50,52 Due to a higher resting
heart rate, functional heart rate reserve at rest and submaximal exercise are reduced during pregnancy. 43 Heart rate reserve will be lower due to the higher resting heart rate and lower maximal heart rate reserve will be lower due to the higher resting heart rate reserve at rest and submaximal exercise are reduced during pregnancy.
overestimate intensity at lower work rates.43 Based on the variation found in adults,35,42 the implications for pregnantwomen are that exercise intensity based on heart rate estimated from age alone, orage and resting heart, is likely to have substantial error. To demonstrate the challenges specifically with the heart rate recommendations, Figure 3
plots target heartsrates for pregnant women 20 to 40 years of age from ACOG 202028 and from ACSM using heart rate maximum and heart rate can be made. There is variation in both moderate and vigorous target heart rates across the 5
examples. Considering percent of heart rates than older women. The heart rate mores foryounger women who generally have higher maximal heart rates than older women. The heart rate cap also restricts women with
higher resting heart rate compared to allower resting heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around themedian of the heart rate cap, only reaching to around the heart rate cap, only reaching th
observations, it seemsprudent to highlight that the heart rate recommendations should be reconsideredamong women taking beta-blockers or other medication that alters heart rate recommendations during moderate and
vigorous exercise by agefrom ACSM30 for adults and ACOG28 for pregnant women; Abbreviations: ACOG, American College of SportsMedicine; BPM, beats per minute; HRR, heart rate reserve using Karvonenformula; HRmax, heart rate using Fox formula (220-age). Self-assessment of heart
rate is an important consideration with the ACOG heart rate recommendation. 28 The most common options a pregnant woman have for measuring heart rateinclude (i) palpitation, (ii) wearing a device (e.g., activity tracker, smartwatch, and pulse oximeter), or (iii) using a device (e.g., activity tracker, smartwatch, and pulse oximeter), or (iii) using a device (e.g., activity tracker, smartwatch, and pulse oximeter).
radial artery on the wrist, rather than thecarotid artery at the neck, to avoid possible syncope particularly during exercise. It can be difficult to palpitate and count heart rate for at least 10 seconds whileexercising. Second, wearing a device offers the option to collect and usually store heart rate over an extended period of time, both at rest and exercise.
For many years, cheststraps were the best option for measurement. The advantages to a chest strapincluded their accuracy and lower cost, but the disadvantages include slipping, discomfort over longer periods of time, and not providing a reading when not indirect contact to the body. The strap often needed water between its surface and theskin to
read correctly. An alternative to the chest strap is the wrist band. It has gained popularity inrecent years since heart rate assessment is integrated into activity trackers and smartwatches. 53 The wrist bands use contact photoplethysmography (PPG) to estimate heart rate by utilizing differential reflection of light-emitting diodes in response to
the pulsatile changes in blood volume near the skin surface with each heart contraction. 54,55 In a review of 5 studies documenting the validity of heart rateassessment on Garmin activity trackers, agreement with the gold standard measure wasnot optimal; the Garmin performed better at rest compared to higher intensity activities. 56 Other wrist-worn
brands indicate similar variability when using PPG for heart rate assessment creatively utilizeheadphones, rings, clothing, or pulse oximetry. Third, consumers can use smartphone apps that measure heart rate assessment creatively utilizeheadphones, rings, clothing, or pulse oximetry. Third, consumers can use smartphone apps that measure heart rate assessment creatively utilizeheadphones, rings, clothing, or pulse oximetry. Third, consumers can use smartphone apps that measure heart rate assessment creatively utilize the phones camera and flash to
detectchanges in blood volume near the skins surface. Apps that required contact (such astouching your fingers) to the phones camera tend to be more accurate when the individual is in normal sinus rhythmcompared to rhythms with irregular rate or
tachycardia.60 Limitations of this method include variation in heart rate assessment due toskin tone, ambient light, user movement, finger pressure, and lower than optimalsampling rate of the phone.53 Other smartphone options include (i) mobile phone apps combined withaccelerometry using the seismocardiogram and the ballistocardiogram
signals61 and (ii) mobile phones with an electrocardiogram sensor and app to assessheart rate through the handheld electrocardiogram recorder.53The original ratings of perceived exertion scale approximates exercise heart rate from 6 (i.e., 200 bpm)62; predicted heart rate is in essence based on the numeric rating of
perceived exertion multiplied by 10. The ACSM provides recommendations for ratings of perceived exertion using the Borg scale, summarized in Table 2.30 Although describing exercise based on perceived exertion can be useful sinceit allows an approximately equivalent work-rate in individuals who have differing baseline fitness or exercise
capabilities, 63 it is not without challenges. Studies in non-pregnant populations suggest that perceived exertion may be bothunder- and over-estimated based on intensity level. For example, among 343 womenaged 4091 years, estimates of perceived intensity were higher for light and vigorous physical activity, but lower for moderate physical activity
compared to absolute intensity based on MET values from a compendium of physical activities. 64 The mismatch was largest with vigorous physical activity. A similar mismatch was largest with vigorous physical activity. A similar mismatch was largest with vigorous physical activity.
effort.65 When participants were asked to walk at a pace to benefit health, about half(52%) walked at light intensity, with fewer walking at moderate or vigorousintensity. Results did not differ by sex, ethnicity, or body mass index, but youngeradults (
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