Academy of Nutrition and Dietetics Gestational Diabetes Evidence-Based Nutrition Practice Guideline

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GESTATIONAL DIABETES MELLITUS (GDM) is a common perinatal complication characterized by glucose intolerance that develops during pregnancy.[1,2] The American Diabetes Association (ADA) defines GDM as "diabetes diagnosed in the second or third trimester of pregnancy that was not clearly overt diabetes prior to gestation."[3]

The exact prevalence of GDM is unknown.[4] In 2010, GDM prevalence in the United States was estimated to be 4.6% to 9.2%.[4] However, not all experts agree on the criteria to diagnose GDM and the estimated incidence of GDM depends on the population, the diagnostic criteria used, and the source of the data.[1,3] Over the past few decades, GDM rates have risen in the same trend as the rates of obesity and type 2 diabetes mellitus.[1]

A number of factors increase the risk for developing GDM. These include older maternal age (>30 years); body mass index (BMI) >25; past history of GDM; a first-degree relative with diabetes; and women of Hispanic, African American, Native American, South or East Asian, or Pacific Island descent.[1,2]

GDM poses risks to both the mother and baby. Pregnant women with GDM are at increased risk for preeclampsia and caesarean section. Infants are at risk for fetal macrosomia (which can cause shoulder dystocia and birth injury), and neonatal hypoglycemia. GDM also predisposes the infant to childhood obesity, and the mother to development of type 2 diabetes.[3,5,6] Obese women with GDM carry an even greater risk for adverse outcomes during pregnancy, compared with either GDM or obesity alone.[5]

Medical nutrition therapy (MNT) and physical activity are the first-line treatment of GDM. In some women, pharmacologic therapy may be added.[3,7] The goal of MNT is to encourage a healthful diet to achieve and maintain normoglycemia and promote appropriate pregnancy weight gain and adequate fetal growth.[8] Frequent glucose monitoring and ketone testing are recommended to provide feedback about day-to-day control and to make treatment adjustments.[8] Efforts are aimed at reducing perinatal and postpartum complications.

During 2008, the Academy of Nutrition and Dietetics (Academy) published its first GDM Evidence-Based Nutrition Practice Guideline (EBNPG) on the Evidence Analysis Library (EAL) online (www.andeal.org). According to the Academy, "EBNPGs are a series of guiding statements that are developed using a systematic process for identifying, analyzing, and synthesizing scientific evidence."[9] EBNPGs provide timely and comprehensive guidance to assist registered dietitian nutritionists (RDNs) in decisions about appropriate nutrition care for their patients. During 2013, a new evidence analysis work group was formed to update the original EBNPG and was subsequently published as part of the EAL during January 2017. This publication outlines the methods used to complete the systematic review (SR) and guideline and examines the guideline recommendations and supporting evidence.

The GDM EBNPG provides the latest, evidence-based summary of effective practice in the nutrition management of women with GDM. Principal areas include MNT, calories, macronutrients and micronutrients, dietary patterns, distribution of meals and snacks, high-intensity sweeteners, exercise, and alcohol. Using the Nutrition Care Process (NCP)[10] as a framework for practice, these recommendations begin with a referral to an RDN for MNT and follow with individualized nutrition assessment, intervention, and monitoring and evaluation (M&E). Implementation of these evidence-based nutrition practice recommendations will assist RDNs and other clinicians in improving maternal and fetal/neonatal outcomes in women with GDM.

GUIDELINE METHODOLOGY

Six volunteers with extensive experience in GDM nutrition practice and/or research were appointed to the expert work group in 2013 by the Academy's Evidence-Based Practice Committee. The work group was assisted by an Academy project manager, a lead analyst, and nine evidence analysts. As the work progressed, the scope and complexity of the evidence analysis required the addition of a consultant and a co-lead analyst to the project team. The work group followed the Academy evidence analysis methodology for conducting SRs and developing guidelines.[9,11] All work group business was conducted via conference calls and through a shared online work environment.

Based on the landscape of available evidence, current GDM nutrition practices, and the needs of practitioners, the work group developed 12 guiding questions for SRs under the following topics: effectiveness of MNT for treatment and prevention of GDM; effect of varying levels of calorie consumption;

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influence of amount and type of carbohydrate (CHO), protein, and fat consumption; effect of dietary patterns based on Dietary Approaches to Stop Hypertension (DASH) and the Glycemic Index (GI); and influence of distribution of meals and snacks. Outcomes of interest were identified as glycemic control; maternal weight gain; fetal growth/birth weight; and adverse fetal, maternal, and neonatal outcomes.

The work group provided parameters and inclusion/exclusion criteria for a systematic search of the scientific literature using the PubMed database (Figure 1). The dates encompassed by the search were January 2000 to August 2015. Studies published in English in peer-reviewed journals were eligible for inclusion. The search focused on pregnant adult women aged ≥19 years diagnosed with GDM (with or without insulin therapy). Study design preferences were randomized controlled trials (RCTs), large nonrandomized observational studies, cohort studies, and case–control studies. Studies were excluded in the case that groups were composed of fewer than 10 subjects, or when the study dropout rate was >20%. For MNT questions, only studies that evaluated the effects of nutrition therapy provided by an RDN or international equivalent were included in the review. The Academy EAL uses the term *international equivalent* to allow for MNT studies conducted outside the United States. To qualify as an international equivalent, reported credentials must be recognized by the International Confederation of Dietetic Associations.[12]

Additional searches were completed by mining the reference lists of identified meta-analyses and review articles for primary studies and relevant articles included in the 2008 GDM EAL project. The work group considered each study identified and determined inclusion or exclusion by consensus. A total of 29 studies (Figure 2[13]) were included in the SRs, five of which were used to answer more than one question.[14-18] Trained evidence analysts extracted data and critically appraised each article. Draft evidence summaries and overview tables were prepared by the lead analyst. The work group reviewed, summarized, and graded the quality of the evidence, summarizing the results in 12 conclusion statements. Not all evidence analysis questions were used to develop recommendations. MNT for prevention of GDM was outside the scope of the guideline. In addition, no evidence was found to answer several of the research questions. Six of the 12 completed SRs were used in the 2016 GDM guideline. A complete list of the evidence analysis questions, conclusions and grades, and the identification of conclusion statements used to support the guideline recommendations can be found in Figure 3.

Before development of the 2016 guideline, the work group selected the following topics from the 2008 GDM EBNPG for update: caloric intake, macronutrient and micronutrient intake, physical activity, use of nonnutritive sweeteners, alcohol consumption, and nutrition M&E. The 2008 recommendations for GDM risk assessment and screening, blood glucose (BG) monitoring, breastfeeding promotion, pharmacologic therapy, and prevention of type 2 diabetes were not included because the topics were outside the scope of the 2016 GDM guideline. New recommendations were added for referral to an RDN and meal and snack distribution. The 2008 recommendation for assessment of BMI and weight gain was moved to the 2016 nutrition assessment recommendation. The 2008 macronutrient and micronutrient recommendation was split into two separate recommendations in the 2016 guideline. Figure 4 provides an overview of the 2008 and 2016 recommendation revisions and updates.

No relevant studies were identified for some questions. According to the Academy's guideline development methodology,[11] external evidence-based guidelines (non-Academy) may be incorporated into EAL EBNPGs with a rating equivalent to the Academy's recommendation rating scheme. The work group identified the Endocrine Society's Diabetes and Pregnancy clinical practice guideline[19] and the ADA Standards of Medical Care in Diabetes 2016[20] for this purpose. Both external guidelines were subsequently approved by the Academy Evidence-Based Practice Committee during September 2016. In addition, other credible resources, such as consensus reports, position papers, standards of practice, and other guidelines, were used to strengthen and broaden the scope of the EAL EBNPG.

Following completion of the SR and the review of the 2008 GDM Guideline, the work group developed 18 evidence-based nutrition practice recommendations within 11 topic areas (Figure 5). Recommendations were rated Strong, Fair, Weak, Consensus, or Insufficient Evidence, according to the Academy Rating Scheme of Recommendations, and each recommendation was classified as either imperative (broadly applies to the target population) or conditional (applies in certain circumstances).[11]

The GDM EBNPG went through internal and external review, with the latter conducted by an interdisciplinary group of 14 recognized experts in GDM. Following the review, the work group responded to each comment provided and made revisions as indicated, by consensus.

Guideline Recommendations

This EBNPG was developed for RDNs caring for adult women with GDM and provides a starting point for individualizing nutrition care. It may also be a valuable resource to other health professionals involved in the care and treatment of women with GDM. In addition, the guidelines may serve as a resource for institutional development of effective clinical practice policy in nutrition management of GDM or for consumer education. The guidelines are limited to nutrition and lifestyle recommendations and do not address specific information on GDM screening, glycemic goals, medication management, or special populations. Practitioners interested in these topics are encouraged to review GDM resources from other professional organizations, including the ADA, the American College of Obstetricians and Gynecologists, and The Endocrine Society. Application of this guideline is not intended for pregnant women with pre-existing diabetes (type 1 or 2), undiagnosed type 2 diabetes, or women who are at risk for developing GDM (without diagnosis of GDM).

A total of 18 recommendations (Figure 5) make up the 2016 EAL Gestational Diabetes EBNPG. Four recommendations (MNT, calorie prescription, CHO prescription, and CHO and postprandial breakfast glycemia) were based on EAL SRs and two recommendations (referral to an RDN and physical activity) were based on external guidelines.[19,20] All six were rated according to the Academy's recommendation rating scheme.[11] The remaining 11

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Criteria	Inclusion	Exclusion
Age	≥19 y	<19 y
Setting	Any	No exclusions
Health status	Pregnant women	Women who are not pregnant
Nutrition-related problem or condition	GDM with or without insulin therapy Women at risk for GDM[a]	Women with pre-existing diabetes or impaired glucose tolerance before conception, not diagnosed with GDM, or glucose intolerance during pregnancy Women not at risk for GDM[a]
Intervention	Medical nutrition therapy by a registered dietitian nutritionist (or international equivalent); intervention should evaluate the effect of medical nutrition therapy counseling, education, and program by a registered dietitian nutritionist[b] Reports calorie prescription or intake; evaluates distribution of calories in meals and snacks[c] Reports dietary carbohydrate,[d] protein,[e] or fat[f] prescription or intake; compares carbohydrate[d], protein,[e] or fat[f] prescription or intake to ≥1 group; evaluates ≥1 of the following (independent of other macronutrient intake): amount, type, or distribution of carbohydrate,[d] protein,[e] or fat[f] in meals and snacks	Medical nutrition therapy that is not provided by a registered dietitian nutritionist (or international equivalent) or the provider of medical nutrition therapy is not specified or described. Intervention does not evaluate the effect of medical nutrition therapy counseling, education, or program by a registered dietitian nutritionist[b] Does not specify calorie prescription or intake; did not evaluate distribution of calories in meals and snacks[c] Did not specify dietary carbohydrate,[d] protein,[e] or fat[f] prescription or intake; did not compare carbohydrate,[d] protein,[e] or fat[f] prescription or intake to ≥1 groups; did not evaluate ≥1 of the following (independent of other macronutrient intake): amount, type, or distribution of carbohydrate,[d] protein,[e] or fat[f] in meals and snacks
Outcomes	Must report at least 1 of the following: glycemic, maternal weight gain, fetal growth/birth weight, adverse fetal, maternal, and neonatal outcomes	Does not report at least 1 of the following: glycemic, maternal weight gain, fetal growth/birth weight, adverse fetal, maternal, and neonatal outcomes
Study design preferences	Randomized controlled clinical trial or clinical controlled studies; large, nonrandomized observational studies; cohort studies; case-controlled studies; systematic reviews; meta-analyses	Narrative reviews; reference lists of pertinent narrative reviews may be hand-searched at workgroup request
Size of study groups	Minimum of 10 individuals in each study group	<10 Individuals per comparison group
Subject dropout rate	<20%	>20%
Year range	January 2000-August 2015[b] January 2000-January 2015[f] January 2000-July 2015[g] January 2000-December 2014[h]	Before 2000

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Figure 1. Search strategy and inclusion and exclusion criteria for the Evidence Analysis Library gestational diabetes mellitus (GDM) systematic review 2016.

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Criteria	Inclusion	Exclusion
Authorship	If an author is included on >1 review article or primary research article that is similar in content, the most recent review or article will be accepted and earlier versions will be rejected If an author is included on >1 review article or primary research article and the content is different, then both reviews may be accepted	Results of the same trial were also reported in another article, already included
Language	English	Not in English
Subjects	Human	Animal
Other	Article must be peer-reviewed and published in a juried publication	Not published in a juried publication (ie, government reports and position statements) Abstracts or presentations

[a]Criterion applicable only to the following subtopic: Prevention of GDM.

[b]Criteria applicable only to the following subtopics: Medical Nutrition Therapy and Prevention of GDM.

[c]Criteria applicable only to the following subtopic: Calories.

[d]Criteria applicable only to the following subtopics: Carbohydrates, Dietary Approaches to Stop Hypertension, Glycemic Index, and Distribution of Meals and Snacks.

[e]Criteria applicable only to the following subtopic: Protein.

[f]Criteria applicable only to the following subtopic: Fat.

[g]Criteria applicable only to the following subtopics: Medical Nutrition Therapy and Protein.

[h]Criteria applicable only to the following subtopics: Calories, Carbohydrate, Dietary Approaches to Stop Hypertension, Glycemic Index, and Distribution of Meals and Snacks.

Figure 1. *(continued)* Search strategy and inclusion and exclusion criteria for the Evidence Analysis Library gestational diabetes mellitus (GDM) systematic review 2016.

recommendations (nutrition assessment [4 recommendations], macronutrient requirements, meal and snack distribution, vitamin and minerals [2 recommendations], use of high-intensity sweeteners, alcohol intake, and nutrition M&E) were based on credible publications identified by the work group and were rated Consensus.

Due to the length of some recommendations, an abbreviated version is indicated by an asterisk. See Figure 5 for the full recommendation.

Recommendation 1

Referral to an RDN EAL Recommendation 1: Pregnant women who are diagnosed with GDM should be referred to an RDN for MNT. Individualized MNT is important in helping pregnant women with GDM achieve and maintain normal glycemic levels and appropriate weight gain while meeting essential nutrients for pregnancy to promote positive maternal and fetal outcomes.

Rating: Strong (imperative)
Rationale: Although referral to an RDN is outside the NCP, referral provides an entry point for the first step of the process (nutrition assessment).[10] Two external organizations provide strong evidence to support this recommendation. The ADA guidelines for Management of Diabetes in Pregnancy[20] state, "After diagnosis, treatment starts with MNT, physical activity and weight management depending on pregestational weight and glucose monitoring aiming for the targets recommended by the Fifth International Workshop Conference on GDM." Likewise, the Endocrine Society's Diabetes in Pregnancy Clinical Practice Guidelines recommend MNT for management of elevated BG and weight gain targets.[19] A second strong recommendation (moderate quality evidence) by The Endocrine Society also endorses both MNT along with exercise as the initial treatment of GDM.[19] Physical activity will be discussed in Recommendation 10.

Because it is imperative that patients with GDM achieve glycemic control within a tight time frame, the work group suggests that referrals are made to RDNs who have experience working with patients who have diabetes or an RDN who is a certified diabetes educator.

Recommendation 2

Nutrition Assessment *Assessment of Food/Nutrition-Related History of Women with GDM.* EAL Recommendation 2.1: RDNs should assess the factors, including but not limited to food, beverage, and nutrient intake; appetite and changes in appetite; eating environment and meals eaten away from home; diet history and

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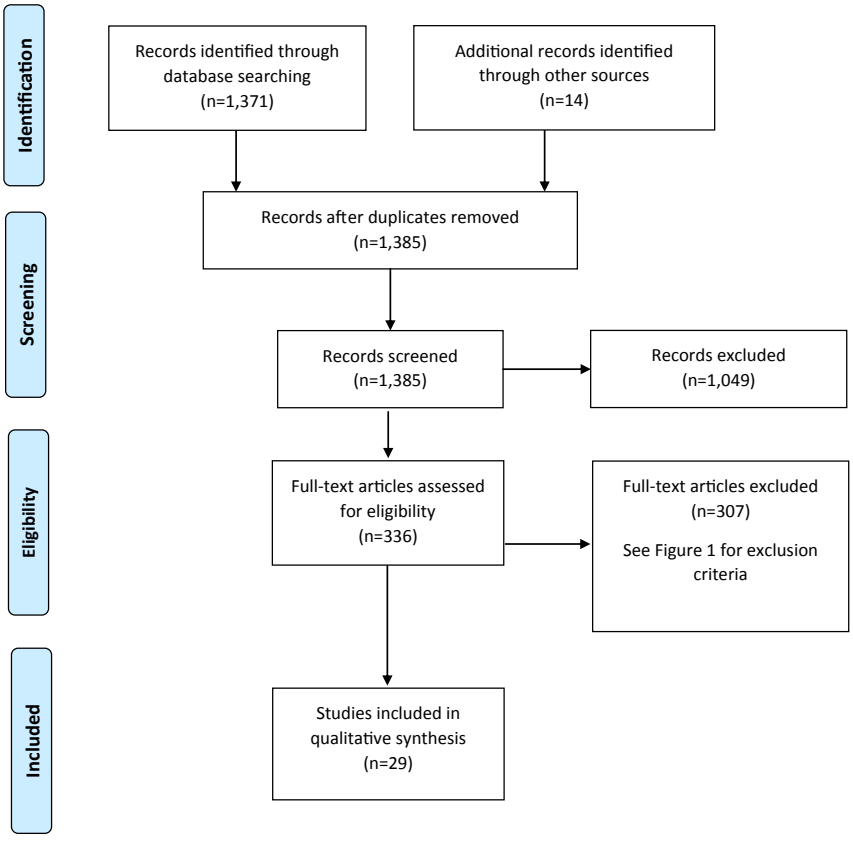

Figure 2. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram[13] for the Evidence Analysis Library Evidence-Based Systematic Review for Gestational Diabetes Mellitus.

behavior; factors influencing access to food, such as psychosocial/economic issues; method of food preparation and food safety; pharmacologic therapy; substance use; use of dietary supplements, prenatal vitamins, over-the-counter medications, complementary and/or herbal medicines; knowledge, beliefs, and attitudes; and physical activity. [*See Figure 5.]

Rating: Consensus (imperative) ***Assessment of Anthropometric Measurement of Women with GDM.*** **EAL Recommendation 2.2:** RDNs should assess the following measurements, including but not limited to height, current weight, prepregnancy weight and BMI, and weight changes during pregnancy. [*See Figure 5.]

Rating: Consensus (imperative) ***Assessment of Biochemical Data, Medical Tests, and Procedures of Women with GDM.*** **EAL Recommendation 2.3:** RDNs should evaluate available data and recommend as indicated biochemical data, medical tests, and procedures, including but not limited to glycemic tests; use of self-monitoring BG meters and urinary ketones, if recommended; maternal and fetal testing; nutrition-related anemia profile; vitamin D and other micronutrient levels, as appropriate; and thyroid and kidney function. [*See Figure 5.]

Rating: Consensus (imperative) ***Assessment of Nutrition-Focused Physical Findings and Client History of Women with GDM.*** **EAL Recommendation 2.4:** RDNs should evaluate available data, including but not limited to age; single or multiple gestations; weeks of gestation; estimated date of delivery; method of delivery; previous obstetric history, including GDM; risk factors for developing GDM or diabetes; general health; vital signs; pertinent medical and dental history; gastrointestinal discomforts; health literacy and numeracy; education and occupation; and social history. [*See Figure 5.]

Rating: Consensus (imperative) **Rationale:** Assessment is needed to effectively determine nutrition diagnoses and formulate a nutrition care plan.[10] Collection and interpretation of relevant data by an RDN and comparison to specified criteria is essential for ongoing nutrition care. The nutrition assessment recommendations are supported by a collection of credible sources addressing each assessment indicator.[10,21-30]

The presence of complicating conditions may require additional in-depth or specialized nutrition assessments and laboratory testing.[3] RDNs should use clinical judgment regarding the need to request additional data.

Recommendation 3

MNT Guiding Question: In women with GDM, what is the effectiveness of MNT intervention provided by an RDN on fetal/neonatal and maternal outcomes?

Effectiveness of MNT. **EAL Recommendation 3.1:** RDNs should provide MNT that includes an individual nutrition prescription and nutrition counseling for all women diagnosed with GDM. Research indicates that MNT provided by an RDN (or international equivalent) as part of a comprehensive nutrition intervention that includes individualization of MNT is effective in improving BG control and neonatal and maternal outcomes in women with GDM. Improved outcomes include lower birth weight and a reduction in incidence of macrosomia (ie, large for gestational age [LGA]), need for insulin therapy, hypertensive disorders of pregnancy and maternal hospitalizations, neonatal intensive care unit admissions and neonatal deaths, premature births and rate of shoulder dystocia, bone fracture, and nerve palsy.

Rating: Strong (imperative) Rationale: The recommendation is based on fair (Grade II) evidence from five studies, including three RCTs,[31-33] one prospective cohort study,[34] and one nonrandomized controlled trial.[35] All studies included individualization of MNT by an RDN (or international equivalent; specifically, dietitian or RDN) as part of a comprehensive intervention. In addition to MNT, the interventions included at least two of

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Research question	Conclusion statement	Grade[9]
MNT[a]		
In women with GDM, what is the effectiveness of MNT intervention, provided by an RDN[b] on fetal/neonatal and maternal outcomes?	MNT, provided by an RDN (or international equivalent), as part of a comprehensive intervention is effective in improving blood glucose control and fetal or neonatal and maternal outcomes in women with GDM. Improved outcomes included lower birth weight and a reduction in: incidence of macrosomia (LGA[c]); need for insulin therapy; hypertensive disorders of pregnancy and maternal hospitalizations; neonatal intensive care unit admissions and neonatal deaths; premature births; and rate of shoulder dystocia, bone fracture, and nerve palsy.	II
In women with GDM, what is the optimal frequency and duration of MNT visits by an RDN to improve fetal/neonatal and maternal outcomes?	No evidence was identified to evaluate the optimal frequency and duration of MNT visits by an RDN (or international equivalent) to improve fetal or neonatal and maternal outcomes.	V
In pregnant women at risk for GDM, what is the effectiveness of MNT intervention by an RDN to prevent the development of GDM?	MNT intervention provided by an RDN (or international equivalent), either alone or as part of a lifestyle counseling or an intensive obstetric intervention, reduced the incidence of GDM in overweight or obese pregnant women, or those with a history of GDM, in 3 of 6 reported studies. In addition, MNT intervention improved 1 or more of the following outcomes: fasting glucose, fasting insulin concentration, insulin resistance, maternal GWG,[d] and the quality of dietary fat or folate intake.	III
Calories		
In women with GDM, what is the effect of caloric consumption on fetal/neonatal and maternal outcomes?	The evidence of the effect of varying levels of caloric consumption on glycemic control, maternal weight gain, fetal growth, or birth weight and adverse fetal or neonatal and maternal outcomes in women with GDM is inconclusive. Limited research did not find significant differences in most outcomes with reported intakes of 1,384-1,863 kcal/d in women with prepregnancy BMI[e] of 22.4±3.2 to 38.0±0.7. In 1 study of women who began pregnancy as obese, GWG slowed after intervention with reported intakes of 1,560 and 1,630 kcal/d, without adverse effects.	III
Macronutrients		
Carbohydrate		
In women with GDM, what influence does the amount of carbohydrate consumed (independent of dietary patterns based on the DASH[f] diet and glycemic index) have on fetal/neonatal and maternal outcomes?	Limited evidence was found to demonstrate the impact of the amount of CHO[g] consumption on fetal or neonatal and maternal outcomes in women with GDM. In 1 study, women prescribed a minimum of 1,800 kcal/d found reductions in PPBG[h] levels at all 3 meals with 202 g/d CHO, whereas those prescribed >270 g CHO showed reductions in PPBG at 2 meals only. Another study of women with an average intake of 1,852±343 kcal/d found 0 incidence of LGA when CHO intake was >211 g/d, but a 23% incidence in women consuming less CHO. No other differences in fetal and maternal outcomes were found in these studies. Results were confounded by use of prescribed vs reported intakes, variable sample sizes, and different outcomes reported, making comparison and synthesis of the research challenging.	III

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Figure 3. Gestational diabetes mellitus (GDM) 2016 Evidence Analysis Library (EAL) systematic review. Blue shading indicates conclusion statement supports 2016 GDM Evidence-Based Nutrition Practice Guideline Recommendations 3.1, 4.0, 5.0, or 5.2 (see Figure 5).

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Research question	Conclusion statement	Grade[9]
In women with GDM, what influence does the amount or type of CHO consumed have on postprandial breakfast glycemia?	Limited evidence was found to demonstrate the influence of the type or amount of CHO consumption on postprandial breakfast glycemia in women with GDM. Three studies that evaluated GI[i] reported that lower GI diets containing 42%-60% total CHO (GI for breakfast meal <55; CHO range=15 to ≥60g) improved glycemic control after breakfast. One study that did not consider the GI showed that lower CHO (45% vs 60% of kcal) improved PPBG after breakfast. No studies evaluated the effect of only restricting individual foods (eg, fruit or milk) at breakfast, although 1 study showed improved blood glucose when fruit, bread, and milk were eaten in a low-GI breakfast vs a high-GI breakfast with CHO from other sources. Interpretation of results was challenging due to inability to compare diets across studies (varying amounts of CHO and GI), prescribed vs reported intakes, or lack of description of the breakfast meal.	III
Protein		
In women with GDM, what influence does the amount or type of protein consumed have on fetal/neonatal and maternal outcomes?	No evidence was identified to evaluate the influenced of the amount or type of protein consumed (independent of CHO or fat intake) on glycemic control, maternal weight gain, fetal growth, or birth weight, and adverse fetal or neonatal and maternal outcomes in women with GDM.	V
Fat		
In women with GDM, what influence does the type of fat (independent of the DASH dietary pattern) consumed have on fetal/neonatal and maternal outcomes?	The evidence for the influence of the type of fat on fetal or neonatal and maternal outcomes in women with GDM is limited. In 1 study of women with GDM who consumed a high MUFA[j] diet (1,982 kcal/d with 46% CHO and 37% fat [22% MUFA]) compared with those who consumed a lower MUFA diet (1,727 kcal/d with 50% CHO and 30% fat [11% MUFA]), no significant differences were found in glucose profile, blood lipid levels, maternal weight gain, or neonatal birth weights. Both diets demonstrated positive effects: The high-MUFA diet lowered diastolic blood pressure and nocturnal pulse rate and the lower MUFA diet improved insulin sensitivity in the third trimester in women with GDM.	III
In women with GDM, what influence does the amount of fat consumed (independent of the DASH dietary pattern) have on fetal/neonatal and maternal outcomes?	No evidence was identified to evaluate the influence of the amount of fat consumed (independent of CHO or protein intake, or the DASH dietary pattern) on glycemic control, maternal weight gain, fetal growth or birth weight, and adverse fetal or neonatal and maternal outcomes in women with GDM.	V

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Figure 3. *(continued)* Gestational diabetes mellitus (GDM) 2016 Evidence Analysis Library (EAL) systematic review. Blue shading indicates conclusion statement supports 2016 GDM Evidence-Based Nutrition Practice Guideline Recommendations 3.1, 4.0, 5.0, or 5.2 (see Figure 5).

the following: diabetes education, self-monitoring BG instruction, regular physician follow-up, counseling on BG monitoring, and physical activity advice. Insulin therapy was initiated as required. Four studies compared MNT intervention to usual care[31-33,35] and one study evaluated the effect of first trimester MNT in women with previous insulin-requiring GDM.[34]

All studies reported that MNT provided by an RDN resulted in improved maternal and fetal outcomes. Improved maternal outcomes included fewer hypertensive disorders of pregnancy and preeclampsia,[32,35] fewer maternal hospitalizations and premature births,[35] decreased need for insulin therapy,[33] and fewer caesarean section deliveries.[32]

Fetal outcomes positively influenced by MNT treatment include fewer neonatal deaths[31,35] and fewer neonatal intensive care unit

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Research question	Conclusion statement	Grade[9]
Dietary patterns		
DASH		
In women with GDM, what influence do dietary patterns based on the DASH diet have on fetal/neonatal and maternal outcomes?	Dietary patterns based on the DASH diet (that contained higher amounts of CHO and dietary fiber, and less sucrose, total fat, dietary cholesterol and less sodium), when compared with a control diet, were effective in improving both fetal and maternal outcomes in women with GDM who did not require insulin at the time of diagnosis. Improvements were found in glucose tolerance, glycosylated hemoglobin levels, insulin resistance, need for insulin, lipid profile, systolic blood pressure, and biomarkers of oxidative stress. There was also a lower incidence of cesarean-section deliveries. Infant birth weights, head circumferences, ponderal indexes, and the incidence of macrosomia were lower in infants whose mothers consumed the DASH diet.	III
GI		
In women with GDM, what influence do dietary patterns based on the glycemic index have on fetal/neonatal and maternal outcomes?	A low- or medium-GI dietary pattern resulted in glycemic control and had similar fetal or neonatal and maternal outcomes in women with GDM in most studies. In a few studies, an LGI[k] diet (36%-47% CHO) was found to significantly reduce the need for insulin therapy and prevent excessive maternal weight gain. One study comparing an LGI-MGI[l] diet (40% CHO and 45% fat) to an LGI-MGI diet (60% CHO and 25% fat) found that both diets achieved glycemia within target levels in women with GDM. Interpretation of results is limited, due to inability to compare diets across studies and none of the studies included a comparison to the HGI[m] diet.	III
Distribution of meals and snacks		
In women with GDM, what influence does the distribution of meals and snacks have on fetal/ neonatal and maternal outcomes?	No evidence was identified to evaluate the influence of the distribution of meals and snacks on glycemic control, maternal weight gain, fetal growth, or birth weight and adverse fetal or neonatal and maternal outcomes in women with GDM.	V

[a]MNT=medical nutrition therapy.

[b]RDN=registered dietitian nutritionist.

[c]LGA=large for gestational age.

[d]GWG=gestational weight gain.

[e]BMI=body mass index.

[f]DASH=Dietary Approaches to Stop Hypertension.

[g]CHO=carbohydrate.

[h]PPBG=postprandial blood glucose.

[i]GI=glycemic index.

[j]MUFA=monounsaturated fatty acid.

[k]LGI=Low Glycemic Index.

[l]MGI=Medium Glycemic Index.

[m]HGI=High Glycemic Index.

Figure 3. *(continued)* Gestational diabetes mellitus (GDM) 2016 Evidence Analysis Library (EAL) systematic review. Blue shading indicates conclusion statement supports 2016 GDM Evidence-Based Nutrition Practice Guideline Recommendations 3.1, 4.0, 5.0, or 5.2 (see Figure 5).

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GDM 2008	GDM 2016	Summary of changes
Screening		
GDM: Risk assessment and screening for gestational diabetes	None	Not reviewed[a] Added brief topic information to GDM Guideline Introduction
GDM: Pregnant women at risk for GDM		Not reviewed[a]
	GDM: Referral to an RDN[b]	Added new recommendation
GDM: MNT[c] **for pregnant women with IGT**[d] **or GDM** *1. GDM: MNT for women with GDM* *2. GDM: MNT for pregnant women with IGT*	**GDM: MNT** *1. GDM: MNT* *2. GDM: Frequency and duration of MNT*	Updated *GDM: MNT for women with GDM* recommendation; did not review MNT for Pregnant Women with IGT (2008) recommendation[a] Added new recommendation *GDM: Frequency and Duration of MNT*
Nutrition assessment		
GDM: Assessment of food intake, physical activity and medications	**GDM: Nutrition assessment** *1. GDM: Assessment of food/nutrition-related history* *2. GDM: Assessment of anthropometric measurement* *3. GDM: Assessment of biochemical data, medical tests, and procedures* *4. GDM: Assessment of nutrition-focused physical findings and client history*	Updated and expanded topic to create 4 separate recommendations
GDM: Assessment of BMI[e] **and weight gain**		Not reviewed; Included in *GDM: Nutrition assessment* recommendation above
Nutrition intervention		
GDM: Caloric intake *1. GDM: Caloric intake for normal and underweight women* *2. GDM: Caloric intake for overweight/obese*	**GDM: Calories**	Updated topic and combined caloric prescription into 1 recommendation
GDM: Macronutrient and micronutrient intake *1. GDM: Carbohydrate intake* *2. GDM: Protein and fat intake* *3. GDM: Vitamin and mineral supplementation*	**GDM: Macronutrients** *1. GDM: Macronutrient requirements* *2. GDM: Carbohydrate prescription* *3. GDM: Carbohydrate and postprandial breakfast glycemia*	Updated topic Added *GDM: Carbohydrate and postprandial breakfast glycemia* recommendation Moved *GDM: Vitamin and mineral supplementation (2008)* recommendation to separate topic below
See above *GDM: Vitamin and mineral supplementation*	**GDM: Micronutrients** *1. GDM: Dietary vitamin and mineral intake* *2. GDM: Vitamin and mineral supplementation*	Updated *GDM: Vitamin and mineral supplementation* recommendation Added *GDM: Dietary vitamin and mineral intake* recommendation
	GDM: Meal and snack distribution	Added new recommendation

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Figure 4. Gestational diabetes mellitus (GDM) 2008 and 2016 guideline comparison.

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GDM 2008	GDM 2016	Summary of changes
GDM: Physical activity	**GDM: Physical activity**	Updated recommendation
GDM: Blood glucose monitoring/ketone testing *1. GDM: Blood glucose monitoring* *2. GDM: Ketone testing*	None	Not reviewed[a]
GDM: Use of nonnutritive sweeteners	**GDM: High-intensity sweeteners**	Updated recommendation
GDM: Promotion of breastfeeding	None	Not reviewed[a]
GDM: Alcohol consumption	**GDM: Alcohol**	Updated recommendation
GDM: Pharmacologic therapy	None	Not reviewed[a]
Nutrition monitoring and evaluation		
GDM: Monitor and evaluate MNT effectiveness	**GDM: Nutrition monitoring and evaluation**	Updated recommendation
Outcomes management		
GDM: Prevention of recurrence/type 2 diabetes	None	Not reviewed[a]

[a]The 2008 GDM recommendation topic was determined to be outside the scope of the 2016 GDM Guideline.

[b]RDN=registered dietitian nutritionist.

[c]MNT=medical nutrition therapy.

[d]IGT=impaired glucose tolerance.

[e]BMI=body mass index.

Figure 4. *(continued)* Gestational diabetes mellitus (GDM) 2008 and 2016 guideline comparison.

admissions.[35] Birth weight was lower in the MNT-treated group[31,35] and neonatal fat mass was also decreased.[32] More specifically, percent of LGA infants was decreased,[31,32] prevalence of macrosomia was lower, and reduced rates of shoulder dystocia, bone fracture, and nerve palsy were observed.[31,32,34,35]

Frequency and Duration of MNT. **EAL Recommendation 3.2:** RDNs should provide regular and frequent MNT visits to women with GDM to optimize outcomes. Visits should include an initial 60- to 90-minute MNT visit followed by a second MNT visit (30 to 45 minutes) within 1 week, and a third MNT visit (15 to 45 minutes) within 2 to 3 weeks. Additional MNT visits should be scheduled every 2 to 3 weeks or as needed for the duration of the pregnancy. MNT assists a woman with GDM in meeting her BG and weight gain targets, contribute to a well-balanced food intake, and promote fetal and maternal well-being.

Rating: Consensus (imperative)
Rationale: There was no evidence identified in the SR to evaluate the optimal frequency and duration of MNT visits by an RDN (or international equivalent). The Joslin Diabetes Center & Joslin Clinic clinical practice guidelines[21] provide guidance for this recommendation. Joslin suggests a minimum of three visits with a certified diabetes educator (ie, an RDN or registered nurse) or an adequately trained RDN for nutrition assessment, meal plan modification, and self-monitoring BG.[21] These visits should be scheduled within the first 3 weeks, and additional MNT visits should be offered as needed until delivery.[21] An RDN should consider possible barriers to achieving the recommended number of MNT visits. Some patients may face financial burdens when costs of multiple visits are not reimbursed. Inability to take time off from work or school, lack of childcare, and lack of transportation may also present challenges to patients.

Recommendation 4

Calorie Prescription Guiding question: In women with GDM, what is the effect of calorie consumption on fetal/neonatal and maternal outcomes?

EAL Recommendation 4: For women with GDM, an RDN should individualize the calorie prescription based on a thorough nutrition assessment with guidance from relevant references (eg, Dietary Reference Intakes [DRIs])[36] and encourage adequate caloric intake to promote

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Nutrition screening and referral	Rating[11]; condition
1. GDM: Referral to an RDN[a] Pregnant women who are diagnosed with GDM should be referred to an RDN for MNT[b]. Individualized MNT is important in helping pregnant women with GDM achieve and maintain normal glycemic levels and appropriate weight gain while meeting essential nutrients for pregnancy to promote positive maternal and fetal outcomes.	Strong; imperative
Nutrition assessment	
2.0. Nutrition assessment	

2.1. GDM: Assessment of food and nutrition-related history of women with GDM
An RDN should assess the food and nutrition-related history of women with GDM, including but not limited to:
• Food, beverage, and nutrient intake, including:
  ○ Calorie intake,
  ○ Types and amount of CHO[c] (including fiber), fat, protein; with special attention to high-calorie, low-nutrient-dense foods such as desserts, candy, and sugar-sweetened beverages;
  ○ Serving sizes; and
  ○ Meal and snack patterns, including frequency and duration such as:
  ■ Recent changes;
  ■ Preferences, avoidance, intolerances, allergies, including:
  ■ In relationship to gastrointestinal discomforts (eg, nausea, vomiting, heartburn, constipation, and ptyalism);
  ■ Reaction to or changes in food tastes/smells related to pregnancy; and
  ■ Cultural and religious considerations
• Appetite and changes in appetite;
• Eating environment and meals eaten away from home;
• Diet history and behavior: previous diets and diet adherence, disordered eating;
• Factors influencing access to food: psychosocial/economic issues (eg, social support) influencing nutrition therapy;
• Method of food preparation and food safety;
• Pharmacologic therapy (including insulin or oral glucose-lowering agent);
• Substance use: alcohol, tobacco, caffeine, and recreational drugs;
• Use of dietary supplements, prenatal vitamins, over-the-counter medications, complementary and/or herbal medicine;
• Knowledge, beliefs, and attitudes: motivation, readiness to change, self-efficacy; and willingness and ability to make lifestyle changes; and
• Physical activity and function: exercise patterns, functionality for activities of daily living, and sleep patterns.
 	
Assessment of these factors is needed to effectively determine nutrition diagnoses and formulate a nutrition care plan. Inability to achieve optimal nutrient intake may contribute to poor outcomes.
	Consensus; imperative

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Figure 5. Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) Gestational Diabetes Mellitus (GDM) 2016 Evidence-Based Nutrition Practice Guideline recommendations. Blue shading indicates recommendation is supported by EAL systematic review. Pink shading indicates recommendation is supported by external (non-Academy) guidelines. Green shading indicates recommendation is supported by credible sources.

fetal/neonatal and maternal health, achieve glycemic goals, and promote appropriate gestational weight gain. No definitive research suggests there is a specific optimal calorie intake for women with GDM or if calorie needs are different than needs of pregnant women without GDM. [*See Figure 5.]

Rating: Fair (imperative) Rationale: Limited (Grade III) evidence from three international studies, including two prospective cohort studies[18,37] and one

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Nutrition screening and referral	Rating[11]; condition
2.2. GDM: Assessment of anthropometric measurement of women with GDM An RDN should assess the following anthropometric measurements in women with GDM, including but not limited to: • Height, current weight, prepregnancy weight, and BMI[d]; and • Weight changes during pregnancy. Assessment of these factors is needed to effectively determine nutrition diagnoses and formulate a nutrition care plan.	Consensus; imperative
2.3. GDM: Assessment of biochemical data, medical tests, and procedures of women with GDM An RDN should evaluate available data of women with GDM and recommend as indicated: biochemical data, medical tests, and procedures, including but not limited to: • Glycemic tests: GCT[e], OGTT[f], hemoglobin A1c[g], fasting glucose, random glucose; • Use of SMBG[h] meters and urinary ketones, when recommended; • Maternal and fetal testing (eg, ultrasounds, biophysical profile, and nonstress testing); • Nutritional anemia profile (eg, hemoglobin, hematocrit, folate, B-12, and iron); • Vitamin D and other micronutrient levels, as appropriate; • Thyroid function; and • Kidney function. Assessment of these factors is needed to effectively determine nutrition diagnoses and formulate a nutrition care plan.	Consensus; imperative
2.4. GDM: Assessment of nutrition-focused physical findings and client history of women with GDM An RDN should evaluate available data regarding the client history and nutrition-focused physical findings of women with GDM, including, but not limited to patient/family/client medical/health history: • Age; • Single or multiple gestations; • Weeks of gestation, estimated date of delivery, and method of delivery; • Previous obstetric history, including GDM; • Risk factors for developing GDM or diabetes, including family history of diabetes; • General health and vital signs; • Pertinent medical and dental history, including other diseases, conditions, and illnesses; • Gastrointestinal discomforts: nausea, vomiting, diarrhea, constipation, heartburn, and ptyalism; • Health literacy and numeracy; • Education and occupation; and • Social history: psychological/socioeconomic factors (eg, social support). Assessment of these factors is needed to effectively determine nutrition diagnoses and formulate a nutrition care plan.	Consensus; imperative

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Figure 5. *(continued)* Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) Gestational Diabetes Mellitus (GDM) 2016 Evidence-Based Nutrition Practice Guideline recommendations. Blue shading indicates recommendation is supported by EAL systematic review. Pink shading indicates recommendation is supported by external (non-Academy) guidelines. Green shading indicates recommendation is supported by credible sources.

RCT,[38] does not confirm an optimal caloric intake for women with GDM. Caloric intake categorized by tertile (calculated kilocalories per kilogram values) demonstrated that nonobese women with GDM whose caloric intake was in the highest tertile (33 kcal/kg) had significantly higher postdinner BG after controlling for pregravid weight and height.[37] In a study of overweight and obese women consuming a caloric intake of 1,842±343 kcal/day, no

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Nutrition screening and referral	Rating[11]; condition
Nutrition intervention	
3.0. MNT	
3.1. GDM: MNT An RDN should provide MNT that includes an individual nutrition prescription and nutrition counseling for all women diagnosed with GDM. Research indicates that MNT provided by an RDN (or international equivalent) as part of a comprehensive nutrition intervention that includes individualization of MNT is effective in improving blood glucose control and neonatal and maternal outcomes in women with GDM. Improved outcomes included lower birth weight and a reduction in the following: incidence of macrosomia (LGA[i]); need for insulin therapy, hypertensive disorders of pregnancy and maternal hospitalizations; neonatal intensive care unit admissions and neonatal deaths; premature births; and rate of shoulder dystocia, bone fracture, and nerve palsy.	Strong; imperative
3.2. GDM: Frequency and duration of MNT An RDN should provide regular and frequent MNT visits to women with GDM to optimize outcomes. Visits should include an initial 60- to 90-min MNT visit followed by a second MNT visit (30-45 min) within 1 week, and a third MNT visit (15-45 min) within 2-3 weeks. Additional MNT visits should be scheduled every 2-3 weeks or as needed for the duration of the pregnancy. MNT assists a woman with GDM in meeting her blood glucose and weight gain targets, contribute to a well-balanced food intake, and promote fetal and maternal well-being.	Consensus; imperative
4.0. GDM: Calorie prescription For women with GDM, an RDN should individualize the calorie prescription based on a thorough nutrition assessment with guidance from relevant references (DRI[j] and IOM[k]) and encourage adequate caloric intake to promote fetal/neonatal and maternal health, achieve glycemic goals, and promote appropriate gestational weight gain. No definitive research suggests there is a specific optimal calorie intake for women with GDM or if calorie needs are different than pregnant women without GDM. Limited research in women with GDM whose prepregnancy weights ranged from normal to obese showed no significant differences in most fetal/neonatal and maternal outcomes with various reported calorie intakes. In a study of obese women only, GWG[l] slowed after women with GDM reportedly consumed 30% below their caloric requirements, without adverse effects.	Fair; imperative
5.0. Macronutrients	
5.1. GDM: Macronutrient requirements For women with GDM, an RDN should provide adequate amounts of macronutrients to support pregnancy, based on nutrition assessment, with guidance from the DRIs. The DRIs for all pregnant women, including those with GDM, recommends a minimum of 175 g CHO, a minimum of 71 g protein (or 1.1 g/kg/d protein) and 28 g fiber.	Consensus; imperative
5.2. GDM: CHO prescription An RDN should individualize both the amount and type of CHO for women with GDM based on nutrition assessment, treatment goals, blood glucose response, and patient needs. Limited evidence does not confirm an ideal amount (grams or percent of total calories) of CHO for all women with GDM, but suggests an interaction between the amount and type of CHO. Several studies showed positive effects on glycemic control and neonatal/fetal and maternal outcomes in women with GDM, when evaluating varying amounts and types of CHO:	Fair; imperative

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Figure 5. *(continued)* Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) Gestational Diabetes Mellitus (GDM) 2016 Evidence-Based Nutrition Practice Guideline recommendations. Blue shading indicates recommendation is supported by EAL systematic review. Pink shading indicates recommendation is supported by external (non-Academy) guidelines. Green shading indicates recommendation is supported by credible sources.

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Nutrition screening and referral	Rating[11]; condition
• Low GI[m] (<55) or medium GI (55-69) diets, containing a range of 36.7% to >60% CHO and • DASH[n] diets (>65% CHO). However, when 2 studies evaluated the amount of CHO alone (without specifying the type of CHO) mixed results were found: • A CHO prescription of 202 g/d CHO was more effective at reducing PPBG[o], compared with >270 g/d CHO. A 23% incidence of LGA infants was found with CHO intake <211 g/d, but no LGA when >211 g/d.	
5.3. GDM: CHO and postprandial breakfast glycemia An RDN should individualize both the amount and type of CHO at breakfast based on nutrition assessment, treatment goals, blood glucose response, and patient needs. When a woman with GDM continues to experience elevated PPBG after breakfast, an RDN may further modify the amount or the type of CHO at breakfast to achieve blood glucose targets. Limited evidence examining the impact of CHO on PPBG after breakfast does not confirm an ideal amount (grams or percentage of total calories) or type of CHO for all women with GDM to achieve PPBG targets after breakfast, but suggests an interaction between the 2. • In women with GDM who followed low or medium GI diets containing 42%-60% total CHO (GI for breakfast meal <55; CHO range 15-60 g CHO or more) met PPBG targets after breakfast; and • One study evaluating a 45% CHO diet overall (without specifying the type of CHO), found improved PPBG after breakfast, compared with one that contained 60% CHO. No studies evaluated the effect of only restricting individual foods (eg, fruit or milk) at breakfast, although 1 study showed improved PPBG when fruit bread and milk were eaten in a low GI breakfast vs a high GI breakfast with CHOs from other sources.	Fair; imperative
6.0. Vitamins and minerals	
6.1. GDM: Dietary vitamin and mineral intake An RDN should encourage women with GDM to make healthy food choices and consume a variety of foods to meet the micronutrient needs of pregnancy. The micronutrient needs of women with GDM are the same as for pregnant women without diabetes (emphasis on dietary intake of iron, folate, calcium, vitamin D, choline, and iodine). The consumption of more food to meet caloric needs and the increased absorption and efficiency of nutrient use that occurs in pregnancy are generally adequate to meet the needs for most nutrients when good food choices are consistently made.	Consensus; imperative
6.2. GDM: Vitamin and mineral supplementation An RDN should consider recommending dietary supplementation within the DRI for pregnancy with a prenatal multivitamin/mineral or specific vitamin or mineral supplement(s) to address inadequate dietary vitamin and mineral intake (eg, iron, folate, calcium, vitamin D, choline, and iodine) or documented micronutrient deficiency. Dietary supplements may be indicated in pregnant women at high risk for inadequate micronutrient intake, such as food insecurity; alcohol, tobacco, or other substance dependency; anemia; strict vegetarian (vegan) diet; or poor eating habits.	Consensus; imperative

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Figure 5. *(continued)* Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) Gestational Diabetes Mellitus (GDM) 2016 Evidence-Based Nutrition Practice Guideline recommendations. Blue shading indicates recommendation is supported by EAL systematic review. Pink shading indicates recommendation is supported by external (non-Academy) guidelines. Green shading indicates recommendation is supported by credible sources.

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Nutrition screening and referral	Rating[11]; condition
7.0. GDM: Meal and snack distribution In women with GDM, an RDN should distribute the total calories and CHO into smaller meals and multiple snacks per day. The distribution should be individualized, based on blood glucose levels, physical activity, and medication, if any (eg, insulin) and adjusted as needed. Three meals and 2 or more snacks helps to distribute CHO intake and reduce PPBG elevations.	Consensus; imperative
8.0. GDM: Use of high-intensity sweeteners In pregnant women with GDM, who choose to consume high-intensity sweeteners, an RDN should educate the woman to select only those approved or generally recognized as safe by the US FDA[p] and to limit her intake to the ADI[q], established by the FDA. The FDA has concluded the safety of 6 high-intensity sweeteners (saccharin, aspartame, acesulfame potassium, sucralose, neotame, and advantame) when consumed within the ADI by the general population, including pregnant women. Steviol glycosides and luo han guo (monk fruit) extracts are also generally recognized as safe when consumed within the ADI.	Consensus; conditional
9.0. GDM: Alcohol intake An RDN should reinforce abstinence from alcohol during pregnancy for women with GDM. The safest choice for all pregnant women is to abstain from alcohol to eliminate the risk for alcohol-related birth defects such as behavioral or neurologic defects, growth deficiencies, facial abnormalities, and impaired intellectual development.	Consensus; imperative
10.0. GDM: Physical activity Unless contraindicated, an RDN should encourage women with GDM to engage in a goal to achieve daily moderate exercise of 30 min or more per day. In addition to a healthy diet, exercise can help improve blood glucose control and achieve weight gain recommendations. Both aerobic exercise and nonweight-bearing exercise (eg, stretching, swimming, and yoga) have been shown to lower blood glucose levels in women with GDM. Lifestyle therapy for GDM results in lower birth weight and a lower incidence of LGA births and pre-eclampsia.	Strong; conditional
Nutrition monitoring and evaluation	
11.0. GDM: Nutrition monitoring and evaluation Following the nutrition intervention of women with GDM, to check progress, an RDN should monitor and evaluate the following components at each visit and compare with desired individual outcomes relevant to the nutrition diagnosis and nutrition intervention. This may include, but is not limited to: **Food and nutrition-related history outcomes** • Daily food intake in relation to postmeal glucose readings; • Food, beverage, and nutrient intake, including ○ Calorie intake, types, and amount of CHO (including fiber) fat, and protein with special attention to high-calorie, low-nutrient-dense foods such as desserts, candy, and sugar-sweetened beverages; ○ Serving sizes; ○ Meal and snack patterns, including frequency and duration; ○ Recent changes to food choices and/or eating pattern; ○ Preferences, avoidance, intolerances, and allergies, including ■ In relationship to gastrointestinal discomforts (eg, nausea, vomiting, heartburn, constipation, and ptyalism), ■ Reaction to or changes in food tastes/smells related to pregnancy, and ■ Cultural and religious considerations;	Consensus; imperative

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Figure 5. *(continued)* Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) Gestational Diabetes Mellitus (GDM) 2016 Evidence-Based Nutrition Practice Guideline recommendations. Blue shading indicates recommendation is supported by EAL systematic review. Pink shading indicates recommendation is supported by external (non-Academy) guidelines. Green shading indicates recommendation is supported by credible sources.

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Nutrition screening and referral	Rating[11]; condition
○ Appetite and changes in appetite; and ○ Frequency and intake of meals and snacks and meals eaten away from home; ○ Methods of food preparation and food safety; ○ Recommendation to add pharmacologic therapy (oral and/or insulin therapy) to maintain nutrient intake and achieve glycemic targets ■ Pharmacologic therapy (ie, dose of diabetes medications like oral glucose-lowering agent and insulin); ○ Changes in substance use: alcohol, tobacco, caffeine, and recreational drugs; ○ Knowledge, beliefs, and attitudes: motivation, readiness to change, self-efficacy; willingness and ability to make lifestyle changes; understanding of the treatment plan for GDM; and ○ Physical activity and function: exercise patterns, functionality for activities of daily living, and sleep patterns. **Anthropometric measurement outcomes** • Weight changes compared with previous obstetric visit or MNT visit. **Biochemical data, medical tests, and procedure outcomes:** • SMBG records, including meter downloads, • Ketone testing records (when previously recommended because of weight loss or inadequate calorie intake), and • Updated fetal and maternal testing or lab values. Nutrition monitoring and evaluation of these factors is needed to correctly/effectively diagnose nutrition problems that should be the focus of further nutrition interventions. Inability to achieve optimal nutrient intake may contribute to poor outcomes or initiation of or changes in pharmacologic therapy.	

[a]RDN=registered dietitian nutritionist.

[b]MNT=medical nutrition therapy.

[c]CHO=carbohydrate(s).

[d]BMI=body mass index.

[e]GCT=glucose challenge test.

[f]OGTT=oral glucose tolerance test.

[g]A1c=glycosylated hemoglobin.

[h]SMBG=self-monitoring blood glucose.

[i]LGA=large for gestational age.

[j]DRI=Dietary Reference Intake.

[k]IOM=Institute of Medicine.

[l]GWG=gestational weight gain.

[m]GI=glycemic index.

[n]DASH=Dietary Approaches to Stop Hypertension.

[o]PPBG=postprandial blood glucose.

[p]FDA=Food and Drug Administration.

[q]ADI=acceptable daily intake.

Figure 5. *(continued)* Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) Gestational Diabetes Mellitus (GDM) 2016 Evidence-Based Nutrition Practice Guideline recommendations. Blue shading indicates recommendation is supported by EAL systematic review. Pink shading indicates recommendation is supported by external (non-Academy) guidelines. Green shading indicates recommendation is supported by credible sources.

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relationship between caloric intake and infant birth weight was found.[18] In two groups of obese women who consumed roughly the same caloric intake (~70% of the recommended dietary intakes for Australia) (1,560 kcal intervention vs 1,630 kcal control), no significant differences were found for gestational weight gain or neonatal outcomes, including small for gestational age and LGA.[38] Calculated caloric intake per kilogram body weight was not feasible for two of the three studies.[18,38]

When individualizing the calorie prescription, prepregnancy weight and BMI, gestational weight gain, and level of physical activity should be considered.[31]

Recommendation 5

Macronutrient Requirements Guiding Questions: In women with GDM, what influence does the amount of CHO consumed (independent of dietary patterns based on the DASH diet and GI) have on fetal/neonatal and maternal outcomes? What influence does the amount or type of CHO consumed have on postprandial breakfast glycemia? In women with GDM, what influence do the DASH diet and GI dietary patterns have on fetal/neonatal and maternal outcomes?

Macronutrient Requirements. **EAL Recommendation 5.1:** In women with GDM, an RDN should provide adequate amounts of macronutrients to support pregnancy, based on nutrition assessment, with guidance from the DRIs. The DRIs for all pregnant women, including those with GDM, recommend a minimum of 175 g CHO, a minimum of 71 g protein (or 1.1 g/kg/day protein), and 28 g fiber.

Rating: Consensus (imperative) Rationale: The DRIs provide guidance for determining macronutrient requirements for pregnant women.[36] The macronutrient needs of pregnant women with GDM are likely similar to those of pregnant women without GDM. Therefore, the same DRI recommendations should be applied.[36]

Carbohydrate Prescription. **EAL Recommendation 5.2:** RDNs should individualize both the amount and type of CHO for women with GDM based on nutrition assessment, treatment goals, BG response, and patient needs. Limited evidence does not confirm an ideal amount (grams or percent of total calories) of CHO for all women with GDM, but suggests an interaction between the amount and type of CHO. Several studies showed positive effects on glycemic control and neonatal/fetal and maternal outcomes in women with GDM, when evaluating varying amounts and types of CHO. [*See Figure 5.]

Rating: Fair (imperative) Rationale: Of the three macronutrients, dietary intake of CHO plays the most significant role in postprandial BG levels for women with GDM. In a mixed diet, it is challenging to elucidate the effects of dietary CHO alone, without consideration of other influencing factors. At a minimum, the amount (grams or percentage) of CHO, the type (eg, complex CHO, fiber, or GI) of CHO, when the CHO is consumed (ie, timing), and the protein and fat consumed along with the CHOs was considered in the analysis.

Twelve studies in 13 publications provide limited (Grade III) evidence on the influence of the amount (grams or percent CHO) or type of CHO on fetal/neonatal and maternal outcomes in women with GDM. The studies included nine RCTs,[14,15,17,39-44] two randomized crossover trials,[16,45] and one prospective cohort study.[18] One other RCT[46] reported additional outcomes for the same subjects in a separate publication. Studies examining the DASH diet[40,41,46] and GI[15-17,39,42,44] were reviewed separately because they evaluated dietary patterns with a combination of the amount and type of CHO. Dietary patterns are defined by US Department of Agriculture as "quantities, proportions, variety or combinations of different foods and beverages in diets, and the frequency with which they are habitually consumed."[47]

CHO. Three studies (two RCTs[14,43] and one prospective cohort study[18]) evaluated the amount of dietary CHO on fetal/neonatal and maternal outcomes in women with GDM. One RCT found that postprandial BG levels were significantly reduced at all three meals in women prescribed a low CHO prescription (202 g/day) vs postprandial BG reductions in two meals only in women prescribed >270 g/day CHO.[14] Actual CHO intake was not reported. In another RCT of women consuming an average of 1,852±343 kcal and 43.4% CHO (202 g/day), no relationship between reported calorie intake and infant birth weight was found. However, there was an inverse relationship between CHO intake and birth weight. In women who consumed >211 g/day CHO and proportionately lower fat, there were zero LGA births. In women consuming less CHO, 23% of women had LGA infants.[18] In an RCT of women assigned to either a low-CHO diet (40%) or high-CHO diet (55%), no significant difference was found in the need for insulin therapy between groups.[43] No other differences in fetal and maternal outcomes were found in these studies.

DASH. Two RCTs in three publications evaluated the effect of the DASH diet in women with GDM who did not require insulin at the time of diagnosis.[40,41,46] The prescribed DASH diet and the control diet contained the same macronutrient profile (40% to 55% CHO, 10% to 20% protein, and 25% to 30% fat), with the DASH diet emphasizing fruits, vegetables, whole grains and low-fat dairy and decreased amounts of saturated fats, dietary cholesterol, refined grains, and sodium. Actual macronutrient consumption for women on the DASH diet was higher in CHO (65% to 67%) and lower in fat (17% to 18%) than prescribed.

Women following the DASH diet demonstrated significant improvement in maternal clinical outcomes[41] compared with those following the control diet. Investigators also reported fewer caesarean section deliveries,[46] lower infant birth weights, and the incidence of LGA was reduced in women following the DASH diet.[40,46] It should be noted that the authors stated the baseline caesarean section rate in this population was very high (~90%).[46]

GI. GI is defined as "a ranking of carbohydrates on a scale from 0 to 100 according to the extent to which they raise blood sugar (glucose) levels after eating."[48] To compare the studies, the work group used the following scale: low GI=0-55; medium GI=56-69; and high GI=70 or greater.[49]

Six studies (five RCTs[15,17,39,42,44] and one randomized crossover trial[16]) evaluated the influence of low-GI or medium-GI dietary patterns in women with GDM. Three studies compared a low-GI diet to other low-GI diets with variations in CHO or fiber.[17,39,42] Two

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studies compared a low-GI to a medium-GI diet[15,44] with a similar macronutrient percentage between comparison groups. One study[16] compared two low- to medium-GI diets with inverse macronutrient percentages (GI for breakfast meals was <35.7).

A low-GI or medium-GI dietary pattern resulted in glycemic control and had similar neonatal or fetal and maternal outcomes in women with GDM in most studies. Four of five RCTs[15-17,39] reported that fasting BG and glycemic control was achieved in women consuming a low-GI diet, but the differences in glycemic control between comparison groups were not always significant.[15,17,42] One RCT comparing a low- to medium-GI diet (40% CHO and 45% fat) to a different low- to medium-GI diet (60% CHO and 25% fat) found that both diets achieved glycemia within target levels.[16]

Two RCTs found that women following a low-GI diet had less excessive weight gain compared with women following conventional CHO diets[17,42]; however, one study reported that women following a low-GI diet were more likely to deliver prematurely.[17] Consumption of a low-GI diet was associated with a reduction in insulin treatment in two studies,[39,44] whereas three studies did not find a significant difference in insulin use among groups.[15,17,42]

***Carbohydrate and Postprandial Breakfast Glycemia*. EAL Recommendation 5.3:** RDNs should individualize both the amount and type of CHO at breakfast based on nutrition assessment, treatment goals, BG response, and patient needs. In the case that a woman with GDM continues to experience elevated postprandial BG after breakfast, an RDN may further modify the amount or the type of CHO at breakfast to achieve BG targets. Limited evidence examining the influence of CHO on postprandial BG after breakfast does not confirm an ideal amount (grams or percentage of total calories) or type of CHO for all women with GDM to achieve postprandial BG targets after breakfast, but suggests an interaction between the two. [*See Figure 5.]

Rating: Fair (imperative) Rationale: Many women with GDM experience fasting hyperglycemia and/or postprandial elevations in BG. Usually, this phenomenon is addressed by modifications to the total amount, type, or distribution of CHOs at meals and snacks, with attention often focused on the breakfast meal. Restriction of particular foods and beverages at breakfast has traditionally been advised in an attempt to prevent elevated BG levels.

Five RCTs[14-17,45] evaluated the influence of the type and/or amount of CHO on postprandial BG levels after breakfast in women with GDM. Three of these studies included a controlled breakfast meal.

In an RCT comparing low-CHO (45%) and high-CHO (>60%) diets, investigators reported a significant reduction in postprandial BG for all three meals in women following the low-CHO diet, whereas those on the high-CHO diet showed significant reduction only in postlunch and postdinner BG.[14] In another RCT,[15] no significant difference was found in fasting or postprandial BG levels between women following a low-GI diet (GI=49±0.8) and a medium-GI diet (GI=58±0.5), although fasting and mean postprandial BG decreased significantly in both groups. In addition, there was a strong positive relationship between pregravid BMI and self-monitoring BG after breakfast for the medium GI group. The percentage of CHO in the diets was not reported.

In studies with a controlled breakfast meal, one small RCT[16] comparing two low- to medium-GI diets, found that 1- and 2-hour postprandial BG levels were modestly higher in women on a higher-complex CHO diet (60% CHO and 25% fat), when compared with a conventional lower-CHO diet (40% CHO and 45% fat). However, postprandial BG after-breakfast values fell within current glycemic targets for both diets. The breakfast meal composition for both groups contained 25% of total kilocalories and reflected the overall macronutrient percent for each and the breakfast was low GI (GI=35.7 vs 34.8, respectively). Another RCT[17] found that a low-GI diet (46.6%±9.1% CHO, GI=47.2±6.9) was equally effective in improving glycemic control as an all types of CHO diet (45.8%±8.3% CHO, GI=48.6±8.4). Breakfast was limited to 15 to 30 g CHO in both diets. There was a statistically significant increase in the number of women in the low-GI group who met glycemic targets after lunch, predinner, and postdinner, whereas the increase was only at the postlunch time in the all types of CHO diet group. There was no significant difference between groups or within groups for 2-hour postprandial breakfast glucose throughout the study. Finally, an RCT[45] of 10 subjects examined the effect of two macronutrient-matched breakfast meals with different GI values. The low-GI breakfast meal (44.7 g CHO), which contained fruit and muesli bread, margarine, a fiber supplement, and skim milk resulted in a lower postprandial BG level when compared with the high-GI meal (42.7 g CHO), which contained whole-meal bread, a glucose drink, and an egg. This finding is notable because women with GDM are often advised to avoid fruit and milk at the breakfast meal.

An RDN should use clinical judgment when individualizing the CHO content of breakfast meals based on evaluation of patient's BG records.[28]

Recommendation 6

Vitamins and Minerals *Dietary Vitamin and Mineral Intake*. EAL Recommendation 6.1: RDNs should encourage women with GDM to make healthy food choices and consume a variety of foods to meet the micronutrient needs of pregnancy. The micronutrient needs of women with GDM are the same as for pregnant women without diabetes (ie, emphasis on dietary intake of iron, folate, calcium, vitamin D, choline, and iodine). The consumption of more food to meet caloric needs and the increased absorption and efficiency of nutrient utilization that occurs in pregnancy, are generally adequate to meet the needs for most nutrients, when good food choices are consistently made.

Rating: Consensus (imperative) Rationale: The recommendation is based on best practice clinical care guidelines.[26,28,50] Choosing healthy foods with sufficient calories along with increased absorption will generally meet the nutrition needs of a pregnant woman.[26] In addition, dietary intake of fortified foods and beverages and prescribed and nonprescribed vitamin and mineral supplements should be considered when evaluating dietary micronutrient intake.

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Vitamin and Mineral Supplementation. **EAL Recommendation 6.2:** RDNs should consider recommending dietary supplementation within the DRI for pregnancy with a prenatal multivitamin/mineral or specific vitamin or mineral supplement(s) to address inadequate dietary vitamin and mineral intake (eg, iron, folate, calcium, vitamin D, choline, and iodine) or documented micronutrient deficiency. Dietary supplements may be indicated in pregnant women at high risk for inadequate micronutrient intake, such as food insecurity; alcohol, tobacco or other substance dependency; anemia; strict vegetarian (vegan) diet; or poor eating habits.

Rating: Consensus (imperative)
Rationale: The recommendation is based on credible resources with applicability to all pregnant women. These include DRIs,[51] the Academy's position statement on nutrient supplementation,[50] the California Diabetes and Pregnancy Program Sweet Success Guidelines for Care,[28] and recommendations of the US Preventative Services Task Force.[52] Folic acid supplementation to decrease risk of neural tube defects is routinely advised for women in their childbearing years and pregnancy.[27,28,51] Other micronutrients that may require supplementation include iron, calcium, vitamin D, choline, and iodine. Iron is routinely supplemented (30 mg/day) beginning in early pregnancy, yet the US Preventative Services Task Force reports that there is not clear evidence that prenatal iron supplementation has a positive clinical influence on maternal or infant health.[52] Choline is considered an essential nutrient during pregnancy and iodine requirements increase during pregnancy[51] and it has been reported that most pregnant women do not consume sufficient amounts of these micronutrients in their diet.[27] Many pregnant women do not consume adequate dietary calcium or vitamin D; therefore, supplementation may be required.[27] Assessing for conditions and sociocultural factors, including vegan diet, multiple gestations, food insecurity, anemia, malabsorption disorder, gastrointestinal discomfort, substance abuse, religious dietary restrictions, and poor quality diets that may influence adequate micronutrient intake can help identify pregnant women who require additional vitamin and mineral supplementation.[26,28] Clinical judgment should be used when assessing nutritional status and recommending vitamin and mineral supplementation for high-risk patients.[25,26]

Some pregnant women might not tolerate vitamin and mineral supplementation and may require more intense nutrition therapy. Pregnant women who are taking or planning to take a nonprescribed OTC micronutrient supplement that exceeds the Tolerable Upper Limits for a specific vitamin or mineral or is taking herbal or dietary supplements should seek consultation from a pharmacist or physician.[26]

Recommendation 7

Meal and Snack Distribution EAL Recommendation 7: When treating women with GDM, RDNs should distribute the total calories and CHO into smaller meals and multiple snacks per day. The distribution should be individualized, based on BG levels, physical activity, and medication, if any (eg, insulin) and adjusted as needed. Three meals and two or more snacks helps to distribute CHO intake and reduce postprandial BG elevations.

Rating: Consensus (imperative)
Rationale: In the absence of evidence evaluating the influence of meal and snack distribution on glycemic control in women with GDM, the work group drew upon guidance from the Joslin Diabetes Center and Joslin Clinical Guidelines for Detection and Management of Diabetes in Pregnancy, American College of Obstetricians and Gynecologists, and the Sweet Success Guidelines for Care.[21,28,29] Meal distribution pattern recommendations vary among consensus statements, ranging from three meals with two to three snacks[28,29] to six to eight small meals and snacks[21] to distribute the CHO and reduce postprandial BG spikes.

When individualizing the meal and snack pattern, usual intake, food preferences, work schedule, sleep patterns, physical activity, cultural and religious beliefs and practices, and food insecurity should be considered. Pregnant women who choose to fast for >12 hours due to cultural or religious reasons should be evaluated by a medical provider before the fasting period for intensive management and appropriate adjustment of diet and medication.[53-56] Although there is no specific range for CHO distribution at meals and snacks, customary practice suggests limiting the amount and type of CHO at breakfast.[21] See Recommendation 5.3.

Recommendation 8

Use of High-Intensity Sweeteners EAL Recommendation 8: When treating pregnant women with GDM who choose to consume high-intensity sweeteners, RDNs should educate the woman to select only those approved or generally recognized as safe by the US Food and Drug Administration (FDA) and to limit her intake to the acceptable daily intake (ADI), established by the FDA. The FDA has concluded the safety of six high-intensity sweeteners (saccharin, aspartame, acesulfame potassium, sucralose, neotame, and advantame) when consumed within the ADI by the general population, including pregnant women. Steviol glycosides and luo han guo (monk fruit) extracts are also generally recognized as safe when consumed within the ADI.

Rating: Consensus (conditional)
Rationale: High-intensity sweeteners are commonly used as sugar substitutes or sugar alternatives because they are much sweeter than sugar, but have little to no CHO or calories. This recommendation applies to pregnant women with GDM who are considering replacing high calorie sweeteners, with high-intensity sweeteners.

FDA regulations provide the underlying safety direction for this recommendation.[57,58] Saccharin, aspartame, acesulfame potassium, sucralose, neotame, and advantame—consumed within the ADI—have met the FDA safety standards for consumption by the general population, including pregnant women.[57,58] In addition, ateviol glycosides and luo han guo extracts when consumed within the ADI are considered safe.[58]

Statements from the Academy,[26,59,60] the ADA,[61] and Sweet Success Guidelines for Care[28] provide supplementary support for this recommendation. Women with the rare hereditary disorder of phenylketonuria should refrain from consuming aspartame because they are unable to metabolize

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phenylalanine, a component of aspartame.[26,57,60]

Recommendation 9

Alcohol Intake EAL Recommendation 9: RDNs should reinforce abstinence from alcohol during pregnancy for women with GDM. The safest choice for all pregnant women is to abstain from alcohol to eliminate the risk for alcohol-related birth defects such as behavior-related or neurologic defects, growth deficiencies, facial abnormalities, and impaired intellectual development.

Rating: Consensus (imperative)
Rationale: Alcohol exposure during pregnancy has been linked to fetal birth-related defects, including fetal alcohol syndrome and low birth weight.[62] Although there is a lack of consensus regarding the amount of alcohol associated with fetal birth defects, it is the position of the Academy, the American College of Obstetricians and Gynecologists, the American Academy of Pediatrics, March of Dimes, and Centers for Disease Control and Prevention that all pregnant women abstain from alcohol.[27,62-65]

Medical providers and other health professionals typically address alcohol use during pregnancy at the first obstetrics visit. RDNs and other health care team members should continue to reinforce avoidance of alcohol throughout the pregnancy. Pregnant women who are unwilling or unable to discontinue the use of alcohol during pregnancy should be referred for supportive services, including behavioral health counseling and possible treatment.[66]

Recommendation 10

Physical Activity EAL Recommendation 10: Unless contraindicated, RDNs should encourage women with GDM to engage in a goal to achieve daily moderate exercise of 30 minutes or more per day. In addition to a healthy diet, exercise can help improve BG control and achieve weight gain recommendations. Both aerobic exercise and nonweight-bearing exercise (eg, stretching, swimming, and yoga) have been shown to lower BG levels in women with GDM. Lifestyle therapy for GDM results in lower birth weight and a lower incidence of LGA births and preeclampsia.

Rating: Strong (conditional) Rationale: This recommendation applies to women with GDM for whom physical activity is not contraindicated. The Endocrine Society's Diabetes and Pregnancy clinical practice guidelines[19] provide the following strong recommendation: "We recommend that the initial treatment of gestational diabetes should consist of MNT and daily moderate exercise for 30 minutes or more." In addition, moderate evidence was found that lifestyle therapy for GDM improves fetal birth weight and the incidence of maternal preeclampsia.[19] BG levels in women with GDM are positively influenced by both aerobic exercise and nonweight-bearing exercise.[19] Although physical activity during pregnancy is considered safe and desirable, all pregnant women, including those with GDM, should be evaluated by a health care provider before beginning any exercise regimen.[19,22]

Both absolute and relative contraindications for physical activity during pregnancy should be considered. Such contraindications include, but are not limited to cardiovascular, hypertensive, and respiratory conditions (eg, unevaluated maternal cardiac arrhythmia and poorly controlled hypertension), risks associated with premature labor or bleeding, anemia, poorly controlled hypothyroidism, extremes of BMI, history of sedentary lifestyle, and intrauterine growth restriction.[22]

Pregnant women who were physically active before pregnancy can continue to engage in high-intensity aerobic exercise in the absence of any contraindications.[22] Overweight and obese pregnant women should start with a short period of low-intensity exercise and gradually increase as able.[22] Pregnant women who are engaging in physical activity should be advised to consume adequate calories and maintain hydration. Pregnant women should avoid contact sports, activities with a high risk for falls, and exercise in extreme temperatures.[22] Further physical activity intervention advice may require referral to a certified exercise physiologist or athletic trainer.

Recommendation 11

Nutrition Monitoring and Evaluation EAL Recommendation 11: Following a nutrition intervention for a woman with GDM, to check progress, an RDN should monitor and evaluate the following components at each visit and compare with desired individual outcomes relevant to the nutrition diagnosis and nutrition intervention. This may include, but is not limited to: *Food/Nutrition-Related Outcomes:* daily food intake in relation to postmeal glucose readings; food, beverage, and nutrient intake; recommendation to add pharmacologic therapy (oral and/or insulin therapy) to maintain nutrient intake and achieve glycemic targets; dose of diabetes medications such as oral glucose-lowering agents and insulin; changes in substance use; knowledge, beliefs, and attitudes; and physical activity and function. *Anthropometric Measurement Outcomes:* Weight changes compared with previous obstetric or MNT visit. *Biochemical Data, Medical Tests, and Procedure Outcomes:* Self-monitoring BG records, including meter downloads; ketone testing records (when previously recommended); and updated fetal and maternal testing or lab values. [*See Figure 5.]

Rating: Consensus (imperative)
Rationale: Nutrition M&E is needed to correctly diagnose nutrition problems that should be the focus of further nutrition interventions. Similar to Recommendation 2, this recommendation is supported by a collection of credible sources addressing each M&E indicator.[10,21-23,25,26,28-30]

Reassessment of food and nutrition intake, anthropometric measurements, and biochemical data such as self-monitoring BG provide the basis for RDN evaluation of the effectiveness of the nutrition intervention in achieving nutrition-related goals and desired outcomes. An RDN uses the data from nutrition care indicators to continually individualize and adjust the nutrition prescription and exercise regimen based on each patient's response to MNT over time. RDNs should be alert to potential psychosocial stressors throughout a patient's pregnancy and refer for further screening or additional services as needed.[26]

SUMMARY

The focus of this publication is to present updated nutrition guidelines

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for the care and treatment of women with GDM, based on EAL SR, current national guidelines, and consensus publications. The Academy's Gestational Diabetes EBNPG is a valuable resource for RDNs as well as other clinicians involved in the care and treatment of women with GDM. Institutions may also find the guidelines beneficial in developing effective clinical practice policy in nutrition management of GDM or for consumer education.

Strengths/Limitations

The strength of this publication is the work group's rigorous adherence to the well-defined EAL methodology used to complete the SR[9] and develop the guideline.[11]

The EAL methodology allowed for the use of two recent external guidelines[19,20] that were available to provide evidence-based guidance on topics either not evaluated in the EAL SR or which further supported the findings of the SR. In addition, a number of credible documents were used to support consensus recommendations when either no research was found for evidence analysis or the documents could improve the comprehensive reach of the guideline.

Although the majority of studies were RCTs, a major weakness of this review was the substantial number of inconsistencies found within the body of evidence meeting inclusion criteria, which made the formulation of recommendations challenging. Specific limitations are described below:

- Great variability in the studies' reporting of dietary intake was observed.
  - Of included studies, only two reported actual dietary intake.[16,45]
    - A majority of studies utilized self-reported intake, which is easily susceptible to errors.
    - Three studies reported results for the prescribed diet only, not the diet as consumed.[14,15,39] Thus, for these three studies, it is unknown whether subjects consumed the diet as prescribed.
    - In four studies, the diet intended to be studied was not followed.[17,18,40,41] For example, the CHO content and GI of diets consumed by intervention and control groups within one study[17] were roughly identical and were not the diets prescribed by the investigators.
- Varying amounts (grams or percentages) and types (fiber or GI) of CHO in different studies hampered the ability to make meaningful comparisons. In studies that mentioned the breakfast meal, there were few descriptions of the meal composition.
- Inconsistent terminology across studies made it difficult to assess differences among studies (eg, "high" and "low" CHO diets, and "high" and "low" GI values). Comparative standards have been proposed for these terms; however, their usage within the body of evidence was inconsistent, subjective, and easily confused or misinterpreted.
- Few studies reported the qualifications and credentials of the individuals providing nutrition therapy, or the number, frequency, and length of nutrition visits.
- The studies evaluating calorie needs, types, and amount of CHO, and dietary patterns had relatively small and widely varying sample sizes ranging from 10 to 150.
- For studies examining calorie level, stratification by prepregnancy BMI was inconsistent and prepregnancy weights were not reported. In the same studies, women appeared to restrict—or perhaps under-report—their calorie intake compared with prescribed amounts.
- In terms of the outcome sets described, there was little consistency among studies.

Readers should exercise caution in interpreting the results of this SR, due to the inability to compare diets across studies and the numerous confounding variables within and among studies that hampered synthesizing results and drawing conclusions. Furthermore, the heterogeneity of the available evidence is heightened by the inherent complexity of nutrition science. That is, intake of a given nutrient, in a given amount, by a particular individual is influenced by myriad factors, including physiological state, circadian rhythm, timing of meals, cooking methods, other foods consumed along with CHO, fiber content, and so on. Thus, the work group underscored individualization as a fundamental component of this EBNPG in the absence of clear and decisive evidence for a standardized or optimal nutrition prescription.

Suggestions for Further Research

This review established that a great need exists for further high-quality research in all aspects of the nutrition-related management of GDM. More information is needed to determine optimal calorie levels, amount and types of macronutrients, and distribution of meals and snacks for optimal clinical outcomes for both mothers with GDM and their infants. Specific suggestions include:

- A minimum list of the most important standardized outcomes (clinical and dietary) in the treatment of GDM should be developed and used consistently.
- Comparative standards for low-, moderate-, and high-CHO diets, and low-, medium- and high-GI diets, should be established and used consistently in future research.
- Investigators should clearly describe the diet prescription (calories [total and kilocalories per kilogram], grams, and percentage of macronutrients and fiber), as well as the meal and snack distribution and timing of meals and snacks. When possible/feasible, actual intake should be documented, rather than self-reported intake, to limit under- and over-reporting of nutrient consumption.
- Information, including the qualifications and credentials of the nutrition therapy provider, and the number, frequency, and

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length of nutrition visits should be reported.
- RCTs with large samples and standardized protocols are needed to determine appropriate levels of calories, types and amounts of macronutrients, and dietary patterns to optimize fetal/neonatal and maternal outcomes of GDM.

IMPLICATIONS FOR PRACTICE

The Academy's EAL EBNPGs promote the application of a consistent approach to quality clinical practice to achieve positive patient outcomes.[9] Despite the lack of clear evidence for an ideal nutrition prescription for all women with GDM, a number of dietary approaches or combinations of approaches may be considered within the framework of the guideline. For example, no studies evaluated CHO counting, a common tool used by RDNs. However, the guideline recommendations may be facilitated by use of CHO counting, helping to explain and implement the recommendations for the amount, type, and distribution of CHO as part of a strategy to achieved better glycemic control.

All women with GDM should be referred to an RDN for MNT to start the NCP. Effective practice begins with a nutrition assessment to determine nutrition diagnosis and formulate a nutrition plan, an individualized nutrition prescription and counseling, and adjustments made through ongoing nutrition M&E. MNT visits should be regular and frequent throughout the pregnancy. MNT by an RDN (or international equivalent) as part of a comprehensive nutrition intervention that includes individualization of MNT is effective in improving BG control and neonatal and maternal outcomes in women with GDM.

The goal of the nutrition therapy is to promote fetal/neonatal and maternal health, achieve glycemic control goals, maintain appropriate gestational weight gain, and reduce the risk for adverse outcomes. Adequate amounts of calories, macronutrients, and micronutrients to support pregnancy should be provided, with guidance from the DRIs. RDNs should individualize the nutrition prescription based on a thorough nutrition assessment; the patient's BG levels and response; treatment goals; physical activity; medication, if any (eg, insulin); and patient needs. The amount and type of CHO at meals and snacks should be individualized and distributed into three meals and two or more snacks per day to reduce postprandial BG elevations. In the case that a patient continues to experience elevated postprandial BG after breakfast, further modification to the amount or the type of CHO at breakfast may be incorporated to achieve BG targets.

RDNs should encourage women with GDM to make healthy food choices and consume a variety of foods to meet the micronutrient needs of pregnancy. However, a dietary supplement within the DRIs for pregnancy may be considered in the case that a patient is unable to meet micronutrient needs through diet. In the case that high-intensity sweeteners are considered, RDNs should only encourage selection of those approved or generally recognized as safe by the FDA and to limit intake to the ADI. Abstinence from alcohol during pregnancy should be reinforced at nutrition therapy visits. Unless contraindicated, daily moderate exercise of 30 minutes or more should be encouraged to help improve BG control and achieve weight gain recommendations.

This EBNPG does not address preconception nutrition guidance for prevention of GDM or postpartum prevention of diabetes. Nutrition and dietetics practitioners are encouraged to explore other EAL guidelines or SRs on the EAL for further information on treatment beyond this guideline.

Women with GDM are at increased risk for maternal and fetal complications. MNT is an integral component of lifestyle treatment for GDM to improve maternal and fetal outcomes. Through nutrition therapy, RDNs assist patients in obtaining BG and weight gain targets and adequate fetal growth while meeting pregnancy requirements for essential nutrients. It is imperative that RDNs continuously apply the NCP steps to individualize and adjust the nutrition prescription based on each patient's response to MNT over time. The EAL 2016 Gestational Diabetes EBNPG provides 18 nutrition recommendations presented within the NCP framework. Given the lack of robust evidence to support an optimal nutrition prescription for all women with GDM, the EBNPG provides a practical and sound approach to nutrition care. The guidelines serve as a valuable resource for nutrition and dietetics practitioners and other health professionals to provide the best treatment during this critical period.

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